The COMPLETE Lojban Language

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by John Woldemar Cowan

The Logical Language Group, Inc.

2904 Beau Lane

Fairfax Virginia 22031-1303 USA

703-385-0273

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<p>

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For information, contact:

The Logical Language Group, 2904 Beau Lane, Fairfax VA 22031-1303 USA

Telephone 703-385-0273.

Electronic address: lojbab@access.digex.net

World Wide Web: http://xiron.pc.helsinki.fi/lojban/

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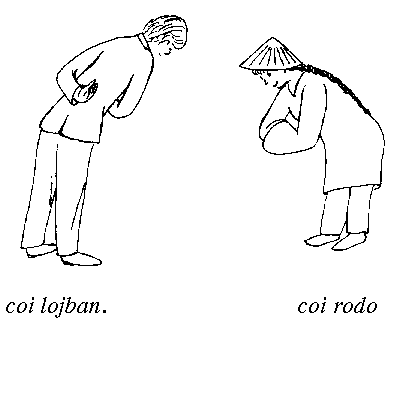
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## <h2>Chapter 1<br>

## Lojban As We Mangle It In Lojbanistan: About This Book</h2>

###### <h6>$Revision: 4.3 $<br> mkhtml: 1.1</h6></p></center>

<p>

### <a name=s1><h3>What is Lojban?</h3>

<p>

<cx "Lojban, history of"><cx "Logical Language Group, relation to Lojban">Lojban (pronounced “LOZH-bahn”) is a constructed lan­guage. Previous ver­sions of the language were called “Loglan” by Dr. James Cooke Brown, who founded the Log­lan Project and started the development of the language in 1955. The goals for the lan­guage were first described in the open literature in the arti­cle “Loglan”, pub­lished in <cite>Scientific American</cite>, June, 1960. Made well-known by that article and by oc­casional references in science fiction (most notably in Robert Heinlein's novel <cite>The Moon Is A Harsh Mistress) </cite>and computer publications, Loglan and Lojban have been built over four decades by doz­ens of workers and hun­dreds of supporters, led since 1987 by The Logical Language Group (who are the publishers of this book).

<p>

<cx "Lojban, features of">There are thousands of artificial languages (of which Es­peranto is the best-known), but Loglan/Lojban has been engi­neered to make it unique in several ways. The follow­ing are the main features of Lojban:

<p>

* <dl compact><dt><dd>Lojban is designed to be used by people in communi­cation with each other, and possibly in the future with computers.
* <p><dt><dd>Lojban is designed to be neutral between cultures.
* <p><dt><dd>Lojban grammar is based on the principles of predi­cate logic.
* <p><dt><dd>Lojban has an unambiguous yet flexible grammar.
* <p><dt><dd>Lojban has phonetic spelling, and unambiguously re­solves its sounds into words.
* <p><dt><dd>Lojban is simple compared to natural languages; it is easy to learn.
* <p><dt><dd>Lojban's 1300 root words can be easily combined to form a vocabulary of millions of words.
* <p><dt><dd>Lojban is regular; the rules of the language are with­out exceptions.
* <p><dt><dd>Lojban attempts to remove restrictions on creative and clear thought and communication.
* <p><dt><dd>Lojban has a variety of uses, ranging from the crea­tive to the scientific, from the theoretical to the practi­cal.
* <p><dt><dd>Lojban has been demonstrated in translation and in original works of prose and poetry.

### </dl><a name=s2><h3>What is this book?</h3>

<p>

<cx "reference grammar"><cx "this book, goal of"><cx "goal of this book">This book is what is called a “reference grammar”. It at­tempts to expound the whole Lojban language, or at least as much of it as is understood at present. Lojban is a rich lan­guage with many features, and an attempt has been made to discover the func­tions of those features. The word “discover” is used ad­visedly; Lojban was not “invented” by any one person or commit­tee. Often, grammatical features were intro­duced into the lan­guage long be­fore their usage was fully understood. Sometimes they were intro­duced for one reason, only to prove more useful for other reasons not recog­nized at the time.

<p>

By intention, this book is complete in description but not in explanation. For every rule in the formal Lojban grammar (given in <a href=chap21.html>Chapter 21</a>), there is a bit of expla­nation and an example some­where in the book, and often a great deal more than a bit. In es­sence, <a href=chap2.html>Chapter 2 </a>gives a brief overview of the language, <a href=chap21.html>Chap­ter 21 </a>gives the for­mal structure of the language, and the chap­ters in between put semantic bones on that for­mal flesh. I hope that eventually more grammatical material founded on (or even cor­recting) the explana­tions in this book will become available.

<p>

<cx "Lojban, stability of"><cx "linguistic drift">Nevertheless, the publication of this book is, in one sense, the completion of a long period of language evolution. With the exception of a possible revision of the lan­guage that will not even be considered until five years from publication date, and any revi­sions of this book needed to correct outright errors, the language described in this book will not be changing by deliberate act of its creators any more. Instead, language change will take place in the form of new vocabulary — Lojban does not yet have nearly the vocabulary it needs to be a fully usable language of the modern world, as <a href=chap12.html>Chapter 12 </a>explains — and through the irregular natural processes of drift and (who knows?) native-speaker evolu­tion. (Teach your children Lojban!) You can learn the language de­scribed here with as­surance that (unlike previous versions of Loj­ban and Loglan, as well as most other artifi­cial languages) it will not be subject to further fid­dling by language-meisters.

<p>

<cx "structure of this book"><cx "this book, structure of">It is probably worth mentioning that this book was written somewhat piece­meal. Each chapter began life as an explication of a specific Lojban topic; only later did these begin to clump to­gether into a larger structure of words and ideas. Therefore, there are perhaps not as many cross-references as there should be. However, I have at­tempted to make the index as comprehensive as possible.

<p>

<cx "Lojbanistan"><cx "jokes"><cx "chapter titles, intent of">Each chapter has a descriptive title, often involving some play on words; this is an attempt to make the chapters more memorable. The title of <a href=chap1.html>Chapter 1 </a>(which you are now reading), for example, is an allusion to the book <cite>English As We Speak It In Ire­land</cite>, by P. W. Joyce, which is a sort of informal reference grammar of Hiberno-English. “Lojbanistan” is both an imaginary country where Lojban is the native language, and a term for the actual community of Lojban-speakers, scattered over the world. Why “mangle”? As yet, nobody in the real Lojbanistan speaks the lan­guage at all well, by the standards of the imaginary Lojbanistan; that is one of the circumstances this book is meant to help rem­edy.

<p>

### What are the typographical conventions of this book?</h3>

<p><cx "typographical conventions"><a name=s3><h3>

<cx "sections of this book"><cx "this book, sections of">Each chapter is broken into numbered sections; each sec­tion contains a mixture of expository text, numbered examples, and possibly tables.

<p>

<cx "examples in this book"><cx "this book, examples of">The reader will notice a certain similarity in the examples used throughout the book. One chapter after another rings the changes on the self-same sentences:

<p>

<ex "go to the store"><pre><a name=e1d1>1.1) mi klama le zarci

I go-to that-which-I-describe-as-a store.

I go to the store.

</pre>will become wearisomely familiar before <a href=chap21.html>Chapter 21 </a>is reached. This method is delib­erate; I have tried to use simple and (eventually) familiar examples wherever possible, to avoid obscur­ing new grammatical points with new vocabulary. Of course, this is not the method of a textbook, but this book is not a textbook (although people have learned Loj­ban from it and its predeces­sors). Rather, it is intended both for self-learning (of course, at present would-be Lojban teachers must be self-learners) and to serve as a reference in the usual sense, for looking up obscure points about the language.

<p>

<cx "example of examples"><cx "structure of examples"><cx "examples, structure of">It is useful to talk further about <a href=#e1d1>Example 1.1 </a>for what it il­lustrates about exam­ples in this book. Examples usually occupy three lines. The first of these is in Lojban, the second in a word-by-word literal translation of the Lojban into English, and the third in collo­quial English. The second and third lines are sometimes called the “literal transla­tion” and the “colloquial translation” re­spectively. Sometimes, when clarity is not sacri­ficed thereby, one or both are omitted. If there is more than one Lojban sen­tence, it generally means that they have the same meaning.

<p>

<cx "square brackets, use of in notation">Words are sometimes surrounded by square brackets. In Lojban texts, these enclose optional grammatical particles that may (in the context of the particular exam­ple) be ei­ther omitted or included. In literal translations, they enclose words that are used as con­ventional translations of specific Lojban words, but don't have exactly the meanings or uses that the English word would suggest. In <a href=chap3.html>Chapter 3</a>, square brackets surround pho­netic repre­sentations in the International Phonetic Alphabet.

<p>

<cx "tables, format of"><cx "grammatical categories, use of upper case for">Many of the tables, especially those placed at the head of various sections, are in three columns. The first column contains Lojban words discussed in that section; the sec­ond column con­tains the grammatical category (represented by an UPPER CASE Lojban word) to which the word belongs, and the third column contains a brief English gloss, not necessarily or typically a full explanation. Other tables are explained in con­text.

<p>

<cx "technical terms">A few Lojban words are used in this book as technical terms. All of these are ex­plained in <a href=chap2.html>Chapter 2</a>, except for a few used only in single chapters, which are ex­plained in the introduc­tory sections of those chapters.

<p>

### <a name=s4><h3>Disclaimers</h3>

<p>

<cx "disclaimers">It is necessary to add, alas, that the examples used in this book do not refer to any existing person, place, or institution, and that any such resemblance is entirely co­inci­dental and uninten­tional, and not intended to give offense.

<p>

<cx "dictionary, superior authority of">When definitions and place structures of gismu, and espe­cially of lujvo, are given in this book, they may differ from those given in the Lojban/English dictionary (which, as of this writing, is not yet published). If so, the information given in the dic­tionary super­sedes whatever is given here.

<p>

### <a name=s5><h3>Acknowledgements and Credits</h3>

<p>

<cx "author of this book"><cx "this book, author of"><cx "LLG">Although the bulk of this book was written for the Logical Language Group (LLG) by John Cowan, who is represented by the occasional authorial “I”, certain chapters were first written by others and then heavily edited by me to fit into this book.

<p>

<cx "contributors to this book"><cx "this book, contributors to">In particular: <a href=chap2.html>Chapter 2 </a>is a fusion of originally separate documents, one by Athel­stan, and one by Nora Tansky LeCheva­lier and Bob LeChevalier; <a href=chap3.html>Chapters 3 </a>and <a href=chap4.html>4 </a>were originally written by Bob LeChevalier with contributions by Chuck Barton; <a href=chap12.html>Chapter 12 </a>was originally written (in much longer form) by Nick Nicholas; the dialogue near the end of <a href=chap13.html>Chapter 13 </a>was contributed by Nora Tansky LeChevalier; <a href=chap15.html>Chapter 15 </a>and parts of <a href=chap16.html>Chapter 16 </a>were originally by Bob LeChevalier; and the YACC grammar in <a href=chap21.html>Chapter 21 </a>is the work of several hands, but is primarily by Bob LeCheva­lier and Jeff Taylor. The BNF grammar, which is also in <a href=chap21.html>Chapter 21</a>, was originally written by me, then rewritten by Clark Nelson, and finally touched up by me again.

<p>

<cx "credits for this book"><cx "this book, credits for">The research into natural languages from which parts of <a href=chap5.html>Chapter 5 </a>draw their mate­rial was performed by Ivan Derzhanski. LLG acknowledges his kind permission to use the fruits of his re­search.

<p>

<cx "credits for pictures"><cx "pictures, credits for">The pictures in this book were drawn by Nora Tansky LeChevalier, except for the picture appearing in <a href=chap4.html>Chapter 4</a>, which is by Sylvia Rutiser Rissell.

The index was made by Nora Tansky LeChevalier.

<p>

<cx "reviewers of this book"><cx "this book, reviewers of">I would like to thank the following people for their de­tailed reviews, sugges­tions, comments, and early detection of my em­barrassing errors in Lojban, logic, Eng­lish, and cross-refer­ences: Nick Nicholas, Mark Shoulson, Veijo Vilva, Colin Fine, And Rosta, Jorge Llambias, Iain Alexander, Paulo S. L. M. Barreto, Robert J. Chassell, Gale Cowan, Karen Stein, Ivan Derzhanski, Jim Carter, Irene Gates, Bob LeChevalier, John Parks-Clif­ford (also known as “pc”), and Nora Tansky LeChevalier.

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Nick Nicholas (NSN) would like to thank the following Loj­banists: Mark Shoulson, Veijo Vilva, Colin Fine, And Rosta, and Iain Alexander for their suggestions and com­ments; John Cowan, for his extensive comments, his exemplary trailblazing of Lojban grammar, and for solving the “manskapi” dilemma for NSN; Jorge Llambias, for his even more extensive comments, and for forcing NSN to think more than he was in­clined to; Bob LeChevalier, for his skeptical overview of the issue, his encourage­ment, and for scouring all Lojban text his computer has been burdened with for lujvo; Nora Tansky LeChevalier, for writing the program converting old rafsi text to new rafsi text, and spar­ing NSN from embar­rass­ing errors; and Jim Carter, for his dogged persis­tence in ana­lyz­ing lujvo algorithmically, which inspired this research, and for first identifying the three lujvo classes.

<p>

<cx "Brown, James Cooke">Of course, the entire Loglan Project owes a considerable debt to James Cooke Brown as the language inventor, and also to several earlier contributors to the develop­ment of the language. Especially noteworthy are Doug Landauer, Jeff Prothero, Scott Layson, Jeff Taylor, and Bob McIvor. Final responsibility for the remaining errors and infelicities is solely mine.

<p>

### <a name=s6><h3>Informal Bibliography</h3>

<p>

<cx "bibliography"><cx "Loglan">The founding document for the Loglan Project, of which this book is one of the products, is <cite>Loglan 1: A Logical Language </cite>by James Cooke Brown (4th ed. 1989, The Loglan Institute, Gainesville, Florida, U.S.A.) The language described therein is not Loj­ban, but is very close to it and may be considered an ancestral version. It is regretta­bly necessary to state that nothing in this book has been approved by Dr. Brown, and that the very exis­tence of Lojban is disapproved of by him.

<p>

The logic of Lojban, such as it is, owes a good deal to the American philoso­pher W. v.O. Quine, especially <cite>Word and Object </cite>(1960, M.I.T. Press). Much of Quine's philo­sophical writ­ings, es­pecially on observation sentences, reads like a literal transla­tion from Lojban.

<p>

The theory of negation expounded in <a href=chap15.html>Chapter 15 </a>is de­rived from a reading of Larry Horn's work <cite>The Natural History of Negation</cite>.

<p>

Of course, neither Brown nor Quine nor Horn is in any way responsible for the uses or misuses I have made of their works.

<p>

<cx "books about Lojban">Depending on just when you are reading this book, there may be three other books about Lojban available: a textbook, a Lojban/English dictionary, and a book containing general informa­tion about Lojban. You can probably get these books, if they have been published, from the same place where you got this book. In addition, other books not yet foreseen may also exist.

<p>

### Captions to Pictures</h3>

<p><cx "captions to pictures"><cx "pictures, captions to"><a name=s7><h3>

The following examples list the Lojban caption, with a translation, for the picture at the head of each chapter. If a chap­ter's picture has no caption, “(none)” is specified in­stead.

<p>

<pre><a name=e7d1>7.1) <a href=chap1.gif>coi lojban. coi rodo </a>

Greetings, O Lojban! Greetings, all-of you

<a name=e7d2>7.2) (none)

<a name=e7d3>7.3) <a href=chap3.gif>.i .ai .i .ai .o </a>

[untranslatable]

<a name=e7d4>7.4) <a href=chap4.gif>jbobliku </a>

Lojbanic-blocks

<a name=e7d5>7.5) (none)

<a name=e7d6>7.6) <a href=chap6.gif>lei re nanmu cu bevri le re nanmu </a>

The-mass-of two men carry the two men

Two men (jointly) carry two men (both of them).

<a name=e7d7>7.7) <a href=chap7.gif>ma drani danfu </a>

.i di'e

.i di'u

.i dei

.i ri

.i do'i

[What sumti] is-the-correct type-of-answer?

The-next-sentence.

The-previous-sentence.

This-sentence.

The-previous-sentence.

An-unspecified-utterance.

<a name=e7d8>7.8) <a href=chap8.gif>ko viska re prenu poi bruna la santas. </a>

[You!] see two persons who-are brothers-of Santa.

<a name=e7d9>7.9) (none)

<a name=e7d10>7.10) <a href=chap10.gif>za'o klama </a>

[superfective] come/go

Something goes (or comes) for too long.

<a name=e7d11>7.11) <a href=chap11.gif>le si'o kunti </a>

The concept-of emptiness

<a name=e7d12>7.12) (none)

<a name=e7d13>7.13) <a href=chap13.gif>.oi ro'i ro'a ro'o </a>

[Pain!] [emotional] [social] [physical]

<a name=e7d14>7.14) (none)

<a name=e7d15>7.15) <a href=chap15.gif>mi na'e lumci le karce </a>

I other-than wash the car.

I didn't wash the car.

<a name=e7d16>7.16) <a href=chap16.gif>drata mupli pe'u .djan. </a>

Another example [please] John.

Another example, John, please!

<a name=e7d17>7.17) <a href=chap17.gif>zai xanlerfu by. ly. .obu .jy by. .abu ny. </a>

[Shift] hand-letters l o j b a n

"Lojban" in the U.S. manual alphabet

<a name=e7d18>7.18) <a href=chap18.gif>no no </a>

0 0

<a name=e7d19>7.19) (none)

<a name=e7d20>7.20) (none)

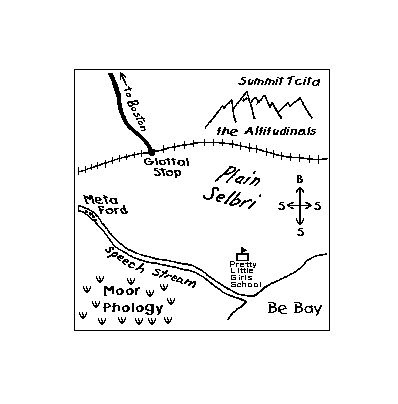
<a name=e7d21>7.21) (none)

<p></pre><cx "boring legalities"><cx "legalities, boring"><cx "permissions notice"><a name=s8><h3>

<p>

</body></html>

<img src=chap2.gif alt=[Cartoon] align=center width=405 height=405>



## <h2>Chapter 2

## <br>

## A Quick Tour of Lojban Grammar, With Diagrams</h2>

###### <h6>$Revision: 4.1 $<br> mkhtml: 1.1</h6></p></center>

<p>

### <a name=s1><h3>The concept of the bridi</h3>

<p>

<cx "bridi, concept of">This chapter gives diagrammed examples of basic Lojban sentence structures. The most general pattern is covered first, fol­lowed by successive variations on the basic com­ponents of the Loj­ban sen­tence. There are many more capabilities not covered in this chapter, but covered in detail in later chapters, so this chapter is a “quick tour” of the material later covered more slowly throughout the book. It also introduces most of the Lojban words used to discuss Lojban grammar.

<p>

<ex "John and Sam"><ex "father"><ex "hits"><ex "taller">Let us consider John and Sam and three statements about them:

<p>

<pre><a name=e1d1>1.1) John is the father of Sam.

<a name=e1d2>1.2) John hits Sam.

<a name=e1d3>1.3) John is taller than Sam.

</pre><cx "relationship, active/static/attributive compared"><cx "predication, as a relationship"><cx "bridi, compared with predication"><cx "predication, compared with bridi"><cx "brivla, relation to bridi"><cx "sumti, relation with bridi">These examples all describe relationships between John and Sam. However, in English, we use the noun “father” to describe a static relationship in <a href=#e1d1>Example 1.1</a>, the verb “hits” to describe an active rela­tionship in <a href=#e1d2>Example 1.2</a>, and the adjective “taller” to describe an at­tributive relationship in <a href=#e1d3>Example 1.3</a>. In Lojban we make no such grammatical distinc­tions; these three sentences, when expressed in Lojban, are structurally identical. The same part of speech is used to represent the relationship. In formal logic this whole structure is called a “predication”; in Lojban it is called a “bridi”, and the central part of speech is the “selbri”. Logicians refer to the things thus re­lated as “arguments”, while Lojbanists call them “sumti”. These Lojban terms will be used for the rest of the book.

<p>

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| bridi (predicate) | | | | | |
|  |  |  |  |  |
| John |  | is the father of |  | Sam |
|  |  |  |  |  |
| | sumti |  | | selbri |  | | sumti (argument) |

</pre><ex "give">In a relationship, there are a definite number of things being related. In Eng­lish, for example, “give” has three places: the donor, the recipient and the gift. For ex­ample:

<p>

<pre><a name=e1d4>1.4) John gives Sam the book.

</pre>and

<p>

<pre><a name=e1d5>1.5) Sam gives John the book.

</pre>mean two different things because the relative positions of “John” and “Sam” have been switched. <p>

Further,

<p>

<pre><a name=e1d6>1.6) The book gives John Sam.

</pre>seems strange to us merely because the places are being filled by unorthodox argu­ments. The relationship expressed by “give” has not changed.

<p>

<cx "place structure, definition of">In Lojban, each selbri has a specified number and type of ar­guments, known col­lec­tively as its “place structure”. The simplest kind of selbri consists of a single root word, called a “gismu”, and the defi­nition in a dictionary gives the place structure ex­plicitly. The primary task of constructing a Lojban sentence, after choosing the relation­ship itself, is deciding what you will use to fill in the sumti places.

<p>

This book uses the Lojban terms “bridi”, “sumti”, and “selbri”, because it is best to come to understand them independently of the English associations of the corre­spond­ing words, which are only roughly similar in meaning anyhow.

<p>

<ex "underlines"><cx "notation conventions, for Quick Tour chapter"><cx " notation convention for Quick Tour chapter">cx "= notation convention for Quick Tour chapter">The Lojban examples in this chapter (but not in the rest of the book) use a sin­gle un­derline ( ) under each sumti, and a double un­derline ( ) under each selbri, to help you to tell them apart.

<p>

### <a name=s2><h3>Pronunciation</h3>

<p>

<cx "pronunciation (quick-tour version)">Detailed pronunciation and spelling rules are given in <a href=chap3.html>Chapter 3</a>, but what fol­lows will keep the reader from going too far astray while digesting this chapter.

<p>

<cx "vowels, pronunciation of (quick-tour version)">Lojban has six recognized vowels: “a”, “e”, “i”, “o”, “u” and “y”. The first five are roughly pronounced as “a” as in “father”, “e” as in “let”, “i” as in “machine”, “o” as in “dome” and “u” as in “flute”. “y” is pronounced as the sound called “schwa”, that is, as the unstressed “a” as in “about” or “around”.

<p>

<cx "consonants, pronunciation of (quick-tour version)">Twelve consonants in Lojban are pronounced more or less as their counterparts are in English: “b”, “d”, “f”, “k”, “l”, “m”, “n”, “p”, “r”, “t”, “v” and “z”. The letter “c”, on the other hand is pro­nounced as the “sh” in “hush”, while “j” is its voiced counter­part, the sound of the “s” in “pleasure”. “g” is always pronounced as it is in “gift”, never as in “giant”. “s” is as in “sell”, never as in “rose”. The sound of “x” is not found in English in normal words. It is found as “ch” in Scottish “loch”, as “j” in Span­ish “junta”, and as “ch” in German “Bach”; it also ap­pears in the English interjection “yecchh!”. It gets eas­ier to say as you practice it. The letter “r” can be trilled, but does­n't have to be.

<p>

<cx "diphthongs, pronunciation of (quick-tour version)">The Lojban diphthongs “ai”, “ei”, “oi”, and “au” are pro­nounced much as in the English words “sigh”, “say”, “boy”, and “how”. Other Lojban diphthongs begin with an “i” pronounced like English “y” (for example, “io” is pronounced “yo”) or else with a “u” pronounced like English “w” (for example, “ua” is pronounced “wa”).

<p>

<cx "apostrophe (quick-tour version)"><cx "comma (quick-tour version)"><cx "period (quick-tour version)">Lojban also has three “semi-letters”: the period, the comma and the apostro­phe. The period represents a glottal stop or a pause; it is a required stoppage of the flow of air in the speech stream. The apostrophe sounds just like the English letter “h”. Un­like a regular consonant, it is not found at the beginning or end of a word, nor is it found adja­cent to a consonant; it is only found between two vowels. The comma has no sound associated with it, and is used to separate syllables that might ordinarily run to­gether. It is not used in this chapter.

<p>

<cx "stress (quick-tour version)">Stress falls on the next to the last syllable of all words, un­less that vowel is “y”, which is never stressed; in such words the third-to-last syllable is stressed. If a word only has one syllable, then that syllable is not stressed.

<p>

All Lojban words are pronounced as they are spelled: there are no silent letters.

<p>

### <a name=s3><h3>Words that can act as sumti</h3>

<p>

<cx "pro-sumti (quick-tour version)">Here is a short table of single words used as sumti. This ta­ble provides exam­ples only, not the entire set of such words, which may be found in <a href=chap7.html>Chapter 7 </a>.

<p>

<pre>mi I/me, we/us

do you

ti this, these

ta that, those

tu that far away, those far away

zo'e unspecified value (used when a sumti is unimportant or ob­vious)

</pre><p>Lojban sumti are not specific as to number (singular or plu­ral), nor gender (masculine/feminine/neutral). Such distinctions can be optionally added by methods that are beyond the scope of this chapter.

<p>

<cx "pointing cmavo (quick-tour version)">The cmavo “ti”, “ta”, and “tu” refer to whatever the speaker is pointing at, and should not be used to refer to things that cannot in principle be pointed at.

<p>

<cx "names (quick-tour version)">Names may also be used as sumti, provided they are pre­ceded with the word “la”:

<p>

<pre>la meris. the one/ones named Mary

la djan. the one/ones named John

</pre><p>Other Lojban spelling versions are possible for names from other lan­guages, and there are restrictions on which letters may appear in Loj­ban names: see <a href=chap6.html>Chapter 6 </a>for more infor­mation.

<p>

### <a name=s4><h3>Some words used to indicate selbri relations</h3>

<p>

<cx "selbri list for quick tour">Here is a short table of some words used as Lojban selbri in this chapter:

<p>

<pre>vecnu x1 (seller) sells x2 (goods) to x3 (buyer) for x4 (price)

tavla x1 (talker) talks to x2 (audience) about x3 (topic) in lan­guage x4

sutra x1 (agent) is fast at doing x2 (action)

blari'o x1 (object/light source) is blue-green

melbi x1 (object/idea) is beautiful to x2 (observer) by standard x3

cutci x1 is a shoe/boot for x2 (foot) made of x3 (material)

bajra x1 runs on x2 (surface) using x3 (limbs) in manner x4 (gait)

klama x1 goes/comes to x2 (destination) from x3 (origin point) via x4 (route) us­ing x5 (means of transportation)

pluka x1 pleases/is pleasing to x2 (experiencer) under conditions x3

gerku x1 is a dog of breed x2

kurji x1 takes care of x2

kanro x1 is healthy by standard x2

stali x1 stays/remains with x2

zarci x1 is a market/store/shop selling x2 (products) operated by x3 (storekeeper)

</pre><cx "x1, notation convention (quick-tour version)">Each selbri (relation) has a specific rule that defines the role of each sumti in the bridi, based on its position. In the table above, that order was expressed by labeling the sumti positions as x1, x2, x3, x4, and x5.

<p>

<cx "words not in the dictionary">Like the table in <a href=#s3>Section 3</a>, this table is far from complete: in fact, no complete ta­ble can exist, because Lojban allows new words to be created (in specified ways) when­ever a speaker or writer finds the existing supply of words inadequate. This notion is a basic dif­fer­ence between Lojban (and some other languages such as German and Chi­nese) and English; in English, most people are very leery of using words that “aren't in the diction­ary”. Lojbanists are encouraged to invent new words; doing so is a major way of partici­pating in the development of the language. <a href=chap4.html>Chapter 4 </a>explains how to make new words, and <a href=chap12.html>Chapter 12 </a>explains how to give them appropriate mean­ings.

<p>

### <a name=s5><h3>Some simple Lojban bridi</h3>

<p>

<cx "bridi (quick-tour version)">Let's look at a simple Lojban bridi. The place structure of the gismu “tavla” is

<p>

<pre><a name=e5d1>5.1) x1 talks to x2 about x3 in language x4

</pre>where the “x”es with following numbers represent the various argu­ments that could be inserted at the given positions in the English sentence. For example:

<p>

<ex "engineering"><pre><a name=e5d2>5.2) John talks to Sam about engineering in Lojban.

</pre>has “John” in the x1 place, “Sam” in the x2 place, “engineering” in the x3 place, and “Lojban” in the x4 place, and could be paraphrased:

<p>

<pre><a name=e5d3>5.3) Talking is going on,

with speaker John

and listener Sam

and subject matter engineering

and language Lojban.

</pre><p>The Lojban bridi corresponding to <a href=#e5d1>Example 5.1 </a>will have the form

<p>

<lx "tavla"><pre><a name=e5d4>5.4) x1 [cu] tavla x2 x3 x4

</pre><cx "cu, omission of (quick-tour version)"><cx "cu, use of (quick-tour version)"><lx "cu (quick-tour version)">The word “cu” serves as a separator between any preceding sumti and the sel­bri. It can often be omitted, as in the following ex­amples.

<p>

<pre><a name=e5d5>5.5) mi tavla do zo'e zo'e

I talk to you about something in some language.

<a name=e5d6>5.6) do tavla mi ta zo'e

You talk to me about that thing in a language.

<a name=e5d7>5.7) mi tavla zo'e tu ti

I talk to someone about that thing yonder in this lan­guage.

</pre>(<a href=#e5d7>Example 5.7 </a>is a bit unusual, as there is no easy way to point to a language; one might point to a copy of this book, and hope the meaning gets across!)

<p>

<cx "ellipsis (quick-tour version)"><lx "zo'e (quick-tour version)">When there are one or more occurrences of the cmavo “zo'e” at the end of a bridi, they may be omitted, a process called “ellipsis”. <a href=#e5d5>Example 5.5 </a>and <a href=#e5d6>Example 5.6 </a>may be expressed thus:

<p>

<pre><a name=e5d8>5.8) mi tavla do

I talk to you (about something in some language).

<a name=e5d9>5.9) do tavla mi ta

You talk to me about that thing (in some language).

</pre><p>Note that <a href=#e5d7>Example 5.7 </a>is not subject to ellipsis by this direct method, as the “zo'e” in it is not at the end of the bridi.

<p>

### <a name=s6><h3>Variant bridi structure</h3>

<p>

<cx "sumti placement, variant (quick-tour version)">Consider the sentence

<p>

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 6.1) | mi | [cu] | vecnu | ti | ta | zo’e |
|  | seller-x1 |  | sells | goods-sold-x2 | buyer-x3 | price-x4 |
|  | I |  | sell | this | to that | for some price. |
|  | I sell this-thing/these-things to that-buyer/those-buyers. (The price is obvious or unimportant.) | | | | | |

</pre><a href=#e6d1>Example 6.1 </a>has one sumti (the x1) before the selbri. It is also possi­ble to put more than one sumti before the selbri, without changing the order of sumti:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 6.2) | mi | ti | [cu] | vecnu | | ta | | | |
|  | seller-x1 | goods-sold-x2 |  | sells | | buyer-x3 | | | |
|  | I | this |  | sell | | to that. | | | |
|  | (translates as stilted or poetic English) I this thing do sell to that buyer. | | | | | |
| 6.3) | mi | ti | ta | | [cu] | | vecnu | |  | |
|  | seller-x1 | goods-sold-x2 | buyer-x3 | |  | | sells | |  | |
|  | I | this | to that | |  | | sell. | |  | |
|  | (translates as stilted or poetic English) I this thing to that buyer do sell. | | | | | | |

<p>

</pre><a href=#e6d{1}>Examples 6.1 </a>through <a href=#e6d3>6.3 </a>mean the same thing. Usually, placing more than one sumti before the selbri is done for style or for empha­sis on the sumti that are out-of-place from their normal position. (Native speakers of languages other than English may prefer such orders.)

<p>

<cx "observatives (quick-tour version)">If there are no sumti before the selbri, then it is understood that the x1 sumti value is equivalent to “zo'e”; i.e. unimportant or ob­vious, and therefore not given. Any sumti after the selbri start count­ing from x2.

|  |  |  |  |
| --- | --- | --- | --- |
| 6.4) | ta | [cu] | melbi |
|  | object/idea-x1 |  | is-beautiful (to someone by some standard) |
|  | That/Those |  | is/are beautiful. |
|  | That is beautiful. | | |
|  | Those are beautiful. | | |

<p>

</pre>when the x1 is omitted, becomes:

|  |  |  |  |
| --- | --- | --- | --- |
| 6.5) | \_ \_ | [cu] | melbi |
|  | unspecified-x1 |  | is-beautiful (to someone by some standard) |
|  | Beautiful! | | |
|  | It’s beautiful! | | |

<p>

</pre><p>Omitting the x1 adds emphasis to the selbri relation, which has become first in the sentence. This kind of sentence is termed an observative, because it is often used when someone first observes or takes note of the relationship, and wishes to quickly commu­nicate it to someone else. Commonly understood English observatives include “Smoke!” upon seeing smoke or smelling the odor, or “Car!” to a per­son crossing the street who might be in danger. Any Lojban selbri can be used as an observative if no sumti appear before the selbri.

<p>

The word “cu” does not occur in an observative; “cu” is a separator, and there must be a sumti before the selbri that needs to be kept separate for “cu” to be used. With no sumti preceding the selbri, “cu” is not permitted. Short words like “cu” which serve gram­matical functions are called “cmavo” in Lojban.

<p>

### <a name=s7><h3>Varying the order of sumti</h3>

<p>

<cx "sumti reordering (quick-tour version)"><lx "se (quick-tour version)"><lx "SE (quick-tour version)">For one reason or another you may want to change the or­der, placing one par­ticular sumti at the front of the bridi. The cmavo “se”, when placed before the last word of the selbri, will switch the meanings of the first and second sumti places. So

<p>

<pre><a name=e7d1>7.1) mi tavla do ti

I talk to you about this.

</pre>has the same meaning as

<p>

<pre><a name=e7d2>7.2) do se tavla mi ti

You are talked to by me about this.

</pre><p><lx "te (quick-tour version)">The cmavo “te”, when used in the same location, switches the meanings of the first and the third sumti places.

<p>

<pre><a name=e7d3>7.3) mi tavla do ti

I talk to you about this.

</pre>has the same meaning as

<p>

<pre><a name=e7d4>7.4) ti te tavla do mi

This is talked about to you by me.

</pre><p>Note that only the first and third sumti have switched places; the sec­ond sumti has re­mained in the second place.

<p>

<lx "ve (quick-tour version)"><lx "xe (quick-tour version)">The cmavo “ve” and “xe” switch the first and fourth sumti places, and the first and fifth sumti places, respectively. These changes in the order of places are known as “conversions”, and the “se”, “te”, “ve”, and “xe” cmavo are said to convert the selbri.

<p>

More than one of these operators may be used on a given selbri at one time, and in such a case they are evaluated from left to right. However, in practice they are used one at a time, as there are better tools for complex manipulation of the sumti places. See <a href=chap5.html>Chap­ter 5 </a>for details.

<p>

<cx "passive voice">The effect is similar to what in English is called the “passive voice”. In Loj­ban, the converted selbri has a new place structure that is renumbered to reflect the place rever­sal, thus having effects when such a conversion is used in combination with other con­structs such as “le selbri [ku]” (see <a href=#s10>Section 10</a>).

<p>

### <a name=s8><h3>The basic structure of longer utterances</h3>

<p>

<lx ".i (quick-tour version)"><lx "I (quick-tour version)"><lx "ni'o (quick-tour version)"><lx "NIhO (quick-tour version)">People don't always say just one sentence. Lojban has a specific structure for talk or writing that is longer than one sentence. The entirety of a given speech event or written text is called an ut­ter­ance. The sentences (usually, but not always, bridi) in an utter­ance are separated by the cmavo “ni'o” and “.i”. These correspond to a brief pause (or nothing at all) in spoken English, and the various punctuation marks like period, question mark, and exclamation mark in written English. These separators prevent the sumti at the begin­ning of the next sentence from being mistaken for a trailing sumti of the previous sen­tence.

<p>

The cmavo “ni'o” separates paragraphs (covering different topics of discus­sion). In a long text or utterance, the topical struc­ture of the text may be indicated by multiple “ni'o”s, with perhaps “ni'oni'oni'o” used to indicate a chapter, “ni'oni'o” to in­dicate a sec­tion, and a single “ni'o” to indicate a subtopic corresponding to a single English para­graph.

<p>

The cmavo “.i” separates sentences. It is sometimes com­pounded with words that modify the exact meaning (the semantics) of the sentence in the context of the ut­ter­ance. (The cmavo “xu”, dis­cussed in <a href=#s1>Section 1</a>.7, is one such word — it turns the sen­tence from a statement to a question about truth.) When more than one person is talk­ing, a new speaker will usually omit the “.i” even though she/he may be continuing on the same topic.

<p>

It is still O.K. for a new speaker to say the “.i” before con­tinuing; indeed, it is en­couraged for maximum clarity (since it is pos­sible that the second speaker might merely be adding words onto the end of the first speaker's sentence). A good translation for “.i” is the “and” used in run-on sentences when people are talking infor­mally: “I did this, and then I did that, and <dots>…</dots>, and <dots>…</dots>”.

<p>

### <a name=s9><h3>tanru</h3>

<p>

<cx "tanru (quick-tour version)">When two gismu are adjacent, the first one modifies the sec­ond, and the selbri takes its place structure from the rightmost word. Such combinations of gismu are called “tanru”. For example,

<p>

<pre><a name=e9d1>9.1) sutra tavla

</pre>has the place structure

<p>

<ex "fast talker"><pre><a name=e9d2>9.2) x1 is a fast type-of talker to x2 about x3 in language x4

x1 talks fast to x2 about x3 in language x4

</pre><cx "tanru default grouping (quick-tour version)">When three or more gismu are in a row, the first modifies the second, and that com­bined meaning modifies the third, and that com­bined meaning modifies the fourth, and so on. For example

<p>

<ex "fast-talker shoe"><pre><a name=e9d3>9.3) sutra tavla cutci

</pre>has the place structure

<p>

<pre><a name=e9d4>9.4) s1 is a fast-talker type of shoe worn by s2 of material s3

</pre><p>That is, it is a shoe that is worn by a fast talker rather than a shoe that is fast and is also worn by a talker.

<p>

Note especially the use of “type-of” as a mechanism for con­necting the English translations of the two or more gismu; this con­vention helps the learner understand each tanru in its context. Crea­tive interpretations are also possible, however:

<p>

<ex "runner shoe"><pre><a name=e9d5>9.5) bajra cutci

runner shoe

</pre>most probably refers to shoes suitable for runners, but might be in­terpreted in some imaginative instances as “shoes that run (by them­selves?)”. In general, however, the meaning of a tanru is determined by the literal meaning of its components, and not by any connotations or figurative meanings. Thus

<p>

<pre><a name=e9d6>9.6) sutra tavla

fast-talker

</pre>would not necessarily imply any trickery or deception, unlike the Eng­lish idiom, and a

<p>

<ex "social butterfly"><ex "butterfly, social"><pre><a name=e9d7>9.7) jikca toldi

social butterfly

</pre><ex "Lepidoptera">must always be an insect with large brightly-colored wings, of the family <i>*Lepidoptera*</i>.

<p>

<cx "tanru, place structure of (quick-tour version)">The place structure of a tanru is always that of the final com­ponent of the tanru. Thus, the following has the place structure of “klama”:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 9.8) | mi | [cu] | sutra klama | la meris. |
|  | I |  | quickly-go | to Mary. |

<p>

</pre><cx "tanru conversion, effect on place structure (quick-tour version)">With the conversion “se klama” as the final component of the tanru, the place struc­ture of the entire selbri is that of “se klama”: the x1 place is the destination, and the x2 place is the one who goes:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 9.9) | mi | [cu] | sutra se klama | la meris. |
|  | I |  | quickly am-gone-to | by Mary. |

<p>

</pre><cx "tanru, and conversion (quick-tour version)">The following example shows that there is more to conver­sion than merely switching places, though:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 9.10) | la tam. | [cu] | melbi tavla | la meris. |
|  | Tom |  | beautifully-talks | to Mary. |
|  | Tom is a beautiful-talker to Mary. | | | |

<p>

</pre>has the place structure of “tavla”, but note the two distinct interpre­tations.

<p>

Now, using conversion, we can modify the place structure or­der:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 9.11) | la meris. | [cu] | melbi se tavla | la tam. |
|  | Mary |  | is beautifully-talked-to | by Tom. |
|  | Mary is a beautiful-audience for Tom. | | | |

<p>

</pre>and we see that the modification has been changed so as to focus on Mary's role in the bridi relationship, leading to a different set of pos­sible interpretations.

<p>

Note that there is no place structure change if the modifying term is converted, and so less drastic variation in possible meanings:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 9.12) | la tam. | [cu] | tavla melbi | la meris. |
|  | Tom |  | is talkerly-beautiful | to Mary. |

<p>

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 9.13) | la tam. | [cu] | se tavla melbi | la meris. |
|  | Tom |  | is audiencely-beautiful | to Mary. |

</pre>and we see that the manner in which Tom is seen as beautiful by Mary changes, but Tom is still the one perceived as beautiful, and Mary, the observer of beauty.

<p>

### <a name=s10><h3>Description sumti</h3>

<p>

<cx "descriptions (quick-tour version)"><ex "talker">Often we wish to talk about things other than the speaker, the listener and things we can point to. Let's say I want to talk about a talker other than “mi”. What I want to talk about would naturally fit into the first place of “tavla”. Lojban, it turns out, has an op­era­tor that pulls this first place out of a selbri and converts it to a sumti called a “description sumti”. The description sumti “le tavla ku” means “the talker”, and may be used wherever any sumti may be used.

<p>

For example,

<p>

<pre><a name=e10d1>10.1) mi tavla do le tavla ku

</pre>means the same as

<p>

<pre><a name=e10d2>10.2) I talk to you about the talker

</pre>where “the talker” is presumably someone other than me, though not necessarily.

<p>

Similarly “le sutra tavla ku” is “the fast talker”, and “le sutra te tavla ku” is “the fast subject of talk” or “the subject of fast talk”. Which of these related meanings is under­stood will depend on the context in which the expression is used. The most plau­sible in­terpre­tation within the context will generally be assumed by a listener to be the intended one.

<p>

In many cases the word “ku” may be omitted. In particular, it is never neces­sary in a description at the end of a sentence, so:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 10.3) | mi | tavla | do | le tavla |
|  | I | talk-to | you | about-the talker. |

<p>

</pre>means exactly the same thing as <a href=#e10d1>Example 10.1</a>.

<p>

<cx "cu, need for (quick-tour version)">There is a problem when we want to say “The fast one is talking.” The “obvious” translation “le sutra tavla” turns out to mean “the fast talker”, and has no selbri at all. To solve this problem we can use the word “cu”, which so far has always been optional, in front of the selbri.

<p>

The word “cu” has no meaning, and exists only to mark the beginning of the selbri within the bridi, separating it from a previous sumti. It comes before any other part of the selbri, including other cmavo like “se” or “te”. Thus:

<p>

<pre><a name=e10d4>10.4) le sutra tavla

The fast talker

<a name=e10d5>10.5) le sutra cu tavla

The fast one is talking.

<a name=e10d6>10.6) le sutra se tavla

The fast talked-to one

<a name=e10d7>10.7) le sutra cu se tavla

The fast one is talked to.

</pre><cx "ku (quick-tour version)"><cx "KU (quick-tour version)">Consider the following more complex example, with two de­scription sumti.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 10.8) | mi | [cu] | tavla | le vecnu [ku] | le blari’o [ku] |
|  | I |  | talk-to | the seller | about the blue-green-thing. |

<p>

</pre><p>The sumti “le vecnu” contains the selbri “vecnu”, which has the “seller” in the x1 place, and uses it in this sentence to describe a par­ticular “seller” that the speaker has in mind (one that he or she probably expects the listener will also know about). Similarly, the speaker has a particular blue-green thing in mind, which is described using “le” to mark “blari'o”, a selbri whose first sumti is something blue-green.

<p>

It is safe to omit both occurrences of “ku” in <a href=#e10d8>Example 10.8 </a>, and it is also safe to omit the “cu”.

<p>

### <a name=s11><h3>Examples of brivla</h3>

<p>

<cx "brivla, types of (quick-tour version)">The simplest form of selbri is an individual word. A word which may by itself ex­press a selbri relation is called a “brivla”. The three types of brivla are gismu (root words), lujvo (compounds), and fu'ivla (borrowings from other languages). All have identical gram­matical uses. So far, most of our selbri have been gismu or tanru built from gismu.

<p>

<cx "gismu (quick-tour version)">gismu:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 11.1) | mi | [cu] | klama | ti | zo’e | zo’e | ta |
|  | Go-er |  | goes | destination | origin | route | means. |
|  | I go here (to this) using that means (from somewhere via some route). | | | | | | |

<p>

</pre><cx "lujvo (quick-tour version)">lujvo:

|  |  |  |  |
| --- | --- | --- | --- |
| 11.2) | ta | [cu] | blari’o |
|  | That |  | is-blue-green. |

<p>

</pre><cx "fu'ivla (quick-tour version)">fu'ivla:

|  |  |  |  |
| --- | --- | --- | --- |
| 11.3) | ti | [cu] | djarspageti |
|  | This |  | is-spaghetti. |

<p>

</pre><cx "cmavo as selbri (quick-tour version)">Some cmavo may also serve as selbri, acting as variables that stand for another sel­bri. The most commonly used of these is “go'i”, which represents the main bridi of the previous Lojban sen­tence, with any new sumti or other sentence features being ex­pressed replacing the previously expressed ones. Thus, in this con­text:

|  |  |  |  |
| --- | --- | --- | --- |
| 11.4) | ta | [cu] | go’i |
|  | That |  | too/same-as-last selbri. |
|  | That (is spaghetti), too. | | |

<p>

### </pre><a name=s12><h3>The sumti “di'u” and “la'e di'u”</h3>

<p>

<cx "reference (quick-tour version)">In English, I might say “The dog is beautiful”, and you might reply “This pleases me.” How do you know what “this” refers to? Loj­ban uses different expressions to con­vey the possible meanings of the English:

<p>

<ex "beautiful dog"><pre><a name=e12d1>12.1) le gerku [ku] cu melbi

The dog is beautiful.

</pre><p>The following three sentences all might translate as “This pleases me.”

<p>

<cx "pleases"><pre><a name=e12d2>12.2) ti [cu] pluka mi

This (the dog) pleases me.

</pre><lx "di'u (quick-tour version)"><pre><a name=e12d3>12.3) di'u [cu] pluka mi

This (the last sentence) pleases me (perhaps because it is grammatical

or sounds nice).

</pre><lx "la'edi'u (quick-tour version)"><pre><a name=e12d4>12.4) la'e di'u [cu] pluka mi

This (the meaning of the last sentence; i.e. that the dog is beautiful)

pleases me.

</pre><a href=#e12d4>Example 12.4 </a>uses one sumti to point to or refer to another by infer­ence. It is common to write “la'edi'u” as a single word; it is used more often than “di'u” by itself.

<p>

### <a name=s13><h3>Possession</h3>

<p>

<cx "possession (quick-tour version)">“Possession” refers to the concept of specifying an object by saying who it be­longs to (or with). A full explanation of Lojban pos­session is given in <a href=chap8.html>Chapter 8</a>. A simple means of expressing posses­sion, however, is to place a sumti representing the possessor of an object within the description sumti that refers to the object: specifi­cally, between the “le” and the selbri of the description:

|  |  |  |  |
| --- | --- | --- | --- |
| 13.1) | le mi gerku | cu | sutra |
|  | The of-me dog |  | is fast. |
|  | My dog is fast. | | |

<p>

</pre><cx "possession not ownership (quick-tour version)">In Lojban, possession doesn't necessarily mean ownership: one may “possess” a chair simply by sitting on it, even though it ac­tually belongs to someone else. English uses pos­session casually in the same way, but also uses it to refer to actual ownership or even more intimate relationships: “my arm” doesn't mean “some arm I own” but rather “the arm that is part of my body”. Lojban has meth­ods of specifying all these different kinds of possession precisely and easily.

<p>

### <a name=s14><h3>Vocatives and commands</h3>

<p>

<cx "vocatives (quick-tour version)"><lx "doi (quick-tour version)"><lx "DOI (quick-tour version)">You may call someone's attention to the fact that you are ad­dressing them by using “doi” followed by their name. The sentence

<p>

<pre><a name=e14d1>14.1) doi djan.

</pre>means “Oh, John, I'm talking to you”. It also has the effect of setting the value of “do”; “do” now refers to “John” until it is changed in some way in the conversation. Note that <a href=#e14d1>Example 14.1 </a>is not a bridi, but it is a legitimate Lojban sentence nevertheless; it is known as a “vocative phrase”.

<p>

<lx "coi (quick-tour version)"><lx "co'o (quick-tour version)">Other cmavo can be used instead of “doi” in a vocative phrase, with a different sig­nificance. For example, the cmavo “coi” means “hello” and “co'o” means “good-bye”. Either word may stand alone, they may follow one another, or either may be fol­lowed by a pause and a name. (Vocative phrases with “doi” do not need a pause before the name.)

<p>

<pre><a name=e14d2>14.2) coi. djan.

Hello, John.

<a name=e14d3>14.3) co'o. djan.

Good-bye, John.

</pre><cx "commands (quick-tour version)"><cx "imperatives (quick-tour version)">Commands are expressed in Lojban by a simple variation of the main bridi struc­ture. If you say

<p>

<pre><a name=e14d4>14.4) do tavla

You are-talking.

</pre>you are simply making a statement of fact. In order to issue a com­mand in Lojban, sub­stitute the word “ko” for “do”. The bridi

<p>

<ex "Talk!"><lx "ko (quick-tour version)"><pre><a name=e14d5>14.5) ko tavla

</pre>instructs the listener to do whatever is necessary to make <a href=#e14d4>Example 14.4 true; it means “Talk!” Other examples:

<p>

<pre><a name=e14d6>14.6) ko sutra

Be fast!

</pre><p>The “ko” need not be in the x1 place, but rather can occur anywhere a sumti is allowed, leading to possible Lojban commands that are very unlike English commands:

<p>

<pre><a name=e14d7>14.7) mi tavla ko

Be talked to by me.

Let me talk to you.

</pre><p>The cmavo “ko” can fill any appropriate sumti place, and can be used as often as is ap­propriate for the selbri:

<p>

<pre><a name=e14d8>14.8) ko kurji ko

</pre>and

<p>

<ex "Take care!"><pre><a name=e14d9>14.9) ko ko kurji

</pre>both mean “You take care of you” and “Be taken care of by you”, or to put it colloqui­ally, “Take care of yourself”.

<p>

### <a name=s15><h3>Questions</h3>

<p>

<cx "questions (quick-tour version)">There are many kinds of questions in Lojban: full explana­tions appear in <a href=chap19.html>Chapter 19 </a>and in various other chapters throughout the book. In this chapter, we will introduce three kinds: sumti ques­tions, selbri questions, and yes/no questions.

<p>

<cx "questions (quick-tour version)"><cx "sumti questions (quick-tour version)"><lx "ma (quick-tour version)">The cmavo “ma” is used to create a sumti question: it indi­cates that the speaker wishes to know the sumti which should be placed at the location of the “ma” to make the bridi true. It can be translated as “Who?” or “What?” in most cases, but also serves for “When?”, “Where?”, and “Why?” when used in sumti places that ex­press time, lo­cation, or cause. For example:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 15.1) | ma | tavla | do | mi |
|  | Who? | talks | to-you | about-me. |
|  | Who is talking to you about me? | | | |

<p>

</pre><p>The listener can reply by simply stating a sumti:

<p>

<pre><a name=e15d2>15.2) la djan.

John (is talking to you about me).

</pre><p>Like “ko”, “ma” can occur in any position where a sumti is al­lowed, not just in the first position:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 15.3) | do | [cu] | tavla | ma |
|  | You |  | talk | to what/whom? |

<p>

</pre><p>A “ma” can also appear in multiple sumti positions in one sentence, in effect asking sev­eral questions at once.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 15.4) | ma | [cu] | tavla | ma |
|  | What/Who |  | talks | to what/whom? |

<p>

</pre><cx "separate questions (quick-tour version)">The two separate “ma” positions ask two separate questions, and can therefore be an­swered with different values in each sumti place.

<p>

<cx "selbri questions (quick-tour version)"><cx "bridi questions (quick-tour version)"><lx "mo (quick-tour version)">The cmavo “mo” is the selbri analogue of “ma”. It asks the respondent to pro­vide a selbri that would be a true relation if in­serted in place of the “mo”:

|  |  |  |  |
| --- | --- | --- | --- |
| 15.5) | do | [cu] | mo |
|  | You |  | are-what/do-what? |

<p>

</pre><p>A “mo” may be used anywhere a brivla or other selbri might. Keep this in mind for later examples. Unfortunately, by itself, “mo” is a very non-specific question. The re­sponse to the question in <a href=#e15d5>Example 15.5 </a>could be:

<p>

<pre><a name=e15d6>15.6) mi [cu] melbi

I am beautiful.

</pre>or:

<p>

<pre><a name=e15d7>15.7) mi [cu] tavla

I talk.

</pre><cx "speaker-listener cooperation">Clearly, “mo” requires some cooperation between the speaker and the respon­dent to ensure that the right question is being answered. If context doesn't make the question spe­cific enough, the speaker must ask the question more specifically using a more com­plex construction such as a tanru (see <a href=#s9>Section 9</a>).

<p>

It is perfectly permissible for the respondent to fill in other un­specified places in re­sponding to a “mo” question. Thus, the re­spon­dent in <a href=#e15d7>Example 15.7 </a>could have also specified an audience, a topic, and/or a language in the response.

<p>

<cx "yes/no questions (quick-tour version)">Finally, we must consider questions that can be answered “Yes” or “No”, such as

<p>

<pre><a name=e15d8>15.8) Are you talking to me?

</pre><p>Like all yes-or-no questions in English, <a href=#e15d8>Example 15.8 </a>may be refor­mulated as

<p>

<pre><a name=e15d9>15.9) Is it true that you are talking to me?

</pre><lx "xu (quick-tour version)">In Lojban we have a word that asks precisely that question in pre­cisely the same way. The cmavo “xu”, when placed in front of a bridi, asks whether that bridi is true as stated. So

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 15.10) | xu | do | tavla | mi |
|  | Is-it-true-that | you | are-talking | to-me? |

<p>

</pre>is the Lojban translation of <a href=#e15d8>Example 15.8</a>.

<p>

<cx "go'i with xu (quick-tour version)"><cx "affirmative answer (quick-tour version)">The answer “Yes” may be given by simply restating the bridi without the “xu” ques­tion word. Lojban has a shorthand for doing this with the word “go'i”, mentioned in <a href=#s11>Sec­tion 11</a>. Instead of a negative answer, the bridi may be restated in such a way as to make it true. If this can be done by substituting sumti, it may be done with “go'i” as well. For example:

<p>

<ex "healthy"><pre><a name=e15d11>15.11) xu do kanro

Are you healthy?

</pre>can be answered with

<p>

<pre><a name=e15d12>15.12) mi kanro

I am healthy.

</pre>or

<p>

<pre><a name=e15d13>15.13) go'i

I am healthy.

</pre>(Note that “do” to the questioner is “mi” to the respondent.)

<p>

or

<p>

<pre><a name=e15d14>15.14) le tavla cu kanro

The talker is healthy.

</pre>or

<p>

<pre><a name=e15d15>15.15) le tavla cu go'i

The talker is healthy.

</pre><lx "nago'i (quick-tour version)"><cx "negative answer (quick-tour version)">A general negative answer may be given by “na go'i”. “na” may be placed be­fore any selbri (but after the “cu”). It is equivalent to stating “It is not true that <dots>…</dots>” be­fore the bridi. It does not imply that anything else is true or untrue, only that that spe­cific bridi is not true. More details on negative statements are available in <a href=chap15.html>Chapter 15</a>.

<p>

### <a name=s16><h3>Indicators</h3>

<p>

<cx "indicators (quick-tour version)"><cx "attitudinal indicators (quick-tour version)"><cx "interjections (quick-tour version)">Different cultures express emotions and attitudes with a vari­ety of intonations and gestures that are not usually included in written lan­guage. Some of these are avail­able in some languages as interjec­tions (i.e. Aha!, Oh no!, Ouch!, Aahh!, etc.), but they vary greatly from culture to culture.

<p>

Lojban has a group of cmavo known as “attitudinal indicators” which specifi­cally covers this type of commentary on spoken state­ments. They are both written and spo­ken, but require no specific in­tonation or gestures. Grammatically they are very simple: one or more attitu­dinals at the beginning of a bridi apply to the entire bridi; anywhere else in the bridi they apply to the word immediately to the left. For example:

<p>

<lx "UI (quick-tour version)"><pre><a name=e16d1>16.1) .ie mi [cu] klama

Agreement! I go.

Yep! I'll go.

<a name=e16d2>16.2) .ei mi [cu] klama

Obligation! I go.

I should go.

<a name=e16d3>16.3) mi [cu] klama le melbi .ui [ku]

I go to the beautiful-thing (and I am happy because it is the beautiful

thing I'm going to).

</pre><cx "discursives (quick-tour version)"><cx "metalinguistic words (quick-tour version)"><cx "but/and equivalence">Not all indicators indicate attitudes. Discursives, another group of cmavo with the same grammatical rules as attitudinal indi­cators, allow free expression of certain kinds of commentary about the main utter­ances. Using discursives allows a clear sepa­ration of these so-called “metalinguistic” features from the underlying state­ments and logical structure. By comparison, the English words “but” and “also”, which discur­sively indi­cate contrast or an added weight of example, are logically equivalent to “and”, which does not have a dis­cursive con­tent. The average English-speaker does not think about, and may not even realize, the paradoxical idea that “but” basically means “and”.

<p>

<pre><a name=e16d4>16.4) mi [cu] klama .i do [cu] stali

I go. You stay.

<a name=e16d5>16.5) mi [cu] klama .i ji'a do [cu] stali

I go. In addition, you stay. (added weight)

<a name=e16d6>16.6) mi [cu] klama .i ku'i do [cu] stali

I go. However, you stay. (contrast)

</pre><cx "evidentials (quick-tour version)">Another group of indicators are called “evidentials”. Evidentials show the speaker's rela­tionship to the statement, specifically how the speaker came to make the statement. These include “za'a” (I directly observe the relationship), “pe'i” (I believe that the rela­tionship holds), “ru'a” (I postulate the relationship), and others. Many American Indian languages use this kind of words.

<p>

<pre><a name=e16d7>16.7) pe'i do [cu] melbi

I opine! You are beautiful.

<a name=e16d8>16.8) za'a do [cu] melbi

I directly observe! You are beautiful.

### </pre><a name=s17><h3>Tenses</h3>

<p>

<cx "tenses (quick-tour version)"><cx "time tenses (quick-tour version)">In English, every verb is tagged for the grammatical category called tense: past, pres­ent, or future. The sentence

<p>

<pre><a name=e17d1>17.1) John went to the store

</pre>necessarily happens at some time in the past, whereas

<p>

<pre><a name=e17d2>17.2) John is going to the store

</pre>is necessarily happening right now.

<p>

<cx "sentences, tenseless (quick-tour version)">The Lojban sentence

<p>

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 17.3) | la djan. | [cu] | klama | le zarci |
|  | John |  | goes/went/will-go | to-the store. |

</pre>serves as a translation of either <a href=#e17d1>Example 17.1 </a>or <a href=#e17d2>Example 17.2</a>, and of many other pos­sible English sentences as well. It is not marked for tense, and can refer to an event in the past, the present or the fu­ture. This rule does not mean that Lojban has no way of repre­senting the time of an event. A close translation of <a href=#e17d1>Example 17.1 </a>would be:

|  |  |  |  |
| --- | --- | --- | --- |
| 17.4) | la djan. | pu klama | le zarci |
|  | John | [past] goes | to-the store. |

<p>

</pre>where the tag “pu” forces the sentence to refer to a time in the past. Similarly,

|  |  |  |  |
| --- | --- | --- | --- |
| 17.5) | la djan. | ca klama | le zarci |
|  | John | [present] goes | to-the store. |

<p>

</pre>necessarily refers to the present, because of the tag “ca”. Tags used in this way always appear at the very beginning of the selbri, just after the “cu”, and they may make a “cu” unnecessary, since tags cannot be absorbed into tanru. Such tags serve as an equivalent to Eng­lish tenses and adverbs. In Lojban, tense in­formation is completely optional. If un­speci­fied, the appropri­ate tense is picked up from context.

<p>

<cx "space tenses (quick-tour version)">Lojban also extends the notion of “tense” to refer not only to time but to space. The following example uses the tag “vu” to specify that the event it describes happens far away from the speaker:

|  |  |  |  |
| --- | --- | --- | --- |
| 17.6) | do | vu vecnu | zo’e |
|  | You | yonder sell | something-unspecified. |

<p>

</pre><p>In addition, tense tags (either for time or space) can be pre­fixed to the selbri of a de­scription, producing a tensed sumti:

|  |  |  |  |
| --- | --- | --- | --- |
| 17.7) | le pu bajra [ku] | cu | tavla |
|  | The earlier/former/past runner |  | talked/talks. |

<p>

</pre>(Since Lojban tense is optional, we don't know when he or she talks.)

<p>

Tensed sumti with space tags correspond roughly to the Eng­lish use of “this” or “that” as adjectives, as in the following example, which uses the tag “vi” meaning “nearby”:

|  |  |  |  |
| --- | --- | --- | --- |
| 17.8) | le vi bajra [ku] | cu | tavla |
|  | The nearby runner |  | talks. |
|  | This runner talks. | | |

<p>

</pre><p>Do not confuse the use of “vi” in <a href=#e17d8>Example 17.8 </a>with the cmavo “ti”, which also means “this”, but in the sense of “this thing”.

<p>

<cx "sumti with tenses (quick-tour version)">Furthermore, a tense tag can appear both on the selbri and within a description, as in the following example (where “ba” is the tag for future time):

|  |  |  |  |
| --- | --- | --- | --- |
| 17.9) | le vi bajra [ku] | cu | ba klama |
|  | The here runner |  | [future] goes. |
|  | The talker who is here will go. | | |
|  | This talker will go. | | |

<p>

### </pre><a name=s18><h3>Lojban grammatical terms</h3>

<p>

<cx "grammatical terms (quick-tour version)">Here is a review of the Lojban grammatical terms used in this chap­ter, plus some others used throughout this book. Only terms that are themselves Lojban words are in­cluded: there are of course many ex­pressions like “indicator” in <a href=chap16.html>Chapter 16 </a>that are not explained here. See the Index for further help with these.

* <p>
* <cx "bridi, definition (quick-tour version)"><dl compact><dt>bridi: <dd>predication; the basic unit of Lojban expression; the main kind of Lojban sentence; a claim that some objects stand in some relationship, or that some single object has some property.
* </dl><cx "sumti, definition (quick-tour version)"><dl compact><dt>sumti: <dd>argument; words identifying something which stands in a specified relationship to something else, or which has a specified property. See <a href=chap6.html>Chapter 6</a>.
* </dl><cx "selbri, definition (quick-tour version)"><dl compact><dt>selbri: <dd>logical predicate; the core of a bridi; the word or words specifying the relationship between the objects referred to by the sumti. See <a href=chap5.html>Chapter 5</a>.
* </dl><cx "cmavo, definition (quick-tour version)"><dl compact><dt>cmavo: <dd>one of the Lojban parts of speech; a short word; a structural word; a word used for its grammatical func­tion.
* </dl><cx "brivla, definition (quick-tour version)"><dl compact><dt>brivla: <dd>one of the Lojban parts of speech; a content word; a predicate word; can function as a selbri; is a gismu, a lujvo, or a fu'ivla. See <a href=chap4.html>Chapter 4</a>.
* </dl><cx "gismu, definition (quick-tour version)"><dl compact><dt>gismu: <dd>a root word; a kind of brivla; has associated rafsi. See <a href=chap4.html>Chapter 4</a>.
* </dl><cx "lujvo, definition (quick-tour version)"><dl compact><dt>lujvo: <dd>a compound word; a kind of brivla; may or may not appear in a dic­tionary; does not have associated rafsi. See <a href=chap4.html>Chapter 4 </a>and <a href=chap12.html>Chapter 12</a>.
* </dl><cx "fu'ivla, definition (quick-tour version)"><dl compact><dt>fu'ivla: <dd>a borrowed word; a kind of brivla; may or may not appear in a dic­tionary; copied in a modified form from some non-Lojban language; usu­ally refers to some aspect of culture or the natural world; does not have as­sociated rafsi. See <a href=chap4.html>Chapter 4</a>.
* </dl><cx "rafsi, definition (quick-tour version)"><dl compact><dt>rafsi: <dd>a word fragment; one or more is associated with each gismu; can be assembled according to rules in or­der to make lujvo; not a valid word by itself. See <a href=chap4.html>Chapter 4</a>.
* </dl><cx "tanru, definition (quick-tour version)"><dl compact><dt>tanru: <dd>a group of two or more brivla, possibly with asso­ciated cmavo, that form a selbri; always divisible into two parts, with the first part modifying the meaning of the second part (which is taken to be basic). See <a href=chap5.html>Chapter 5</a>.
* </dl><cx "selma'o, definition (quick-tour version)"><dl compact><dt>selma'o: <dd>a group of cmavo that have the same gram­matical use (can ap­pear interchangeably in sentences, as far as the grammar is concerned) but differ in mean­ing or other usage. See <a </a>href=chap20.html>Chapter 20</a>.

</body></html>

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## <h2>Chapter 3

## <br>

## The Hills Are Alive With The Sounds Of Lojban</h2>

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<p>

### <a name=s1><h3>Orthography</h3>

<p>

<cx "isomorphism, audio-visual"><cx "audio-visual isomorphism"><cx "pronunciation, relation to orthography"><cx "orthography, relation to pronunciation">Lojban is designed so that any properly spoken Lojban utter­ance can be uniquely transcribed in writing, and any properly written Lojban can be spoken so as to be uniquely reproduced by another person. As a consequence, the standard Lojban or­thog­raphy must assign to each distinct sound, or phoneme, a unique letter or symbol. Each letter or symbol has only one sound or, more accurately, a lim­ited range of sounds that are permitted pronunciations for that pho­neme. Some symbols indicate stress (speech emphasis) and pause, which are also essential to Lojban word recognition. In addition, eve­rything that is represented in other languages by punctuation (when writ­ten) or by tone of voice (when spoken) is represented in Lojban by words. These two properties together are known technically as “audio-visual isomorphism”.

<p>

<cx "Latin alphabet"><cx "Lojban alphabet"><cx "alphabet, Lojban">Lojban uses a variant of the Latin (Roman) alphabet, con­sisting of the follow­ing let­ters and symbols:

<p>

<dl compact><dt><dd> ' , . a b c d e f g i j k l m n o p r s t u v x y z

</dl>omitting the letters “h”, “q”, and “w”.

<p>

<cx "alphabetic order">The alphabetic order given above is that of the ASCII coded character set, widely used in computers. By making Lojban alphabeti­cal order the same as ASCII, computer­ized sorting and searching of Lojban text is facilitated.

<p>

<cx "capital letters, use of"><cx "stress, showing non-standard">Capital letters are used only to represent non-standard stress, which can appear only in the representation of Lojbanized names. Thus the English name “Josephine”, as nor­mally pronounced, is Lojbanized as “DJOsefin.”, pronounced <font face="SILDoulosIPA">[]</font>. (See <a href=#s2>Sec­tion 2 </a>for an explanation of the symbols within square brackets.) Techni­cally, it is suffi­cient to capitalize the vowel letter, in this case “O”, but it is easier on the reader to capi­talize the whole syllable.

<p>

Without the capitalization, the ordinary rules of Lojban stress would cause the “se” syllable to be stressed. Lojbanized names are meant to represent the pronunciation of names from other languages with as little distortion as may be; as such, they are ex­empt from many of the regular rules of Lojban phonology, as will appear in the rest of this chapter.

<p>

### <a name=s2><h3>Basic phonetics</h3>

<p>

<cx "International Phonetic Alphabet (see also IPA)"><cx "IPA"><cx "phonetic alphabet"><cx "brackets, use in IPA notation">Lojban pronunciations are defined using the International Phonetic Alphabet, or IPA, a standard method of transcribing pronun­ciations. By convention, IPA tran­scriptions are always within square brackets: for example, the word “cat” is pronounced (in General American pronunciation) <font face="SILDoulosIPA">[]</font>. <a href=#s10>Section 10 </a>contains a brief explana­tion of the IPA char­acters used in this chapter, with their nearest analogues in English, and will be especially useful to those not famil­iar with the technical terms used in describing speech sounds.

<p>

<cx "pronunciation, standard"><cx "standard pronunciation">The standard pronunciations and permitted variants of the Lojban letters are listed in the table below. The descriptions have de­liberately been made a bit ambiguous to cover variations in pronun­ciation by speakers of different native languages and dia­lects. In all cases except “r” the first IPA symbol shown represents the preferred pro­nun­ciation; for “r”, all of the variations (and any other rhotic sound) are equally accept­able.

<p>

<cx "pronunciation, IPA for Lojban"><cx "Lojban letters, IPA for pronouncing"><cx "Lojban letters, list with IPA pronunciation"><pre> Letter IPA Description

' <font face="SILDoulosIPA">[]</font> a unvoiced glottal spirant

, — the syllable separator

. <font face="SILDoulosIPA">[]</font> a glottal stop or a pause

a <font face="SILDoulosIPA">[]</font>, <font face="SILDoulosIPA">[]</font> an open vowel

b <font face="SILDoulosIPA">[]</font> a voiced bilabial stop

c <font face="SILDoulosIPA">[]</font>, <font face="SILDoulosIPA">[]</font> an unvoiced coronal sibilant

d <font face="SILDoulosIPA">[]</font> a voiced dental/alveolar stop

e <font face="SILDoulosIPA">[]</font>, <font face="SILDoulosIPA">[]</font> a front mid vowel

f <font face="SILDoulosIPA">[]</font>, <font face="SILDoulosIPA">[]</font> an unvoiced labial fricative

g <font face="SILDoulosIPA">[]</font> a voiced velar stop

i <font face="SILDoulosIPA">[]</font> a front close vowel

j <font face="SILDoulosIPA">[]</font>,<font face="SILDoulosIPA">[]</font> a voiced coronal sibilant

k <font face="SILDoulosIPA">[]</font> an unvoiced velar stop

l <font face="SILDoulosIPA">[]</font>, <font face="SILDoulosIPA">[]</font> a voiced lateral approximant

(may be syllabic)

m <font face="SILDoulosIPA">[]</font>, <font face="SILDoulosIPA">[]</font> a voiced bilabial nasal

(may be syllabic)

n <font face="SILDoulosIPA">[]</font>, <font face="SILDoulosIPA">[]</font>, a voiced dental or velar nasal

<font face="SILDoulosIPA">[]</font>, <font face="SILDoulosIPA">[]</font> (may be syllabic)

o <font face="SILDoulosIPA">[]</font>, <font face="SILDoulosIPA">[]</font> a back mid vowel

p <font face="SILDoulosIPA">[]</font> an unvoiced bilabial stop

r <font face="SILDoulosIPA">[]</font>, <font face="SILDoulosIPA">[]</font>, <font face="SILDoulosIPA">[]</font>, <font face="SILDoulosIPA">[]</font>, a rhotic sound

<font face="SILDoulosIPA">[]</font>, <font face="SILDoulosIPA">[]</font>, <font face="SILDoulosIPA">[]</font>, <font face="SILDoulosIPA">[]</font>

s <font face="SILDoulosIPA">[]</font> an unvoiced alveolar sibilant

t <font face="SILDoulosIPA">[]</font> an unvoiced dental/alveolar stop

u <font face="SILDoulosIPA">[]</font> a back close vowel

v <font face="SILDoulosIPA">[]</font>, <font face="SILDoulosIPA">[]</font> a voiced labial fricative

x <font face="SILDoulosIPA">[]</font> an unvoiced velar fricative

y <font face="SILDoulosIPA">[]</font> a central mid vowel

z <font face="SILDoulosIPA">[]</font> a voiced alveolar sibilant

</pre><cx "clarity of sounds"><cx "sounds, clarity of">The Lojban sounds must be clearly pronounced so that they are not mistaken for each other. Voicing and placement of the tongue are the key factors in correct pro­nunciation, but other subtle differ­ences will develop between consonants in a Lojban-speaking com­munity. At this point these are the only mandatory rules on the range of sounds.

<p>

<cx "rounded/unrounded vowels">Note in particular that Lojban vowels can be pronounced with either rounded or un­rounded lips; typically “o” and “u” are rounded and the others are not, as in Eng­lish, but this is not a requirement; some people round “y” as well. Lojban consonants can be aspi­rated or unaspirated. Palatalizing of consonants, as found in Russian and other languages, is not generally acceptable in pronunciation, though a following “i” may cause it.

<p>

<cx "sounds, difficult"><cx "sounds for letters, Lojban contrasted with English">The sounds represented by the letters “c”, “g”, “j”, “s”, and “x” require special atten­tion for speakers of English, either because they are ambiguous in the orthography of English (“c”, “g”, “s”), or because they are strikingly different in Lojban (“c”, “j”, “x”). The English “c” rep­resents three different sounds, <font face="SILDoulosIPA">[] </font>in “cat” and <font face="SILDoulosIPA">[] </font>in “cent”, as well as the <font face="SILDoulosIPA">[] </font>of “ocean”. Similarly, English “g” can represent <font face="SILDoulosIPA">[] </font>as in “go”, <font face="SILDoulosIPA">[] </font>as in “gentle”, and <font face="SILDoulosIPA">[] </font>as in the second “g” in “garage” (in some pronunciations). English “s” can be either <font face="SILDoulosIPA">[] </font>as in “cats”, <font face="SILDoulosIPA">[] </font>as in “cards”, <font face="SILDoulosIPA">[] </font>as in “tension”, or <font face="SILDoulosIPA">[] </font>as in “measure”. The sound of Lojban “x” doesn't ap­pear in most English dialects at all.

<p>

<cx "sounds, complex"><cx "“ts”-sound in Russian, representation in Lojban"><cx "“ch”-sound in English, representation in Lojban"><cx "“j”-sound in English, representation in Lojban">There are two common English sounds that are found in Loj­ban but are not Lojban consonants: the “ch” of “church” and the “j” of “judge”. In Lojban, these are considered two consonant sounds spoken together without an intervening vowel sound, and so are rep­resented in Lojban by the two separate consonants: “tc” (IPA <font face="SILDoulosIPA">[]</font>) and “dj” (IPA <font face="SILDoulosIPA">[]</font>). In general, whether a complex sound is considered one sound or two depends on the lan­guage: Russian views “ts” as a single sound, whereas English, French, and Lojban con­sider it to be a consonant cluster.

<p>

### <a name=s3><h3>The special Lojban characters</h3>

<p>

<cx "characters, special">The apostrophe, period, and comma need special attention. They are all used as indi­cators of a division between syllables, but each has a different pronunciation, and each is used for different rea­sons:

<p>

<cx "apostrophe, definition of"><cx "“ ' ”, definition (see also apostrophe)"><cx "apostrophe, type of letter in word-formation">The apostrophe represents a phoneme similar to a short, breathy English “h”, (IPA <font face="SILDoulosIPA">[]</font>). The letter “h” is not used to represent this sound for two reasons: primarily in order to simplify explanations of the morphology, but also because the sound is very common, and the apostrophe is a visually lightweight representation of it. The apostro­phe sound is a consonant in nature, but is not treated as ei­ther a consonant or a vowel for purposes of Lojban morphology (word-formation), which is explained in <a href=chap4.html>Chapter 4</a>. In addition, the apostrophe visually parallels the comma and the period, which are also used (in different ways) to separate syllables.

<p>

<cx "apostrophe, purpose of"><cx "unvoiced vowel glide, apostrophe as">The apostrophe is included in Lojban only to enable a smooth transitionseparation between vow­els, while joining the vowels within a single word. In fact, one way to think of the apostrophe is as representing a unvoiced vowel glide.

<p>

<cx "apostrophe, variant of">As a permitted variant, any unvoiced fricative other than those already used in Loj­ban may be used to render the apostrophe: IPA <font face="SILDoulosIPA">[] </font>is one possibility. The conven­ience of the listener should be regarded as paramount in deciding to use a substitute for <font face="SILDoulosIPA">[]</font>.

<p>

<cx "period, definition of"><cx "glottal stop, as pause in Lojban"><cx "pause, representation of in Lojban">The period represents a mandatory pause, with no specified length; a glottal stop (IPA <font face="SILDoulosIPA">[]</font>) is considered a pause of shortest length. A pause (or glottal stop) may appear between any two words, and in certain cases – explained in detail in <a href=chap4.html>Chapter 4 </a>— must occur. In particular, a word beginning with a vowel is always preceded by a pause, and a word ending in a consonant is always followed by a pause.

<p>

<cx "period, optional">Technically, the period is an optional reminder to the reader of a mandatory pause that is dictated by the rules of the language; because these rules are unambiguous, a missing period can be in­ferred from otherwise correct text. Periods are included only as an aid to the reader.

<p>

<cx "period, within a word">A period also may be found apparently embedded in a word. When this occurs, such a written string is not one word but two, writ­ten together to indicate that the writer in­tends a unitary meaning for the compound. It is not really necessary to use a space be­tween words if a period appears.

<p>

<cx "comma, definition of"><cx "syllable break, representation in Lojban"><cx "syllable break, contrasted with pause"><cx "pause, contrasted with syllable break">The comma is used to indicate a syllable break within a word, generally one that is not obvious to the reader. Such a comma is written to separate syllables, but in­dicates that there must be no pause between them, in contrast to the period. Between two vowels, a comma indicates that some type of glide may be necessary to avoid a pause that would split the two syllables into separate words. It is always legal to use the apostrophe (IPA <font face="SILDoulosIPA">[]</font>) sound in pronouncing a comma. However, a comma cannot be pronounced as a pause or glottal stop between the two letters separated by the comma, be­cause that pro­nuncia­tion would split the word into two words.

<p>

<cx "comma, main use of"><cx "comma, optional">Otherwise, a comma is usually only used to clarify the pres­ence of syllabic “l”, “m”, “n”, or “r” (discussed later). Commas are never required: no two Lojban words differ solely because of the presence or placement of a comma.

<p>

<ex "Old McDonald">Here is a somewhat artificial example of the difference in pronunciation be­tween pe­riods, commas and apostrophes. In the English song about Old MacDonald's Farm, the vowel string written “ee-i-ee-i-o” in English could be Lojban­ized with periods as:

<p>

<cx "period, example of"><pre><a name=e3d1>3.1) .i.ai.i.ai.o

<font face="SILDoulosIPA">[]</font>

Ee! Eye! Ee! Eye! Oh!

</pre><p>However, this would sound clipped, staccato, and unmusical com­pared to the English. Furthermore, although <a href=#e3d1>Example 3.1 </a>is a string of meaningful Lojban words, as a sen­tence it makes very little sense. (Note the use of periods embedded within the written word.)

<p>

If commas were used instead of periods, we could represent the English string as a Lojbanized name, ending in a consonant:

<p>

<cx "comma, example of"><pre><a name=e3d2>3.2) .i,ai,i,ai,on.

<font face="SILDoulosIPA">[]</font>

</pre><p>The commas represent new syllable breaks, but prohibit the use of pauses or glottal stop. The pronunciation shown is just one possibility, but closely parallels the intended English pronunciation.

<p>

<cx "comma, variant of">However, the use of commas in this way is risky to unambi­guous interpreta­tion, since the glides might be heard by some listen­ers as diphthongs, producing some­thing like

<p>

<pre><a name=e3d3>3.3) .i,iai,ii,iai,ion.

</pre>which is technically a different Lojban name. Since the intent with Lojbanized names is to allow them to be pronounced more like their native counterparts, the comma is al­lowed to represent vowel glides or some non-Lojbanic sound. Such an exception affects only spelling accuracy and the ability of a reader to replicate the desired pronun­ciation exactly; it will not affect the recognition of word boundaries.

<p>

<cx "apostrophe, as preferable over comma in names">Still, it is better if Lojbanized names are always distinct. Therefore, the apos­trophe is preferred in regular Lojbanized names that are not attempting to simulate a non-Lojban pronunciation per­fectly. (Perfection, in any event, is not really achievable, because some sounds simply lack reasonable Lojbanic counterparts.)

<p>

If apostrophes were used instead of commas in <a href=#e3d2>Example 3.2</a>, it would appear as:

<p>

<cx "apostrophe, example of"><pre><a name=e3d4>3.4) .i'ai'i'ai'on.

<font face="SILDoulosIPA">[]</font>

</pre>which preserves the rhythm and length, if not the exact sounds, of the original English.

<p>

### <a name=s4><h3>Diphthongs and syllabic consonants</h3>

<p>

<cx "diphthongs, definition of">There exist 16 diphthongs in the Lojban language. A diph­thong is a vowel sound that consists of two elements, a short vowel sound and a glide, either a labial (IPA <font face="SILDoulosIPA">[]</font>) or palatal (IPA <font face="SILDoulosIPA">[]</font>) glide, that either precedes (an on-glide) or follows (an off-glide) the main vowel. Diphthongs always constitute a single syllable.

<p>

<cx "consonants, contrasted with vowels"><cx "vowels, contrasted with consonants">For Lojban purposes, a vowel sound is a relatively long speech-sound that forms the nucleus of a syllable. Consonant sounds are relatively brief and normally re­quire an ac­companying vowel sound in order to be audible. Consonants may occur at the beginning or end of a syllable, around the vowel, and there may be several con­so­nants in a cluster in either position. Each separate vowel sound constitutes a distinct syllable; consonant sounds do not affect the determination of syllables.

<p>

<cx "vowels, definition of">The six Lojban vowels are “a”, “e”, “i”, “o”, “u”, and “y”. The first five vow­els ap­pear freely in all kinds of Lojban words. The vowel “y” has a limited distribution: it ap­pears only in Lojbanized names, in the Lojban names of the letters of the alphabet, as a glue vowel in compound words, and standing alone as a space-filler word (like Eng­lish “uh” or “er”).

<p>

The Lojban diphthongs are shown in the table below. (Variant pronunciations have been omitted, but are much as one would expect based on the variant pronuncia­tions of the separate vowel letters: “ai” may be pronounced <font face="SILDoulosIPA">[]</font>, for example.)

<p>

<cx "diphthongs, IPA for"><cx "diphthongs, list of"><pre>Letters IPA Description

ai <font face="SILDoulosIPA">[] </font> an open vowel with palatal off-glide

ei <font face="SILDoulosIPA">[] </font> a front mid vowel with palatal off-glide

oi <font face="SILDoulosIPA">[] </font> a back mid vowel with palatal off-glide

au <font face="SILDoulosIPA">[] </font> an open vowel with labial off-glide

ia <font face="SILDoulosIPA">[] </font> an open vowel with palatal on-glide

ie <font face="SILDoulosIPA">[] </font> a front mid vowel with palatal on-glide

ii <font face="SILDoulosIPA">[] </font> a front close vowel with palatal on-glide

io <font face="SILDoulosIPA">[] </font> a back mid vowel with palatal on-glide

iu <font face="SILDoulosIPA">[] </font> a back close vowel with palatal on-glide

ua <font face="SILDoulosIPA">[] </font> an open vowel with labial on-glide

ue <font face="SILDoulosIPA">[] </font> a front mid vowel with labial on-glide

ui <font face="SILDoulosIPA">[] </font> a front close vowel with labial on-glide

uo <font face="SILDoulosIPA">[] </font> a back mid vowel with labial on-glide

uu <font face="SILDoulosIPA">[] </font> a back close vowel with labial on-glide

iy <font face="SILDoulosIPA">[] </font> a central mid vowel with palatal on-glide

uy <font face="SILDoulosIPA">[] </font> a central mid vowel with labial on-glide

</pre>(Approximate English equivalents of most of these diphthongs exist: see <a href=#s11>Section 11 for examples.)

<p>

<cx "diphthongs, classification of">The first four diphthongs above (“ai”, “ei”, “oi”, and “au”, the ones with off-glides) are freely used in most types of Lojban words; the ten following ones are used only as stand-alone words and in Loj­banized names and borrowings; and the last two (“iy” and “uy”) are used only in Lojbanized names.

<p>

<cx "consonants, syllabic"><cx "syllabic consonants">The syllabic consonants of Lojban, <font face="SILDoulosIPA">[]</font>, <font face="SILDoulosIPA">[]</font>, <font face="SILDoulosIPA">[]</font>, and <font face="SILDoulosIPA">[]</font>, are variants of the non-syl­labic <font face="SILDoulosIPA">[]</font>, <font face="SILDoulosIPA">[]</font>, <font face="SILDoulosIPA">[]</font>, and <font face="SILDoulosIPA">[] </font>respectively. They normally have only a limited distri­bution, appearing in Lojban names and borrowings, although in principle any “l”, “m”, “n”, or “r” may be pronounced syllabically. If a syllabic consonant appears next to a “l”, “m”, “n”, or “r” that is not syllabic, it may not be clear which is which:

<p>

<pre><a name=e4d1>4.1) brlgan.

<font face="SILDoulosIPA">[]</font>

or <font face="SILDoulosIPA">[]</font>

</pre>is a hypothetical Lojbanized name with more than one valid pronun­ciation; however it is pronounced, it remains the same word.

<p>

<ex "Earl"><cx "syllabic consonants, final in word">Syllabic consonants are treated as consonants rather than vowels from the standpoint of Lojban morphology. Thus Lojbanized names, which are generally re­quired to end in a consonant, are al­lowed to end with a syllabic consonant. An example is “rl.”, which is an approximation of the English name “Earl”, and has two syllabic consonants.

<p>

<cx "stress, effect of syllabic consonants on"><cx "syllabic consonants, effect on stress">Syllables with syllabic consonants and no vowel are never stressed or counted when determining which syllables to stress (see <a href=#s9>Section 9</a>).

<p>

### <a name=s5><h3>Vowel pairs</h3>

<p>

<cx "vowel pairs, definition of"><cx "apostrophe, use in vowel pairs"><cx "vowel pairs, use of apostrophe in">Lojban vowels also occur in pairs, where each vowel sound is in a separate syllable. These two vowel sounds are connected (and separated) by an apostrophe. Loj­ban vowel pairs should be pro­nounced continuously with the <font face="SILDoulosIPA">[] </font>sound between (and not by a glottal stop or pause, which would split the two vowels into separate words).

<p>

<cx "vowel pairs, contrasted with diphthongs"><cx "diphthongs, contrasted with vowel pairs">All vowel combinations are permitted in two-syllable pairs with the apostrophe sepa­rating them; this includes those which constitute diphthongs when the apostrophe is not included.

<p>

<cx "vowel pairs, list of">The Lojban vowel pairs are:

<p>

<pre> a'a a'e a'i a'o a'u a'y

e'a e'e e'i e'o e'u e'y

i'a i'e i'i i'o i'u i'y

o'a o'e o'i o'o o'u o'y

u'a u'e u'i u'o u'u u'y

y'a y'e y'i y'o y'u y'y

</pre><cx "vowel pairs, involving “y”">Vowel pairs involving “y” appear only in Lojbanized names. They could ap­pear in cmavo (structure words), but only “.y'y.” is so used — it is the Lojban name of the apos­trophe letter (see <a href=chap17.html>Chapter 17</a>).

<p>

<cx "vowel pairs, grouping of">When more than two vowels occur together in Lojban, the normal pronuncia­tion pairs vowels from the left into syllables, as in the Lojbanized name:

<p>

<pre><a name=e5d1>5.1) meiin.

mei,in.

</pre><a href=#e5d1>Example 5.1 contains the diphthong “ei” followed by the vowel “i”. In order to indicate a different grouping, the comma must always be used, leading to:

<p>

<pre><a name=e5d2>5.2) me,iin.

</pre>which contains the vowel “e” followed by the diphthong “ii”. In rough English repre­sen­tation, <a href=#e5d1>Example 5.1 </a>is “May Een”, whereas <a href=#e5d2>Example 5.2 </a>is “Meh Yeen”.

<p>

### <a name=s6><h3>Consonant clusters</h3>

<p>

<cx "consonant, definition"><cx "consonant, effect on syllable count">A consonant sound is a relatively brief speech-sound that precedes or follows a vowel sound in a syllable; its presence either preceding or following does not add to the count of syllables, nor is a consonant required in either position for any syllable. Lojban has sev­enteen consonants: for the purposes of this section, the apostrophe is not counted as a consonant.

<p>

<cx "consonants, voicing of">An important distinction dividing Lojban consonants is that of voicing. The follow­ing table shows the unvoiced consonants and the corresponding voiced ones:

<p>

<cx "consonants, voiced/unvoiced equivalents"><pre>UNVOICED VOICED

p b

t d

k g

f v

c j

s z

x -

</pre><p>The consonant “x” has no voiced counterpart in Lojban. The remain­ing consonants, “l”, “m”, “n”, and “r”, are typically pronounced with voice, but can be pronounced un­voiced.

<p>

<cx "consonant clusters, definition of"><cx "single consonants, contrasted with doubled consonants"><cx "single consonants, contrasted with consonant clusters"><cx "doubled consonants, contrasted with single consonants"><cx "doubled consonants, contrasted with consonant clusters"><cx "consonant clusters, contrasted with doubled consonants"><cx "consonant clusters, contrasted with single consonants">Consonant sounds occur in languages as single consonants, or as doubled, or as clustered combinations. Single consonant sounds are isolated by word boundaries or by intervening vowel sounds from other consonant sounds. Doubled consonant sounds are either lengthened like <font face="SILDoulosIPA">[] </font>in English “hiss”, or repeated like <font face="SILDoulosIPA">[] </font>in Eng­lish “backcourt”. Consonant clusters consist of two or more single or doubled consonant sounds in a group, each of which is different from its immediate neighbor. In Lojban, doubled con­sonants are excluded altogether, and clusters are limited to two or three members, ex­cept in Loj­banized names.

<p>

<cx "consonants, position of">Consonants can occur in three positions in words: initial (at the beginning), medial (in the middle), and final (at the end). In many languages, the sound of a conso­nant varies depending upon its posi­tion in the word. In Lojban, as much as possible, the sound of a con­sonant is unrelated to its position. In particular, the common Ameri­can English trait of changing a “t” between vowels into a “d” or even a flap (IPA <font face="SILDoulosIPA">[]</font>) is un­acceptable in Loj­ban.

<p>

<cx "consonants, restrictions on"><cx "consonants, final">Lojban imposes no restrictions on the appearance of single consonants in any valid consonant position; however, no consonant (including syllabic consonants) occurs final in a word except in Loj­banized names.

<p>

<cx "consonant pairs, restrictions on">Pairs of consonants can also appear freely, with the following restrictions:

<p>

<dl compact><dt>1) <dd>It is forbidden for both consonants to be the same, as this would violate the rule against double consonants.

</dl><cx "voiced/unvoiced consonants, restrictions on"><dl compact><dt>2) <dd>It is forbidden for one consonant to be voiced and the other unvoiced. The consonants “l”, “m”, “n”, and “r” are exempt from this restriction. As a re­sult, “bf” is forbid­den, and so is “sd”, but both “fl” and “vl”, and both “ls” and “lz”, are permitted.

<p><dt>3) <dd>It is forbidden for both consonants to be drawn from the set “c”, “j”, “s”, “z”.

<p><dt>4) <dd>The specific pairs “cx”, “kx”, “xc”, “xk”, and “mz” are forbid­den.

</dl><ex "James"><cx "“y”, use in avoiding forbidden consonant pairs">These rules apply to all kinds of words, even Lojbanized names. If a name would normally contain a forbidden consonant pair, a “y” can be inserted to break up the pair:

<p>

<pre><a name=e6d1>6.1) djeimyz.

<font face="SILDoulosIPA">[]</font>

James

</pre><p>The regular English pronunciation of “James”, which is <font face="SILDoulosIPA">[]</font>, would Lojbanize as “djeimz.”, which contains a forbidden consonant pair.

<p>

### <a name=s7><h3>Initial consonant pairs</h3>

<p>

<cx "consonant pairs, initial">The set of consonant pairs that may appear at the beginning of a word (excluding Lojbanized names) is far more restricted than the fairly large group of per­missible conso­nant pairs described in <a href=#s6>Section 6</a>. Even so, it is more than English allows, although hope­fully not more than English-speakers (and others) can learn to pronounce.

<p>

<cx "initial consonant pairs, list of">There are just 48 such permissible initial consonant pairs, as follows:

<p>

<dl compact><dt> <dd>bl br

cf ck cl cm cn cp cr ct

dj dr dz

fl fr

gl gr

jb jd jg jm jv

kl kr

ml mr

pl pr

sf sk sl sm sn sp sr st

tc tr ts

vl vr

xl xr

zb zd zg zm zv

</dl><p>Lest this list seem almost random, a pairing of voiced and unvoiced equivalent vow­els will show significant patterns which may help in learning:

<p>

<pre> pl pr fl fr

bl br vl vr

cp cf ct ck cm cn cl cr

jb jv jd jg jm

sp sf st sk sm sn sl sr

zb zv zd zg zm

tc tr ts kl kr

dj dr dz gl gr

ml mr xl xr

</pre><cx "voiced consonants, contrasted with unvoiced in allowable consonant pairs"><cx "unvoiced consonants, contrasted with voiced in allowable consonant pairs">Note that if both consonants of an initial pair are voiced, the unvoiced equivalent is also permissible, and the voiced pair can be pronounced simply by voicing the unvoiced pair. (The converse is not true: “cn” is a permissible initial pair, but “jn” is not.)

<p>

<cx "consonant triples">Consonant triples can occur medially in Lojban words. They are subject to the fol­lowing rules:

<p>

<cx "consonant triples, restrictions on"><dl compact><dt>1) <dd> The first two consonants must constitute a permissi­ble con­sonant pair;

<p><dt>2) <dd>The last two consonants must constitute a permissi­ble initial consonant pair;

<p><dt>3) <dd>The triples “ndj”, “ndz”, “ntc”, and “nts” are forbidden.

</dl><cx "consonant clusters, more than three consonants in">Lojbanized names can begin or end with any permissible consonant pair, not just the 48 initial consonant pairs listed above, and can have consonant triples in any location, as long as the pairs making up those triples are permissible. In addition, names can con­tain consonant clusters with more than three consonants, again re­quiring that each pair within the cluster is valid.

<p>

### <a name=s8><h3>Buffering of consonant clusters</h3>

<p>

<cx "consonant clusters, buffering of"><cx "buffer vowel"><cx "vowel, buffer">Many languages do not have consonant clusters at all, and even those lan­guages that do have them often allow only a subset of the full Lojban set. As a result, the Lojban de­sign allows the use of a buffer sound between consonant combinations which a speaker finds unpronounceable. This sound may be any non-Lojbanic vowel which is clearly separable by the listener from the Lojban vowels. Some possibilities are IPA <font face="SILDoulosIPA">[]</font>, <font face="SILDoulosIPA">[]</font>, <font face="SILDoulosIPA">[]</font>, or even <font face="SILDoulosIPA">[]</font>, but there probably is no universally acceptable buffer sound. When using a consonant buffer, the sound should be made as short as possible. Two examples showing such buffering (we will use <font face="SILDoulosIPA">[] </font>in this chapter) are:

<p>

<pre><a name=e8d1>8.1) vrusi

<font face="SILDoulosIPA">[]</font>

or <font face="SILDoulosIPA">[]</font>

</pre><ex "Amsterdam"><pre><a name=e8d2>8.2) .AMsterdam.

<font face="SILDoulosIPA">[]</font>

or <font face="SILDoulosIPA">[]</font>

</pre><cx "buffer vowel, and stress"><cx "stress, effect of buffer vowel on">When a buffer vowel is used, it splits each buffered conso­nant into its own syllable. However, the buffering syllables are never stressed, and are not counted in determining stress. They are, in ef­fect, not really syllables to a Lojban listener, and thus their impact is ignored.

<p>

Here are more examples of unbuffered and buffered pronun­ciations:

<p>

<pre><a name=e8d3>8.3) klama

<font face="SILDoulosIPA">[]</font>

<font face="SILDoulosIPA">[]</font>

<a name=e8d4>8.4) xapcke

<font face="SILDoulosIPA">[]</font>

<font face="SILDoulosIPA">[]</font>

<font face="SILDoulosIPA">[]</font>

</pre><p>In <a href=#e8d4>Example 8.4</a>, we see that buffering vowels can be used in just some, rather than all, of the possible places: the second pronuncia­tion buffers the “pc” consonant pair but not the “ck”. The third pronun­ciation buffers both.

<p>

<pre><a name=e8d5>8.5) ponyni'u

<font face="SILDoulosIPA">[]</font>

</pre><cx "vowel buffer, contrasted with “y”"><cx "“y”, contrasted with vowel buffer"><ex "bone bread"><a href=#e8d5>Example 8.5 cannot contain any buffering vowel. It is important not to confuse the vowel “y”, which is pronounced <font face="SILDoulosIPA">[]</font>, with the buffer, which has a variety of possible pronuncia­tions and is never written. Con­sider the contrast between

<p>

<pre><a name=e8d6>8.6) bongynanba

<font face="SILDoulosIPA">[]</font>

</pre>an unlikely Lojban compound word meaning “bone bread” (note the use of <font face="SILDoulosIPA">[] </font>as a rep­resentative of “n” before “g”) and

<p>

<pre><a name=e8d7>8.7) bongnanba

<font face="SILDoulosIPA">[]</font>

</pre>a possible borrowing from another language (Lojban borrowings can only take a limited form). If <a href=#e8d7>Example 8.7 </a>were pronounced with buff­ering, as

<p>

<pre><a name=e8d8>8.8) <font face="SILDoulosIPA">[]</font>

</pre>it would be very similar to <a href=#e8d6>Example 8.6</a>. Only a clear distinction be­tween “y” and any buffering vowel would keep the two words distinct.

<p>

<cx "vowels, length of"><cx "buffer vowel, shortening of">Since buffering is done for the benefit of the speaker in order to aid pro­nounceability, there is no guarantee that the listener will not mistake a buffer vowel for one of the six regular Lojban vowels. The buffer vowel should be as laxly pronounced as possible, as central as possible, and as short as possible. Furthermore, it is worth­while for speakers who use buffers to pronounce their regular vowels a bit longer than usual, to avoid confu­sion with buffer vowels. The speak­ers of many languages will have trouble correctly hearing any of the suggested buffer vowels otherwise. By this guide­line, <a href=#e8d8>Example 8.8 would be pronounced

<p>

<pre><a name=e8d9>8.9) <font face="SILDoulosIPA">[]</font>

</pre>with lengthened vowels.

<p>

### <a name=s9><h3>Syllabication and stress</h3>

<p>

<cx "syllabication, definition of">A Lojban word has one syllable for each of its vowels, diph­thongs, and syl­labic con­sonants (referred to simply as “vowels” for the purposes of this section.) Syl­labication rules determine which of the consonants separating two vowels belong to the preceding vowel and which to the following vowel. These rules are conventional only; the phonetic facts of the matter about how utterances are syllabified in any language are always very complex.

<p>

<cx "syllabication, rules for">A single consonant always belongs to the following vowel. A consonant pair is nor­mally divided between the two vowels; however, if the pair constitute a valid initial con­sonant pair, they are normally both assigned to the following vowel. A consonant triple is divided between the first and second consonants. Apostrophes and commas, of course, also represent syllable breaks. Syllabic consonants usually appear alone in their syllables.

<p>

<cx "syllabication, and names">It is permissible to vary from these rules in Lojbanized names. For example, there are no definitive rules for the syllabication of names with consonant clusters longer than three consonants. The comma is used to indicate variant syllabication or to explicitly mark normal syllabication.

<p>

<cx "syllabication, examples of">Here are some examples of Lojban syllabication:

<p>

<pre><a name=e9d1>9.1) pujenaicajeba

pu,je,nai,ca,je,ba

</pre><p>This word has no consonant pairs and is therefore syllabified before each medial conso­nant.

<p>

<pre><a name=e9d2>9.2) ninmu

nin,mu

</pre><p>This word is split at a consonant pair.

<p>

<pre><a name=e9d3>9.3) fitpri

fit,pri

</pre><p>This word is split at a consonant triple, between the first two conso­nants of the triple.

<p>

<pre><a name=e9d4>9.4) sairgoi

sair,goi

sai,r,goi

</pre><p>This word contains the consonant pair “rg”; the “r” may be pro­nounced syllabically or not.

<p>

<pre><a name=e9d5>9.5) klezba

klez,ba

kle,zba

</pre><p>This word contains the permissible initial pair “zb”, and so may be syllabicated either between “z” and “b” or before “zb”.

<p>

<cx "stress, definition of"><cx "stressed syllable, compared with stressed vowel"><cx "stressed vowel, compared with stressed syllable">Stress is a relatively louder pronunciation of one syllable in a word or group of words. Since every syllable has a vowel sound (or diphthong or syllabic consonant) as its nucleus, and the stress is on the vowel sound itself, the terms “stressed syllable” and “stressed vowel” are largely interchangeable concepts.

<p>

<cx "stress, rules for">Most Lojban words are stressed on the next-to-the-last, or penultimate, sylla­ble. In counting syllables, however, syllables whose vowel is “y” or which contain a syllabic consonant (“l”, “m”, “n”, or “r”) are never counted. (The Lojban term for pe­nultimate stress is “da'amoi terbasna”.) Similarly, syllables created solely by adding a buffer vowel, such as <font face="SILDoulosIPA">[]</font>, are not counted.

<p>

<cx "stress, levels of">There are actually three levels of stress — primary, secon­dary, and weak. Weak stress is the lowest level, so it really means no stress at all. Weak stress is re­quired for syllables containing “y”, a syllabic consonant, or a buffer vowel.

<p>

<cx "stress, primary"><cx "cmavo, stress on"><cx "brivla, stress on"><cx "names, stress on">Primary stress is required on the penultimate syllable of Lojban content words (called “brivla”). Lojbanized names may be stressed on any syllable, but if a syllable other than the penultimate is stressed, the syllable (or at least its vowel) must be capi­talized in writ­ing. Lojban structural words (called “cmavo”) may be stressed on any syllable or none at all. However, primary stress may not be used in a syllable just pre­ceding a brivla, unless a pause divides them; oth­erwise, the two words may run to­gether.

<p>

<cx "stress, secondary">Secondary stress is the optional and non-distinctive empha­sis used for other syllables besides those required to have either weak or primary stress. There are few rules govern­ing secondary stress, which typically will follow a speaker's native lan­guage habits or preferences. Secondary stress can be used for contrast, or for em­phasis of a point. Secon­dary stress can be emphasized at any level up to primary stress, al­though the speaker must not allow a false pri­mary stress in brivla, since errors in word resolution could result.

<p>

<ex "Armstrong">The following are Lojban words with stress explicitly shown:

<p>

<pre><a name=e9d6>9.6) dikyjvo

DI,ky,jvo

</pre>(In a fully-buffered dialect, the pronunciation would be: <font face="SILDoulosIPA">[]</font>.) Note that the syl­lable “ky” is not counted in determining stress. The vowel “y” is never stressed in a nor­mal Lojban context.

<p>

<pre><a name=e9d7>9.7) .armstrong.

.ARM,strong.

</pre><p>This is a Lojbanized version of the name “Armstrong”. The final “g” must be explicitly pronounced. With full buffering, the name would be pronounced:

<p>

<pre><a name=e9d8>9.8) <font face="SILDoulosIPA">[]</font>

</pre><p>However, there is no need to insert a buffer in every possible place just because it is in­serted in one place: partial buffering is also ac­ceptable. In every case, however, the stress remains in the same place: on the first syllable.

<p>

<cx "-ng, Lojban contrasted with English">The English pronunciation of “Armstrong”, as spelled in Eng­lish, is not correct by Lojban standards; the letters “ng” in English rep­resent a velar nasal (IPA <font face="SILDoulosIPA">[]</font>) which is a single consonant. In Lojban, “ng” represents two separate consonants that must both be pro­nounced; you may not use <font face="SILDoulosIPA">[] </font>to pronounce Lojban “ng”, although <font face="SILDoulosIPA">[] </font>is accept­able. English speakers are likely to have to pronounce the ending with a buffer, as one of the following:

<p>

<pre><a name=e9d9>9.9) <font face="SILDoulosIPA">[]</font>

or <font face="SILDoulosIPA">[]</font>

or even <font face="SILDoulosIPA">[]</font>

</pre><p>The normal English pronunciation of the name “Armstrong” could be Lojbanized as:

<p>

<pre><a name=e9d10>9.10) .ARMstron.

</pre>since Lojban “n” is allowed to be pronounced as the velar nasal <font face="SILDoulosIPA">[]</font>.

<p>

Here is another example showing the use of “y”:

<p>

<pre><a name=e9d11>9.11) bisydja

BI,sy,dja

BI,syd,ja

</pre><p>This word is a compound word, or lujvo, built from the two affixes “bis” and “dja”. When they are joined, an impermissible consonant pair results: “sd”. In accordance with the algorithm for making lujvo, explained in <a href=chap4.html>Chapter 4</a>, a “y” is inserted to sepa­rate the im­permissible consonant pair; the “y” is not counted as a syllable for purposes of stress de­termination.

<p>

<ex "syllabication, variants of"><pre><a name=e9d12>9.12) da'udja

da'UD,ja

da'U,dja

</pre><p>These two syllabications sound the same to a Lojban listener — the association of un­buffered consonants in syllables is of no import in recognizing the word.

<p>

<pre><a name=e9d13>9.13) e'u bridi

e'u BRI,di

E'u BRI,di

e'U.BRI,di

</pre><p>In <a href=#e9d13>Example 9.13</a>, “e'u” is a cmavo and “bridi” is a brivla. Either of the first two pronun­ciations is permitted: no primary stress on either syl­lable of “e'u”, or primary stress on the first syllable. The third pronun­ciation, which places primary stress on the second syllable of the cmavo, requires that — since the following word is a brivla — the two words must be separated by a pause. Consider the following two cases:

<p>

<pre><a name=e9d14>9.14) le re nobli prenu

le re NObli PREnu

<a name=e9d15>9.15) le re no bliprenu

le re no bliPREnu

</pre><p>If the cmavo “no” in <a href=#e9d15>Example 9.15 </a>were to be stressed, the phrase would sound exactly like the given pronunciation of <a href=#e9d14>Example 9.14</a>, which is unacceptable in Lojban: a single pronunciation cannot repre­sent both.

### <p> <a name=s10><h3>IPA for English-speakers</h3>

<p> <cx "General American"><cx "Received Pronunciation"><cx "television"><cx "IPA pronunciation, description">There are many dialects of English, thus making it difficult to define the stan­dardized symbols of the IPA in terms useful to every reader. All the symbols used in this chapter are repeated here, in more or less alphabetical order, with examples drawn from General American. In addition, some attention is given to the Received Pro­nun­ciation of (British) English. These two dialects are referred to as GA and RP respec­tively. Speakers of other dialects should consult a book on phonetics or their local tele­vision sets.

<p> <dl compact><dt><font face="SILDoulosIPA">[]</font> <dd>An IPA indicator of primary stress; the syllable which fol­lows <font face="SILDoulosIPA">[] </font>receives pri­mary stress.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>An allowed variant of Lojban “.”. This sound is not usually considered part of English. It is the catch in your throat that sometimes occurs prior to the be­ginning of a word (and some­times a syllable) which starts with a vowel. In some dialects, like Cockney and some kinds of American English, it is used between vowels instead of “t”: “bottle” <font face="SILDoulosIPA">[]</font>. The English interjection “uh-oh!” almost always has it between the syllables.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>A symbol indicating that the previous vowel is to be spoken for a longer time than usual. Lojban vowels can be pronounced long in order to make a greater contrast with buffer vowels.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>The preferred pronunciation of Lojban “a”. This sound doesn't occur in GA, but sounds somewhat like the “ar” of “park”, as spo­ken in RP or New England American. It is pronounced further forward in the mouth than <font face="SILDoulosIPA">[]</font>.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>An allowed variant of Lojban “a”. The “a” of GA “father”. The sound <font face="SILDoulosIPA">[] </font>is preferred because GA speakers often relax an un­stressed <font face="SILDoulosIPA">[] </font>into a schwa <font face="SILDoulosIPA">[]</font>, as in the usual pronunciations of “about” and “sofa”. Because schwa is a dis­tinct vowel in Lojban, English speakers must either learn to avoid this shift or to use <font face="SILDoulosIPA">[] </font>instead: the Lojban word for “sofa” is “sfofa”, pronounced <font face="SILDoulosIPA">[] </font>or <font face="SILDoulosIPA">[] </font>but never <font face="SILDoulosIPA">[] </font>which would be the non-word “sfofy”.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>Not a Lojban sound. The “a” of English “cat”.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>The preferred pronunciation of Lojban “b”. As in English “boy”, “sober”, or “job”.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>An allowed variant of Lojban “v”. Not an English sound; the Spanish “b” or “v” between vowels. This sound should not be used for Lojban “b”.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>The preferred pronunciation of Lojban “d”. As in English “dog”, “soda”, or “mad”.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>The preferred pronunciation of Lojban “e”. The “e of English “met”.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>An allowed variant of Lojban “e”. This sound is not found in English, but is the Spanish “e”, or the tense “e” of Italian. The vowel of English “say” is similar except for the off-glide: you can learn to make this sound by holding your tongue steady while saying the first part of the English vowel.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>The preferred pronunciation of Lojban “y”. As in the “a” of English “sofa” or “about”. Schwa is generally unstressed in Loj­ban, as it is in English. It is a totally relaxed sound made with the tongue in the middle of the mouth.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>The preferred pronunciation of Lojban “f”. As in “fee”, “loafer”, or “chef”.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>An allowed variant of Lojban “f”. Not an English sound; the Japanese “f” sound.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>The preferred pronunciation of Lojban “g”. As in English “go”, “eagle”, or “dog”.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>The preferred pronunciation of the Lojban apostrophe sound. As in English “aha” or the second “h” in “oh, hello”.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>The preferred pronunciation of Lojban “i”. Essentially like the English vowel of “pizza” or “machine”, although the English vowel is sometimes pro­nounced with an off-glide, which should not be present in Lojban.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>A possible Lojban buffer vowel. The “i” of English “bit”.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>A possible Lojban buffer vowel. The “u” of “just” in some va­rieties of GA, those which make the word sound more or less like “jist”. Also Russian “y” as in “byt'” (to be); like a schwa <font face="SILDoulosIPA">[]</font>, but higher in the mouth.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>Used in Lojban diphthongs beginning or ending with “i”. Like the “y” in Eng­lish “yard” or “say”.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>The preferred pronunciation of Lojban “k”. As in English “kill”, “token”, or “flak”.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>The preferred pronunciation of Lojban “l”. As in English “low”, “nylon”, or “excel”.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>The syllabic version of Lojban “l”, as in English “bottle” or “middle”.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>The preferred pronunciation of Lojban “m”. As in English “me”, “humor”, or “ham”.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>The syllabic version of Lojban “m”. As in English “catch 'em” or “bottom”.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>The preferred pronunciation of Lojban “n”. As in English “no”, “honor”, or “son”.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>The syllabic version of Lojban “n”. As in English “button”.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>An allowed variant of Lojban “n”, especially in Lojbanized names and before “g” or “k”. As in English “sing” or “singer” (but not “finger” or “danger”).

<p><dt><font face="SILDoulosIPA">[]</font> <dd>An allowed variant of Lojban syllabic “n”, especially in Loj­banized names.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>The preferred pronunciation of Lojban “o”. As in the French “haute (cuisine)” or Spanish “como”. There is no exact English equivalent of this sound. The nearest GA equivalent is the “o” of “dough” or “joke”, but it is essential that the off-glide (a <font face="SILDoulosIPA">[]</font>-like sound) at the end of the vowel is not pronounced when speaking Lojban. The RP sound in these words is <font face="SILDoulosIPA">[] </font>in IPA terms, and has no <font face="SILDoulosIPA">[] </font>in it at all; unless you can speak with a Scots, Irish, or Ameri­can accent, you may have trouble with this sound.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>An allowed variant of Lojban “o”, especially before “r”. This sound is a short­ened form of the “aw” in GA “dawn” (for those people who don't pronounce “dawn” and “Don” alike; if you do, you may have trouble with this sound). In RP, but not GA, it is the “o” of “hot”.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>The preferred pronunciation of Lojban “p”. As in English “pay”, “super”, or “up”.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>One version of Lojban “r”. Not an English sound. The Spanish “rr” and the Scots “r”, a tongue-tip trill.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>One version of Lojban “r”. As in GA “right”, “baron”, or “car”. Not found in RP.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>One version of Lojban “r”. In GA, appears as a variant of “t” or “d” in the words “metal” and “medal” respectively. A tongue-tip flap.

<font face="SILDoulosIPA">[]</font> One version of Lojban “r”. Not an English sound. The French or German “r” in “reine” or “rot” respectively. A uvular trill.

<p><dt><dd><font face="SILDoulosIPA">[]</font>, <font face="SILDoulosIPA">[]</font>, <font face="SILDoulosIPA">[]</font>, <font face="SILDoulosIPA">[] </font>are syllabic versions of the above. <font face="SILDoulosIPA">[] </font>appears in the GA (but not RP) pronunciation of “bird”.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>The preferred pronunciation of Lojban “s”. As in English “so”, “basin”, or “yes”.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>The preferred pronunciation of Lojban “c”. The “sh” of Eng­lish “ship”, “ashen”, or “dish”.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>An allowed variant of Lojban “s”. Not an English sound. The Hindi retroflex “s” with dot below, or Klingon “S”.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>The preferred pronunciation of Lojban “t”. As in English “tea”, “later”, or “not”. It is important to avoid the GA habit of pro­nounc­ing the “t” between vowels as <font face="SILDoulosIPA">[] </font>or <font face="SILDoulosIPA">[]</font>.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>Not normally a Lojban sound, but a possible variant of Loj­ban “ ' ”. The “th” of English “thin” (but not “then”).

<p><dt><font face="SILDoulosIPA">[]</font> <dd>The preferred pronunciation of Lojban “v”. As in English “voice”, “savor”, or “live”.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>Used in Lojban diphthongs beginning or ending with “u”. Like the “w” in English “wet” <font face="SILDoulosIPA">[] </font>or “cow” <font face="SILDoulosIPA">[]</font>.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>The preferred pronunciation of Lojban “x”. Not normally an English sound, but used in some pronunciations of “loch” and “Bach”; “gh” in Scots “might” and “night”. The German “Ach-Laut”. To pronounce <font face="SILDoulosIPA">[]</font>, force air through your throat without vibrating your vocal chords; there should be lots of scrape.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>A possible Lojban buffer vowel. Not an English sound: the “ü” of German “hübsch”.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>The preferred pronunciation of Lojban “z”. As in English “zoo”, “hazard”, or “fizz”.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>The preferred pronunciation of Lojban “j”. The “si” of English “vision”, or the consonant at the end of GA “garage”.

<p><dt><font face="SILDoulosIPA">[]</font> <dd>An allowed variant of Lojban “z”. Not an English sound. The voiced version of <font face="SILDoulosIPA">[</font>.

### </dl><a name=s11><h3>English analogues for Lojban diphthongs</h3>

<p>

<cx "diphthongs, English analogues of">Here is a list of English words that contain diphthongs that are similar to the Lojban diphthongs. This list does not constitute an official pronunciation guide; it is intended as a help to English-speak­ers.

<p>

<pre> Lojban English

ai “pie”

ei “pay”

oi “boy”

au “cow”

ia “yard”

ie “yes”

ii “ye”

io “yodel” (in GA only)

iu “unicorn” or “few”

ua “suave”

ue “wet”

ui “we”

uo “woe” (in GA only)

uu “woo”

iy “million” (the “io” part, that is)

uy “was” (when unstressed)

### </pre><a name=s12><h3>Oddball orthographies</h3>

<p>

<cx "orthography, non-standard">The following notes describe ways in which Lojban has been written or could be written that differ from the standard orthography explained in the rest of this chapter. No­body needs to read this sec­tion except people with an interest in the obscure. Techni­cali­ties are used without explanation or further apology.

<p>

There exists an alternative orthography for Lojban, which is designed to be as com­patible as possible (but no more so) with the orthography used in pre-Lojban versions of Loglan. The consonants un­dergo no change, except that “x” is replaced by “h”. The indi­vidual vowels likewise remain unchanged. However, the vowel pairs and diph­thongs are changed as follows:

* <p>
* <dl compact><dt><dd>“ai”, “ei”, “oi”, “au” become “ai”, “ei”, “oi”, “ao”.
* <p><dt><dd>“ia” through “iu” and “ua” through “uu” remain un­changed.
* <p><dt><dd>“a'i”, “e'i”, “o'i” and “a'o” become “a,i”, “e,i”, “o,i” and “a,o”.
* <p><dt><dd>“i'a” through “i'u” and “u'a” through “u'u” are changed to “ia” through “iu” and “ua” through “uu” in lujvo and cmavo other than attitudinals, but be­come “i,a” through “i,u” and “u,a” through “u,u” in names, fu'ivla, and at­titudinal cmavo.
* <p><dt><dd>All other vowel pairs simply drop the apostrophe.

</dl><p>The result of these rules is to eliminate the apostrophe alto­gether, replacing it with comma where necessary, and otherwise with nothing. In addition, names and the cmavo “.i” are capitalized, and irregular stress is marked with an apostrophe (now no longer used for a sound) following the stressed syllable.

<p>

Three points must be emphasized about this alternative or­thography:

* <p>
* <cx "non-standard orthographies, caveat"><dl compact><dt><dd>It is not standard, and has not been used.
* <p><dt><dd>It does not represent any changes to the standard Loj­ban phonology; it is simply a representation of the same phonology using a different written form.
* <p><dt><dd>It was designed to aid in a planned rapprochement be­tween the Logical Language Group and The Loglan In­stitute, a group headed by James Cooke Brown. The rapprochement never took place.

</dl><cx "non-standard orthographies, Cyrillic">There also exists a Cyrillic orthography for Lojban which was designed when the in­troductory Lojban brochure was translated into Russian. It uses the “à”, “á”, “â”, “ã”, “ä”, “å”, “æ”, “ç”, “è”, “ê”, “ë”, “ì”, “í”, “î”, “ï”, “ð”, “ñ”, “ò”, “ó”, “ô”, “õ”, and “ø” in the obvious ways. The Latin letter “y” is mapped onto the hard sign “ú”, as in Bulgarian. The apostrophe, comma, and period are unchanged. Diphthongs are written as vowel pairs, as in the Roman representation.

<p>

<cx "non-standard orthographies, Tengwar"><cx "Tolkien, and non-standard Lojban orthography">Finally, an orthography using the Tengwar of Fé&eacute;anor, a fic­tional orthography in­vented by J. R. R. Tolkien and described in the Appendixes to <cite>The Lord Of The Rings</cite>, has been devised for Lojban. The following mapping, which closely resembles that used for Westron, will be meaningful only to those who have read those ap­pen­dixes. In brief, the tincoté&eacute;ma and parmaté&eacute;ma are used in the con­ventional ways; the calmaté&eacute;ma repre­sents palatal consonants, and the quesseté&eacute;ma represents velar conso­nants.<p>

<pre> t tinco p parma

- calma k quesse

d ando b umbar

- anga g ungwe

- thule f formen

c harma x hwesta

- anto v ampa

j anca - unque

n numen m malta

- noldo - nwalme

r ore u vala

i anna - vilya

</pre><p>The letters “vala” and “anna” are use for “u” and “i” only when those letters are used to represent glides. Of the additional letters, “r”, “l”, “s”, and “z” are written with “ró&oacute;men”, “lambe”, “silme”, and “á&aacute;re/“esse” respectively; the inverted forms are used as free vari­ants.

<p>

<p>

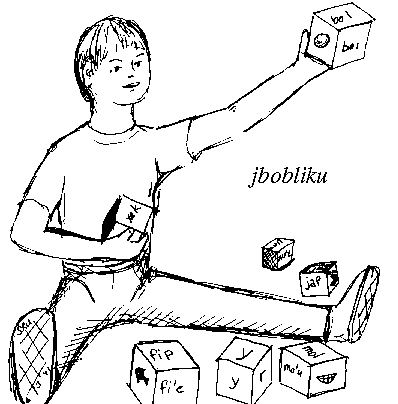
Lojban, like Quenya, is a vowel-last language, so tehtar are read as following the tengwar on which they are placed. The conven­tional tehtar are used for the five regular vowels, and the dot below for “y”. The Lojban apostrophe is represented by “halla”. There is no equivalent of the Lojban comma or period.

<p>

<dl compact><dt><dd>

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## <h2>Chapter 4

## <br>

## The Shape Of Words To Come: Lojban Mor­phology</h2>

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<p>

### <a name=s1><h3>Introductory</h3>

<p>

<cx "morphology, simplicity of"><cx "morphology, definition"><cx "word forms, in Lojban (see also morphology)">Morphology is the part of grammar that deals with the form of words. Lojban's mor­phology is fairly simple compared to that of many languages, because Lojban words don't change form depending on how they are used. English has only a small number of such changes compared to languages like Russian, but it does have changes like “boys” as the plural of “boy”, or “walked” as the past-tense form of “walk”. To make plurals or past tenses in Lojban, you add separate words to the sentence that express the number of boys, or the time when the walking was going on.

<p>

<cx "morphology, derivational"><cx "derivational morphology, definition"><cx "word forms, as related to grammatical uses">However, Lojban does have what is called “derivational mor­phology”: the ca­pability of building new words from old words. In ad­dition, the form of words tells us something about their grammatical uses, and sometimes about the means by which they entered the language. Lojban has very orderly rules for the formation of words of vari­ous types, both the words that already exist and new words yet to be created by speakers and writers.

<p>

<cx "morphology, conventions for">A stream of Lojban sounds can be uniquely broken up into its component words ac­cording to specific rules. These so-called “morphology rules” are summarized in this chapter. (However, a de­tailed algorithm for breaking sounds into words has not yet been fully debugged, and so is not presented in this book.) First, here are some con­ventions used to talk about groups of Lojban letters, including vowels and consonants.

<p>

<cx "morphology, symbolic conventions for discussing"><cx "“V”, as a symbol for a single vowel"><cx "“y”, as not a vowel for morphological discussions"><dl compact><dt>1) <dd>V represents any single Lojban vowel except “y”; that is, it represents “a”, “e”, “i”, “o”, or “u”.

</dl><cx "“VV”, as a symbol for a double vowel"><dl compact><dt>2) <dd>VV represents either a diphthong, one of the following:

<p><dt> <dd>ai ei oi au

<p><dt><dd> or a two-syllable vowel pair with an apostrophe separating the vowels, one of the following:

<p><dt> <dd>a'a a'e a'i a'o a'u

e'a e'e e'i e'o e'u

i'a i'e i'i i'o i'u

o'a o'e o'i o'o o'u

u'a u'e u'i u'o u'u

</dl><cx "“C”, as a symbol for a single consonant"><cx "syllabic “l”, as a consonant for morphological discussions"><cx "syllabic “m”, as a consonant for morphological discussions"><cx "syllabic “n”, as a consonant for morphological discussions"><cx "syllabic “r”, as a consonant for morphological discussions"><cx "apostrophe, as not a consonant for morphological discussions"><dl compact><dt>3) <dd>C represents a single Lojban consonant, not including the apostrophe, one of “b”, “c”, “d”, “f”, “g”, “j”, “k”, “l”, “m”, “n”, “p”, “r”, “s”, “t”, “v”, “x”, or “z”. Syllabic “l”, “m”, “n”, and “r” always count as consonants for the pur­poses of this chapter.

</dl><cx "“CC”, as a symbol for a permissible initial consonant pair"><dl compact><dt>4) <dd>CC represents two adjacent consonants of type C which con­stitute one of the 48 permissible initial consonant pairs:

<p><dt> <dd>bl br

cf ck cl cm cn cp cr ct

dj dr dz

fl fr

gl gr

jb jd jg jm jv

kl kr

ml mr

pl pr

sf sk sl sm sn sp sr st

tc tr ts

vl vr

xl xr

zb zd zg zm zv

</dl><cx "“C/C”, as a symbol for a permissible consonant pair"><dl compact><dt>5) <dd>C/C represents two adjacent consonants which constitute one of the permis­sible consonant pairs (not necessarily a permis­sible initial consonant pair). The permissible consonant pairs are explained in <a href=chap3.html>Chapter 3</a>. In brief, any con­sonant pair is permissible unless it: contains two identical letters, contains both a voiced (excluding “r”, “l”, “m”, “n”) and and an unvoiced consonant, or is one of certain specified forbidden pairs.

</dl><cx "“C/CC”, as a symbol for a consonant triple"><dl compact><dt>6) <dd>C/CC represents a consonant triple. The first two conso­nants must constitute a permissible consonant pair; the last two conso­nants must constitute a per­missible initial consonant pair.

</dl><cx "word classes"><cx "parts of speech"><cx "cmavo, as one of the 3 basic word classes"><cx "cmene, as one of the 3 basic word classes"><cx "brivla, as one of the 3 basic word classes">Lojban has three basic word classes — parts of speech — in contrast to the eight that are traditional in English. These three classes are called cmavo, brivla, and cmene. Each of these classes has uniquely identifying properties — an arrangement of letters that al­lows the word to be uniquely and unambiguously recognized as a separate word in a string of Lojban, upon either reading or hearing, and as belonging to a spe­cific word-class.

<p>

They are also functionally different: cmavo are the structure words, corre­sponding to English words like “and”, “if”, “the” and “to”; brivla are the content words, correspond­ing to English words like “come”, “red”, “doctor”, and “freely”; cmene are proper names, corre­sponding to English “James”, “Afghanistan”, and “Pope John Paul II”.

<p>

### <a name=s2><h3>cmavo</h3>

<p>

<cx "cmavo, definition"><cx "selma'o, definition"><cx "structure words"><cx "articles, cmavo as Lojban equivalents"><cx "conjunctions, cmavo as Lojban equivalents"><cx "prepositions, cmavo as Lojban equivalents"><cx "numbers, cmavo as Lojban equivalents"><cx "punctuation marks, cmavo as Lojban equivalents">The first group of Lojban words discussed in this chapter are the cmavo. They are the structure words that hold the Lojban lan­guage together. They often have no se­mantic meaning in them­selves, though they may affect the semantics of brivla to which they are attached. The cmavo include the equivalent of English articles, conjunctions, preposi­tions, numbers, and punctuation marks. There are over a hundred subcategories of cmavo, known as “selma'o”, each having a specifically defined grammatical usage. The various selma'o are discussed throughout <a href=chap5.html>Chapters 5 </a>to <a href=chap19.html>19 </a>and summarized in <a href=chap20.html>Chapter 20</a>.

<p>

<cx "cmavo, structure of">Standard cmavo occur in four forms defined by their word structure. Here are some examples of the various forms:

<p>

<pre> V-form .a .e .i .o .u

CV-form ba ce di fo gu

VV-form .au .ei .ia .o'u .u'e

CVV-form ki'a pei mi'o coi cu'u

</pre><p>In addition, there is the cmavo “.y.” (remember that “y” is not a V), which must have pauses before and after it.

<p>

<cx "cmavo, simple"><cx "cmavo, for experimental use"><cx "experimental cmavo, forms for"><cx "cmavo, lack of relation of form to grammatical use">A simple cmavo thus has the property of having only one or two vowels, or of having a single consonant followed by one or two vowels. Words consisting of three or more vowels in a row, or a sin­gle consonant followed by three or more vowels, are also of cmavo form, but are reserved for experimental use: a few examples are “ku'a'e”, “sau'e”, and “bai'ai”. All CVV cmavo beginning with the letter “x” are also reserved for experi­mental use. In general, though, the form of a cmavo tells you little or nothing about its grammatical use.

<p>

<cx "cmavo, experimental"><cx "experimental cmavo, definition">“Experimental use” means that the language designers will not assign any stan­dard meaning or usage to these words, and words and usages coined by Lojban speakers will not appear in official dic­tionaries for the indefinite future. Experimental-use words pro­vide an escape hatch for adding grammatical mechanisms (as opposed to semantic con­cepts) the need for which was not foreseen.

<p>

<cx "cmavo, diphthongs in">The cmavo of VV-form include not only the diphthongs and vowel pairs listed in <a href=#s1>Section 1</a>, but also the following ten additional diphthongs:

<p>

<pre> .ia .ie .ii .io .iu

.ua .ue .ui .uo .uu

</pre><p>In addition, cmavo can have the form “Cy”, a consonant followed by the letter “y”. These cmavo represent letters of the Lojban alphabet, and are discussed in detail in <a href=chap17.html>Chapter 17</a>.

<p>

<cx "cmavo, compound"><cx "compound cmavo, definition"><cx "compound cmavo, compared with sequence of simple cmavo">Compound cmavo are sequences of cmavo attached to­gether to form a single written word. A compound cmavo is always identical in meaning and in grammatical use to the separated se­quence of simple cmavo from which it is composed. These words are written in compound form merely to save visual space, and to ease the reader's bur­den in identi­fying when the component cmavo are acting together.

<p>

<cx "compound cmavo, recognition of">Compound cmavo, while not visually short like their compo­nents, can be readily identified by two characteristics:

<p>

<dl compact><dt>1) <dd>They have no consonant pairs or clusters, and

<p><dt>2) <dd>They end in a vowel.

</dl><p>For example:

<p>

<pre><a name=e2d1>2.1) .iseci'i

.i se ci'i

<a name=e2d2>2.2) punaijecanai

pu nai je ca nai

<a name=e2d3>2.3) ki'e.u'e

ki'e .u'e

</pre><cx "pauses, before vowels">The cmavo “.u'e” begins with a vowel, and like all words beginning with a vowel, re­quires a pause (represented by “.”) before it. This pause cannot be omitted simply be­cause the cmavo is incorporated into a compound cmavo. On the other hand,

<p>

<pre><a name=e2d4>2.4) ki'e'u'e

</pre>is a single cmavo reserved for experimental purposes: it has four vowels.

<p>

<pre><a name=e2d5>2.5) cy.ibu.abu

cy. .ibu .abu

</pre><p>Again the pauses are required (see <a href=#s9>Section 9</a>); the pause after “cy.” merges with the pause before “.ibu”.

<p>

<cx "cmavo, stress on"><cx "stress, on cmavo">There is no particular stress required in cmavo or their com­pounds. Some con­ven­tions do exist that are not mandatory. For two-syllable cmavo, for example, stress is typi­cally placed on the first vowel; an example is

<p>

<pre><a name=e2d6>2.6) .e'o ko ko kurji

.E'o ko ko KURji

</pre><p>This convention results in a consistent rhythm to the language, since brivla are required to have penultimate stress; some find this estheti­cally pleasing.

<p>

<cx "pause, requirement between stressed syllables">If the final syllable of one word is stressed, and the first sylla­ble of the next word is stressed, you must insert a pause or glottal stop between the two stressed sylla­bles. Thus

<p>

<pre><a name=e2d7>2.7) le re nanmu

</pre>can be optionally pronounced

<p>

<pre><a name=e2d8>2.8) le RE. NANmu

</pre>since there are no rules forcing stress on either of the first two words; the stress on “re”, though, demands that a pause separate “re” from the following syllable “nan” to ensure that the stress on “nan” is prop­erly heard as a stressed syllable. The alternative pronun­ciation

<p>

<pre><a name=e2d9>2.9) LE re NANmu

</pre>is also valid; this would apply secondary stress (used for purposes of emphasis, contrast or sentence rhythm) to “le”, comparable in rhyth­mical effect to the English phrase “THE two men”. In <a href=#e2d8>Example 2.8</a>, the secondary stress on “re” would be similar to that in the English phrase “the TWO men”.

<p>

Both cmavo may also be left unstressed, thus:

<p>

<pre><a name=e2d10>2.10) le re NANmu

</pre><p>This would probably be the most common usage.

<p>

### <a name=s3><h3>brivla</h3>

<p>

<cx "brivla, definition"><cx "nouns, brivla as Lojban equivalents"><cx "adjectives, brivla as Lojban equivalents"><cx "verbs, brivla as Lojban equivalents"><cx "adverbs, brivla as Lojban equivalents">Predicate words, called “brivla”, are at the core of Lojban. They carry most of the semantic information in the language. They serve as the equivalent of English nouns, verbs, adjectives, and ad­verbs, all in a single part of speech.

<p>

<cx "types and subtypes of words"><cx "subtypes of words">Every brivla belongs to one of three major subtypes. These subtypes are de­fined by the form, or morphology, of the word — all words of a particular structure can be as­signed by sight or sound to a particular type (cmavo, brivla, or cmene) and sub­type. Knowing the type and subtype then gives you, the reader or listener, significant clues to the meaning and the origin of the word, even if you have never heard the word before.

<p>

<cx "flexible vocabulary">The same principle allows you, when speaking or writing, to invent new brivla for new concepts “on the fly”; yet it offers people that you are trying to communicate with a good chance to figure out your meaning. In this way, Lojban has a flexible vo­cabulary which can be expanded indefinitely.

<p>

<cx "brivla, properties of">All brivla have the following properties:

<p>

<dl compact><dt>1) <dd>always end in a vowel;

<p><dt>2) <dd>always contain a consonant pair in the first five letters, where “y” and apos­trophe are not counted as letters for this pur­pose (See <a href=#s6>Section 6</a>);

<p><dt>3) <dd>always are stressed on the next-to-the-last (penultimate) syl­lable; this im­plies that they have two or more syllables.

</dl><cx "brivla, recognition of"><cx "brivla form, contrasted with cmavo form"><cx "brivla form, contrasted with cmene form"><cx "cmavo form, contrasted with brivla form"><cx "cmene form, contrasted with brivla form">The presence of a consonant pair distinguishes brivla from cmavo and their compounds. The final vowel distinguishes brivla from cmene, which always end in a consonant. Thus “da'amei” must be a compound cmavo because it lacks a consonant pair; “lojban.” must be a name because it lacks a final vowel.

<p>

<cx "brivla, consonant pairs in"><cx "consonant pairs, in brivla"><cx "“y”, between letters of consonant pair"><cx "consonant pairs, “y” within">Thus, “bisycla” has the consonant pair “sc” in the first five non-“y” letters even though the “sc” actually appears in the form of “syc”. Similarly, the word “ro'inre'o” contains “nr” in the first five letters because the apostrophes are not counted for this pur­pose.

<p>

<cx "brivla, subtypes of">The three subtypes of brivla are:

<p>

<cx "primitive roots, gismu as"><cx "gismu, as a subtype of brivla"><dl compact><dt>1) <dd>gismu, the Lojban primitive roots from which all other brivla are built;

</dl><cx "lujvo, as a subtype of brivla"><cx "compound of gismu, lujvo as"><dl compact><dt>2) <dd>lujvo, the compounds of two or more gismu; and

</dl><cx "fu'ivla, as a subtype of brivla"><cx "borrowing from other language, fu'ivla as"><pre>3) fu'ivla (literally “copy-word”), the specialized words that are not Lojban primitives or natural compounds, and are therefore borrowed from other lan­guages.

### </pre><a name=s4><h3>gismu</h3>

<p>

<cx "gismu, definition"><cx "gismu, rationale for choice of">The gismu, or Lojban root words, are those brivla represent­ing concepts most basic to the language. The gismu were chosen for various reasons: some represent con­cepts that are very familiar and basic; some represent concepts that are frequently used in other lan­guages; some were added because they would be helpful in con­structing more complex words; some because they represent funda­mental Lojban concepts (like “cmavo” and “gismu” themselves).

<p>

<cx "gismu, selection of"><cx "gismu, as partitioning semantic space">The gismu do not represent any sort of systematic partition­ing of semantic space. Some gismu may be superfluous, or appear for historical reasons: the gismu list was be­ing collected for almost 35 years and was only weeded out once. Instead, the intention is that the gismu blanket semantic space: they make it possible to talk about the entire range of human concerns.

<p>

<cx "gismu and cmavo, major"><cx "cmavo and gismu, major"><cx "learning Lojban, magnitude of task">There are about 1350 gismu. In learning Lojban, you need only to learn most of these gismu and their combining forms (known as “rafsi”) as well as perhaps 200 major cmavo, and you will be able to communicate effectively in the language. This may sound like a lot, but it is a small number compared to the vocabulary needed for simi­lar communica­tions in other languages.

<p>

<cx "gismu, rules for">All gismu have very strong form restrictions. Using the con­ventions defined in <a href=#s1>Sec­tion 1</a>, all gismu are of the forms CVC/CV or CCVCV. They must meet the rules for all brivla given in <a href=#s3>Section 3</a>; furthermore, they:

<p>

<dl compact><dt>1) <dd>always have five letters;

<p><dt>2) <dd>always start with a consonant and end with a single vowel;

<p><dt>3) <dd>always contain exactly one consonant pair, which is a per­missible initial pair (CC) if it's at the beginning of the gismu, but otherwise only has to be a permissible pair (C/C);

<p><dt>4) <dd>are always stressed on the first syllable (since that is penul­timate).

</dl><cx "gismu, length of">The five letter length distinguishes gismu from lujvo and fu'ivla. (It is possible to have fu'ivla like “spa'i” that are five letters long, but they must have “ ' ”; no gismu contains “ ' ”.)

<p>

<cx "gismu, special"><cx "gismu, conflicts between">With the exception of five special brivla variables, “broda”, “brode”, “brodi”, “brodo”, and “brodu”, no two gismu differ only in the final vowel. Furthermore, the set of gismu was specifically designed to reduce the likelihood that two similar sounding gismu could be confused. For example, because “gismu” is in the set of gismu, “kismu”, “xismu”, “gicmu”, “gizmu”, and “gisnu” cannot be.

<p>

<cx "gismu, source of">Almost all Lojban gismu are constructed from pieces of words drawn from other lan­guages, specifically Chinese, English, Hindi, Spanish, Russian, and Arabic, the six most widely spoken natural languages. For a given concept, words in the six lan­guages that rep­resent that concept were written in Lojban phonetics. Then a gismu was selected to maximize the recognizability of the Lojban word for speakers of the six lan­guages by weighting the inclusion of the sounds drawn from each language by the num­ber of speak­ers of that language. See <a href=#s14>Section 14 </a>for a full explanation of the algorithm.

<p>

<cx "gismu, examples of">Here are a few examples of gismu, with rough English equivalents (not defini­tions):

<p>

<pre><a name=e4d1>4.1) creka

shirt

<a name=e4d2>4.2) lijda

religion

<a name=e4d3>4.3) blanu

blue

<a name=e4d4>4.4) mamta

mother

<a name=e4d5>4.5) cukta

book

<a name=e4d6>4.6) patfu

father

<a name=e4d7>4.7) nanmu

man

<a name=e4d8>4.8) ninmu

woman

<p>

</pre><p>A small number of gismu were formed differently; see <a href=#s15>Section 15 </a>for a list.

<p>

### <a name=s5><h3>lujvo</h3>

<p>

<cx "tanru, explanation of"><cx "seltau, compared with English adjective"><cx "seltau, compared with English adverb"><cx "modifying brivla (see also seltau)">When specifying a concept that is not found among the gismu (or, more spe­cifically, when the relevant gismu seems too general in meaning), a Lojbanist generally attempts to express the concept as a tanru. Lojban tanru are an elaboration of the con­cept of “metaphor” used in English. In Lojban, any brivla can be used to modify an­other brivla. The first of the pair modifies the second. This modification is usually re­strictive — the modifying brivla reduces the broader sense of the modified brivla to form a more narrow, concrete, or specific concept. Modifying brivla may thus be seen as acting like English adverbs or adjectives. For example,

<p>

<pre><a name=e5d1>5.1) skami pilno

</pre>is the tanru which expresses the concept of “computer user”.

<p>

<cx "tanru, combination of">The simplest Lojban tanru are pairings of two concepts or ideas. Such tanru take two simpler ideas that can be represented by gismu and combine them into a single more complex idea. Two-part tanru may then be recombined in pairs with other tanru, or with indi­vidual gismu, to form more complex or more specific ideas, and so on.

<p>

<cx "tanru, ambiguity of">The meaning of a tanru is usually at least partly ambiguous: “skami pilno” could re­fer to a computer that is a user, or to a user of computers. There are a variety of ways that the modifier component can be related to the modified component. It is also possible to use cmavo within tanru to provide variations (or to prevent ambiguities) of meaning.

<p>

<cx "tanru, and creativity">Making tanru is essentially a poetic or creative act, not a sci­ence. While the syntax expressing the grouping relationships within tanru is unambiguous, tanru are still seman­tically ambiguous, since the rules defining the relationships between the gismu are flexi­ble. The process of devising a new tanru is dealt with in detail in <a href=chap5.html>Chapter 5</a>.

<p>

<cx "tanru, expression of"><ex "big boat"><ex "father mother"><ex "mother father">To express a simple tanru, simply say the component gismu together. Thus the binary metaphor “big boat” becomes the tanru

<p>

<pre><a name=e5d2>5.2) barda bloti

</pre>representing roughly the same concept as the English word “ship”.

<p>

<ex "paternal grandmother">The binary metaphor “father mother” can refer to a paternal grandmother (“a father-ly type of mother”), while “mother father” can refer to a maternal grandfather (“a mother-ly type of father”). In Loj­ban, these become the tanru

<p>

<pre><a name=e5d3>5.3) patfu mamta

</pre>and

<p>

<pre><a name=e5d4>5.4) mamta patfu

</pre>respectively.

<p>

<cx "tanru, ambiguity in">The possibility of semantic ambiguity can easily be seen in the last case. To interpret <a href=#e5d4>Example 5.4</a>, the listener must determine what type of motherliness pertains to the father being referred to. In an appropriate context, “mamta patfu” could mean not “grandfather” but simply “father with some motherly attributes”, depending on the culture. If absolute clarity is required, there are ways to expand upon and explain the exact interrelationship between the components; but such detail is usually not needed.

<p>

<cx "brivla, from tanru"><cx "lujvo, from tanru"><cx "tanru, to lujvo">When a concept expressed in a tanru proves useful, or is fre­quently expressed, it is desirable to choose one of the possible meanings of the tanru and assign it to a new brivla. For <a href=#e5d1>Example 5.1</a>, we would probably choose “user of computers”, and form the new word

<p>

<pre><a name=e5d5>5.5) sampli

</pre><p>Such a brivla, built from the rafsi which represent its component words, is called a “lujvo”. Another example, corresponding to the tanru of <a href=#e5d2>Example 5.2</a>, would be:

<p>

<pre><a name=e5d6>5.6) bralo'i

big-boat

ship

</pre><cx "lujvo, unambiguous decomposition of"><cx "rafsi, definition"><cx "lujvo, construction of">The lujvo representing a given tanru is built from units representing the component gismu. These units are called “rafsi” in Lojban. Each rafsi represents only one gismu. The rafsi are attached together in the order of the words in the tanru, occasionally in­serting so-called “hyphen” letters to ensure that the pieces stick together as a single word and cannot accidentally be broken apart into cmavo, gismu, or other word forms. As a result, each lujvo can be readily and accu­rately recognized, allowing a listener to pick out the word from a string of spoken Lojban, and if necessary, unambiguously de­compose the word to a unique source tanru, thus providing a strong clue to its meaning.

<p>

The lujvo that can be built from the tanru “mamta patfu” in <a href=#e5d4>Example 5.4 </a>is

<p>

<pre><a name=e5d7>5.7) mampa'u

</pre>which refers specifically to the concept “maternal grandfather”. The two gismu that con­stitute the tanru are represented in “mampa'u” by the rafsi “mam-” and “-pa'u”, re­spec­tively; these two rafsi are then concatenated together to form “mampa'u”.

<p>

<cx "lujvo, meaning of"><cx "lujvo, multiple forms of"><cx "rafsi form, effect of choice on meaning of lujvo"><cx "short rafsi form, compared with long form in effect on lujvo meaning"><cx "long rafsi form, compared with short form in effect on lujvo meaning">Like gismu, lujvo have only one meaning. When a lujvo is formally entered into a dictionary of the language, a specific definition will be assigned based on one particular interrelationship between the terms. (See <a href=chap12.html>Chapter 12 </a>for how this has been done.) Unlike gismu, lujvo may have more than one form. This is because there is no dif­ference in meaning between the various rafsi for a gismu when they are used to build a lujvo. A long rafsi may be used, especially in noisy environments, in place of a short rafsi; the result is considered the same lujvo, even though the word is spelled and pro­nounced differ­ently. Thus the word “brivla”, built from the tanru “bridi valsi”, is the same lujvo as “brivalsi”, “bridyvla”, and “bridyvalsi”, each of which uses a different combination of rafsi.

<p>

<cx "lujvo, rules for formation of"><cx "rafsi, rules for combining to form lujvo"><cx "“y”-hyphen, and consonant cluster determination"><cx "“ ' ”, and consonant cluster determination in lujvo"><cx "apostrophe, and consonant cluster determination in lujvo">When assembling rafsi together into lujvo, the rules for valid brivla must be fol­lowed: a consonant cluster must occur in the first five letters (excluding “y” and “ ' ”), and the lujvo must end in a vowel.

<p>

<cx "“y”-hyphen, use of"><cx "“y”-hyphen, and stress determination"><cx "glue in lujvo, “y”-hyphen as">A “y” (which is ignored in determining stress or consonant clusters) is inserted in the middle of the consonant cluster to glue the word together when the resulting cluster is either not permissible or the word is likely to break up. There are specific rules describing these conditions, detailed in <a href=#s6>Section 6</a>.

<p>

<cx "“r”-hyphen, use of"><cx "glue in lujvo, “r”-hyphen as"><cx "“n”-hyphen, use of"><cx "glue in lujvo, “n”-hyphen as">An “r” (in some cases, an “n”) is inserted when a CVV-form rafsi attaches to the be­ginning of a lujvo in such a way that there is no consonant cluster. For example, in the lujvo

<p>

<ex "field rations"><pre><a name=e5d8>5.8) soirsai

sonci sanmi

soldier meal

field rations

</pre><cx "rafsi, contrasted with same-form cmavo in meaning"><cx "cmavo, contrasted with same-form rafsi in meaning">the rafsi “soi-” and “-sai” are joined, with the additional “r” making up the “rs” conso­nant pair needed to make the word a brivla. Without the “r”, the word would break up into “soi sai”, two cmavo. The pair of cmavo have no relation to their rafsi lookalikes; they will either be un­grammatical (as in this case), or will express a different meaning from what was intended.

<p>

Learning rafsi and the rules for assembling them into lujvo is clearly seen to be nec­essary for fully using the potential Lojban vo­cabulary.

<p>

<cx "lujvo, invention of">Most important, it is possible to invent new lujvo while you speak or write in order to represent a new or unfamiliar concept, one for which you do not know any ex­isting Loj­ban word. As long as you follow the rules for building these compounds, there is a good chance that you will be understood without explanation.

<p>

### <a name=s6><h3>rafsi</h3>

<p>

<cx "rafsi, use of"><cx "rafsi, uniqueness in gismu referent of"><cx "rafsi, multiplicity of for single gismu"><cx "rafsi, level of uniqueness of relation to gismu"><cx "gismu, level of uniqueness of rafsi relating to"><cx "rafsi, selection considerations in making lujvo">Every gismu has from two to five rafsi, each of a different form, but each such rafsi represents only one gismu. It is valid to use any of the rafsi forms in building lujvo — whichever the reader or lis­tener will most easily understand, or whichever is most pleas­ing — subject to the rules of lujvo making. There is a scoring algorithm which is intended to determine which of the possible and legal lujvo forms will be the standard dictionary form (see <a href=#s12>Section 12</a>).

<p>

<cx "rafsi, forms of"><cx "rafsi, long"><cx "lujvo, unreduced"><cx "gismu, basic rafsi for"><cx "5-letter rafsi, definition"><cx "4-letter rafsi, definition"><cx "long rafsi, definition"><cx "unreduced lujvo, definition">Each gismu always has at least two rafsi forms; one is the gismu itself (used only at the end of a lujvo), and one is the gismu without its final vowel (used only at the begin­ning or middle of a luj­vo). These forms are represented as CVC/CV or CCVCV (called “the 5-letter rafsi”), and CVC/C or CCVC (called “the 4-letter rafsi”) re­spectively. The dashes in these rafsi form representations show where other rafsi may be attached to form a valid lujvo. When lujvo are formed only from 4-letter and 5-letter rafsi, known collec­tively as “long rafsi”, they are called “unreduced lujvo”.

<p>

Some examples of unreduced lujvo forms are:

<p>

<pre><a name=e6d1>6.1) mamtypatfu

from “mamta patfu”

“mother father” or “maternal grandfather”

<a name=e6d2>6.2) lerfyliste

from “lerfu liste”

“letter list” or a “list of letters”

(letters of the alphabet)

<a name=e6d3>6.3) nancyprali

from “nanca prali”

“year profit” or “annual profit”

<a name=e6d4>6.4) prunyplipe

from “pruni plipe”

“elastic (springy) leap” or “spring” (the verb)

</pre><ex "supper"><pre><a name=e6d5>6.5) vancysanmi

from “vanci sanmi”

“evening meal” or “supper”

</pre><cx "rafsi, short"><cx "short rafsi">In addition to these two forms, each gismu may have up to three ad­ditional short rafsi, three letters long. All short rafsi have one of the forms CVC, CCV, or CVV. The total number of rafsi forms that are assigned to a gismu depends on how useful the gismu is, or is presumed to be, in making lujvo, when compared to other gismu that could be assigned the rafsi.

<p>

<cx "comparatives, use of zmadu in forming"><cx "-er, use of zmadu in forming">For example, “zmadu” (“more than”) has the two short rafsi “zma” and “mau” (in addition to its unreduced rafsi “zmad” and “zmadu”), because a vast num­ber of lujvo have been created based on “zmadu”, corresponding in general to English comparative adjec­tives ending in “-er” such as “whiter” (Lojban “labmau”). On the other hand, “bakri” (“chalk”) has no short rafsi and few lujvo.

<p>

There are at most one CVC-form, one CCV-form, and one CVV-form rafsi per gismu. In fact, only a tiny handful of gismu have both a CCV-form and a CVV-form rafsi assigned, and still fewer have all three forms of short rafsi. However, gismu with both a CVC-form and another short rafsi are fairly common, partly because more pos­sible CVC-form rafsi exist. Yet CVC-form rafsi, even though they are fairly easy to remember, can­not be used at the end of a lujvo (because lujvo must end in vowels), so justifying the as­signment of an additional short rafsi to many gismu.

<p>

<cx "rafsi space"><cx "rafsi, rationale for assignments of">The intention was to use the available “rafsi space” — the set of all possible short rafsi forms — in the most efficient way possible; the goal is to make the most-used lujvo as short as possible (thus maximizing the use of short rafsi), while keeping the rafsi very recog­nizable to anyone who knows the source gismu. For this reason, the letters in a rafsi have always been chosen from among the five letters of the corre­sponding gismu. As a result, there are a limited set of short rafsi available for assign­ment to each gismu. At most seven possible short rafsi are available for consideration (of which at most three can be used, as explained above).

<p>

<cx "rafsi, possible forms for construction of">Here are the only short rafsi forms that can possibly exist for gismu of the form CVC/CV, like “sakli”. The digits in the second col­umn represent the gismu letters used to form the rafsi.

<p>

<pre> CVC 123 -sak-

CVC 124 -sal-

CVV 12'5 -sa'i-

CVV 125 -sai-

CCV 345 -kli-

CCV 132 -ska-

</pre>(The only actual short rafsi for “sakli” is “-sal-”.)

<p>

For gismu of the form CCVCV, like “blaci”, the only short rafsi forms that can exist are:

<p>

<pre> CVC 134 -bac-

CVC 234 -lac

CVV 13'5 -ba'i-

CVV 135 -bai-

CVV 23'5 -la'i-

CVV 235 -lai-

CCV 123 -bla-

</pre><cx "rafsi assignments, non-reassignability of">(In fact, “blaci” has none of these short rafsi; they are all assigned to other gismu. Loj­ban speakers are not free to reassign any of the rafsi; the tables shown here are to help under­stand how the rafsi were cho­sen in the first place.)

<p>

<cx "rafsi, considerations restricting construction of">There are a few restrictions: a CVV-form rafsi without an apostrophe cannot exist unless the vowels make up one of the four diphthongs “ai”, “ei”, “oi”, or “au”; and a CCV-form rafsi is possible only if the two consonants form a permissible initial con­so­nant pair (see <a href=#s1>Section 1</a>). Thus “mamta”, which has the same form as “salci”, can only have “mam”, “mat”, and “ma'a” as possible rafsi: in fact, only “mam” is assigned to it.

<p>

<cx "rafsi for numbers"><cx "numbers, rafsi for">Some cmavo also have associated rafsi, usually CVC-form. For example, the ten common numerical digits, which are all CV form cmavo, each have a CVC-form rafsi formed by adding a consonant to the cmavo. Most cmavo that have rafsi are ones used in composing tanru (for a complete list, see <a href=chap12.html>Chapter 12</a>).

<p>

<cx "lujvo, fully reduced"><cx "fully reduced lujvo, definition">The term for a lujvo made up solely of short rafsi is “fully re­duced lujvo”. Here are some examples of fully reduced lujvo:

<p>

<pre><a name=e6d6>6.6) cumfri

from “cumki lifri”

“possible experience”

<a name=e6d7>6.7) klezba

from “klesi zbasu”

“category make”

<a name=e6d8>6.8) kixta'a

from “krixa tavla”

“cry-out talk”

<a name=e6d9>6.9) sniju'o

from “sinxa djuno”

“sign know”

</pre><p>In addition, some of the unreduced forms in the previous example may be fully reduced to:

<p>

<pre><a name=e6d10>6.10) mampa'u

from “mamta patfu”

“mother father” or “maternal grandfather”

<a name=e6d11>6.11) lerste

from “lerfu liste”

“letter list” or a “list of letters”

</pre><cx "lujvo, summary of form characteristics"><cx "lujvo form, final letter of"><cx "lujvo form, consonant cluster requirement in"><cx "lujvo form, number of letters in"><cx "lujvo, recognizing">As noted above, CVC-form rafsi cannot appear as the final rafsi in a lujvo, because all lujvo must end with one or two vowels. As a brivla, a lujvo must also contain a conso­nant cluster within the first five let­ters — this ensures that they cannot be mistaken for com­pound cmavo. Of course, all lujvo have at least six letters since they have two or more rafsi, each at least three letters long; hence they cannot be confused with gismu.

<p>

<cx "hyphens, use of"><cx "hyphen letter, definition"><cx "lujvo form, requirements for hyphen insertion in">When attaching two rafsi together, it may be necessary to in­sert a hyphen let­ter. In Lojban, the term “hyphen” always refers to a letter, either the vowel “y” or one of the consonants “r” and “n”. (The letter “l” can also be a hyphen, but is not used as one in luj­vo.)

<p>

<cx "lujvo form, requirements for “y”-hyphen insertion in">The “y”-hyphen is used after a CVC-form rafsi when joining it with the fol­lowing rafsi could result in an impermissible consonant pair, or when the resulting lujvo could fall apart into two or more words (either cmavo or gismu).

<p>

<cx "lujvo, and consonant pairs">Thus, the tanru “pante tavla” (“protest talk”) cannot produce the lujvo “patta'a”, be­cause “tt” is not a permissible consonant pair; the lujvo must be “patyta'a”. Similarly, the tanru “mudri siclu” (“wooden whistle”) cannot form the lujvo “mudsiclu”; instead, “mudysiclu” must be used. (Remember that “y” is not counted in de­termining whether the first five letters of a brivla contain a consonant cluster: this is why.)

<p>

<cx "rafsi, four-letter, requirement for “y”-hyphen">The “y”-hyphen is also used to attach a 4-letter rafsi, formed by dropping the final vowel of a gismu, to the following rafsi. (This procedure was shown, but not ex­plained, in <a href=#e6d{1}>Examples 6.1 </a>to <a href=#e6d5>6.5</a>.)

The lujvo forms “zunlyjamfu”, “zunlyjma”, “zuljamfu”, and “zuljma” are all legiti­mate and equivalent forms made from the tanru “zunle jamfu” (“left foot”). Of these, “zuljma” is the preferred one since it is the shortest; it thus is likely to be the form listed in a Lojban dic­tionary.

<p>

<cx "“r”-hyphen, use of"><cx "lujvo form, requirements for “r”-hyphen insertion in"><cx "lujvo form, requirements for “n”-hyphen insertion in">The “r”-hyphen and its close relative, the “n”-hyphen, are used in lujvo only after CVV-form rafsi. A hyphen is always required in a two-part lujvo of the form CVV-CVV, since otherwise there would be no consonant cluster.

<p>

An “r-”hyphen or “n”-hyphen is also required after the CVV-form rafsi of any lujvo of the form CVV-CVC/CV or CVV-CCVCV since it would otherwise fall apart into a CVV-form cmavo and a gismu. In any lujvo with more than two parts, a CVV-form rafsi in the initial position must always be followed by a hyphen. If the hyphen were to be omitted, the supposed lujvo could be broken into smaller words without the hyphen: be­cause the CVV-form rafsi would be in­terpreted as a cmavo, and the remain­der of the word as a valid lujvo that is one rafsi shorter.

<p>

<cx "“n”-hyphen, use of"><cx "“n”-hyphen, contrasted with “r”-hyphen in requirements for use"><cx "“r”-hyphen, contrasted with “n”-hyphen in requirements for use">An “n”-hyphen is only used in place of an “r”-hyphen when the following rafsi be­gins with “r”. For example, the tanru “rokci renro” (“rock throw”) cannot be ex­pressed as “ro'ire'o” (which breaks up into two cmavo), nor can it be “ro'irre'o” (which has an im­permissible dou­ble consonant); the “n”-hyphen is required, and the correct form of the hyphenated lujvo is “ro'inre'o”. The same lujvo could also be ex­pressed without hy­phenation as “rokre'o”.

<p>

<lx "zei"><lx "ZEI"><cx "lujvo, with zei">There is also a different way of building lujvo, or rather phrases which are grammati­cally and semantically equivalent to lujvo. You can make a phrase containing any desired words, joining each pair of them with the special cmavo “zei”. Thus,

<p>

<pre><a name=e6d12>6.12) bridi zei valsi

</pre><cx "lujvo, from cmavo with no rafsi"><cx "rafsi, lack of, effect on forming lujvo"><cx "cmene, method of including in lujvo"><cx "fu'ivla, method of including in lujvo"><cx "cmavo without rafsi, method of including in lujvo">is the exact equivalent of “brivla” (but not necessarily the same as the underlying tanru “bridi valsi”, which could have other meanings.) Us­ing “zei” is the only way to get a cmavo lacking a rafsi, a cmene, or a fu'ivla into a lujvo:

<p>

<ex "X-ray"><pre><a name=e6d13>6.13) xy. zei kantu

X ray

</pre><ex "Persian rug"><ex "rug, Persian"><pre><a name=e6d14>6.14) kulnr,farsi zei lolgai

Farsi floor-cover

Persian rug

</pre><ex "hepatitis"><pre><a name=e6d15>6.15) na'e zei .a zei na'e zei by. livgyterbilma

non-A, non-B liver-disease

non-A, non-B hepatitis

</pre><ex "Sherman tank"><ex "tank, Sherman"><pre><a name=e6d16>6.16) .cerman. zei xarnykarce

Sherman war-car

Sherman tank

</pre><a href=#e6d15>Example 6.15 is particularly noteworthy because the phrase that would be produced by removing the “zei”s from it doesn't end with a brivla, and in fact is not even grammati­cal. As written, the example is a tanru with two components, but by adding a “zei” be­tween “by.” and “livgyterbilma” to produce

<p>

<pre><a name=e6d17>6.17) na'e zei .a zei na'e zei by. zei livgyterbilma

non-A-non-B-hepatitis

</pre>the whole phrase would become a single lujvo. The longer lujvo of <a href=#e6d17>Example 6.17 </a>may be preferable, because its place structure can be built from that of “bilma”, whereas the place structure of a lujvo with­out a brivla must be constructed ad hoc.

<p>

<cx "rafsi, contrasted with words"><cx "rafsi, contrasted with cmavo in usage"><cx "cmavo, contrasted with rafsi in usage">Note that rafsi may not be used in “zei” phrases, because they are not words. CVV rafsi look like words (specifically cmavo) but there can be no confusion between the two uses of the same letters, because cmavo appear only as separate words or in compound cmavo (which are really just a notation for writing separate but closely re­lated words as if they were one); rafsi appear only as parts of lujvo.

<p>

### <a name=s7><h3>fu'ivla</h3>

<p>

<cx "fu'ivla, use of"><cx "concrete terms, use of fu'ivla for"><cx "specific terms, use of fu'ivla for"><cx "jargon, use of fu'ivla for"><cx "plants, use of fu'ivla for specific"><cx "animals, use of fu'ivla for specific"><cx "food, use of fu'ivla for specific"><cx "lujvo, unsuitability of for concrete/specific terms and jargon">The use of tanru or lujvo is not always appropriate for very concrete or specific terms (e.g. “brie” or “cobra”), or for jargon words specialized to a narrow field (e.g. “quark”, “integral”, or “iambic pen­tameter”). These words are in effect names for con­cepts, and the names were invented by speakers of another language. The vast majority of words referring to plants, animals, foods, and scientific terminology cannot be easily expressed as tanru. They thus must be borrowed (actually “copied”) into Lojban from the original language.

<p>

<cx "borrowing, four stages of"><lx "la'o"><cx "borrowings, using foreign-language name"><cx "borrowings, Stage 1">There are four stages of borrowing in Lojban, as words be­come more and more modified (but shorter and easier to use). Stage 1 is the use of a foreign name quoted with the cmavo “la'o” (explained in full in <a href=chap19.html>Chapter 19</a>):

<p>

<cx "spaghetti"><pre><a name=e7d1>7.1) me la'o ly. spaghetti .ly.

</pre>is a predicate with the place structure “x1 is a quantity of spaghetti”.

<p>

<cx "borrowings, using lojbanized name"><cx "borrowings, Stage 2">Stage 2 involves changing the foreign name to a Lojbanized name, as ex­plained in <a href=#s8>Section 8</a>:

<p>

<pre><a name=e7d2>7.2) me la spagetis.

</pre><p>One of these expedients is often quite sufficient when you need a word quickly in con­versation. (This can make it easier to get by when you do not yet have full command of the Lojban vocabulary, provided you are talking to someone who will recognize the bor­rowing.)

<p>

<cx "borrowings, fu'ivla form with categorizing rafsi"><cx "borrowings, Stage 3"><cx "fu'ivla, as Stage 3 borrowings">Where a little more universality is desired, the word to be bor­rowed must be Loj­banized into one of several permitted forms. A rafsi is then usually attached to the begin­ning of the Lojbanized form, us­ing a hyphen to ensure that the resulting word doesn't fall apart.

<p>

<cx "fu'ivla categorizer"><cx "rafsi, as fu'ivla categorizer"><cx "fu'ivla, uniqueness of meaning in"><cx "borrowings, most common form for">The rafsi categorizes or limits the meaning of the fu'ivla; oth­erwise a word having several different jargon meanings in other lan­guages would require the word-inventor to choose which meaning should be assigned to the fu'ivla, since fu'ivla (like other brivla) are not permitted to have more than one definition. Such a Stage 3 bor­rowing is the most common kind of fu'ivla.

<p>

<cx "borrowings, fu'ivla form without categorizing rafsi"><cx "borrowings, Stage 4"><cx "fu'ivla, as Stage 4 borrowings">Finally, Stage 4 fu'ivla do not have any rafsi classifier, and are used where a fu'ivla has become so common or so important that it must be made as short as possible. (See <a href=#s16>Section 16 </a>for a proposal concerning Stage 4 fu'ivla.)

<p>

<cx "fu'ivla, construction of"><cx "fu'ivla, form of">The form of a fu'ivla reliably distinguishes it from both the gismu and the cmavo. Like cultural gismu, fu'ivla are generally based on a word from a single non-Lojban lan­guage. The word is “borrowed” (actually “copied”, hence the Lojban tanru “fukpi valsi”) from the other language and Lojbanized — the phonemes are converted to their closest Lojban equivalent and modifications are made as necessary to make the word a legitimate Lojban fu'ivla-form word. All fu'ivla:

<p>

<cx "fu'ivla, rules for formation of"><cx "fu'ivla, initial consonant cluster in"><dl compact><dt>1) <dd>must contain a consonant cluster in the first five letters of the word; if this consonant cluster is at the beginning, it must ei­ther be a permissible initial consonant pair, or a longer cluster such that each pair of adjacent conso­nants in the cluster is a permissi­ble initial consonant pair: “spraile” is ac­ceptable, but not “ktraile” or “trkaile”;

<p><dt>2) <dd>must end in one or more vowels;

</dl><cx "slinku'i test, definition"><dl compact><dt>3) <dd>must not be gismu or lujvo, or any combination of cmavo, gismu, and lujvo; furthermore, a fu'ivla with a CV cmavo joined to the front of it must not have the form of a lujvo (the so-called “slinku'i test”, not discussed further in this book);

</dl><ex "syllabic pronunciations of consonants, in fu'ivla"><cx "“y”, prohibition from fu'ivla"><dl compact><dt>4) <dd>cannot contain “y”, although they may contain syllabic pro­nunciations of Lojban consonants;

</dl><cx "fu'ivla, stress in"><dl compact><dt>5) <dd>like other brivla, are stressed on the penultimate syllable.

</dl><cx "fu'ivla, consonant clusters in">Note that consonant triples or larger clusters that are not at the be­ginning of a fu'ivla can be quite flexible, as long as all consonant pairs are permissible. There is no need to re­strict fu'ivla clusters to permis­sible initial pairs except at the beginning.

<p>

<cx "fu'ivla, categorized contrasted with uncategorized in ease of construction"><cx "borrowings, Stage 3 contrasted with Stage 4 in ease of construction">This is a fairly liberal definition and allows quite a lot of possi­bilities within “fu'ivla space”. Stage 3 fu'ivla can be made easily on the fly, as lujvo can, because the procedure for forming them always guarantees a word that cannot violate any of the rules. Stage 4 fu'ivla require running tests that are not simple to characterize or perform, and should be made only after deliberation and by someone knowl­edgeable about all the considerations that apply.

<p>

<cx "fu'ivla, algorithm for constructing">Here is a simple and reliable procedure for making a non-Loj­ban word into a valid Stage 3 fu'ivla:

<p>

<dl compact><dt>1) <dd>Eliminate all double consonants and silent letters.

<p><dt>2) <dd>Convert all sounds to their closest Lojban equivalents. Loj­ban “y”, however, may not be used in any fu'ivla.

<p><dt>3) <dd>If the last letter is not a vowel, modify the ending so that the word ends in a vowel, either by removing a final consonant or by adding a suggestively cho­sen final vowel.

<p><dt>4) <dd>If the first letter is not a consonant, modify the beginning so that the word begins with a consonant, either by removing an ini­tial vowel or adding a suggestively chosen initial consonant.

</dl><cx "“l”-hyphen, use of"><cx "fu'ivla categorizer, selection consideration for"><dl compact><dt>5) <dd>Prefix the result of steps 1-5 with a 4-letter rafsi that catego­rizes the fu'ivla into a “topic area”. It is only safe to use a 4-letter rafsi; short rafsi some­times produce invalid fu'ivla. Hyphenate the rafsi to the rest of the fu'ivla with an “r”-hyphen; if that would pro­duce a double “r”, use an “n”-hyphen instead; if the rafsi ends in “r” and the rest of the fu'ivla begins with “n” (or vice versa) use an “l”-hyphen. (This is the only use of “l”-hyphen in Lojban.)

<p><dt><dd>Alternatively, if a CVC-form short rafsi is available it can be used instead of the long rafsi.

<p><dt>6) <dd>Remember that the stress necessarily appears on the penultimate (next-to-the-last) syllable.

</dl><ex "syllabic pronunciations of consonants, in fu'ivla category attachment">In this section, the hyphen is set off with commas in the ex­amples, but these commas are not required in writing, and the hy­phen need not be pronounced as a sepa­rate syllable.

<p>

Here are a few examples:

<p>

<ex "spaghetti"> <pre><a name=e7d3>7.3) spaghetti (from English or Italian)

spageti (Lojbanize)

cidj,r,spageti (prefix long rafsi)

dja,r,spageti (prefix short rafsi)

</pre>where “cidj-” is the 4-letter rafsi for “cidja”, the Lojban gismu for “food”, thus catego­rizing “cidjrspageti” as a kind of food. The form with the short rafsi happens to work, but such good fortune cannot be relied on: in any event, it means the same thing.

<p>

<ex "maple trees"><ex "Acer"><pre><a name=e7d4>7.4) Acer (the scientific name of maple trees)

acer (Lojbanize)

xaceru (add initial consonant and final vowel)

tric,r,xaceru (prefix rafsi)

ric,r,xaceru (prefix short rafsi)

</pre><ex "maple sugar">where “tric-” and “ric-” are rafsi for “tricu”, the gismu for “tree”. Note that by the same principles, “maple sugar” could get the fu'ivla “saktrxaceru”, or could be represented by the tanru “tricrxaceru sakta”. Technically, “ricrxaceru” and “tricrxaceru” are distinct fu'ivla, but they would surely be given the same meanings if both happened to be in use.

<p>

<ex "brie"><pre><a name=e7d5>7.5) brie (from French)

bri (Lojbanize)

cirl,r,bri (prefix rafsi)

</pre>where “cirl-” represents “cirla” (“cheese”).

<p>

<ex "cobra"><pre><a name=e7d6>7.6) cobra

kobra (Lojbanize)

sinc,r,kobra (prefix rafsi)

</pre>where “sinc-” represents “since” (“snake”).

<p>

<ex "quark"><pre><a name=e7d7>7.7) quark

kuark (Lojbanize)

kuarka (add final vowel)

sask,r,kuarka (prefix rafsi)

</pre><cx "fu'ivla, diphthongs in"><cx "diphthongs, in fu'ivla"><cx "allowable diphthongs, in fu'ivla contrasted with in gismu/lujvo"><cx "allowable diphthongs, in gismu/lujvo contrasted with in fu'ivla">where “sask-” represents “saske” (“science”). Note the extra vowel “a” added to the end of the word, and the diphthong “ua”, which never appears in gismu or lujvo, but may ap­pear in fu'ivla.

<p>

<cx "fu'ivla, disambiguation of"><cx "fu'ivla categorizer, for distinguishing fu'ivla form">The use of the prefix helps distinguish among the many pos­sible meanings of the borrowed word, depending on the field. As it happens, “spageti” and “kuarka” are valid Stage 4 fu'ivla, but “xaceru” looks like a compound cmavo, and “kobra” like a gismu.

<p>

<cx "fu'ivla categorizer, for distinguishing specialized meanings">For another example, “integral” has a specific meaning to a mathematician. But the Lojban fu'ivla “integrale”, which is a valid Stage 4 fu'ivla, does not convey that mathe­matical sense to a non-mathematical listener, even one with an English-speaking back­ground; its source — the English word “integral” — has various other specialized mean­ings in other fields.

<p>

Left uncontrolled, “integrale” almost certainly would eventually come to mean the same collection of loosely related concepts that English associates with “integral”, with only the context to indicate (possibly) that the mathematical term is meant.

<p>

<ex "integral, mathematical concept"><ex "integral, architectural concept">The prefix method would render the mathematical concept as “cmacrntegrale”, if the “i” of “integrale” is removed, or something like “cmacrnintegrale”, if a new con­sonant is added to the beginning; “cmac-” is the rafsi for “cmaci” (“mathematics”). The architec­tural sense of “integral” might be conveyed with “djinrnintegrale” or “tarmrnintegrale”, where “dinju” and “tarmi” mean “building” and “form” respectively.

<p>

Here are some fu'ivla representing cultures and related things, shown with more than one rafsi prefix:

<p>

<ex "Bulgarian"><pre><a name=e7d8>7.8) bang,r,blgaria

Bulgarian (in language)

<a name=e7d9>7.9) kuln,r,blgaria

Bulgarian (in culture)

<a name=e7d10>7.10) gugd,r,blgaria

Bulgaria (the country)

</pre><ex "Korean"><pre><a name=e7d11>7.11) bang,r,kore,a

Korean (the language)

<a name=e7d12>7.12) kuln,r,kore,a

Korean (the culture)

</pre><cx "invalid diphthongs, in fu'ivla"><cx "fu'ivla, with invalid diphthongs"><cx "fu'ivla, considerations for choosing basis word"><ex "Navajo">Note the commas in <a href=#e7d{11}>Examples 7.11 </a>and <a href=#e7d12>7.12</a>, used because “ea” is not a valid diph­thong in Lojban. Arguably, some form of the native name “Chosen” should have been used in­stead of the internationally known “Korea”; this is a recurring problem in all borrowings. In gen­eral, it is better to use the native name unless using it will severely impede under­standing: “Navajo” is far more widely known than “Dine'e”.

<p>

### <a name=s8><h3>cmene</h3>

<p>

<cx "cmene, purpose of"><cx "names, purpose of"><cx "cmene, definition"><cx "names in Lojban (see also “cmene”)">Lojbanized names, called “cmene”, are very much like their counterparts in other languages. They are labels applied to things (or people) to stand for them in de­scriptions or in direct address. They may convey meaning in themselves, but do not necessarily do so.

<p>

<cx "cmene, examples of"><cx "names, examples of"><cx "cmene, and analyzability of speech stream"><cx "cmene, rationale for lojbanizing"><cx "names, rationale for lojbanizing">Because names are often highly personal and individual, Loj­ban attempts to allow native language names to be used with a mini­mum of modification. The require­ment that the Lojban speech stream be unambiguously analyzable, however, means that most names must be modified somewhat when they are Lojbanized. Here are a few ex­amples of Eng­lish names and possible Lojban equivalents:

<p>

<ex "Jim"><pre><a name=e8d1>8.1) djim.

Jim

</pre><ex "Jane"><pre><a name=e8d2>8.2) djein.

Jane

</pre><ex "Arnold"><pre><a name=e8d3>8.3) .arnold.

Arnold

</pre><ex "Pete"><pre><a name=e8d4>8.4) pit.

Pete

</pre><ex "Katrina"><pre><a name=e8d5>8.5) katrinas.

Katrina

</pre><ex "Catherine"><pre><a name=e8d6>8.6) kat,r,in.

Catherine

</pre><cx "syllabic consonant, effect on stress determination">(Note that syllabic “r” is skipped in determining the stressed syllable, so <a href=#e8d6>Example 8.6 </a>is stressed on the “ka”.)

<p>

<ex "Cathy"><pre><a name=e8d7>8.7) katis.

Cathy

</pre>

<ex "Kate"><pre><a name=e8d8>8.8) keit.

Kate

</pre><cx "cmene, rules for formation"><cx "names, rules for formation"><cx "cmene, stress in"><cx "names, stress in"><cx "cmene, unusual stress in"><cx "names, unusual stress in">Names may have almost any form, but always end in a con­sonant, and are fol­lowed by a pause. They are penultimately stressed, unless unusual stress is marked with capitali­zation. A name may have multiple parts, each ending with a consonant and pause, or the parts may be combined into a single word with no pause. For ex­ample,

<p>

<ex "John Jones"><ex "Jones, John"><pre><a name=e8d9>8.9) djan. djonz.

</pre>and

<p>

<pre><a name=e8d10>8.10) djandjonz.

</pre>are both valid Lojbanizations of “John Jones”.

<p>

<cx "cmene, authority for"><cx "names, authority for">The final arbiter of the correct form of a name is the person doing the naming, al­though most cultures grant people the right to determine how they want their own name to be spelled and pro­nounced. The English name “Mary” can thus be Lojbanized as “meris.”, “maris.”, “meiris.”, “merix.”, or even “marys.”. The last alter­native is not pro­nounced much like its English equivalent, but may be desirable to someone who values spelling over pronunciation. The final consonant need not be an “s”; there must, however, be some Lojban consonant at the end.

<p>

<cx "cmene, restrictions on form of"><cx "names, restrictions on form of">Names are not permitted to have the sequences “la”, “lai”, or “doi” embedded in them, unless the sequence is immediately pre­ceded by a consonant. These minor re­stric­tions are due to the fact that all Lojban cmene embedded in a speech stream will be pre­ceded by one of these words or by a pause. With one of these words em­bedded, the cmene might break up into valid Lojban words followed by a shorter cmene. However, break-up cannot happen after a con­sonant, because that would imply that the word be­fore the “la”, or whatever, ended in a consonant without pause, which is impossible.

<p>

<ex "Laplace"><ex "Nederlands">For example, the invalid name “laplas.” would look like the Lojban words “la plas.”, and “ilanas.” would be misunderstood as “.i la nas.”. However, “NEderlants.” cannot be misheard as “NEder lants.”, because “NEder” with no following pause is not a possible Lojban word.

<p>

<cx "cmene, alternatives for restricted sequences in"><cx "names, alternatives for restricted sequences in">There are close alternatives to these forbidden sequences that can be used in Lojban­izing names, such as “ly”, “lei”, and “dai” or “do'i”, that do not cause these problems.

<p>

<cx "names, rules for"><cx "cmene, rules for">Lojban cmene are identifiable as word forms by the following characteristics:

<p>

<cx "cmene, final letter in"><cx "cmene, consonant clusters permitted in"><dl compact><dt>1) <dd>They must end in one or more consonants. There are no rules about how many consonants may appear in a cluster in cmene, provided that each con­sonant pair (whether standing by itself, or as part of a larger cluster) is a permissible pair.

</dl><cx "“iy”, in cmene"><cx "“uy”, in cmene"><cx "diphthongs, specific to names"><cx "diphthongs, specific to cmene"><dl compact><dt>2) <dd>They may contain the letter y as a normal, non-hyphenating vowel. They are the only kind of Lojban word that may contain the two diphthongs “iy” and “uy”.

</dl><cx "cmene, requirement for pause after"><cx "names, requirement for pause after"><dl compact><dt>3) <dd>They are always followed in speech by a pause after the fi­nal consonant, writ­ten as “.”.

</dl><cx "cmene, stress in"><cx "names, stress in"><cx "capitalization, use in names"><cx "capitalization, for unusual stress in names"><cx "capitalization, use of"><dl compact><dt>4) <dd>They may be stressed on any syllable; if this syllable is not the penultimate one, it must be capitalized when writing. Neither names nor words that be­gin sentences are capitalized in Lojban, so this is the only use of capital let­ters.

</dl><cx "cmene, from Lojban words"><cx "names, from Lojban words">Names meeting these criteria may be invented, Lojbanized from names in other lan­guages, or formed by appending a consonant onto a cmavo, a gismu, a fu'ivla or a lujvo. Some cmene built from Lojban words are:

<p>

<ex "One, the"><pre><a name=e8d11>8.11) pav.

the One

from the cmavo “pa”, with rafsi “pav”, meaning “one”

</pre><ex "Sun, the"><pre><a name=e8d12>8.12) sol.

the Sun

from the gismu “solri”, meaning “solar”, or actually “pertaining to the Sun”

</pre><ex "Chief"><pre><a name=e8d13>8.13) ralj.

Chief (as a title)

from the gismu “ralju”, meaning “principal”.

</pre><ex "Lord"><ex "Lady"><pre><a name=e8d14>8.14) nol.

Lord/Lady

from the gismu “nobli”, with rafsi “nol”, meaning “noble”.

</pre><cx "names, algorithm for"><cx "cmene, algorithm for">To Lojbanize a name from the various natural languages, ap­ply the following rules:

<p>

<dl compact><dt>1) <dd>Eliminate double consonants and silent letters.

<p><dt>2) <dd>Add a final “s” or “n” (or some other consonant that sounds good) if the name ends in a vowel.

<p><dt>3) <dd>Convert all sounds to their closest Lojban equivalents.

<p><dt>4) <dd>If possible and acceptable, shift the stress to the penulti­mate (next-to-the-last) syllable. Use commas and capitalization in writ­ten Lojban when it is necessary to preserve non-standard syllabi­cation or stress. Do not capitalize names otherwise.

</dl><cx "cmene, avoiding impermissible consonant clusters in"><dl compact><dt>5) <dd>If the name contains an impermissible consonant pair, in­sert a vowel be­tween the consonants: “y” is recommended.

</dl><cx "cmene, proscribed syllables in"><dl compact><dt>6) <dd>No cmene may have the syllables “la”, “lai”, or “doi” in them, unless imme­di­ately preceded by a consonant. If these combina­tions are present, they must be converted to something else. Possible substitutions include “ly”, “ly'i”, and “dai” or “do'i”, re­spectively.

</dl><cx "Linnaean names, rules for"><cx "scientific names, rules for">There are some additional rules for Lojbanizing the scientific names (technically known as “Linnaean binomials” after their inven­tor) which are internation­ally applied to each species of animal or plant. Where precision is essential, these names need not be Loj­banized, but can be directly inserted into Lojban text using the cmavo “la'o”, ex­plained in <a href=chap19.html>Chapter 19</a>. Using this cmavo makes the already lengthy Latinized names at least four syllables longer, however, and leaves the pronunciation in doubt. The following suggestions, though incomplete, will assist in converting Linnaean binomals to valid Loj­ban names. They can also help to create fu'ivla based on Linnaean bino­mials or other words of the international scientific vocabulary. The term “back vowel” in the following list refers to any of the letters “a”, “o”, or “u”; the term “front vowel” correspondingly refers to any of the letters “e”, “i”, or “y”.

<p>

<dl compact><dt>1) <dd>Change double consonants other than “cc” to single conso­nants.

<p><dt>2) <dd>Change “cc” before a front vowel to “kc”, but otherwise to “k”.

<p><dt>3) <dd>Change “c” before a back vowel and final “c” to “k”.

<p><dt>4) <dd>Change “ng” before a consonant (other than “h”) and final “ng” to “n”.

<p><dt>5) <dd>Change “x” to “z” initially, but otherwise to “ks”.

<p><dt>6) <dd>Change “pn” to “n” initially.

<p><dt>7) <dd>Change final “ie” and “ii” to “i”.

<p><dt>8) <dd>Make the following idiosyncratic substitutions:

<p><dt><dd> aa a

ae e

ch k

ee i

eigh ei

ew u

igh ai

oo u

ou u

ow au

ph f

q k

sc sk

w u

y i

<p><dt><dd>However, the diphthong substitutions should not be done if the two vowels are in two different syllables.

<p><dt>9) <dd>Change “h” between two vowels to “ ' ”, but otherwise re­move it completely. If preservation of the “h” seems essential, change it to “x” instead.

<p><dt>10) <dd>Place “ ' ” between any remaining vowel pairs that do not form Lojban diph­thongs.

<p><dt><dd>Some further examples of Lojbanized names are:

</dl><ex "William"><ex "Svetlana"><ex "Mao Zedong"><ex "Lech Walesa"><ex "Krishna"><ex "Khrushchev"><ex "Johnson"><ex "Fujiko"><ex "Don Quixote"><ex "De Gaulle"><pre> English “Mary” meris.

or meiris.

English “Smith” smit.

English “Jones” djonz.

English “John” djan. or jan. (American)

or djon. or jon. (British)

English “Alice” .alis.

English “Elise” .eLIS.

English “Johnson” djansn.

English “William” .uiliam.

or .uil,iam.

English “Brown” braun.

English “Charles” tcarlz.

French “Charles” carl.

French “De Gaulle” dyGOL.

German “Heinrich” xainrix.

Spanish “Joaquin” xuaKIN.

Russian “Svetlana” sfietlanys.

Russian “Khrushchev” xrucTCOF.

Hindi “Krishna” kricnas.

Polish “Lech Walesa” lex. va,uensas.

Spanish “Don Quixote” don. kicotes.

or modern Spanish: don. kixotes.

or Mexican dialect: don. ki'otes.

Chinese “Mao Zedong” maudzydyn.

Japanese “Fujiko” fudjikos.

or fujikos.

### </pre><a name=s9><h3>Rules for inserting pauses</h3>

<p>

<cx "pauses, rules for">Summarized in one place, here are the rules for inserting pauses between Loj­ban words:

<p>

<cx "pause, proscribed within words"><cx "pause, between words"><dl compact><dt>1) <dd>Any two words may have a pause between them; it is al­ways illegal to pause in the middle of a word, because that breaks up the word into two words.

</dl><cx "consonant-final words, necessity for pause after"><cx "pause, and consonant-final words"><dl compact><dt>2) <dd>Every word ending in a consonant must be followed by a pause. Necessarily, all such words are cmene.

</dl><cx "vowel-initial words, necessity for pause before"><cx "pause, and vowel-initial words"><dl compact><dt>3) <dd>Every word beginning with a vowel must be preceded by a pause. Such words are either cmavo, fu'ivla, or cmene; all gismu and lujvo begin with conso­nants.

</dl><cx "cmene, rules for pause before"><cx "pause, and cmene"><dl compact><dt>4) <dd>Every cmene must be preceded by a pause, unless the im­mediately preceding word is one of the cmavo “la”, “lai”, “la'i”, or “doi” (which is why those strings are forbidden in cmene). How­ever, the situation triggering this rule rarely occurs.

</dl><cx "stress, final syllable, rules for pause after"><cx "final syllable stress, rules for pause after"><cx "pause, and final-syllable stress"><dl compact><dt>5) <dd>If the last syllable of a word bears the stress, and a brivla follows, the two must be separated by a pause, to prevent confu­sion with the primary stress of the brivla. In this case, the first word must be either a cmavo or a cmene with unusual stress (which already ends with a pause, of course).

</dl><cx "“Cy”-form cmavo, rules for pause after"><cx "cmavo, rules for pause after “Cy”-form"><cx "pause, and “Cy”-form cmavo"><dl compact><dt>6) <dd>A cmavo of the form “Cy” must be followed by a pause un­less another “Cy”-form cmavo follows.

</dl><cx "pause, and non-Lojban text"><cx "non-Lojban text, rules for pause with"><dl compact><dt>7) <dd>When non-Lojban text is embedded in Lojban, it must be pre­ceded and fol­lowed by pauses. (How to embed non-Lojban text is explained in <a href=chap19.html>Chapter 19</a>.)

### </dl><a name=s10><h3>Considerations for making lujvo</h3>

<p>

Given a tanru which expresses an idea to be used frequently, it can be turned into a lujvo by following the lujvo-making algorithm which is given in <a href=#s11>Section 11</a>.

<p>

In building a lujvo, the first step is to replace each gismu with a rafsi that uniquely represents that gismu. These rafsi are then at­tached together by fixed rules that allow the resulting compound to be recognized as a single word and to be analyzed in only one way.

<p>

There are three other complications; only one is serious.

<p>

<cx "rafsi, multiple for each gismu">The first is that there is usually more than one rafsi that can be used for each gismu. The one to be used is simply whichever one sounds or looks best to the speaker or writer. There are usually many valid combinations of possible rafsi. They all are equally valid, and all of them mean exactly the same thing. (The scoring algorithm given in <a href=#s12>Section 12 </a>is used to choose the standard form of the lujvo — the version which would be entered into a dictionary.)

<p>

<cx "lujvo, unambiguity of"><cx "lujvo, consideration in choosing meaning for"><cx "linguistic drift in Lojban, possible source of">The second complication is the serious one. Remember that a tanru is ambigu­ous — it has several possible meanings. A lujvo, or at least one that would be put into the dic­tionary, has just a single meaning. Like a gismu, a lujvo is a predicate which encompasses one area of the semantic universe, with one set of places. Hopefully the meaning chosen is the most useful of the possible semantic spaces. A possible source of linguistic drift in Lojban is that as Lojbanic soci­ety evolves, the concept that seems the most useful one may change.

<p>

<cx "lujvo, meaning drift of"><lx "za'e"><cx "za'e, use to avoid lujvo misunderstandings">You must also be aware of the possibility of some prior meaning of a new lu­jvo, es­pecially if you are writing for posterity. If a lujvo is invented which involves the same tanru as one that is in the dictionary, and is assigned a different meaning (or even just a differ­ent place structure), linguistic drift results. This isn't necessarily bad. Every natural language does it. But in communication, when you use a meaning different from the dic­tionary definition, someone else may use the dictionary and therefore misunder­stand you. You can use the cmavo “za'e” (explained in <a href=chap19.html>Chapter 19</a>) before a newly coined lujvo to indicate that it may have a non-dictionary meaning.

<p>

<cx "lujvo, ultimate guideline for choice of meaning/place-structure">The essential nature of human communication is that if the listener under­stands, then all is well. Let this be the ultimate guideline for choosing meanings and place structures for invented lujvo.

<p>

<cx "Zipf's Law"><cx "lujvo, dropping elements of">The third complication is also simple, but tends to scare new Lojbanists with its im­plications. It is based on Zipf's Law, which says that the length of words is in­versely pro­portional to their usage. The shortest words are those which are used more; the longest ones are used less. Conversely, commonly used concepts will be tend to be abbreviated. In English, we have abbreviations and acronyms and jargon, all of which represent com­plex ideas that are used often by small groups of people, so they short­ened them to con­vey more in­formation more rapidly.

<p>

Therefore, given a complicated tanru with grouping markers, abstraction markers, and other cmavo in it to make it syntactically unambiguous, the psychological basis of Zipf's Law may compel the lujvo-maker to drop some of the cmavo to make a shorter (technically incorrect) tanru, and then use that tanru to make the lujvo.

<p>

<cx "lujvo, based on multiple tanru">This doesn't lead to ambiguity, as it might seem to. A given lujvo still has ex­actly one meaning and place structure. It is just that more than one tanru is competing for the same lujvo. But more than one meaning for the tanru was already competing for the “right” to define the meaning of the lujvo. Someone has to use judgment in de­ciding which one meaning is to be chosen over the others.

<p>

<cx "lujvo, considerations for retaining elements of"><cx "lujvo, shorter for more general concepts">If the lujvo made by a shorter form of tanru is in use, or is likely to be useful for an­other meaning, the decider then retains one or more of the cmavo, preferably ones that set this meaning apart from the shorter form meaning that is used or anticipated. As a rule, therefore, the shorter lujvo will be used for a more general concept, possibly even instead of a more frequent word. If both words are needed, the simpler one should be shorter. It is easier to add a cmavo to clarify the meaning of the more complex term than it is to find a good alternate tanru for the simpler term.

<p>

<cx "lujvo, and the listener"><cx "lujvo, and plausibility">And of course, we have to consider the listener. On hearing an unknown word, the listener will decompose it and get a tanru that makes no sense or the wrong sense for the context. If the listener realizes that the grouping operators may have been dropped out, he or she may try alternate groupings, or try inserting an abstraction op­erator if that seems plausible. (The grouping of tanru is explained in <a href=chap5.html>Chapter 5</a>; ab­straction is explained in <a href=chap11.html>Chapter 11</a>.) Plausibility is the key to learning new ideas and to evaluating unfamiliar lujvo.

<p>

### <a name=s11><h3>The lujvo-making algorithm</h3>

<p>

<cx "lujvo, algorithm for">The following is the current algorithm for generating Lojban lujvo given a known tanru and a complete list of gismu and their as­signed rafsi. The algorithm was designed by Bob LeChevalier and Dr. James Cooke Brown for computer program im­plementation. It was modified in 1989 with the assistance of Nora LeChevalier, who de­tected a flaw in the original “tosmabru test”.

<p>

Given a tanru that is to be made into a lujvo:

<p>

<dl compact><dt>1) <dd>Choose a 3-letter or 4-letter rafsi for each of the gismu and cmavo in the tanru except the last.

<p><dt>2) <dd>Choose a 3-letter (CVV-form or CCV-form) or 5-letter rafsi for the final gismu in the tanru.

<p><dt>3) <dd>Join the resulting string of rafsi, initially without hyphens.

</dl><cx "hyphens in lujvo, proscribed where not required"><dl compact><dt>4) <dd>Add hyphen letters where necessary. It is illegal to add a hy­phen at a place that is not required by this algorithm. Right-to-left tests are recommended, for reasons discussed below.

<p><dt>4a) <dd>If there are more than two words in the tanru, put an “r”-hy­phen (or an “n”-hyphen) after the first rafsi if it is CVV-form. If there are exactly two words, then put an “r”-hyphen (or an “n”-hy­phen) between the two rafsi if the first rafsi is CVV-form, unless the second rafsi is CCV-form (for example, “saicli” requires no hyphen). Use an “r”-hyphen unless the letter after the hyphen is “r”, in which case use an “n”-hyphen. Never use an “n”-hyphen unless it is required.

<p><dt>4b) <dd>Put a “y”-hyphen between the consonants of any impermis­si­ble conso­nant pair. This will always appear between rafsi.

<p><dt>4c) <dd>Put a “y”-hyphen after any 4-letter rafsi form.

</dl><cx "tosmabru test"><dl compact><dt>5) <dd>Test all forms with one or more initial CVC-form rafsi — with the pattern “CVC <dots>…</dots>CVC + X” — for “tosmabru failure”. X must either be a CVCCV long rafsi that happens to have a permissible initial pair as the consonant cluster, or is something which has caused a “y”-hyphen to be installed between the previous CVC and itself by one of the above rules.

The test is as follows:

<p><dt>5a) <dd>Examine all the C/C consonant pairs that join the CVC rafsi, and also the pair between the last CVC and the X portion, ignor­ing any “y”-hyphen before the X.

These consonant pairs are called “joints”.

<p><dt>5b) <dd>If all of those joints are permissible initials, then the trial word will break up into a cmavo and a shorter brivla. If not, the word will not break up, and no further hyphens are needed.

<p><dt>5c) <dd>Install a “y”-hyphen at the first such joint.

</dl><p>Note that the “tosmabru test” implies that the algorithm will be more efficient if rafsi junctures are tested for required hyphens from right to left, instead of from left to right; when the test is required, it cannot be completed until hyphenation to the right has been deter­mined.

<p>

### <a name=s12><h3>The lujvo scoring algorithm</h3>

<p>

<cx "lujvo, scoring of"><cx "lujvo, selection of best form of">This algorithm was devised by Bob and Nora LeChevalier in 1989. It is not the only possible algorithm, but it usually gives a choice that people find preferable. The algorithm may be changed in the fu­ture. The lowest-scoring variant will usually be the dictionary form of the lujvo. (In previous versions, it was the highest-scoring variant.)

<p>

<dl compact><dt>1) <dd>Count the total number of letters, including hyphens and apostrophes; call it “L”.

<p><dt>2) <dd>Count the number of apostrophes; call it “A”.

<p><dt>3) <dd>Count the number of “y”-, “r”-, and “n”-hyphens; call it “H”.

<p><dt>4) <dd>For each rafsi, find the value in the following table. Sum this value over all rafsi; call it “R”:

<p><dt> <dd>CVC/CV (final) (-sarji) 1

CVC/C (-sarj-) 2

CCVCV (final) (-zbasu) 3

CCVC (-zbas-) 4

CVC (-nun-) 5

CVV with an apostrophe (-ta'u-) 6

CCV (-zba-) 7

CVV with no apostrophe (-sai-) 8

<p><dt>5) <dd>Count the number of vowels, not including “y”; call it “V”.

</dl><p>The score is then:

<p>

<dl compact><dt> <dd>(1000 \* L) - (500 \* A) + (100 \* H) - (10 \* R) - V

</dl><cx "hierarchy of priorities for selecting lujvo form"><cx "lujvo form, hierarchy of priorities for selection of">In case of ties, there is no preference. This should be rare. Note that the algo­rithm es­sentially encodes a hierarchy of priorities: short words are preferred (counting apostro­phes as half a letter), then words with fewer hyphens, words with more pleasing rafsi (this judg­ment is subjective), and finally words with more vowels are chosen. Each decision principle is applied in turn if the ones before it have failed to choose; it is pos­sible that a lower-ranked principle might dominate a higher-ranked one if it is ten times better than the alterna­tive.

<p>

<cx "lujvo, scored examples of">Here are some lujvo with their scores (not necessarily the lowest scoring forms for these lujvo, nor even necessarily sensible lujvo):

<p>

<pre><a name=e12d1>12.1) zbasai

zba + sai

(1000 \* 6) - (500 \* 0) + (100 \* 0) - (10 \* 15) - 3

= 5847

<a name=e12d2>12.2) nunynau

nun + y + nau

32500 - (1000 \* 7) + (500 \* 0) - (100 \* 1) + (10 \* 13) + 3

= 6967

<a name=e12d3>12.3) sairzbata'u

sai + r + zba + ta'u

32500 - (1000 \* 11) + (500 \* 1) - (100 \* 1) + (10 \* 21) + 5

= 10385

<a name=e12d4>12.4) zbazbasysarji

zba + zbas + y + sarji

32500 - (1000 \* 13) + (500 \* 0) - (100 \* 1) + (10 \* 12) + 4

= 12976

### </pre><a name=s13><h3>lujvo-making examples</h3>

<p>

<cx "lujvo, examples of making"><ex "doghouse">This section contains examples of making and scoring lujvo. First, we will start with the tanru “gerku zdani” (“dog house”) and con­struct a lujvo meaning “doghouse”, that is, a house where a dog lives. We will use a brute-force application of the algo­rithm in <a href=#s12>Sec­tion 12</a>, using every possible rafsi.

<p>

The rafsi for “gerku” are:

<p>

<dl compact><dt> <dd>-ger-, -ge'u-, -gerk-, -gerku

</dl><p>The rafsi for “zdani” are:

<p>

<dl compact><dt> <dd>-zda-, -zdan-, -zdani.

</dl><p>Step 1 of the algorithm directs us to use “-ger-”, “-ge'u-” and “-gerk-” as pos­sible rafsi for “gerku”; Step 2 directs us to use “-zda-” and “-zdani” as possible rafsi for “zdani”. The six possible forms of the lujvo are then:

<p>

<dl compact><dt> <dd>ger-zda

ger-zdani

ge'u-zda

ge'u-zdani

gerk-zda

gerk-zdani

</dl><p>We must then insert appropriate hyphens in each case. The first two forms need no hyphenation: “ge” cannot fall off the front, be­cause the following word would begin with “rz”, which is not a permis­sible initial consonant pair. So the lujvo forms are “gerzda” and “gerzdani”.

<p>

The third form, “ge'u-zda”, needs no hyphen, because even though the first rafsi is CVV, the second one is CCV, so there is a consonant cluster in the first five letters. So “ge'uzda” is this form of the lujvo.

<p>

The fourth form, “ge'u-zdani”, however, requires an “r”-hy­phen; otherwise, the “ge'u-” part would fall off as a cmavo. So this form of the lujvo is “ge'urzdani”.

<p>

The last two forms require “y”-hyphens, as all 4-letter rafsi do, and so are “gerkyzda” and “gerkyzdani” respectively.

<p>

The scoring algorithm is heavily weighted in favor of short luj­vo, so we might expect that “gerzda” would win. Its L score is 6, its A score is 0, its H score is 0, its R score is 12, and its V score is 3, for a final score of 5878. The other forms have scores of 7917, 6367, 9506, 8008, and 10047 respectively. Consequently, this lujvo would probably ap­pear in the dictionary in the form “gerzda”.

<p>

<ex "boat class">For the next example, we will use the tanru “bloti klesi” (“boat class”) pre­sumably referring to the category (rowboat, motorboat, cruise liner) into which a boat falls. We will omit the long rafsi from the process, since lujvo containing long rafsi are almost never preferred by the scoring algorithm when there are short rafsi available.

<p>

The rafsi for “bloti” are “-lot-”, “-blo-”, and “-lo'i-”; for “klesi” they are “-kle-” and “-lei-”. Both these gismu are among the handful which have both CVV-form and CCV-form rafsi, so there is an un­usual number of possibilities available for a two-part tanru:

<p>

<pre> lotkle blokle lo'ikle

lotlei blolei lo'irlei

</pre><p>Only “lo'irlei” requires hyphenation (to avoid confusion with the cmavo sequence “lo'i lei”). All six forms are valid versions of the lujvo, as are the six further forms using long rafsi; however, the scoring algorithm produces the following results:

<p>

<pre> lotkle 5878 blokle 5858 lo'ikle 6367

lotlei 5867 blolei 5847 lo'irlei 7456

</pre><p>So the form “blolei” is preferred, but only by a tiny margin over “blokle”; “lotlei” and “lotkle” are only slightly worse; “lo'ikle” suffers because of its apostrophe, and “lo'irlei” because of having both apos­trophe and hyphen.

<p>

<ex "Logical Language Group">Our third example will result in forming both a lujvo and a name from the tanru “logji bangu girzu”, or “logical-language group” in English. (“The Logical Lan­guage Group” is the name of the publisher of this book and the organization for the promotion of Lojban.)

The available rafsi are “-loj-” and “-logj-”; “-ban-”, “-bau-”, and “-bang-”; and “-gri-” and “-girzu”, and (for name purposes only) “-gir-” and “-girz-”. The resulting 12 lujvo possibilities are:

<p>

<pre> loj-ban-gri loj-bau-gri loj-bang-gri

logj-ban-gri logj-bau-gri logj-bang-gri

loj-ban-girzu loj-bau-girzu loj-bang-girzu

logj-ban-girzu logj-bau-girzu logj-bang-girzu

</pre>and the 12 name possibilities are:

<p>

<pre> loj-ban-gir. loj-bau-gir. loj-bang-gir.

logj-ban-gir. logj-bau-gir. logj-bang-gir.

loj-ban-girz. loj-bau-girz. loj-bang-girz.

logj-ban-girz. logj-bau-girz. logj-bang-girz.

</pre><p>After hyphenation, we have:

<p>

<pre> lojbangri lojbaugri lojbangygri

logjybangri logjybaugri logjybangygri

lojbangirzu lojbaugirzu lojbangygirzu

logjybangirzu logjybaugirzu logjybangygirzu

lojbangir. lojbaugir. lojbangygir.

logjybangir. logjybaugir. logjybangygir.

lojbangirz. lojbaugirz. lojbangygirz.

logjybangirz. logjybaugirz. logjybangygirz.

</pre><p>The only fully reduced lujvo forms are “lojbangri” and “lojbaugri”, of which the latter has a slightly lower score: 8827 versus 8796, respec­tively. However, for the name of the organization, we chose to make sure the name of the language was embedded in it, and to use the clearer long-form rafsi for “girzu”, producing “lojbangirz.”

<p>

<ex "male sexual teacher"><ex "sexual teacher, male">Finally, here is a four-part lujvo with a cmavo in it, based on the tanru “nakni ke cinse ctuca” or “male (sexual teacher)”. The “ke” cmavo ensures the interpretation “teacher of sexuality who is male”, rather than “teacher of male sexuality”. Here are the possible forms of the lujvo, both before and after hyphenation:

<p>

<pre> nak-kem-cin-ctu nakykemcinctu

nak-kem-cin-ctuca nakykemcinctuca

nak-kem-cins-ctu nakykemcinsyctu

nak-kem-cins-ctuca nakykemcinsyctuca

nakn-kem-cin-ctu naknykemcinctu

nakn-kem-cin-ctuca naknykemcinctuca

nakn-kem-cins-ctu naknykemcinsyctu

nakn-kem-cins-ctuca naknykemcinsyctuca

</pre><p>Of these forms, “nakykemcinctu” is the shortest and is preferred by the scoring algo­rithm. On the whole, however, it might be better to just make a lujvo for “cinse ctuca” (which would be “cinctu”) since the sex of the teacher is rarely important. If there was a reason to specify “male”, then the simpler tanru “nakni cinctu” (“male sexual-teacher”) would be appropriate. This tanru is actually shorter than the four-part lujvo, since the “ke” required for grouping need not be expressed.

<p>

### <a name=s14><h3>The gismu creation algorithm</h3>

<p>

<cx "gismu, algorithm for">The gismu were created through the following process:

<p>

<cx "source languages, use in creating gismu"><dl compact><dt>1) <dd>At least one word was found in each of the six source lan­guages (Chinese, English, Hindi, Spanish, Russian, Arabic) cor­responding to the proposed gismu. This word was rendered into Lojban phonetics rather liberally: conso­nant clusters consisting of a stop and the corresponding fricative were sim­plified to just the fricative (“tc” became “c”, “dj” became “j”) and non-Loj­ban vowels were mapped onto Lojban ones. Furthermore, morphological end­ings were dropped. The same mapping rules were applied to all six lan­guages for the sake of consistency.

<p><dt>2) <dd>All possible gismu forms were matched against the six source-language forms. The matches were scored as follows:

</dl><cx "gismu creation, scoring rules"><dl compact><dt>2a) <dd>If three or more letters were the same in the proposed gismu and the source-language word, and appeared in the same order, the score was equal to the number of letters that were the same. Intervening letters, if any, did not matter.

<p><dt>2b) <dd>If exactly two letters were the same in the proposed gismu and the source-language word, and either the two letters were consecutive in both words, or were separated by a single letter in both words, the score was 2. Letters in reversed order got no score.

<p><dt>2c) <dd>Otherwise, the score was 0.

<p><dt>3) <dd>The scores were divided by the length of the source-lan­guage word in its Loj­banized form, and then multiplied by a weighting value specific to each lan­guage, reflecting the propor­tional number of first-language and second-lan­guage speakers of the language. (Second-language speakers were reck­oned at half their actual numbers.) The weights were chosen to sum to 1.00. The sum of the weighted scores was the total score for the pro­posed gismu form.

</dl><cx "gismu creation, considerations for selection after scoring"><dl compact><dt>4) <dd>Any gismu forms that conflicted with existing gismu were re­moved. Obvi­ously, being identical with an existing gismu consti­tutes a conflict. In addi­tion, a proposed gismu that was identical to an existing gismu except for the final vowel was considered a conflict, since two such gismu would have iden­tical 4-letter rafsi.

</dl><cx "gismu, too-similar"><cx "gismu creation, proscribed gismu pairs"><dl compact><dt><dd>More subtly: If the proposed gismu was identical to an existing gismu except for a single consonant, and the consonant was “too similar” based on the follow­ing table, then the proposed gismu was rejected.

<p><dt> <dd>proposed gismu existing gismu

<p><dt> <dd>b p, v

c j, s

d t

f p, v

g k, x

j c, z

k g, x

l r

m n

n m

p b, f

r l

s c, z

t d

v b, f

x g, k

z j, s

</dl><p> See <a href=#s4>Section 4 </a>for an example.

<p>

<cx "gismu creation, and transcription blunders"><dl compact><dt>5) <dd>The gismu form with the highest score usually became the actual gismu. Sometimes a lower-scoring form was used to pro­vide a better rafsi. A few gismu were changed in error as a result of transcription blunders (for exam­ple, the gismu “gismu” should have been “gicmu”, but it's too late to fix it now).

</dl><cx "gismu, source-language weights for">The language weights used to make most of the gismu were as follows:

<p>

<pre> Chinese 0.36

English 0.21

Hindi 0.16

Spanish 0.11

Russian 0.09

Arabic 0.07

</pre>reflecting 1985 number-of-speakers data. A few gismu were made much later <dl compact><dt>using updated weights: <dd>

<p><dt> <dd>Chinese 0.347

Hindi 0.196

English 0.160

Spanish 0.123

Russian 0.089

Arabic 0.085

</dl>(English and Hindi switched places due to demographic changes.)

<p>

Note that the stressed vowel of the gismu was considered sufficiently distinctive that two or more gismu may differ only in this vowel; as an extreme example, “bradi”, “bredi”, “bridi”, and “brodi” (but fortunately not “brudi”) are all existing gismu.

<p>

### <a name=s15><h3>Cultural and other non-algorithmic gismu</h3>

<p>

<cx "gismu, exceptions to gismu creation by algorithm"><cx "gismu, coined">The following gismu were not made by the gismu creation al­gorithm. They are, in ef­fect, coined words similar to fu'ivla. They are exceptions to the otherwise mandatory gismu creation algorithm where there was sufficient justification for such exceptions. Except for the small metric prefixes and the assignable predicates beginning with “brod”, they all end in the letter “o”, which is otherwise a rare letter in Lojban gismu.

<p>

<cx "gismu, Lojban-specific">The following gismu represent concepts that are sufficiently unique to Lojban that they were either coined from combining forms of other gismu, or else made up out of whole cloth. These gismu are thus conceptually similar to lujvo even though they are only five let­ters long; however, unlike lujvo, they have rafsi assigned to them for use in build­ing more complex lujvo. Assigning gismu to these con­cepts helps to keep the re­sulting lujvo reasonably short.

<p>

<pre> broda 1st assignable predicate

brode 2nd assignable predicate

brodi 3rd assignable predicate

brodo 4th assignable predicate

brodu 5th assignable predicate

cmavo structure word (from “cmalu valsi”)

lojbo Lojbanic (from “logji bangu”)

lujvo compound word (from “pluja valsi”)

mekso Mathematical EXpression

</pre><p>It is important to understand that even though “cmavo”, “lojbo”, and “lujvo” were made up from parts of other gismu, they are now full-fledged gismu used in exactly the same way as all other gismu, both in grammar and in word formation.

<p>

<cx "gismu, scientific-mathematical">The following three groups of gismu represent concepts drawn from the inter­national language of science and mathematics. They are used for concepts that are rep­resented in most languages by a root which is recognized internationally.

<p>

Small metric prefixes (values less than 1):

<p>

<pre> decti .1/deci

centi .01/centi

milti .001/milli

mikri 1E-6/micro

nanvi 1E-9/nano

picti 1E-12/pico

femti 1E-15/femto

xatsi 1E-18/atto

zepti 1E-21/zepto

gocti 1E-24/yocto

</pre><p>Large metric prefixes (values greater than 1):

<p>

<pre> dekto 10/deka

xecto 100/hecto

kilto 1000/kilo

megdo 1E6/mega

gigdo 1E9/giga

terto 1E12/tera

petso 1E15/peta

xexso 1E18/exa

zetro 1E21/zetta

gotro 1E24/yotta

</pre><p>Other scientific or mathematical terms:

<p>

<pre> delno candela

kelvo kelvin

molro mole

radno radian

sinso sine

stero steradian

tanjo tangent

xampo ampere

</pre><p>The gismu “sinso” and “tanjo” were only made non-algorithmically be­cause they were identical (having been borrowed from a common source) in all the dictionaries that had translations. The other terms in this group are units in the international metric system; some metric units, however, were made by the ordinary process (usually because they are different in Chinese).

<p>

<cx "gismu, cultural">Finally, there are the cultural gismu, which are also borrowed, but by modify­ing a word from one particular language, instead of us­ing the multi-lingual gismu crea­tion al­gorithm. Cultural gismu are used for words that have local importance to a par­ticular culture; other cultures or languages may have no word for the concept at all, or may bor­row the word from its home culture, just as Lojban does. In such a case, the gismu algo­rithm, which uses weighted averages, doesn't accurately represent the fre­quency of usage of the individual concept. Cultural gismu are not even required to be based on the six major languages.

<p>

<cx "gismu, for languages"><cx "gismu for Lojban source languages">The six Lojban source languages:

<p>

<pre> jungo Chinese (from “Zhong<sup>1</sup>guo<sup>2</sup>”)

glico English

xindo Hindi

spano Spanish

rusko Russian

xrabo Arabic

</pre><p>Seven other widely spoken languages that were on the list of candi­dates for gismu-mak­ing, but weren't used:

<p>

<pre> bengo Bengali

porto Portuguese

baxso Bahasa Melayu/Bahasa Indonesia

ponjo Japanese (from “Nippon”)

dotco German (from “Deutsch”)

fraso French (from “Franç&ccedil;ais”)

xurdo Urdu

</pre>(Urdu and Hindi began as the same language with different writing systems, but have now become somewhat different, principally in bor­rowed vocabulary. Urdu-speakers were counted along with Hindi-speakers when weights were assigned for gismu-making purposes.)

<p>

<cx "gismu, for countries">Countries with a large number of speakers of any of the above languages (where the meaning of “large” is dependent on the specific language):

<p>

<dl compact><dt> <dd>English:

merko American

brito British

skoto Scottish

sralo Australian

kadno Canadian

<p><dt> <dd>Spanish:

gento Argentinian

mexno Mexican

<p><dt> <dd>Russian:

softo Soviet/USSR

vukro Ukrainian

<p><dt> <dd>Arabic:

filso Palestinian

jerxo Algerian

jordo Jordanian

libjo Libyan

lubno Lebanese

misro Egyptian (from “Mizraim”)

morko Moroccan

rakso Iraqi

sadjo Saudi

sirxo Syrian

<p><dt> <dd>Bahasa Melayu/Bahasa Indonesia:

bindo Indonesian

meljo Malaysian

<p><dt> <dd>Portuguese:

brazo Brazilian

<p><dt> <dd>Urdu:

kisto Pakistani

</dl><cx "gismu, geographical"><cx "continents, gismu for">The continents (and oceanic regions) of the Earth:

<p>

<pre> bemro North American (from “berti merko”)

dzipo Antarctican (from “cadzu cipni”)

ketco South American (from “Quechua”)

friko African

polno Polynesian/Oceanic

ropno European

xazdo Asiatic

</pre><cx "gismu, ethnic">A few smaller but historically important cultures:

<p>

<pre> latmo Latin/Roman

srito Sanskrit

xebro Hebrew/Israeli/Jewish

xelso Greek (from “Hellas”)

</pre><cx "gismu, religious">Major world religions:

<p>

<pre> budjo Buddhist

dadjo Taoist

muslo Islamic/Moslem

xriso Christian

</pre><p>A few terms that cover multiple groups of the above:

<p>

<pre> jegvo Jehovist (Judeo-Christian-Moslem)

semto Semitic

slovo Slavic

xispo Hispanic (New World Spanish)

### </pre><a name=s16><h3>rafsi fu'ivla: a proposal</h3>

<p>

<cx "rafsi fu'ivla"><cx "cultural words, rafsi fu'ivla proposal for">The list of cultures represented by gismu, given in <a href=#s15>Section 15</a>, is unavoidably contro­versial. Much time has been spent debating whether this or that culture “deserves a gismu” or “must languish in fu'ivla space”. To help defuse this argument, a last-min­ute proposal was made when this book was already substantially complete. I have added it here with experimental status: it is not yet a standard part of Lojban, since all its im­plica­tions have not been tested in open debate, and it affects a part of the language (lujvo-making) that has long been stable, but is known to be fragile in the face of small changes. (Many attempts were made to add general mechanisms for making lujvo that contained fu'ivla, but all failed on obvious or obscure counterexam­ples; finally the gen­eral “zei” mechanism was devised instead.)

<p>

<cx "CCVVCV fu'ivla, and rafsi fu'ivla proposal"><cx "fu'ivla, form for rafsi fu'ivla proposal">The first part of the proposal is uncontroversial and involves no change to the lan­guage mechanisms. All valid Type 4 fu'ivla of the form CCVVCV would be re­served for cultural brivla analogous to those described in <a href=#s15>Section 15</a>. For example,

<p>

<pre><a name=e16d1>16.1) tci'ile

Chilean

is of the appropriate form, and passes all tests required of a Stage 4 fu'ivla. No two fu'ivla of this form would be allowed to coexist if they differed only in the final vowel; this rule was applied to gismu, but does not apply to other fu'ivla or to lujvo.

<p>

The second, and fully experimental, part of the proposal is to allow rafsi to be formed from these cultural fu'ivla by removing the final vowel and treating the result as a 4-letter rafsi (although it would contain five letters, not four). These rafsi could then be used on a par with all other rafsi in forming lujvo. The tanru

<p>

<ex "Chilean desert"><pre><a name=e16d2>16.2) tci'ile ke canre tutra

Chilean type-of (sand territory)

Chilean desert

</pre>could be represented by the lujvo

<p>

<pre><a name=e16d3>16.3) tci'ilykemcantutra

</pre>which is an illegal word in standard Lojban, but a valid lujvo under this proposal. There would be no short rafsi or 5-letter rafsi assigned to any fu'ivla, so no fu'ivla could ap­pear as the last element of a lujvo.

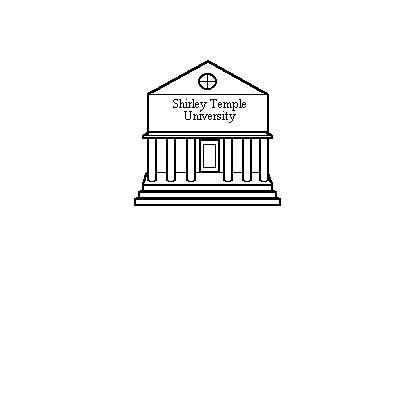
<p>

The cultural fu'ivla introduced under this proposal are called “rafsi fu'ivla”, since they are distinguished from other Type 4 fu'ivla by the property of having rafsi. If this proposal is workable and intro­duces no problems into Lojban morphology, it might be­come standard for all Type 4 fu'ivla, including those made for plants, animals, food­stuffs, and other things.

<p>

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## <h2>Chapter 5

## <br>

## “Pretty Little Girls' School”: The Structure Of Lojban selbri</h2>

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<p>

### <a name=s1><h3>Lojban content words: brivla</h3>

<p>

<cx "bridi, definition"><cx "selbri, definition"><cx "selbri, relation to bridi"><cx "bridi, relation to selbri">At the center, logically and often physically, of every Lojban bridi is one or more words which constitute the selbri. A bridi ex­presses a relationship between things: the selbri specifies which rela­tionship is referred to. The difference between:

<p>

<pre><a name=e1d1>1.1) do mamta mi

You are-a-mother-of me.

You are my mother.

</pre>and

<p>

<pre><a name=e1d2>1.2) do patfu mi

You are-a-father-of me.

You are my father.

</pre>lies in the different selbri.

<p>

<cx "selbri, brivla as"><cx "brivla as selbri"><cx "brivla, types">The simplest kind of selbri is a single Lojban content word: a brivla. There are three different varieties of brivla: those which are built into the language (the gismu), those which are derived from combinations of the gismu (the lujvo), and those which are taken (usually in a modified form) from other languages (the fu'ivla). In ad­dition, there are a few cmavo that can act like brivla; these are men­tioned in <a href=#s9>Section 9</a>, and discussed in full in <a href=chap7.html>Chapter 7</a>.

<p>

For the purposes of this chapter, however, all brivla are alike. For example,

<p>

<pre><a name=e1d3>1.3) ta bloti

That is-a-boat.

That is a boat.

<a name=e1d4>1.4) ta brablo

That is-a-large-boat.

That is a ship.

</pre<ex "schooner"><pre><a name=e1d5>1.5) ta blotrskunri

That is-a-(boat)-schooner.

That is a schooner.

</pre>illustrate the three types of brivla (gismu, lujvo, and fu'ivla respec­tively), but in each case the selbri is composed of a single word whose meaning can be learned independent of its origins.

<p>

The remainder of this chapter will mostly use gismu as ex­ample brivla, be­cause they are short. However, it is important to keep in mind that wherever a gismu appears, it could be replaced by any other kind of brivla.

<p>

### <a name=s2><h3>Simple tanru</h3>

<p>

<cx "tanru, simple"><cx "tanru, definition">Beyond the single brivla, a selbri may consist of two brivla placed together. When a selbri is built in this way from more than one brivla, it is called a tanru, a word with no single English equivalent. The nearest analogue to tanru in English are combi­nations of two nouns such as “lemon tree”. There is no way to tell just by looking at the phrase “lemon tree” exactly what it refers to, even if you know the meanings of “lemon” and “tree” by themselves. As English-speakers, we must simply know that it refers to “a tree which bears lemons as fruits”. A person who didn't know English very well might think of it as analogous to “brown tree” and wonder, “What kind of tree is lemon-colored?”

<p>

<cx "adverb-verb combination, with tanru"><cx "adjective-noun combination, with tanru">In Lojban, tanru are also used for the same purposes as Eng­lish adjective-noun com­binations like “big boy” and adverb-verb com­binations like “quickly run”. This is a con­sequence of Lojban not hav­ing any such categories as “noun”, “verb”, “adjective”, or “adverb”. English words belonging to any of these categories are translated by sim­ple brivla in Lojban. Here are some examples of tanru:

<p>

<ex "lemon tree"><pre><a name=e2d1>2.1) tu pelnimre tricu

That-yonder is-a-(lemon tree).

That is a lemon tree.

<a name=e2d2>2.2) la djan. barda nanla

John is-a-big boy.

John is a big boy.

<a name=e2d3>2.3) mi sutra bajra

I quick run.

I quickly run/I run quickly.

</pre><p>Note that “pelnimre” is a lujvo for “lemon”; it is derived from the gismu “pelxu”, yel­low, and “nimre”, citrus. Note also that “sutra” can mean “fast/quick” or “quickly” de­pending on its use:

<p>

<pre><a name=e2d4>2.4) mi sutra

I am-fast/quick.

</pre><ex "quick runner">shows “sutra” used to translate an adjective, whereas in <a href=#e2d3>Example 2.3 </a>it is translating an adverb. (Another correct translation of <a href=#e2d3>Example 2.3</a>, however, would be “I am a quick runner”.)

<p>

<cx "seltau, definition of"><cx "tertau, definition of">There are special Lojban terms for the two components of a tanru, derived from the place structure of the word “tanru”. The first component is called the “seltau”, and the second component is called the “tertau”.

<p>

<cx "tanru, primary meaning of"><cx "tertau, effect on meaning of tanru">The most important rule for use in interpreting tanru is that the tertau carries the pri­mary meaning. A “pelnimre tricu” is primarily a tree, and only secondarily is it connected with lemons in some way. For this reason, an alternative translation of <a href=#e2d1>Ex­ample 2.1 </a>would be:

<p>

<pre><a name=e2d5>2.5) That is a lemon type of tree.

</pre><p>This “type of” relationship between the components of a tanru is fun­damental to the tanru concept.

<p>

<cx "seltau, effect on meaning of tanru"><cx "modifier, seltau as">We may also say that the seltau modifies the meaning of the tertau:

<p>

<pre><a name=e2d6>2.6) That is a tree which is lemon-ish (in the way appropriate to trees)

</pre>would be another possible translation of <a href=#e2d1>Example 2.1</a>. In the same way, a more explicit translation of <a href=#e2d2>Example 2.2 </a>might be:

<p>

<pre><a name=e2d7>2.7) John is a boy who is big in the way that boys are big.

</pre><p>This “way that boys are big” would be quite different from the way in which elephants are big; big-for-a-boy is small-for-an-elephant.

<p>

<cx "tanru, ambiguity of"><cx "ambiguity of tanru">All tanru are ambiguous semantically. Possible translations of:

<p>

<pre><a name=e2d8>2.8) ta klama jubme

That is-a-goer type-of-table.

</pre>include:

<p>

<ex "goer table"><dl compact><dt> <dd>That is a table which goes (a wheeled table, perhaps).

That is a table owned by one who goes.

That is a table used by those who go (a sports doctor's table?).

That is a table when it goes (otherwise it is a chair?).

</dl><cx "tanru, as ambiguous">In each case the object referred to is a “goer type of table”, but the ambiguous “type of” relationship can mean one of many things. A speaker who uses tanru (and pragmatically all speakers must) takes the risk of being misunderstood. Using tanru is convenient be­cause they are short and expressive; the circumlocution required to squeeze out all am­biguity can require too much effort.

<p>

<cx "tanru, meaning of">No general theory covering the meaning of all possible tanru exists; probably no such theory can exist. However, some regularities obviously do exist:

<p>

<pre><a name=e2d9>2.9) do barda prenu

You are-a-large person.

<a name=e2d10>2.10) do cmalu prenu

You are-a-small person.

</pre>are parallel tanru, in the sense that the relationship between “barda” and “prenu” is the same as that between “cmalu” and “prenu”. <a href=#s14>Section 14 </a>and <a href=#s15>Section 15 </a>contain a partial listing of some types of tanru, with examples.

<p>

### <a name=s3><h3>Three-part tanru grouping with “bo”</h3>

<p>

The following cmavo is discussed in this section:

<p>

<pre> bo BO closest scope grouping

</pre><ex "girls' school, little"><cx "tanru grouping, three-part">Consider the English sentence:

<p>

<pre><a name=e3d1>3.1) That's a little girls' school.

</pre><p>What does it mean? Two possible readings are:

<p>

<pre><a name=e3d2>3.2) That's a little school for girls.

<a name=e3d3>3.3) That's a school for little girls.

</pre><cx "speech rhythm, for grouping in English">This ambiguity is quite different from the simple tanru ambiguity de­scribed in <a href=#s2>Section 2</a>. We understand that “girls' school” means “a school where girls are the students”, and not “a school where girls are the teachers” or “a school which is a girl” (!). Likewise, we un­derstand that “little girl” means “girl who is small”. This is an ambiguity of grouping. Is “girls' school” to be taken as a unit, with “little” specifying the type of girls' school? Or is “little girl” to be taken as a unit, speci­fying the type of school? In English speech, differ­ent tones of voice, or exaggerated speech rhythm showing the grouping, are used to make the distinction; English writing usually leaves it unrepre­sented.

<p>

<lx "bo"><lx "BO">Lojban makes no use of tones of voice for any purpose; ex­plicit words are used to do the work. The cmavo “bo” (which belongs to selma'o BO) may be placed between the two brivla which are most closely associated. Therefore, a Lojban translation of <a href=#e3d2>Example 3.2 </a>would be:

<p>

<pre><a name=e3d4>3.4) ta cmalu nixli bo ckule

That is-a-small girl – school.

</pre><a href=#e3d3>Example 3.3 </a>might be translated:

<p>

<pre><a name=e3d5>3.5) ta cmalu bo nixli ckule

That is-a-small – girl school.

</pre><p>The “bo” is represented in the literal translation by a hyphen because in written English a hyphen is sometimes used for the same purpose: “a big dog-catcher” would be quite dif­ferent from a “big-dog catcher” (presumably someone who catches only big dogs).

<p>

<cx "tanru nested within tanru">Analysis of <a href=#e3d4>Example 3.4 </a>and <a href=#e3d5>Example 3.5 </a>reveals a tanru nested within a tanru. In <a href=#e3d4>Example 3.4</a>, the main tanru has a seltau of “cmalu” and a tertau of “nixli bo ckule”; the tertau is itself a tanru with “nixli” as the seltau and “ckule” as the tertau. In <a href=#e3d5>Example 3.5</a>, on the other hand, the seltau is “cmalu bo nixli” (itself a tanru), whereas the tertau is “ckule”. This structure of tanru nested within tanru forms the basis for all the more com­plex types of selbri that will be explained below.

<p>

What about <a href=#e3d6>Example 3.6</a>? What does it mean?

<p>

<pre><a name=e3d6>3.6) ta cmalu nixli ckule

That is-a-small girl school.

</pre><cx "left-grouping rule, definition of"><cx "tanru, default left-grouping of">The rules of Lojban do not leave this sentence ambiguous, as the rules of English do with <a href=#e3d1>Example 3.1</a>. The choice made by the lan­guage designers is to say that <a href=#e3d6>Example 3.6 </a>means the same as <a href=#e3d5>Ex­ample 3.5</a>. This is true no matter what three brivla are used: the left­most two are always grouped together. This rule is called the “left-grouping rule”. Left-grouping in seemingly ambiguous structures is quite common — though not universal — in other contexts in Lojban.

<p>

Another way to express the English meaning of <a href=#e3d4>Example 3.4 </a>and <a href=#e3d5>Example 3.5</a>, using parentheses to mark grouping, is:

<p>

<pre><a name=e3d7>3.7) ta cmalu nixli bo ckule

That is-a-small type-of (girl type-of school).

<a name=e3d8>3.8) ta cmalu bo nixli ckule

That is-a-(small type-of girl) type-of school.

</pre><p>Because “type-of” is implicit in the Lojban tanru form, it has no Lojban equivalent.

<p>

Note: It is perfectly legal, though pointless, to insert “bo” into a simple tanru:

<p>

<pre><a name=e3d9>3.9) ta klama bo jubme

That is-a goer – table

</pre>is a legal Lojban bridi that means exactly the same thing as <a href=#e2d8>Example 2.8</a>, and is am­bigu­ous in exactly the same ways. The cmavo “bo” serves only to resolve grouping am­bigu­ity: it says nothing about the more basic ambiguity present in all tanru.

<p>

### <a name=s4><h3>Complex tanru grouping</h3>

<p>

<cx "tanru grouping, complex">If one element of a tanru can be another tanru, why not both elements?

<p>

<pre><a name=e4d1>4.1) do mutce bo barda gerku bo kavbu

You are-a-(very type-of large) (dog type-of capturer).

You are a very large dog-catcher.

</pre><p>In <a href=#e4d1>Example 4.1</a>, the selbri is a tanru with seltau “mutce bo barda” and tertau “gerku bo kavbu”. It is worth emphasizing once again that this tanru has the same fundamental am­biguity as all other Lojban tanru: the sense in which the “dog type-of capturer” is said to be “very type-of large” is not precisely specified. Presumably it is his body which is large, but theoretically it could be one of his other properties.

<p>

<cx "pretty, English ambiguity of">We will now justify the title of this chapter by exploring the ramifications of the phrase “pretty little girls' school”, an expansion of the tanru used in <a href=#s3>Section 3 </a>to four brivla. (Although this example has been used in the Loglan Project almost since the be­ginning — it first appeared in Quine's book <cite>Word and Object </cite>(1960) — it is actu­ally a mediocre example because of the ambiguity of English “pretty”; it can mean “beautiful”, the sense intended here, or it can mean “very”. Loj­ban “melbi” is not sub­ject to this am­biguity: it means only “beautiful”.)

Here are four ways to group this phrase:

<p>

<pre><a name=e4d2>4.2) ta melbi cmalu nixli ckule

That is-a-((pretty type-of little) type-of girl) type-of school.

That is a school for girls who are beautifully small.

<a name=e4d3>4.3) ta melbi cmalu nixli bo ckule

That is-a-(pretty type-of little) (girl type-of school).

That is a girls' school which is beautifully small.

<a name=e4d4>4.4) ta melbi cmalu bo nixli ckule

That is-a-(pretty type-of (little type-of girl)) type-of school.

That is a school for small girls who are beautiful.

<a name=e4d5>4.5) ta melbi cmalu bo nixli bo ckule

That is-a-pretty type-of (little type-of (girl type-of school)).

That is a small school for girls which is beautiful.

</pre><cx "right-grouping rule, definition of"><cx "right-grouping in tanru, with bo"><cx "tanru grouping, with bo"><cx "bo, for right-grouping in tanru"><a href=#e4d5>Example 4.5 </a>uses a construction which has not been seen before: “cmalu bo nixli bo ckule”, with two consecutive uses of “bo” between brivla. The rule for multiple “bo” con­structions is the opposite of the rule when no “bo” is present at all: the last two are grouped together. Not surprisingly, this is called the “right-grouping rule”, and it is as­so­ciated with every use of “bo” in the language. Therefore,

<p>

<pre><a name=e4d6>4.6) ta cmalu bo nixli bo ckule

That is-a-little type-of (girl type-of school).

</pre>means the same as <a href=#e3d4>Example 3.4</a>, not <a href=#e3d5>Example 3.5</a>. This rule may seem peculiar at first, but one of its consequences is that “bo” is never necessary between the first two ele­ments of any of the com­plex tanru presented so far: all of <a href=#e4d{2}>Examples 4.2 </a>through <a href=#e4d5>4.5 </a>could have “bo” inserted between “melbi” and “cmalu” with no change in meaning.

<p>

### <a name=s5><h3>Complex tanru with “ke” and “ke'e”</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> ke KE start grouping

ke'e KEhE end grouping

</pre><cx "grouping parentheses"><lx "ke"><lx "ke'e"><lx "KE"><lx "KEhE"><cx "tanru grouping, with ke">There is, in fact, a fifth grouping of “pretty little girls' school” that can­not be expressed with the resources explained so far. To handle it, we must introduce the grouping pa­ren­theses cmavo, “ke” and “ke'e” (belonging to selma'o KE and KEhE respectively). Any portion of a selbri sandwiched between these two cmavo is taken to be a single tanru component, independently of what is adjacent to it. Thus, <a href=#e4d2>Ex­ample 4.2 </a>can be rewritten in any of the following ways:

<p>

<pre><a name=e5d1>5.1) ta ke melbi cmalu ke'e nixli ckule

That is-a-( pretty little ) girl school.

<a name=e5d2>5.2) ta ke ke melbi cmalu ke'e nixli ke'e ckule

That is-a-( ( pretty little ) girl ) school.

<a name=e5d3>5.3) ta ke ke ke melbi cmalu ke'e nixli ke'e ckule ke'e

That is-a-( ( ( pretty little ) girl ) school ).

</pre><p>Even more versions could be created simply by placing any number of “ke” cmavo at the beginning of the selbri, and a like number of “ke'e” cmavo at its end. Obviously, all of these are a waste of breath once the left-grouping rule has been grasped. However, the following is equivalent to <a href=#e4d4>Example 4.4 </a>and may be easier to understand:

<p>

<pre><a name=e5d4>5.4) ta melbi ke cmalu nixli ke'e ckule

That is-a-(pretty type-of (little type-of girl) ) type-of school.

</pre><p>Likewise, a “ke” and “ke'e” version of <a href=#e4d3>Example 4.3 </a>would be:

<p>

<pre><a name=e5d5>5.5) ta melbi cmalu ke nixli ckule [ke'e]

That is-a-(pretty type-of little) (girl type-of school).

</pre><p>The final “ke'e” is given in square brackets here to indicate that it can be elided. It is al­ways possible to elide “ke'e” at the end of the selbri, making <a href=#e5d5>Example 5.5 </a>as terse as <a href=#e4d3>Ex­ample 4.3</a>.

<p>

Now how about that fifth grouping? It is

<p>

<pre><a name=e5d6>5.6) ta melbi ke cmalu nixli ckule [ke'e]

That is-a-pretty type-of ( (little type-of girl) type-of school )

That is a beautiful school for small girls.

</pre><a href=#e5d6>Example 5.6 </a>is distinctly different in meaning from any of Examples 4.2 through 4.5. Note that within the “ke <dots>…</dots>ke'e” parentheses, the left-grouping rule is applied to “cmalu nixli ckule”.

<p>

<cx "tanru grouping, with ke and bo">It is perfectly all right to mix “bo” and “ke <dots>…</dots>ke'e” in a single selbri. For in­stance, <a href=#e4d5>Example 4.5</a>, which in pure “ke <dots>…</dots>ke'e” form is

<p>

<pre><a name=e5d7>5.7) ta melbi ke cmalu ke nixli ckule [ke'e] [ke'e]

That is-a-pretty type-of ( little type-of (girl type-of school) ).

</pre>can equivalently be expressed as:

<p>

<pre><a name=e5d8>5.8) ta melbi ke cmalu nixli bo ckule [ke'e]

That is-a-pretty type-of ( little type-of (girl type-of school) ).

</pre>and in many other different forms as well.

<p>

### <a name=s6><h3>Logical connection within tanru</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> je JA tanru logical “and”

ja JA tanru logical “or”

joi JOI mixed mass “and”

gu'e GUhA tanru forethought logical “and”

gi GI forethought connection separator

</pre><ex "big red dog">Consider the English phrase “big red dog”. How shall this be rendered as a Lojban tanru? The naive attempt:

<p>

<pre><a name=e6d1>6.1) barda xunre gerku

(big type-of red) type-of dog

</pre>will not do, as it means a dog whose redness is big, in whatever way redness might be described as “big”. Nor is

<p>

<pre><a name=e6d2>6.2) barda xunre bo gerku

big type-of (red type-of dog)

</pre><cx "adjective ordering">much better. After all, the straightforward understanding of the Eng­lish phrase is that the dog is big as compared with other dogs, not merely as compared with other red dogs. In fact, the bigness and redness are independent properties of the dog, and only obscure rules of English adjective ordering prevent us from saying “red big dog”.

<p>

<cx "logical connectives, in tanru"><lx "je">The Lojban approach to this problem is to introduce the cmavo “je”, which is one of the many equivalents of English “and”. A big red dog is one that is both big and red, and we can say:

<p>

<pre><a name=e6d3>6.3) barda je xunre gerku

(big and red) type-of dog

</pre><p>Of course,

<p>

<pre><a name=e6d4>6.4) xunre je barda gerku

(red and big) type-of dog

</pre><cx "logical connectives in tanru, effect on tanru grouping">is equally satisfactory and means the same thing. As these examples indicate, joining two brivla with “je” makes them a unit for tanru pur­poses. However, explicit grouping with “bo” or “ke <dots>…</dots>ke'e” associates brivla more closely than “je” does:

<p>

<pre><a name=e6d5>6.5) barda je pelxu bo xunre gerku

barda je ke pelxu xunre ke'e gerku

(big and (yellow type-of red)) dog

big yellowish-red dog

</pre><p>With no grouping indicators, we get:

<p>

<pre><a name=e6d6>6.6) barda je pelxu xunre gerku

((big and yellow) type-of red) type-of dog

biggish- and yellowish-red dog

</pre>which again raises the question of <a href=#e6d1>Example 6.1</a>: what is does “biggish-red” mean?

<p>

<cx "logical connectives in tanru, usefulness of">Unlike “bo” and “ke <dots>…</dots>ke'e”, “je” is useful as well as merely legal within sim­ple tanru. It may be used to partly resolve the ambigu­ity of simple tanru:

<p>

<pre><a name=e6d7>6.7) ta blanu je zdani

that is-blue and is-a-house

</pre>definitely refers to something which is both blue and is a house, and not to any of the other possible interpretations of simple “blanu zdani”. Furthermore, “blanu zdani” re­fers to something which is blue in the way that houses are blue; “blanu je zdani” has no such implica­tion — the blueness of a “blanu je zdani” is independent of its house­ness.

<p>

With the addition of “je”, many more versions of “pretty little girls' school” are made possible: see <a href=#s16>Section 16 </a>for a complete list.

<p>

A subtle point in the semantics of tanru like <a href=#e6d3>Example 6.3 </a>needs special eluci­dation. There are at least two possible interpreta­tions of:

<p>

<pre><a name=e6d8>6.8) ta melbi je nixli ckule

That is-a-(beautiful and girl) type-of school.

</pre><p>It can be understood as:

<p>

<pre><a name=e6d9>6.9) That is a girls' school and a beautiful school.

</pre>or as:

<p>

<pre><a name=e6d10>6.10) That is a school for things which are both girls and beautiful.

</pre><cx "logical connectives in tanru, ambiguity of">The interpretation specified by <a href=#e6d9>Example 6.9 </a>treats the tanru as a sort of abbreviation for:

<p>

<pre><a name=e6d11>6.11) ta ke melbi ckule ke'e je ke nixli ckule [ke'e]

That is-a-( beautiful type-of school ) and (girl type-of school)

</pre>whereas the interpretation specified by <a href=#e6d10>Example 6.10 </a>does not. This is a kind of seman­tic ambiguity for which Lojban does not compel a firm resolution. The way in which the school is said to be of type “beautiful and girl” may entail that it is separately a beautiful school and a girls' school; but the alternative interpretation, that the mem­bers of the school are beautiful and girls, is also possible. Still another interpretation is:

<p>

<pre><a name=e6d12>6.12) That is a school for beautiful things and also for girls.

</pre>so while the logical connectives help to resolve the meaning of tanru, they by no means compel a single meaning in and of themselves.

<p>

<cx "logical connectives in tanru, effect on formal logical manipulations">In general, logical connectives within tanru cannot undergo the formal ma­nipulations that are possible with the related logical connectives that exist outside tanru; see <a href=chap14.html>Chapter 14 </a>for further de­tails.

<p>

<lx "JA">The logical connective “je” is only one of the fourteen logical connectives that Loj­ban provides. Here are a few examples of some of the others:

<p>

<pre><a name=e6d13>6.13) le bajra cu jinga ja te jinga

The runner(s) is/are winner(s) or loser(s).

<a name=e6d14>6.14) blanu naja lenku skapi

(blue only-if cold) skin

skin which is blue only if it is cold

<a name=e6d15>6.15) xamgu jo cortu nuntavla

(good if-and-only-if short) speech

speech which is good if (and only if) it is short

<a name=e6d16>6.16) vajni ju selpluka nuntavla

(important whether-or-not pleasing) event-of-talking

speech which is important, whether or not it is pleasing

</pre><p>In <a href=#e6d13>Example 6.13</a>, “ja” is grammatically equivalent to “je” but means “or” (more pre­cisely, “and/or”). Likewise, “naja” means “only if” in <a href=#e6d14>Ex­ample 6.14</a>, “jo” means “if and only if” in <a href=#e6d15>Example 6.15</a>, and “ju” means “whether or not” in <a href=#e6d16>Example 6.16</a>.

<p>

<cx "multiple logical connectives, within tanru">Now consider the following example:

<p>

<pre><a name=e6d17>6.17) ricfu je blanu jabo crino

rich and (blue or green)

</pre><lx "jabo"><cx "tanru grouping with JA+BO, effect on tanru grouping">which illustrates a new grammatical feature: the use of both “ja” and “bo” between tanru components. The two cmavo combine to form a compound whose meaning is that of “ja” but which groups more closely; “jabo” is to “ja” as plain “bo” is to no cmavo at all. How­ever, both “ja” and “jabo” group less closely than “bo” does:

<p>

<pre><a name=e6d18>6.18) ricfu je blanu jabo crino bo blanu

rich and (blue or green – blue)

rich and (blue or greenish-blue)

</pre><p>An alternative form of <a href=#e6d17>Example 6.17 </a>is:

<p>

<pre><a name=e6d19>6.19) ricfu je ke blanu ja crino [ke'e]

rich and (blue or green)

</pre><cx "non-logical connectives, within tanru">In addition to the logical connectives, there are also a variety of non-logical connec­tives, grammatically equivalent to the logical ones. The only one with a well-understood meaning in tanru contexts is “joi”, which is the kind of “and” that denotes a mixture:

<p>

<pre><a name=e6d20>6.20) ti blanu joi xunre bolci

This is-a-(blue and red) ball.

</pre><p>The ball described is neither solely red nor solely blue, but probably striped or in some other way exhibiting a combination of the two col­ors. <a href=#e6d20>Example 6.20 </a>is distinct from:

<p>

<pre><a name=e6d21>6.21) ti blanu xunre bolci

This is a bluish-red ball

</pre>which would be a ball whose color is some sort of purple tending to­ward red, since “xunre” is the more important of the two components. On the other hand,

<p>

<pre><a name=e6d22>6.22) ti blanu je xunre bolci

This is a (blue and red) ball

</pre>is probably self-contradictory, seeming to claim that the ball is inde­pendently both blue and red at the same time, although some sensi­ble interpretation may exist.

<p>

<cx "forethought logical connectives, within tanru"><lx "gu'e"><lx "gi">Finally, just as English “and” has the variant form “both <dots>…</dots>and”, so “je” be­tween tanru components has the variant form “gu'e <dots>…</dots>gi”, where “gu'e” is placed before the components and “gi” between them:

<p>

<pre><a name=e6d23>6.23) gu'e barda gi xunre gerku

(both big and red) type-of dog

</pre>is equivalent in meaning to <a href=#e6d3>Example 6.3</a>. For each logical connective related to “je”, there is a corresponding connective related to “gu'e <dots>…</dots>gi” in a systematic way.

<p>

<cx "forethought logical connectives in tanru, effect on tanru grouping">The portion of a “gu'e <dots>…</dots>gi” construction before the “gi” is a full selbri, and may use any of the selbri resources including “je” logi­cal connections. After the “gi”, logical con­nections are taken to be wider in scope than the “gu'e <dots>…</dots>gi”, which has in effect the same scope as “bo”:

<p>

<pre><a name=e6d24>6.24) gu'e barda je xunre gi gerku ja mlatu

(both (big and red) and dog) or cat

something which is either big, red, and a dog, or else a cat

</pre>leaves “mlatu” outside the “gu'e …gi” construction. The scope of the “gi” arm extends only to a single brivla or to two or more brivla con­nected with “bo” or “ke …ke'e”.

<p>

### <a name=s7><h3>Linked sumti: “be–bei–be'o”</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> be BE linked sumti marker

bei BEI linked sumti separator

be'o BEhO linked sumti terminator

</pre><p>The question of the place structures of selbri has been glossed over so far. This chapter does not attempt to treat place structure issues in detail; they are discussed in <a href=chap9.html>Chapter 9</a>. One grammatical structure related to places belongs here, however. In simple sentences such as <a href=#e1d1>Example 1.1</a>, the place structure of the selbri is simply the defined place struc­ture of the gismu “mamta”. What about more complex sel­bri?

<p>

<cx "tanru, place structures of">For tanru, the place structure rule is simple: the place struc­ture of a tanru is al­ways the place structure of its tertau. Thus, the place structure of “blanu zdani” is that of “zdani”: the x1 place is a house or nest, and the x2 place is its occupants.

<p>

What about the places of “blanu”? Is there any way to get them into the act? In fact, “blanu” has only one place, and this is merged, as it were, with the x1 place of “zdani”. It is whatever is in the x1 place that is being characterized as blue-for-a-house. But if we replace “blanu” with “xamgu”, we get:

<p>

<ex "good house"><pre><a name=e7d1>7.1) ti xamgu zdani

This is-a-good house.

This is a good (for someone, by some standard) house.

</pre><p>Since “xamgu” has three places (x1, the good thing; x2, the person for whom it is good; and x3, the standard of goodness), <a href=#e7d1>Example 7.1 </a>necessarily omits information about the last two: there is no room for them. Room can be made, however!

<p>

<pre><a name=e7d2>7.2) ti xamgu be do bei mi [be'o] zdani

This is-a-good (for you by-standard me) house.

This is a house that is good for you by my standards.

</pre><lx "be"><lx "BE"><lx "bei"><lx "BEI"><lx "be'o"><lx "BEhO"><cx "seltau, filling sumti places in"><cx "linked sumti, in tanru">Here, the gismu “xamgu” has been followed by the cmavo “be” (of selma'o BE), which signals that one or more sumti follows. These sumti are not part of the overall bridi place structure, but fill the places of the brivla they are attached to, starting with x2. If there is more than one sumti, they are separated by the cmavo “bei” (of selma'o BEI), and the list of sumti is terminated by the elidable terminator “be'o” (of selma'o BEhO).

<p>

<cx "linked sumti, definition">Grammatically, a brivla with sumti linked to it in this fashion plays the same role in tanru as a simple brivla. To illustrate, here is a fully fleshed-out version of <a href=#e3d4>Ex­ample 3.4</a>, with all places filled in:

<p>

<ex "Brooklyn"><pre><a name=e7d3>7.3) ti cmalu be le ka canlu

bei lo'e ckule be'o

nixli be li mu bei lo merko be'o bo

ckule la bryklyn. loi pemci

le mela nu,IORK. prenu

le jecta

This is a small (in-dimension the property-of volume

by-standard the-typical school)

(girl (of-years the-number five by-standard some American-thing)

school) in-Brooklyn with-subject poems

for-audience New-York persons

with-operator the state.

This is a school, small in volume compared to the typical school, pertaining to five-year-old girls (by American stan­dards), in Brooklyn, teaching poetry to the New York com­munity and operated by the state.

</pre><p>Here the three places of “cmalu”, the three of “nixli”, and the four of “ckule” are fully specified. Since the places of “ckule” are the places of the bridi as a whole, it was not necessary to link the sumti which follow “ckule”. It would have been legal to do so, how­ever:

<p>

<pre><a name=e7d4>7.4) mi klama be le zarci bei le zdani [be'o]

I go (to-the market from-the house).

</pre>means the same as

<p>

<pre><a name=e7d5>7.5) mi klama le zarci le zdani

I go to-the market from-the house.

</pre><cx "tanru, place structures of">No matter how complex a tanru gets, the last brivla always dictates the place struc­ture: the place structure of

<p>

<pre><a name=e7d6>7.6) melbi je cmalu nixli bo ckule

a (pretty and little) (girl school)

a school for girls which is both beautiful and small

</pre>is simply that of “ckule”. (The sole exception to this rule is discussed in <a href=#s8>Section 8</a>.)

<p>

<lx "FA"><cx "linked sumti and FA tags"><cx "FA tags and linked sumti">It is possible to precede linked sumti by the place structure ordering tags “fe”, “fi”, “fo”, and “fu” (of selma'o FA, discussed further in <a href=chap9.html>Chapter 9</a>), which serve to ex­plicitly specify the x2, x3, x4, and x5 places respectively. Normally, the place follow­ing the “be” is the x2 place and the other places follow in order. If it seems convenient to change the order, however, it can be accomplished as follows:

<p>

<pre><a name=e7d7>7.7) ti xamgu be fi mi bei fe do [be'o] zdani

This is-a-good (by-standard me for you) house

</pre>which is equivalent in meaning to <a href=#e7d2>Example 7.2</a>. Note that the order of “be”, “bei”, and “be'o” does not change; only the inserted “fi” tells us that “mi” is the x3 place (and cor­respondingly, the inserted “fe” tells us that “do” is the x2 place). Changing the order of sumti is often done to match the order of another language, or for emphasis or rhythm.

<p>

Of course, using FA cmavo makes it easy to specify one place while omitting a pre­vious place:

<p>

<pre><a name=e7d8>7.8) ti xamgu be fi mi [be'o] zdani

This is-a-good (by-standard me) house

This is a good house by my standards.

</pre><cx "linked sumti and sumti tcita"><cx "sumti tcita and linked sumti"><cx "modal tags and sumti tcita"><cx "sumti tcita and modal tags"><cx "tense tags and sumti tcita"><cx "sumti tcita and tense tags">Similarly, sumti labeled by modal or tense tags can be in­serted into strings of linked sumti just as they can into bridi:

<p>

<pre><a name=e7d9>7.9) ta blanu be ga'a mi [be'o] zdani

That is-a-blue (to-observer me) house.

That is a blue, as I see it, house.

</pre><p>The meaning of <a href=#e7d9>Example 7.9 </a>is slightly different from:

<p>

<pre><a name=e7d10>7.10) ta blanu zdani ga'a mi

That is-a-blue house to-observer me.

That is a blue house, as I see it.

</pre><p>See discussions in <a href=chap9.html>Chapter 9 </a>of modals and in <a href=chap10.html>Chapter 10 </a>of tenses for more explana­tions.

<p>

<cx "elidability of “be'o”"><cx "be'o, elidability of"><cx "relative clauses, effect on elidability of be'o"><cx "be'o, effect of relative clauses on elidability of">The terminator “be'o” is almost always elidable: however, if the selbri belongs to a description, then a relative clause following it will attach to the last linked sumti unless “be'o” is used, in which case it will attach to the outer description:

<p>

<pre><a name=e7d11>7.11) le xamgu be do noi barda cu zdani

The good-thing for you (who are-large) is-a-house.

<a name=e7d12>7.12) le xamgu be do be'o noi barda cu zdani

The (good-thing for you) (which is-large) is-a-house

</pre>(Relative clauses are explained in <a href=chap8.html>Chapter 8</a>.)

<p>

<cx "ku, effect on elidability of be'o"><cx "be'o, effect of ku on elidability of">In other cases, however, “be'o” cannot be elided if “ku” has also been elided:

<p>

<pre><a name=e7d13>7.13) le xamgu be le ctuca [ku] be'o zdani

the good (for the teacher ) house

</pre>requires either “ku” or “be'o”, and since there is only one occurrence of “be”, the “be'o” must match it, whereas it may be confusing which occurrence of “le” the “ku” termi­nates (in fact the second one is cor­rect).

<p>

### <a name=s8><h3>Inversion of tanru: “co”</h3>

<p>

The following cmavo is discussed in this section:

<p>

<pre> co CO tanru inversion marker

</pre><cx "tanru inversion"><lx "co">The standard order of Lojban tanru, whereby the modifier precedes what it modifies, is very natural to English-speakers: we talk of “blue houses”, not of “houses blue”. In other languages, however, such matters are differently arranged, and Lojban supports this re­verse order (tertau before seltau) by inserting the particle “co”. <a href=#e8d1>Exam­ple 8.1 </a>and <a href=#e8d2>Exam­ple 8.2 </a>mean exactly the same thing:

<p>

<pre><a name=e8d1>8.1) ta blanu zdani

That is-a-blue type-of-house.

That is a blue house.

<a name=e8d2>8.2) ta zdani co blanu

That is-a-house of-type blue.

That is a blue house.

</pre><cx "tanru inversion, definition"><cx "tertau, definition"><cx "seltau, definition">This change is called “tanru inversion”. In tanru inversion, the element before “co” (“zdani” in <a href=#e8d2>Example 8.2</a>) is the tertau, and the element following “co” (“blanu”) in <a href=#e8d2>Ex­ample 8.2</a>) is the seltau.

<p>

<cx "tanru inversion and place structure"><cx "place structure and tanru inversion">The meaning, and more specifically, the place structure, of a tanru is not af­fected by inversion: the place structure of “zdani co blanu” is still that of “zdani”. However, the existence of inversion in a selbri has a very special effect on any sumti which follow that selbri. Instead of being interpreted as filling places of the selbri, they actually fill the places (starting with x2) of the seltau. In <a href=#s7>Section 7</a>, we saw how to fill interior places with “be <dots>…</dots>bei <dots>…</dots>be'o”, and in fact <a href=#e8d3>Example 8.3 </a>and <a href=#e8d4>Example 8.4 </a>have the same meaning:

<p>

<pre><a name=e8d3>8.3) mi klama be le zarci bei le zdani be'o troci

I am-a-(goer to the market from the house) type-of trier.

I try to go to the market from the house.

<a name=e8d4>8.4) mi troci co klama le zarci le zdani

I am-a-trier of-type (goer to-the market from-the house).

I try to go to the market from the house.

</pre><a href=#e8d4>Example 8.4 </a>is a less deeply nested construction, requiring fewer cmavo. As a result it is probably easier to understand.

<p>

<ex "try to go">Note that in Lojban “trying to go” is expressed using “troci” as the tertau. The reason is that “trying to go” is a “going type of trying”, not a “trying type of going”. The trying is more fundamental than the going — if the trying fails, we may not have a going at all.

<p>

<cx "unfilled places of inverted tanru"><cx "inverted tanru, effect on sumti before the selbri"><cx "inverted tanru, effect on sumti after the selbri">Any sumti which precede a selbri with an inverted tanru fill the places of the selbri (i.e., the places of the tertau) in the ordinary way. In <a href=#e8d4>Example 8.4</a>, “mi” fills the x1 place of “troci co klama”, which is the x1 place of “troci”. The other places of the selbri remain unfilled. The trailing sumti “le zarci” and “le zdani” do not occupy selbri places, despite appearances.

<p>

As a result, the regular mechanisms (involving selma'o VOhA and GOhI, ex­plained in <a href=chap7.html>Chapter 7</a>) for referring to individual sumti of a bridi cannot refer to any of the trailing places of <a href=#e8d4>Example 8.4</a>, be­cause they are not really “sumti of the bridi” at all.

<p>

<cx "tanru inversion, in complex tanru"><cx "tanru inversion, where allowed">When inverting a more complex tanru, it is possible to invert it only at the most gen­eral modifier-modified pair. The only possible inversion of <a href=#e3d4>Example 3.4</a>, for instance, is:

<p>

<pre><a name=e8d5>8.5) ta nixli [bo] ckule co cmalu

That (is-a-girl type-of school) of-type little.

That's a girls' school which is small.

</pre><cx "tanru inversion, effect on tanru grouping"><cx "tanru grouping, effect of tanru inversion on">Note that the “bo” of <a href=#e3d4>Example 3.4 </a>is optional in <a href=#e8d5>Example 8.5</a>, because “co” groups more loosely than any other cmavo used in tanru, includ­ing none at all. Not even “ke <dots>…</dots>ke'e” parentheses can encompass a “co”:

<p>

<pre><a name=e8d6>8.6) ta cmalu ke nixli ckule [ke'e] co melbi

That is-a-(little type-of (girl type-of school)) of-type pretty.

That's a small school for girls which is beautiful.

</pre><cx "tanru inversion, rule for removing">In <a href=#e8d6>Example 8.6</a>, the “ke'e” is automatically inserted before the “co” rather than at its usual place at the end of the selbri. As a result, there is a simple and mechanical rule for re­moving “co” from any sel­bri: change “A co B” to “ke B ke'e A”. (At the same time, any sumti following the selbri must be transformed into “be <dots>…</dots>bei <dots>…</dots>be'o” form and attached following B.) Therefore,

<p>

<pre><a name=e8d7>8.7) ckule co melbi nixli

school of-type pretty girl

school for beautiful girls

</pre>means the same as:

<p>

<pre><a name=e8d8>8.8) ke melbi nixli ke'e ckule

(pretty girl) school

</pre><cx "tanru inversion, multiple"><cx "multiple tanru inversion, effect on grouping">Multiple “co” cmavo can appear within a selbri, indicating multiple inversions: a right-grouping rule is employed, as for “bo”. The above rule can be applied to inter­pret such selbri, but all “co” cmavo must be removed simultaneously:

<p>

<pre><a name=e8d9>8.9) ckule co nixli co cmalu

school of-type (girl of-type little)

</pre>becomes formally

<p>

<pre><a name=e8d10>8.10) ke ke cmalu ke'e nixli ke'e ckule

( (little) girl ) school

</pre>which by the left-grouping rule is simply

<p>

<pre><a name=e8d11>8.11) cmalu nixli ckule

little girl school

school for little girls

</pre><p>As stated above, the selbri places, other than the first, of

<p>

<pre><a name=e8d12>8.12) mi klama co sutra

I am-a-goer of-type quick

I go quickly

</pre>cannot be filled by placing sumti after the selbri, because any sumti in that position fill the places of “sutra”, the seltau. However, the tertau places (which means in effect the selbri places) can be filled with “be”:

<p>

<pre><a name=e8d13>8.13) mi klama be le zarci co sutra

I am-a-goer (to the store) of-type quick.

I go to the store quickly.

### </pre><a name=s9><h3>Other kinds of simple selbri</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> go'i GOhA repeats the previous bridi

du GOhA equality

nu'a NUhA math operator to selbri

moi MOI changes number to ordinal selbri

mei MOI changes number to cardinal selbri

nu NU event abstraction

kei KEI terminator for “nu”

</pre><cx "brivla equivalents"><cx "equivalents to brivla">So far we have only discussed brivla and tanru built up from brivla as possible selbri. In fact, there are a few other constructions in Lojban which are grammatically equivalent to brivla: they can be used either directly as selbri, or as components in tanru. Some of these types of simple selbri are discussed at length in <a href=chap7.html>Chapter 7</a>, <a href=chap11.html>Chapter 11</a>, and <a href=chap18.html>Chapter 18</a>; but for completeness these types are mentioned here with a brief explanation and an example of their use in selbri.

<p>

<lx "GOhA"><cx "GOhA, as selbri"><cx "GOhA, as component in tanru"><cx "selbri, with GOhA"><cx "tanru, with GOhA">The cmavo of selma'o GOhA (with one exception) serve as pro-bridi, provid­ing a reference to the content of other bridi; none of them has a fixed meaning. The most com­monly used member of GOhA is probably “go'i”, which amounts to a repeti­tion of the previous bridi, or part of it. If I say:

<p>

<lx "go'i"><pre><a name=e9d1>9.1) la djan. klama le zarci

John goes-to the market.

</pre>you may retort:

<p>

<pre><a name=e9d2>9.2) la djan. go'i troci

John [repeat last] are-a-tryer

John tries to.

</pre><a href=#e9d2>Example 9.2 </a>is short for:

<p>

<pre><a name=e9d3>9.3) la djan. klama be le zarci be'o troci

John is-a-goer (to the market) type-of trier.

</pre>because the whole bridi of <a href=#e9d1>Example 9.1 </a>has been packaged up into the single word “go'i” and inserted into <a href=#e9d2>Example 9.2</a>.

<p>

<cx "du, as an exception in GOhA">The exceptional member of GOhA is “du”, which represents the relation of identity. Its place structure is:

<p>

<dl compact><dt>du: <dd>x1 is identical with x2, x3, <dots>…</dots>

</dl>for as many places as are given. More information on selma'o GOhA is available in <a href=chap7.html>Chapter 7</a>.

<p>

<cx "mathematical expressions in tanru"><lx "nu'a"><lx "su'i"><cx "tanru, containing mathematical expressions">Lojban mathematical expressions (mekso) can be incorpo­rated into selbri in two dif­ferent ways. Mathematical operators such as “su'i”, meaning “plus”, can be transformed into selbri by prefixing them with “nu'a” (of selma'o NUhA). The resulting place struc­ture is:

<p>

<dl compact><dt><dd>x1 is the result of applying (the operator) to arguments x2, x3, etc.

</dl>for as many arguments as are required. (The result goes in the x1 place because the num­ber of following places may be indefinite.) For example:

<p>

<pre><a name=e9d4>9.4) li vo nu'a su'i li re li re

The-number 4 is-the-sum-of the-number 2 and-the-number 2.

</pre><p>A possible tanru example might be:

<p>

<ex "addition problems"><pre><a name=e9d5>9.5) mi jimpe tu’a loi nu'a su'i nabmi

I understand something about the-mass-of is-the-sum-of problems.

I understand addition problems.

</pre><lx "MOI">More usefully, it is possible to combine a mathematical ex­pression with a cmavo of selma'o MOI to create one of various nu­merical selbri. Details are available in <a href=chap18.html>Chapter 18</a>. Here are a few tanru:

<p>

<ex "Preem Palver"><pre><a name=e9d6>9.6) la prim. palvr. pamoi cusku

Preem Palver is-the-1-th speaker.

Preem Palver is the first speaker.

</pre><ex "two brothers"><pre><a name=e9d7>9.7) la an,iis. joi la .asun. bruna remei

Anyi massed-with Asun are-a-brother type-of-twosome.

Anyi and Asun are two brothers.

</pre><lx "NU"><lx "KEI">Finally, an important type of simple selbri which is not a brivla is the abstrac­tion. Grammatically, abstractions are simple: a cmavo of selma'o NU, followed by a bridi, followed by the elidable terminator “kei” of selma'o KEI. Semantically, abstrac­tions are an extremely subtle and powerful feature of Lojban whose full ramifications are docu­mented in <a href=chap11.html>Chapter 11</a>. For example:

<p>

<cx "abstraction bridi, contrasted with component non-abstraction bridi in meaning"><pre><a name=e9d8>9.8) ti nu zdile kei kumfa

This is-an-event-of amusement room.

This is an amusement room.

</pre><a href=#e9d8>Example 9.8 </a>is quite distinct in meaning from:

<p>

<pre><a name=e9d9>9.9) ti zdile kumfa

This is-an-amuser room.

</pre>which suggests the meaning “a room that amuses someone”.

<p>

### <a name=s10><h3>selbri based on sumti: “me”</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> me ME changes sumti to simple selbri

me'u MEhU terminator for “me”

</pre><lx "me"><lx "ME"><lx "me'u"><lx "MEhU"><cx "selbri from sumti"><cx "sumti into selbri"><cx "conversion, sumti into selbri"><cx "me, place structure of">A sumti can be made into a simple selbri by preceding it with “me” (of selma'o ME) and following it with the elidable terminator “me'u” (of selma'o MEhU). This makes a selbri with the place struc­ture

<p>

<dl compact><dt><dd>x1 is one of the referents of “[the sumti]”

</dl>which is true of the thing, or things, that are the referents of the sumti, and not of any­thing else. For example, consider the sumti

<p>

<pre><a name=e10d1>10.1) le ci nolraitru

the three noblest-governors

the three kings

</pre><ex "Three Kings">If these are understood to be the Three Kings of Christian tradition, who arrive every year on January 6, then we may say:

<p>

<pre><a name=e10d2>10.2) la BALtazar. cu me le ci nolraitru

Balthazar is one-of-the-referents-of “the three kings”.

Balthazar is one of the three kings.

</pre>and likewise

<p>

<pre><a name=e10d3>10.3) la kaspar. cu me le ci nolraitru

Caspar is one of the three kings.

</pre>and

<p>

<pre><a name=e10d4>10.4) la melxi,or. cu me le ci nolraitru

Melchior is one of the three kings.

</pre><cx "“me”/“du” equivalence"><cx "me, compared with du in effect"><cx "du, compared with me in effect">If the sumti refers to a single object, then the effect of “me” is much like that of “du”:

<p>

<pre><a name=e10d5>10.5) do du la djan.

You are-identical-with the-one-called “John”.

You are John.

</pre>means the same as

<p>

<pre><a name=e10d6>10.6) do me la djan.

You are-the-referent-of “the-one-called ‘John’”.

You are John.

</pre><cx "“me” and names">It is common to use “me” selbri, especially those based on name sumti using “la”, as seltau. For example:

<p>

<ex "Chrysler"><pre><a name=e10d7>10.7) ta me lai kraislr. [me'u] karce

That (is-a-referent of “the-mass-called ‘Chrysler’”) car.

That is a Chrysler car.

</pre><cx "elidability of “me'u”"><cx "me'u, relative precedence with logical connectives"><cx "logical connectives, relative precedence with me'u">The elidable terminator “me'u” can usually be omitted. It is absolutely required only if the “me” selbri is being used in an indefinite description (a type of sumti ex­plained in <a href=chap6.html>Chapter 6</a>), and if the indefi­nite description is followed by a relative clause (explained in <a href=chap8.html>Chapter 8</a>) or a sumti logical connective (explained in <a href=chap14.html>Chapter 14</a>). With­out a “me'u”, the relative clause or logical connective would appear to be­long to the sumti embedded in the “me” expression. Here is a con­trasting pair of sentences:

<p>

<pre><a name=e10d8>10.8) re me le ci nolraitru .e la djan. [me'u] cu blabi

Two of the group “the three kings and John” are white.

<a name=e10d9>10.9) re me le ci nolraitru me'u .e la djan. cu blabi

Two of the three kings, and John, are white.

</pre><p>In <a href=#e10d8>Example 10.8 </a>the “me” selbri covers the three kings plus John, and the indefinite de­scription picks out two of them that are said to be white: we cannot say which two. In <a href=#e10d9>Example 10.9</a>, though, the “me” selbri covers only the three kings: two of them are said to be white, and so is John.

<p>

Finally, here is another example requiring “me'u”:

<p>

<pre><a name=e10d10>10.10) ta me la'e le se cusku be do me'u cukta

That is-a-(what-you-said) type of book.

That is the kind of book you were talking about.

</pre><p>There are other sentences where either “me'u” or some other elidable termina­tor must be expressed:

<p>

<pre><a name=e10d11>10.11) le me le ci nolraitru [ku] me'u nunsalci

the (the three kings) type-of-event-of-celebrating

the Three Kings celebration

</pre>requires either “ku” or “me'u” to be explicit, and (as with “be'o” in <a href=#s7>Sec­tion 7</a>) the “me'u” leaves no doubt which cmavo it is paired with.

<p>

### <a name=s11><h3>Conversion of simple selbri</h3>

<p>

<lx "SE"><lx "se"><lx "te"><lx "ve"><lx "xe"><cx "conversion and tanru"><cx "tanru and conversion"><cx "conversion, definition"><cx "place structure, re-ordering by conversion">Conversion is the process of changing a selbri so that its places appear in a dif­ferent order. This is not the same as labeling the sumti with the cmavo of FA, as men­tioned in <a href=#s7>Section 7</a>, and then rearranging the order in which the sumti are spoken or written. Con­version transforms the selbri into a distinct, though closely related, selbri with renum­bered places.

<p>

In Lojban, conversion is accomplished by placing a cmavo of selma'o SE be­fore the selbri:

<p>

<pre><a name=e11d1>11.1) mi prami do

I love you.

</pre>is equivalent in meaning to:

<p>

<pre><a name=e11d2>11.2) do se prami mi

You [swap x1 and x2] love me.

You are loved by me.

</pre><p>Conversion is fully explained in <a href=chap9.html>Chapter 9</a>. For the purposes of this chapter, the im­portant point about conversion is that it applies only to the following simple sel­bri. When trying to convert a tanru, therefore, it is necessary to be careful! Consider <a href=#e11d3>Example 11.3</a>:

<p>

<ex "walk to market"><pre><a name=e11d3>11.3) la .alis. cu cadzu klama le zarci

Alice is-a-walker type-of goer to-the market.

Alice walkingly goes to the market.

Alice walks to the market.

</pre><p>To convert this sentence so that “le zarci” is in the x1 place, one cor­rect way is:

<p>

<pre><a name=e11d4>11.4) le zarci cu se ke cadzu klama [ke'e] la .alis.

The market is-a-[swap x1/x2] (walker type-of goer) Alice.

The market is-walkingly gone-to by-Alice.

</pre><cx "conversion with `ke'"><cx "ke, for conversion of tanru">The “ke <dots>…</dots>ke'e” brackets cause the entire tanru to be converted by the “se”, which would otherwise convert only “cadzu”, leading to:

<p>

<pre><a name=e11d5>11.5) le zarci cu se cadzu klama la .alis.

The market (is-a-[swap x1/x2] walker) type-of goer to Alice.

The market is-a-walking-surface type-of goer to Alice.

</pre>whatever that might mean. An alternative approach, since the place structure of “cadzu klama” is that of “klama” alone, is to convert only the latter:

<p>

<pre><a name=e11d6>11.6) le zarci cu cadzu se klama la .alis.

The market walkingly is-gone-to by-Alice.

</pre><p>But the tanru in <a href=#e11d6>Example 11.6 </a>may or may not have the same meaning as that in <a href=#e11d3>Ex­ample 11.3</a>; in particular, because “cadzu” is not converted, there is a suggestion that al­though Alice is the goer, the market is the walker. With a different sumti as x1, this seemingly odd interpretation might make considerable sense:

<p>

<pre><a name=e11d7>11.7) la djan. cu cadzu se klama la .alis

John walkingly is-gone-to by Alice

</pre>suggests that Alice is going to John, who is a moving target.

<p>

<cx "jai, for modal conversion"><cx "tense conversion, with jai">There is an alternative type of conversion, using the cmavo “jai” of selma'o JAI op­tionally followed by a modal or tense construc­tion. Grammatically, such a com­bination behaves exactly like conver­sion using SE. More details can be found in <a href=chap9.html>Chap­ter 9</a>.

<p>

### <a name=s12><h3>Scalar negation of selbri</h3>

<p>

<lx "NAhE"><cx "scalar negation, effect on selbri"><cx "selbri, scalar negation of">Negation is too large and complex a topic to explain fully in this chapter; see <a href=chap15.html>Chapter 15</a>. In brief, there are two main types of negation in Lojban. This section is concerned with so-called “scalar negation”, which is used to state that a true relation between the sumti is something other than what the selbri specifies. Scalar nega­tion is expressed by cmavo of selma'o NAhE:

<p>

<cx "ke, for expanding scope of scalar negation"><pre><a name=e12d1>12.1) la .alis. cu na'e ke cadzu klama [ke'e] le zarci

Alice non- (walkingly goes) to-the market.

Alice other-than (walkingly goes) to-the market.

Alice doesn't walk to the market.

</pre>meaning that Alice's relationship to the market is something other than that of walking there. But if the “ke” were omitted, the result would be:

<p>

<pre><a name=e12d2>12.2) la .alis. cu na'e cadzu klama le zarci

Alice non- walkingly goes to-the market.

Alice doesn't walk to the market.

</pre>meaning that Alice does go there in some way (“klama” is not ne­gated), but by a means other than that of walking. <a href=#e12d1>Example 12.1 </a>ne­gates both “cadzu” and “klama”, suggesting that Alice's relation to the market is something different from walkingly-going; it might be walk­ing without going, or going without walking, or neither.

<p>

Of course, any of the simple selbri types explained in <a href=#s9>Section 9 </a>may be used in place of brivla in any of these examples:

<p>

<pre><a name=e12d3>12.3) la djonz. cu na'e pamoi cusku

Jones is non-1st speaker

Jones is not the first speaker.

</pre><p>Since only “pamoi” is negated, an appropriate inference is that he is some other kind of speaker.

<p>

<cx "complex negation, examples"><cx "negation, complex examples">Here is an assortment of more complex examples showing the interaction of scalar negation with “bo” grouping, “ke” and “ke'e” grouping, logical connection, and sumti linked with “be” and “bei”:

<p>

<cx "na'e, contrasted with na'e ke"><pre><a name=e12d4>12.4) mi na'e sutra cadzu be fi le birka be'o klama le zarci

I ( (non-quickly) (walking using the arms) ) go-to the market.

I go to the market, walking using my arms other than quickly.

</pre><p>In <a href=#e12d4>Example 12.4</a>, “na'e” negates only “sutra”. Contrast <a href=#e12d5>Example 12.5</a>:

<p>

<pre><a name=e12d5>12.5) mi na'e ke sutra cadzu be fi le birka [be'o] ke'e klama le zarci

I non-( quickly (walking using the arms) ) go-to the market.

I go to the market, other than by walking quickly on my arms.

</pre><p>Now consider <a href=#e12d6>Example 12.6 </a>and <a href=#e12d7>Example 12.7</a>, which are equivalent in meaning, but use “ke” grouping and “bo” grouping re­spectively:

<p>

<pre><a name=e12d6>12.6) mi sutra cadzu be fi le birka be'o je masno klama le zarci

I (quickly – (walking using the arms) and slowly) go-to the market.

I go to the market, both quickly walking using my arms and slowly.

<a name=e12d7>12.7) mi ke sutra cadzu be fi le birka [be'o] ke'e je masno klama le zarci

I ((quickly (walking using the arms)) and slowly) go-to the market.

I go to the market, both quickly walking using my arms and slowly.

</pre><p>However, if we place a “na'e” at the beginning of the selbri in both <a href=#e12d6>Example 12.6 </a>and <a href=#e12d7>Example 12.7</a>, we get different results:

<p>

<pre><a name=e12d8>12.8) mi na'e sutra cadzu be fi le birka be'o je masno klama le zarci

I ((non- quickly) – (walking using the arms) and slowly) go-to the market.

I go to the market, both walking using my arms other than quickly, and

also slowly.

<a name=e12d9>12.9) mi na'e ke sutra cadzu be fi le birka [be'o] ke'e je masno klama le zarci

I (non-(quickly (walking using the arms)) and slowly) go-to the market.

I go to the market, both other than quickly walking using my arms, and

also slowly.

</pre><p>The difference arises because the “na'e” in <a href=#e12d9>Example 12.9 </a>negates the whole construc­tion from “ke” to “ke'e”, whereas in <a href=#e12d8>Example 12.8 </a>it negates “sutra” alone.

<p>

<cx "omitting terminators, perils of"><cx "perils of omitting terminators">Beware of omitting terminators in these complex examples! If the explicit “ke'e” is left out in <a href=#e12d9>Example 12.9</a>, it is transformed into:

<p>

<pre><a name=e12d10>12.10) mi na'e ke sutra cadzu be fi le birka be'o je masno klama [ke'e] le zarci

I non-(quickly ((walking using the arms)) and slowly) go-to) the market.

I do something other than quickly both going to the market walking

using my arms and slowly going to the market.

</pre><p>And if both “ke'e” and “be'o” are omitted, the results are even sillier:

<p>

<pre><a name=e12d11>12.11) mi na'e ke sutra cadzu be fi le birka je masno klama [be’o] [ke'e] le zarci

I non-(quickly walk on my (arm-type and slow) goers) on the market.

I do something other than quickly walking using the goers, both arm-type

and slow, relative-to the market.

</pre><p>In <a href=#e12d11>Example 12.11</a>, everything after “be” is a linked sumti, so the place structure is that of “cadzu”, whose x2 place is the surface walked upon. It is less than clear what an “arm-type goer” might be. Further­more, since the x3 place has been occupied by the linked sumti, the “le zarci” following the selbri falls into the nonexistent x4 place of “cadzu”. As a result, the whole example, though grammatical, is com­plete nonsense. (The bracketed Lojban words appear where a fluent Lojbanist would understand them to be implied.)

<p>

<cx "na'e, before gu'e">Finally, it is also possible to place “na'e” before a “gu'e <dots>…</dots>gi” logically con­nected tanru construction. The meaning of this usage has not yet been firmly estab­lished.

<p>

### <a name=s13><h3>Tenses and bridi negation</h3>

<p>

A bridi can have cmavo associated with it which specify the time, place, or mode of action. For example, in

<p>

<pre><a name=e13d1>13.1) mi pu klama le zarci

I [past] go to-the market.

I went to the market.

</pre>the cmavo “pu” specifies that the action of the speaker going to the market takes place in the past. Tenses are explained in full detail in <a href=chap10.html>Chapter 10</a>. Tense is semantically a prop­erty of the entire bridi; how­ever, the usual syntax for tenses attaches them at the front of the selbri, as in <a href=#e13d1>Example 13.1</a>. There are alternative ways of expressing tense information as well. Modals, which are explained in <a href=chap9.html>Chapter 9</a>, behave in the same way as tenses.

<p>

Similarly, a bridi may have the particle “na” (of selma'o NA) attached to the begin­ning of the selbri to negate the bridi. A negated bridi expresses what is false with­out say­ing anything about what is true. Do not confuse this usage with the scalar nega­tion of <a href=#s12>Section 12</a>. For example:

<p>

<pre><a name=e13d2>13.2) la djonz. na pamoi cusku

Jones (Not!) is-the-first speaker

It is not true that Jones is the first speaker.

Jones isn't the first speaker.

</pre><p>Jones may be the second speaker, or not a speaker at all; <a href=#e13d2>Example 13.2 </a>doesn't say. There are other ways of expressing bridi negation as well; the topic is explained fully in <a href=chap15.html>Chapter 15</a>.

<p>

<cx "tense, relative order with bridi negation"><cx "bridi negation, relative order with tense">Various combinations of tense and bridi negation cmavo are permitted. If both are expressed, either order is permissible with no change in meaning:

<p>

<pre><a name=e13d3>13.3) mi na pu klama le zarci

mi pu na klama le zarci

It is false that I went to the market.

I didn't go to the market.

</pre><cx "bridi negation, multiple"><lx "na">It is also possible to have more than one “na”, in which case pairs of “na” cmavo cancel out:

<p>

<pre><a name=e13d4>13.4) mi na na klama le zarci

It is false that it is false that I go to the market.

I go to the market.

</pre><cx "na and tense, multiple"><cx "tense and na, multiple">It is even possible, though somewhat pointless, to have mul­tiple “na” cmavo and tense cmavo mixed together, subject to the limitation that two adjacent tense cmavo will be understood as a compound tense, and must fit the grammar of tenses as ex­plained in <a href=chap10.html>Chapter 10</a>.

<p>

<pre><a name=e13d5>13.5) mi na pu na ca klama le zarci

I [not] [past] [not] [present] go to-the market

It is not the case that in the past it was not the case that in the present I

went to the market.

I didn't not go to the market.

I went to the market.

</pre><cx "tense cmavo, position relative to selbri"><cx "modal cmavo, position relative to selbri"><cx "negation cmavo, position relative to selbri">Tense, modal, and negation cmavo can appear only at the beginning of the sel­bri. They cannot be embedded within it.

<p>

### <a name=s14><h3>Some types of asymmetrical tanru</h3>

<p>

<cx "asymmetrical tanru"><cx "tanru, asymmetrical">This section and <a href=#s15>Section 15 </a>contain some example tanru classified into groups based on the type of relationship between the modifying seltau and the modified tertau. All the examples are paral­leled by compounds actually observed in various natural lan­guages. In the tables which follow, each group is preceded by a brief explana­tion of the relationship. The tables themselves contain a tanru, a lit­eral gloss, an indication of the languages which exhibit a compound analogous to this tanru, and (for those tanru with no English parallel) a translation.

<p>

<cx "languages, abbreviations for">Here are the 3-letter abbreviations used for the various lan­guages (it is pre­sumed to be obvious whether a compound is found in English or not, so English is not explicitly noted):

<p>

<dl compact><dt><dd> Aba = Abazin Kaz = Kazakh

Chi = Chinese Kor = Korean

Ewe = Ewe Mon = Mongolian

Fin = Finnish Qab = Qabardian

Geo = Georgian Que = Quechua

Gua = Guarani Rus = Russian

Hop = Hopi Skt = Sanskrit

Hun = Hungarian Swe = Swedish

Imb = Imbabura Quechua Tur = Turkish

Kar = Karaitic Udm = Udmurt

</dl><p>Any lujvo or fu'ivla used in a group are glossed at the end of that group.

<p>

<cx "asymmetrical tanru, definition">The tanru discussed in this section are asymmetrical tanru; that is, ones in which the order of the terms is fundamental to the meaning of the tanru. For example, “junla dadylsi”, or “clock pendu­lum”, is the kind of pendulum used in a clock, whereas “dadysli junla”, or “pendulum clock”, is the kind of clock that employs a pendulum. Most tanru are asymmetrical in this sense. Symmetrical tanru are discussed in <a href=#s15>Section 15</a>.

<p>

<cx "asymmetrical tanru types, object-of-action + action">The tertau represents an action, and the seltau then repre­sents the object of that ac­tion:

<p>

<dl compact><dt> pinsi nunkilbra <dd>pencil sharpener (Hun)

zgike nunctu music instruction (Hun)

mirli nunkalte deer hunting (Hun)

finpe nunkalte fish hunting (Tur,Kor,Udm,Aba = fishing)

smacu terkavbu mousetrap (Tur,Kor,Hun,Udm,Aba)

zdani turni house ruler (Kar = host)

zerle'a nunte'a thief fear (Skt = fear of thieves)

cevni zekri god crime (Skt = offense against the gods)

nunkilbra = sharpness-apparatus

nunctu = event-of-teaching

nunkalte = event-of-hunting

terkavbu = trap

zerle'a = crime-taker

nunte'a = event-of-fearing

</dl><cx "asymmetrical tanru types, elements-in-set + set">The tertau represents a set, and the seltau the type of the elements contained in that set:

<p>

<dl compact><dt> zdani lijgri <dd>house row

selci lamgri cell block

karda mulgri card pack (Swe)

rokci derxi stone heap (Swe)

tadni girzu student group (Hun)

remna girzu human-being group (Qab = group of people)

cpumi'i lijgri tractor column (Qab)

cevni jenmi god army (Skt)

cevni prenu god folk (Skt)

lijgri = line-group

lamgri = adjacent-group

mulgri = complete-group

cpami'i = pull-machine

</dl><cx "asymmetrical tanru types, set + element-of-set">Conversely: the tertau is an element, and the seltau repre­sents a set in which that element is contained. Implicitly, the meaning of the tertau is restricted from its usual gen­eral meaning to the spe­cific meaning appropriate for elements in the given set. Note the op­position between “zdani linji” in the previous group, and “linji zdani” in this one, which shows why this kind of tanru is called “asymmetrical”.

<p>

<dl compact><dt> carvi dirgo <dd>raindrop (Tur,Kor,Hun,Udm,Aba)

linji zdani row house

</dl><cx "asymmetrical tanru types, object + component/detail">The seltau specifies an object and the tertau a component or detail of that ob­ject; the tanru as a whole refers to the detail, specify­ing that it is a detail of that whole and not some other.

<p>

<dl compact><dt> junla dadysli <dd>clock pendulum (Hun)

purdi vorme garden door (Qab)

purdi bitmu garden wall (Que)

moklu skapi mouth skin (Imb = lips)

nazbi kevna nose hole (Imb = nostril)

karce xislu automobile wheel (Chi)

jipci pimlu chicken feather (Chi)

vinji rebla airplane tail (Chi)

dadysli = hang-oscillator

</dl><cx "asymmetrical tanru types, characteristic/detail + object">Conversely: the seltau specifies a characteristic or important detail of the ob­ject de­scribed by the tertau; objects described by the tanru as a whole are differentiated from other similar objects by this detail.

<p>

<dl compact><dt> pixra cukta <dd>picture book

kerfa silka hair silk (Kar = velvet)

plise tapla apple cake (Tur)

dadysli junla pendulum clock (Hun)

dadysli = hang-oscillator

</dl><cx "asymmetrical tanru types, general-class + sub-class">The tertau specifies a general class of object (a genus), and the seltau specifies a sub-class of that class (a species):

<p>

<dl compact><dt> ckunu tricu <dd>pine tree (Hun,Tur,Hop)

</dl><cx "asymmetrical tanru types, possessor + object">The tertau specifies an object of possession, and the seltau may specify the possessor (the possession may be intrinsic or other­wise). In English, these compounds have an ex­plicit possessive ele­ment in them: “lion's mane”, “child's foot”, “noble's cow”.

<p>

<dl compact><dt> cinfo kerfa <dd>lion mane (Kor,Tur,Hun,Udm,Qab)

verba jamfu child foot (Swe)

nixli tuple girl leg (Swe)

cinfo jamfu lion foot (Que)

danlu skapi animal skin (Ewe)

ralju zdani chief house (Ewe)

jmive munje living world (Skt)

nobli bakni noble cow (Skt)

nolraitru ralju king chief (Skt = emperor)

nolraitru = nobly-superlative-ruler

</dl><cx "asymmetrical tanru types, inhabitant + habitat">The tertau specifies a habitat, and the seltau specifies the in­habitant:

<p>

<dl compact><dt> lanzu tumla <dd>family land

</dl><cx "asymmetrical tanru types, effect + causative agent">The tertau specifies a causative agent, and the seltau speci­fies the effect of that cause:

<p>

<dl compact><dt> kalselvi'i gapci <dd>tear gas (Hun)

terbi'a jurme disease germ (Tur)

fenki litki crazy liquid (Hop = whisky)

pinca litki urine liquid (Hop = beer)

kalselvi'i = eye-excreted-thing

terbi'a = disease

</dl><cx "asymmetrical tanru types, cause + effect">Conversely: the tertau specifies an effect, and the seltau specifies its cause.

<p>

<dl compact><dt> djacu barna <dd>water mark (Chi)

</dl><cx "asymmetrical tanru types, purpose-of-instrument + instrument">The tertau specifies an instrument, and the seltau specifies the purpose of that in­strument:

<p>

<dl compact><dt> taxfu dadgreku <dd>garment rack (Chi)

tergu'i ti'otci lamp shade (Chi)

xirma zdani horse house (Chi = stall)

nuzba tanbo news board (Chi = bulletin board)

dadgreku = hang-frame

tergu'i = source of illumination

ti'otci = shadow-tool

</dl><cx "asymmetrical tanru types, object-of-purpose-of-instrument + instrument">More vaguely: the tertau specifies an instrument, and the seltau specifies the object of the purpose for which that instrument is used:

<p>

<dl compact><dt> cpina rokci <dd>pepper stone (Que = stone for grinding pepper)

jamfu djacu foot water (Skt = water for washing the feet)

grana mudri post wood (Skt = wood for making a post)

moklu djacu mouth water (Hun = water for washing the

mouth)

lanme gerku sheep dog (dog for working sheep)

</dl><cx "asymmetrical tanru types, source + product">The tertau specifies a product from some source, and the seltau specifies the source of the product:

<p>

<dl compact><dt> moklu djacu <dd>mouth water (Aba,Qab = saliva)

ractu mapku rabbit hat (Rus)

jipci sovda chicken egg (Chi)

sikcurnu silka silkworm silk (Chi)

mlatu kalci cat feces (Chi)

bifce lakse bee wax (Chi = beeswax)

cribe rectu bear meat (Tur,Kor,Hun,Udm,Aba)

solxrula grasu sunflower oil (Tur,Kor,Hun,Udm,Aba)

bifce jisra bee juice (Hop = honey)

tatru litki breast liquid (Hop = milk)

kanla djacu eye water (Kor = tear)

sikcurnu = silk-worm

solxrula = solar-flower

</dl><cx "asymmetrical tanru types, product + source">Conversely: the tertau specifies the source of a product, and the seltau specifies the product:

<p>

<dl compact><dt> silna jinto <dd>salt well (Chi)

kolme terkakpa coal mine (Chi)

ctile jinto oil well (Chi)

terkakpa = source of digging

</dl><cx "asymmetrical tanru types, source-material + object">The tertau specifies an object, and the seltau specifies the material from which the object is made. This case is especially inter­esting, because the referent of the tertau may normally be made from just one kind of material, which is then overridden in the tanru.

<p>

<dl compact><dt> rokci cinfo <dd>stone lion

snime nanmu snow man (Hun)

kliti cipni clay bird

blaci kanla glass eye (Hun)

blaci kanla glass eye (Que = spectacles)

solji sicni gold coin (Tur)

solji junla gold watch (Tur,Kor,Hun)

solji djine gold ring (Udm,Aba,Que)

rokci zdani stone house (Imb)

mudri zdani wood house (Ewe = wooden house)

rokci bitmu stone wall (Ewe)

solji carce gold chariot (Skt)

mudri xarci wood weapon (Skt = wooden weapon)

cmaro'i dargu pebble road (Chi)

sudysrasu cutci straw shoe (Chi)

cmaro'i = small-rock

sudysrasu = dry-grass

</dl><p>Note: the two senses of “blaci kanla” can be discriminated as:

<p>

<dl compact><dt> blaci kanla bo tarmi <dd>glass (eye shape) = glass eye

blaci kanla bo sidju glass (eye helper) = spectacles

</dl><cx "asymmetrical tanru types, object-measured + standard-object">The tertau specifies a typical object used to measure a quan­tity and the seltau speci­fies something measured. The tanru as a whole refers to a given quantity of the thing be­ing measured. English does not have compounds of this form, as a rule.

<p>

<dl compact><dt> tumla spisa <dd>land piece (Tur = piece of land)

tcati kabri tea cup (Kor,Aba = cup of tea)

nanba spisa bread piece (Kor = piece of bread)

bukpu spisa cloth piece (Udm,Aba = piece of cloth)

djacu calkyguzme water calabash (Ewe = calabash of water)

calkyguzme = shell-fruit, calabash

</dl><cx "asymmetrical tanru types, overriding-property + object-with-implicit-properties">The tertau specifies an object with certain implicit properties, and the seltau over­rides one of those implicit properties:

<p>

<dl compact><dt> kensa bloti <dd>spaceship

bakni verba cattle child (Ewe = calf)

</dl><cx "asymmetrical tanru types, whole + part">The seltau specifies a whole, and the tertau specifies a part which normally is associ­ated with a different whole. The tanru then refers to a part of the seltau which stands in the same relationship to the whole seltau as the tertau stands to its typical whole.

<p>

<dl compact><dt> kosta degji <dd>coat finger (Hun = coat sleeve)

denci genja tooth root (Imb)

tricu stedu tree head (Imb = treetop)

</dl><cx "asymmetrical tanru types, product + producer">The tertau specifies the producer of a certain product, and the seltau specifies the product. In this way, the tanru as a whole dis­tinguishes its referents from other ref­erents of the tertau which do not produce the product.

<p>

<dl compact><dt> silka curnu <dd>silkworm (Tur,Hun,Aba)

</dl><cx "asymmetrical tanru types, object-giving-characteristic + other-object">The tertau specifies an object, and the seltau specifies an­other object which has a characteristic property. The tanru as a whole refers to those referents of the tertau which possess the property.

<p>

<dl compact><dt> sonci manti <dd>soldier ant

ninmu bakni woman cattle (Imb = cow)

mamta degji mother finger (Imb = thumb)

cifnu degji baby finger (Imb = pinky)

pacraistu zdani hell house (Skt)

fagri dapma fire curse (Skt = curse destructive as fire)

pacraistu = evil-superlative-site

</dl><cx "asymmetrical tanru types, similar-appearance-object + object">As a particular case (when the property is that of resem­blance): the seltau specifies an object which the referent of the tanru resembles.

<p>

<dl compact><dt> grutrceraso jbama <dd>cherry bomb

solji kerfa gold hair (Hun = golden hair)

kanla djacu eye water (Kar = spring)

bakni rokci bull stone (Mon = boulder)

grutrceraso = fu'ivla for “cherry” based on Linnean name

</dl><cx "asymmetrical tanru types, typical-place + object">The seltau specifies a place, and the tertau an object char­acteristically located in or at that place.

<p>

<dl compact><dt> ckana boxfo <dd>bed sheet (Chi)

rostu mojysu'a tomb monument (Chi = tombstone)

jubme tergusni table lamp (Chi)

foldi smacu field mouse (Chi)

briju ci'ajbu office desk (Chi)

rirxe xirma river horse (Chi = hippopotamus)

xamsi gerku sea dog (Chi = seal)

cagyce'u zdani village house (Skt)

mrostu = dead-site

mojysu'a = remember-structure

ci'ajbu = write-table

cagyce'u = farm-community

</dl><cx "asymmetrical tanru types, object + place-sold">Specifically: the tertau is a place where the seltau is sold or made available to the public.

<p>

<dl compact><dt> cidja barja <dd>food bar (Chi = restaurant)

cukta barja book bar (Chi = library)

</dl><cx "asymmetrical tanru types, locus-of-application + object">The seltau specifies the locus of application of the tertau.

<p>

<dl compact><dt> kanla velmikce <dd>eye medicine (Chi)

jgalu grasu nail oil (Chi = nail polish)

denci pesxu tooth paste (Chi)

velmikce = treatment used by doctor

</dl><cx "asymmetrical tanru types, activity + implement-used">The tertau specifies an implement used in the activity de­noted by the seltau.

<p>

<dl compact><dt> me la pinpan. bolci <dd>Ping-Pong ball (Chi)

</dl><cx "asymmetrical tanru types, undesired-object + protection-object">The tertau specifies a protective device against the undesir­able features of the refer­ent of the seltau.

<p>

<dl compact><dt> carvi mapku <dd>rain cap (Chi)

carvi taxfu rain garment (Chi = raincoat)

vindu firgai poison mask (Chi = gas mask)

firgai = face-cover

</dl><cx "asymmetrical tanru types, object + usual-container">The tertau specifies a container characteristically used to hold the referent of the sel­tau.

<p>

<dl compact><dt> cukta vasru <dd>book vessel (Chi = satchel)

vanju kabri wine cup (Chi)

spatrkoka lanka coca basket (Que)

rismi dakli rice bag (Ewe,Chi)

tcati kabri tea cup (Chi)

ladru botpi milk bottle (Chi)

rismi patxu rice pot (Chi)

festi lante trash can (Chi)

bifce zdani bee house (Kor = beehive)

cladakyxa'i zdani sword house (Kor = sheath)

manti zdani ant nest (Gua = anthill)

spatrkoka = fu'ivla for “coca”

cladakyxa'i = (long-knife)-weapon

</dl><cx "asymmetrical tanru types, characteristic-time + event">The seltau specifies the characteristic time of the event specified by the tertau.

<p>

<dl compact><dt> vensa djedi <dd>spring day (Chi)

crisa citsi summer season (Chi)

cerni bumru morning fog (Chi)

critu lunra autumn moon (Chi)

dunra nicte winter night (Chi)

nicte ckule night school (Chi)

</dl><cx "asymmetrical tanru types, energy-source + powered">The seltau specifies a source of energy for the referent of the tertau.

<p>

<dl compact><dt> dikca tergusni <dd>electric lamp (Chi)

ratni nejni atom energy (Chi)

brife molki windmill (Tur,Kor,Hun,Udm,Aba)

tergusni = illumination-source

</dl><cx "asymmetrical tanru types, miscellaneous">Finally, some tanru which don't fall into any of the above categories.

<p>

<dl compact><dt> ladru denci <dd>milk tooth (Tur,Hun,Udm,Qab)

kanla denci eye tooth

</dl><p>It is clear that “tooth” is being specified, and that “milk” and “eye” act as modifiers. However, the relationship between “ladru” and “denci” is something like “tooth which one has when one is drinking milk from one's mother”, a relationship cer­tainly present nowhere ex­cept in this particular concept. As for “kanla denci”, the rela­tionship is not only not present on the surface, it is hardly possible to formulate it at all.

<p>

### <a name=s15><h3>Some types of symmetrical tanru</h3>

<p>

<cx "symmetrical tanru">This section deals with symmetrical tanru, where order is not important. Many of these tanru can be expressed with a logical or non-logical connective between the compo­nents.

<p>

<cx "symmetrical tanru types, both separately true">The tanru may refer to things which are correctly specified by both tanru com­po­nents. Some of these instances may also be seen as asymmetrical tanru where the seltau specifies a material. The connective “je” is appropriate:

<p>

<dl compact><dt> cipnrstrigi pacru'i <dd>owl demon (Skt)

nolraitru prije royal sage (Skt)

remna nakni human-being male (Qab = man)

remna fetsi human-being female (Qab = woman)

sonci tolvri soldier coward (Que)

panzi nanmu offspring man (Ewe = son)

panzi ninmu offspring woman (Ewe = daughter)

solji sicni gold coin (Tur)

solji junla gold watch (Tur,Kor,Hun)

solji djine gold ring (Udm,Aba,Que)

rokci zdani stone house (Imb)

mudri zdani wooden house (Ewe)

rokci bitmu stone wall (Ewe)

solji carce gold chariot (Skt)

mudri xarci wooden weapon (Skt)

zdani tcadu home town (Chi)

cipnrstrigi = fu'ivla for “owl” based on Linnean name

pacru'i = evil-spirit

tolvri = opposite-of-brave

</dl><cx "symmetrical tanru types, one or other true">The tanru may refer to all things which are specified by either of the tanru compo­nents. The connective “ja” is appropriate:

<p>

<dl compact><dt> nunji'a nunterji'a <dd>victory defeat (Skt = victory or defeat)

donri nicte day night (Skt = day and night)

lunra tarci moon stars (Skt = moon and stars)

patfu mamta father mother (Imb,Kaz,Chi = parents)

tuple birka leg arm (Kaz = extremity)

nuncti nunpinxe eating drinking (Udm = cuisine)

bersa tixnu son daughter (Chi = children)

nunji'a = event-of-winning

nunterji'a = event-of-losing

nuncti = event-of-eating

nunpinxe = event-of-drinking

</dl><cx "symmetrical tanru types, using more inclusive class">Alternatively, the tanru may refer to things which are speci­fied by either of the tanru components or by some more inclusive class of things which the components typ­ify:

<p>

<dl compact><dt> curnu jalra <dd>worm beetle (Mon = insect)

jalra curnu beetle worm (Mon = insect)

kabri palta cup plate (Kaz = crockery)

jipci gunse hen goose (Qab = housefowl)

xrula tricu flower tree (Chi = vegetation)

</dl><cx "symmetrical tanru types, using crucial/typical parts">The tanru components specify crucial or typical parts of the referent of the tanru as a whole:

<p>

<dl compact><dt> tumla vacri <dd>land air (Fin = world)

moklu stedu mouth head (Aba = face)

sudysrasu cunmi hay millet (Qab = agriculture)

gugde ciste state system (Mon = politics)

prenu so'imei people multitude (Mon = masses)

djacu dertu water earth (Chi = climate)

sudysrasu = dry-grass

so'imei = manysome

### “Pretty little girls' school”: forty ways to say it</h3>

<p></dl><cx "pretty little girls' school, forty ways">

The following examples show every possible grouping ar­rangement of “melbi cmalu nixli ckule” using “bo” or “ke <dots>…</dots>ke'e” for grouping and “je” or “jebo” for logical connec­tion. Most of these are definitely not plausible interpretations of the English phrase “pretty little girls' school”, especially those which describe something which is both a girl and a school.

<p>

Examples 4.2, 4.3, 4.4, 4.5, and 5.6 are repeated here as Examples 16.1, 16.9, 16.17, 16.25, and 16.33 respectively. The seven examples following each of these share the same grouping pattern, but differ in the presence or absence of “je” at each possible site. Some of the examples have more than one Lojban version. In that case, they differ only in grouping mechanism, and are always equivalent in meaning.

<p>

The logical connective “je” is associative: that is, “A and (B and C)” is the same as “(A and B) and C”. Therefore, some of the examples have the same meaning as others. In particular, 16.8, 16.16, 16.24, 16.32, and 16.40 all have the same meaning because all four brivla are logically connected and the grouping is simply ir­relevant. Other equivalent forms are noted in the examples them­selves. However, if “je” were replaced by “naja” or “jo” or most of the other logical connectives, the meanings would become distinct.

<p>

It must be emphasized that, because of the ambiguity of all tanru, the English trans­lations are by no means definitive — they rep­resent only one possible interpreta­tion of the corresponding Lojban sentence.

<p>

<pre><a name=e16d1>16.1) melbi cmalu nixli ckule

((pretty type-of little) type-of girl) type-of school

school for girls who are beautifully small

<a name=e16d2>16.2) melbi je cmalu nixli ckule

((pretty and little) type-of girl) type-of school

school for girls who are beautiful and small

<a name=e16d3>16.3) melbi bo cmalu je nixli ckule

((pretty type-of little) and girl) type-of school

school for girls and for beautifully small things

<a name=e16d4>16.4) ke melbi cmalu nixli ke'e je ckule

((pretty type-of little) type-of girl) and school

thing which is a school and a beautifully small girl

<a name=e16d5>16.5) melbi je cmalu je nixli ckule

((pretty and little) and girl) type-of school

school for things which are beautiful, small, and girls

Note: same as 16.21

<a name=e16d6>16.6) melbi bo cmalu je nixli je ckule

((pretty type-of little) and girl) and school

thing which is beautifully small, a school, and a girl

Note: same as 16.14

<a name=e16d7>16.7) ke melbi je cmalu nixli ke'e je ckule

((pretty and little) type-of girl) and school

thing which is a school and a girl who is both beautiful and small

<a name=e16d8>16.8) melbi je cmalu je nixli je ckule

((pretty and little) and girl) and school

thing which is beautiful, small, a girl, and a school

<a name=e16d9>16.9) melbi cmalu nixli bo ckule

(pretty type-of little) type-of (girl type-of school)

girls' school which is beautifully small

<a name=e16d10>16.10) melbi je cmalu nixli bo ckule

(pretty and little) type-of (girl type-of school)

girls' school which is beautiful and small

<a name=e16d11>16.11) melbi cmalu nixli je ckule

(pretty type-of little) type-of (girl and school)

something which is a girl and a school which is beautifully small

<a name=e16d12>16.12) melbi bo cmalu je nixli bo ckule

(pretty type-of little) and (girl type-of school)

something which is beautifully small and a girls' school

<a name=e16d13>16.13) melbi je cmalu nixli je ckule

(pretty and little) type-of (girl and school)

a pretty and little type of thing which is both a girl and a school

<a name=e16d14>16.14) melbi bo cmalu je nixli jebo ckule

(pretty type-of little) and (girl and school)

thing which is beautifully small, a school, and a girl

Note: same as 16.6

<a name=e16d15>16.15) melbi jebo cmalu je nixli bo ckule

(pretty and little) and (girl type-of school)

thing which is beautiful and small and a girl's school

Note: same as 16.30

<a name=e16d16>16.16) melbi jebo cmalu je nixli jebo ckule

(pretty and little) and (girl and school)

thing which is beautiful, small, a girl, and a school

<a name=e16d17>16.17) melbi cmalu bo nixli ckule

(pretty type-of (little type-of girl)) type-of school

school for beautiful girls who are small

<a name=e16d18>16.18) melbi cmalu je nixli ckule

(pretty type-of (little and girl)) type-of school

school for beautiful things which are small and are girls

<a name=e16d19>16.19) melbi je cmalu bo nixli ckule

(pretty and (little type-of girl)) type-of school

school for things which are beautiful and are small girls

<a name=e16d20>16.20) ke melbi cmalu bo nixli ke'e je ckule

melbi bo cmalu bo nixli je ckule

(pretty type-of (little type-of girl)) and school

thing which is a school and a small girl who is beautiful

<a name=e16d21>16.21) melbi je cmalu jebo nixli ckule

(pretty and (little and girl)) type-of school

school for things which are beautiful, small, and girls

Note: same as 16.5

<a name=e16d22>16.22) melbi je cmalu bo nixli je ckule

(pretty and (little type-of girl)) and school

thing which is beautiful, a small girl, and a school

Note: same as 16.38

<a name=e16d23>16.23) ke melbi cmalu je nixli ke'e je ckule

(pretty type-of (little and girl)) and school

thing which is beautifully small, a beautiful girl, and a school

<a name=e16d24>16.24) melbi je cmalu jebo nixli je ckule

(pretty and (little and girl)) and school

thing which is beautiful, small, a girl, and a school

<a name=e16d25>16.25) melbi cmalu bo nixli bo ckule

melbi ke cmalu ke nixli ckule [ke'e] [ke'e]

pretty type-of (little type-of (girl type-of school))

small school for girls which is beautiful

<a name=e16d26>16.26) melbi ke cmalu nixli je ckule [ke'e]

pretty type-of (little type-of (girl and school))

small thing, both a girl and a school, which is beautiful

<a name=e16d27>16.27) melbi cmalu je nixli bo ckule

pretty type-of (little and (girl type-of school))

thing which is beautifully small and a girls' school that is beautiful

<a name=e16d28>16.28) melbi je cmalu bo nixli bo ckule

melbi je ke cmalu nixli bo ckule [ke'e]

melbi je ke cmalu ke nixli ckule [ke'e] [ke'e]

pretty and (little type-of (girl type-of school))

thing which is beautiful and a small type of girls' school

<a name=e16d29>16.29) melbi cmalu je nixli jebo ckule

melbi cmalu je ke nixli je ckule [ke'e]

pretty type-of (little and (girl and school))

thing which is beautifully small, a beautiful girl, and a beautiful school

Note: same as 16.37

<a name=e16d30>16.30) melbi je cmalu jebo nixli bo ckule

melbi je ke cmalu je nixli bo ckule [ke'e]

pretty and (little and (girl type-of school))

thing which is beautiful, small and a girls' school

Note: same as 16.15

<a name=e16d31>16.31) melbi je ke cmalu nixli je ckule [ke'e]

pretty and (little type-of (girl and school))

beautiful thing which is a small girl and a small school

<a name=e16d32>16.32) melbi jebo cmalu jebo nixli jebo ckule

pretty and (little and (girl and school))

thing which is beautiful, small, a girl, and a school

<a name=e16d33>16.33) melbi ke cmalu nixli ckule [ke'e]

pretty type-of ((little type-of girl) type-of school)

beautiful school for small girls

<a name=e16d34>16.34) melbi ke cmalu je nixli ckule [ke'e]

pretty type-of ((little and girl) type-of school

beautiful school for things which are small and are girls

<a name=e16d35>16.35) melbi ke cmalu bo nixli je ckule [ke'e]

pretty type-of ((little type-of girl) and school)

beautiful thing which is a small girl and a school

<a name=e16d36>16.36) melbi je ke cmalu nixli ckule [ke'e]

pretty and ((little type-of girl) type-of school)

thing which is beautiful and a school for small girls

<a name=e16d37>16.37) melbi cmalu je nixli je ckule

pretty type-of ((little and girl) and school)

thing which is beautifully small, a beautiful girl, and a beautiful school

Note: same as 16.29

<a name=e16d38>16.38) melbi je ke cmalu bo nixli je ckule [ke'e]

pretty and ((little type-of girl) and school)

thing which is beautiful, a small girl and a school

Note: same as 16.22

<a name=e16d39>16.39) melbi je ke cmalu je nixli ckule [ke'e]

pretty and ((little and girl) type-of school)

thing which is beautiful and is a small school and a girls' school

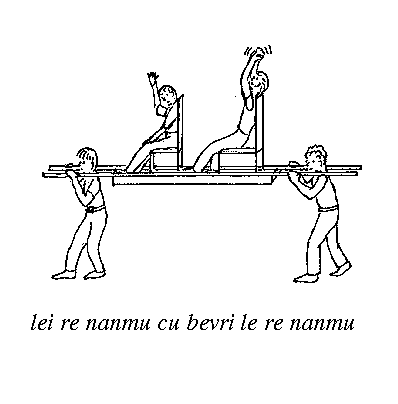
<a name=e16d40>16.40) melbi je ke cmalu je nixli je ckule [ke'e]

pretty and ((little and girl) and school)

thing which is beautiful, small, a girl, and a school

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## <h2>Chapter 6

## <br>

## To Speak Of Many Things: The Lojban sumti</h2>

###### <h6>$Revision: 4.1 $<br> mkhtml: 1.1</h6></p></center>

<p>

### <a name=s1><h3>The five kinds of simple sumti</h3>

<p>

<cx "simple sumti"><cx "sumti, definition">If you understand anything about Lojban, you know what a sumti is by now, right? An argument, one of those things that fills the places of simple Lojban sentences like:

<p>

<pre><a name=e1d1>1.1) mi klama le zarci

I go-to the market

</pre><cx "pro-sumti, contrasted with description">In <a href=#e1d1>Example 1.1</a>, “mi” and “le zarci” are the sumti. It is easy to see that these two sumti are not of the same kind: “mi” is a pro-sumti (the Loj­ban analogue of a pronoun) refer­ring to the speaker, whereas “le zarci” is a description which refers to something de­scribed as being a market.

<p>

<cx "sumti, kinds of">There are five kinds of simple sumti provided by Lojban:

<p>

<cx "sumti, descriptions as"><cx "gadri, definition"><lx "le"><dl compact><dt>1) <dd>descriptions like “le zarci”, which usually begin with a de­scriptor (called a “gadri” in Lojban) such as “le”;

</dl><cx "sumti, pro-sumti as"><lx "mi"><dl compact><dt>2) <dd>pro-sumti, such as “mi”;

</dl><cx "sumti, names as"><lx "la"><dl compact><dt>3) <dd>names, such as “la lojban.”, which usually begin with “la”;

</dl><cx "sumti, quotations as"><lx "lu"><lx "le'u"><lx "zo"><lx "zoi"><dl compact><dt>4) <dd>quotations, which begin with “lu”, “le'u”, “zo”, or “zoi”;

</dl><cx "sumti, numbers as"><lx "li"><dl compact><dt>5) <dd>pure numbers, which usually begin with “li”.

</dl><p>Here are a few examples of each kind of sumti:

<p>

<lx "ko"><pre><a name=e1d2>1.2) e'osai ko sarji la lojban.

Please support Lojban!

</pre><a href=#e1d2>Example 1.2 </a>exhibits “ko”, a pro-sumti; and “la lojban.”, a name.

<p>

<lx "mi"><lx "lu"><lx "li'u"><lx "le"><pre><a name=e1d3>1.3) mi cusku lu e'osai li'u le tcidu

I express “Please!” to-the reader.

</pre><a href=#e1d3>Example 1.3 </a>exhibits “mi”, a pro-sumti; “lu e'osai li'u”, a quotation; and “le tcidu”, a de­scription.

<p>

<lx "ti"><lx "li"><pre><a name=e1d4>1.4) ti mitre li ci

This measures-in-meters the-number three.

This is three meters long.

</pre><a href=#e1d4>Example 1.4 </a>exhibits “ti”, a pro-sumti; and “li ci”, a number.

<p>

Most of this chapter is about descriptions, as they have the most complicated syntax and usage. Some attention is also given to names, which are closely interwoven with de­scriptions. Pro-sumti, numbers, and quotations are described in more detail in <a href=chap7.html>Chapter 7</a>, <a href=chap18.html>Chapter 18</a>, and <a href=chap19.html>Chapter 19 </a>respectively, so this chapter only gives summa­ries of their forms and uses. See <a href=#s13>Section 13 </a>through <a href=#s15>Section 15 </a>for these summaries.

<p>

### <a name=s2><h3>The three basic description types</h3>

<p>

<cx "descriptions, types of">The following cmavo are discussed in this section:

<p>

<pre> le LE the, the one(s) described as

lo LE some, some of those which really are

la LA the one(s) named

ku KU elidable terminator for LE, LA

</pre><cx "descriptions, types of"><cx "descriptions, components of"><cx "descriptor, as part of description"><cx "selbri, as part of description"><lx "LE"><lx "LA">The syntax of descriptions is fairly complex, and not all of it can be explained within the confines of this chapter: relative clauses, in particular, are discussed in <a href=chap8.html>Chapter 8</a>. However, most descriptions have just two components: a descriptor belong­ing to selma'o LE or LA, and a selbri. (The difference between selma'o LE and selma'o LA is not im­portant until <a href=#s12>Section 12</a>.) Furthermore, the selbri is often just a single brivla. Here is an elementary example:

<p>

<pre><a name=e2d1>2.1) le zarci

one-or-more-specific-things-each-of-which-I-describe-as being-a-market

the market

</pre><cx "le, compared with English “the”">The long gloss for “le” is of course far too long to use most of the time, and in fact “le” is quite close in meaning to English “the”. It has particular implications, however, which “the” does not have.

<p>

<cx "descriptors, purpose of"><cx "descriptions, importance of selbri first place in">The general purpose of all descriptors is to create a sumti which might occur in the x1 place of the selbri belonging to the de­scription. Thus “le zarci” conveys some­thing which might be found in the x1 place of “zarci”, namely a market.

<p>

<cx "le, implications of"><cx "le, and specificity"><cx "le, and truth of selbri">The specific purpose of “le” is twofold. First, it indicates that the speaker has one or more specific markets in mind (whether or not the listener knows which ones they are). Second, it also indicates that the speaker is merely describing the things he or she has in mind as markets, without being committed to the truth of that description.

<p>

<pre><a name=e2d2>2.2) le zarci cu barda

One-or-more-specific-things-which-I-describe as “markets” is/are-big.

The market is big.

The markets are big.

</pre><cx "plurals, Lojban contrasted with English in necessity of marking">Note that English-speakers must state whether a reference to mar­kets is to just one (“the market”) or to more than one (“the markets”). Lojban requires no such forced choice, so both colloquial translations of <a href=#e2d2>Example 2.2 </a>are valid. Only the context can specify which is meant. (This rule does not mean that Lojban has no way of specifying the number of markets in such a case: that mechanism is explained in <a href=#s7>Section 7</a>.)

<p>

<ex "The men are women">Now consider the following strange-looking example:

<p>

<pre><a name=e2d3>2.3) le nanmu cu ninmu

One-or-more-specific-things-which-I-describe as “men” are women

The man is a woman.

The men are women.

</pre><cx "le, in false-to-fact descriptions"><a href=#e2d3>Example 2.3 </a>is not self-contradictory in Lojban, because “le nanmu” merely means something or other which, for my present purposes, I choose to describe as a man, whether or not it really is a man. A plausible instance would be: someone we had as­sumed to be a man at a distance turned out to be actually a woman on closer observa­tion. <a href=#e2d3>Example 2.3 </a>is what I would say to point out my observation to you.

<p>

<cx "specific descriptions"><cx "descriptions, specific">In all descriptions with “le”, the listener is presumed to either know what I have in mind or else not to be concerned at present (perhaps I will give more identify­ing details later). In particular, I might be pointing at the supposed man or men: <a href=#e2d3>Exam­ple 2.3 </a>would then be perfectly intelligible, since “le nanmu” merely clarifies that I am point­ing at the supposed man, not at a landscape, or a nose, which hap­pens to lie in the same direction.

<p>

<cx "non-specific descriptions"><cx "descriptions, non-specific"><lx "lo"><cx "lo, implications of">The second descriptor dealt with in this section is “lo”. Unlike “le”, “lo” is nonspe­cific:

<p>

<pre><a name=e2d4>2.4) lo zarci

one-or-more-of-all-the-things-which-really are-markets

a market

some markets

</pre><cx "lo, contrasted with le in specificity"><cx "le, contrasted with lo in specificity"><cx "le, contrasted with lo in truth requirement"><cx "lo, contrasted with le in truth requirement"><cx "lo, and truth of selbri">Again, there are two colloquial English translations. The effect of us­ing “lo” in <a href=#e2d4>Exam­ple 2.4 </a>is to refer generally to one or more markets, without being specific about which. Un­like “le zarci”, “lo zarci” must refer to something which actually is a market (that is, which can ap­pear in the x1 place of a truthful bridi whose selbri is “zarci”). Thus

<p>

<dl compact><dt>2.5) <dd>lo nanmu cu ninmu

Some man is a woman.

Some men are women.

</dl>must be false in Lojban, given that there are no objects in the real world which are both men and women. Pointing at some specific men or women would not make <a href=#e2d5>Example 2.5 </a>true, because those specific individuals are no more both-men-and-women than any oth­ers. In general, “lo” refers to whatever individuals meet its description.

<p>

<lx "la"><cx "la, implications of"><cx "la, compared with le in specificity"><cx "le, compared with la in specificity"><cx "la, use with descriptions contrasted with use before Lojbanized names">The last descriptor of this section is “la”, which indicates that the selbri which fol­lows it has been dissociated from its normal meaning and is being used as a name. Like “le” descriptions, “la” de­scriptions are implicitly restricted to those I have in mind. (Do not confuse this use of “la” with its use before regular Lojbanized names, which is dis­cussed in <a href=#s12>Section 12</a>.) For example:

<p>

<ex "bear wrote story"><pre><a name=e2d6>2.6) la cribe pu finti le lisri

The-one-named “bear” [past] creates the story.

Bear wrote the story.

</pre><cx "naming predicate">In <a href=#e2d6>Example 2.6</a>, “la cribe” refers to someone whose naming predicate is “cribe”, i.e. “Bear”. In English, most names don't mean anything, or at least not anything obvious. The name “Frank” coincides with the English word “frank”, meaning “honest”, and so one way of translating “Frank ate some cheese” into Lojban would be:

<p>

<pre><a name=e2d7>2.7) la stace pu citka lo cirla

The-one-called “Honest/Frank” [past] eats some cheese.

</pre><p>English-speakers typically would not do this, as we tend to be more attached to the sound of our names than their meaning, even if the meaning (etymological or current) is known. Speakers of other lan­guages may feel differently. (In point of fact, “Frank” originally meant “the free one” rather than “the honest one”.)

<p>

<cx "la, contrasted with le in implications">It is important to note the differences between <a href=#e2d6>Example 2.6 </a>and the following:

<p>

<pre><a name=e2d8>2.8) le cribe pu finti le lisri

One-or-more-specific-things-which-I-describe-as a-bear

[past] creates the story.

The bear(s) wrote the story.

</pre><cx "la, contrasted with lo in implications"><pre><a name=e2d9>2.9) lo cribe pu finti le lisri

One-or-more-of-the-things-which-really are-bears

[past] creates the story.

A bear wrote the story.

Some bears wrote the story.

</pre><a href=#e2d8>Example 2.8 </a>is about a specific bear or bearlike thing(s), or thing(s) which the speaker (perhaps whimsically or metaphorically) describes as a bear (or more than one); <a href=#e2d9>Exam­ple 2.9 </a>is about one or more of the really existing, objectively defined bears. In either case, though, each of them must have contributed to the writing of the story, if more than one bear (or “bear”) is meant.

<p>

<cx "descriptions with lo, teddy bear contrasted with real bear">(The notion of a “really existing, objectively defined bear” raises certain diffi­culties. Is a panda bear a “real bear”? How about a teddy bear? In general, the answer is “yes”. Lojban gismu are defined as broadly as possible, allowing tanru and lujvo to nar­row down the definition. There probably are no necessary and sufficient conditions for defin­ing what is and what is not a bear that can be pinned down with complete preci­sion: the real world is fuzzy. In borderline cases, “le” may communicate better than “lo”.)

<p>

So while <a href=#e2d6>Example 2.6 </a>could easily be true (there is a real writer named “Greg Bear”), and <a href=#e2d8>Example 2.8 </a>could be true if the speaker is sufficiently peculiar in what he or she describes as a bear, <a href=#e2d9>Example 2.9 </a>is certainly false.

<p>

Similarly, compare the following two examples, which are analogous to <a href=#e2d8>Ex­ample 2.8 </a>and <a href=#e2d9>Example 2.9 </a>respectively:

<p>

<cx "le, contrasted with lo in implications"><cx "lo, contrasted with le in implications"><pre><a name=e2d10>2.10) le remna pu finti le lisri

The human being(s) wrote the story.

<a name=e2d11>2.11) lo remna pu finti le lisri

A human being wrote the story.

Some human beings wrote the story.

</pre><a href=#e2d10>Example 2.10 </a>says who the author of the story is: one or more par­ticular human beings that the speaker has in mind. If the topic of con­versation is the story, then <a href=#e2d10>Example 2.10 </a>identifies the author as someone who can be pointed out or who has been previously men­tioned; whereas if the topic is a person, then “le remna” is in effect a shorthand reference to that person. <a href=#e2d11>Example 2.11 </a>merely says that the author is human.

<p>

<lx "ku"><cx "ku, as elidable terminator for descriptions"><cx "ku, effect of following selbri on elidability of"><cx "cu, effect on elidability of ku"><cx "ku, uses of">The elidable terminator for all descriptions is “ku”. It can al­most always be omitted with no danger of ambiguity. The main ex­ceptions are in certain uses of rela­tive clauses, which are discussed in <a href=chap8.html>Chapter 8</a>, and in the case of a description immedi­ately preceding the selbri. In this latter case, using an explicit “cu” before the selbri makes the “ku” un­necessary. There are also a few other uses of “ku”: in the compound negator “naku” (discussed in <a href=chap15.html>Chapter 15</a>) and to terminate place-structure, tense, and modal tags that do not have associated sumti (discussed in <a href=chap9.html>Chapter 9 </a>and <a href=chap10.html>Chapter 10</a>).

<p>

### <a name=s3><h3>Individuals and masses</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> lei LE the mass I describe as

loi LE part of the mass of those which really are

lai LA the mass of those named

</pre><cx "sumti, classified by types of objects referred to"><cx "sumti, for individual objects"><cx "sumti, for mass objects"><cx "sumti, for set objects">All Lojban sumti are classified by whether they refer to one of three types of objects, known as “individuals”, “masses”, and “sets”. The term “individual” is mis­leading when used to refer to more than one object, but no less-confusing term has as yet been found. All the descriptions in <a href=#s1>Sections 1 </a>and <a href=#s2>2 </a>refer to individuals, whether one or more than one. Consider the following example:

<p>

<pre><a name=e3d1>3.1) le prenu cu bevri le pipno

One-or-more-of-those-I-describe-as persons carry the piano.

The person(s) carry the piano.

</pre>(Of course the second “le” should really get the same translation as the first, but I am putting the focus of this discussion on the first “le”, the one preceding “prenu”. I will as­sume that there is only one piano under discussion.)

<p>

<cx "plurals with le, meaning of"><cx "le, meaning of in the plural"><cx "multiple individual objects, meaning of"><cx "individual objects, multiple">Suppose the context of <a href=#e3d1>Example 3.1 </a>is such that you can determine that I am talking about three persons. What am I claiming? I am claiming that each of the three persons carried the piano. This claim can be true if the persons carried the piano one at a time, or by turns, or in a variety of other ways. But in order for <a href=#e3d1>Example 3.1 </a>to be true, I must be willing to assert that person 1 carried the piano, and that person 2 carried the piano, and that person 3 carried the piano.

<p>

But suppose I am not willing to claim that. For in fact pianos are heavy, and very few persons can carry a piano all by themselves. The most likely factual situation is that per­son 1 carried one end of the piano, and person 2 the other end, while person 3 either held up the middle or else supervised the whole operation without actually lifting anything. The correct way of expressing such a situation in Loj­ban is:

<p>

<lx "lei"><pre><a name=e3d2>3.2) lei prenu cu bevri le pipno

The-mass-of-one-or-more-of-those-I-describe-as persons carry the piano.

</pre><ex "piano-moving"><cx "mass object, contrasted with multiple individual objects"><cx "multiple individual objects, contrasted with mass object"><cx "mass object, properties of"><cx "mass object, and logical reasoning">Here the same three persons are treated not as individuals, but as a so-called “mass en­tity”, or just “mass”. A mass has the properties of each individual which composes it, and may have other properties of its own as well. This can lead to apparent contradic­tions. Thus sup­pose in the piano-moving example above that person 1 has fair skin, whereas person 2 has dark skin. Then it is correct to say that the person-mass has both fair skin and dark skin. Using the mass de­scriptor “lei” signals that ordinary logical rea­soning is not applicable: contradictions can be maintained, and all sorts of other peculi­arities may exist. However, we can safely say that a mass inherits only the component properties that are relevant to it; it would be ludicrous to say that a mass of two persons is of molecular dimensions, simply because some of the parts (namely, the molecules) of the persons are that small.

<p>

<lx "loi"><lx "lai"><cx "loi, as mass counterpart of lo"><cx "lai, as mass counterpart of lai">The descriptors “loi” and “lai” are analogous to “lo” and “la” respectively, but refer to masses either by property (“loi”) or by name (“lai”). A classic example of “loi” use is:

<p>

<ex "lions in Africa"><pre><a name=e3d3>3.3) loi cinfo cu xabju le fi'ortu'a

Part-of-the-mass-of-those-which-really are-lions dwell in-the African-land.

The lion dwells in Africa.

Lions dwell in Africa.

</pre><cx "lei, contrasted with loi in specificity"><cx "loi, contrasted with lei in specificity">The difference between “lei” and “loi” is that “lei cinfo” refers to a mass of specific individuals which the speaker calls lions, whereas “loi cinfo” refers to some part of the mass of all those indi­viduals which actually are lions. The restriction to “some part of the mass” allows statements like <a href=#e3d3>Example 3.3 </a>to be true even though some lions do not dwell in Africa — they live in various zoos around the world. On the other hand, <a href=#e3d3>Example 3.3 </a>doesn't actually say that most lions live in Africa: equally true is

<p>

<ex "Englishman in Africa"><pre><a name=e3d4>3.4) loi glipre

cu xabju le fi'ortu'a

Part-of-the-mass-of-those-which-really are-English-persons

dwell in-the African-land.

The English dwell in Africa.

</pre>since there is at least one English person living there. <a href=#s4>Section 4 </a>explains another method of saying what is usually meant by “The lion lives in Africa” which does imply that living in Africa is normal, not excep­tional, for lions.

<p>

<cx "mass objects, peculiarities of English translation of">Note that the Lojban mass articles are sometimes translated by English plurals (the most usual case), sometimes by English sin­gulars (when the singular is used to ex­press typicalness or abstrac­tion), and sometimes by singulars with no article:

<p>

<ex "butter is soft"><lx "matne"><pre><a name=e3d5>3.5) loi matne cu ranti

Part-of-the-mass-of-that-which-really is-a-quantity-of-butter is-soft.

Butter is soft.

</pre><cx "mass object, as dependent on intention">Of course, some butter is hard (for example, if it is frozen butter), so the “part-of” im­pli­cation of “loi” becomes once again useful. The rea­son this mechanism works is that the English words like “butter”, which are seen as already describing masses, are trans­lated in Loj­ban by non-mass forms. The place structure of “matne” is “x1 is a quantity of butter from source x2”, so the single English word “butter” is translated as something like “a part of the mass formed from all the quantities of butter that exist”. (Note that the opera­tion of forming a mass entity does not imply, in Lojban, that the components of the mass are necessarily close to one another or even related in any way other than conceptually. Masses are formed by the speaker's inten­tion to form a mass, and can in principle contain anything.)

<p>

<cx "mass name, use of">The mass name descriptor “lai” is used in circumstances where we wish to talk about a mass of things identified by a name which is common to all of them. It is not used to identify a mass by a single name peculiar to it. Thus the mass version of <a href=#e2d5>Exam­ple 2.5</a>,

<p>

<ex "Bears wrote book"><pre><a name=e3d6>3.6) lai cribe pu finti le vi cukta

The-mass-of-those-named “bear” [past] creates the nearby book.

The Bears wrote this book.

</pre><cx "la, contrasted with lai in implications"><cx "lai, contrasted with la in implications">in a context where “la cribe” would be understood as plural, would mean that either Tom Bear or Fred Bear (to make up some names) might have written the book, or that Tom and Fred might have written it as collaborators. Using “la” instead of “lai” in <a href=#e3d6>Ex­ample 3.6 </a>would give the implication that each of Tom and Fred, considered individu­ally, had writ­ten it.

<p>

### <a name=s4><h3>Masses and sets</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> le'i LE the set described as

lo'i LE the set of those which really are

la'i LA the set of those named

</pre><cx "set, contrasted with mass in attribution of component properties"><cx "mass, contrasted with set in attribution of component properties"><cx "set, compared with mass as abstract of multiple individuals"><cx "mass, compared with set as abstract of multiple individuals">Having said so much about masses, let us turn to sets. Sets are easier to under­stand than masses, but are more rarely used. Like a mass, a set is an abstract object formed from a number of individu­als; however, the properties of a set are not derived from any of the properties of the individuals that compose it.

<p>

<cx "inclusion, property of sets"><cx "membership, property of sets"><cx "cardinality, property of sets"><cx "cardinality, definition"><cx "sets, properties of"><lx "le'i"><lx "lo'i"><lx "la'i"><cx "le'i, as set counterpart of lei"><cx "lo'i, as set counterpart of loi"><cx "la'i, as set counterpart of lai">Sets have properties like cardinality (how many elements in the set), member­ship (the relationship between a set and its ele­ments), and set inclusion (the relationship be­tween two sets, one of which — the superset – contains all the elements of the other — the subset). The set descriptors “le'i”, “lo'i” and “la'i” correspond exactly to the mass de­scriptors “lei”, “loi”, and “lai” except that normally we talk of the whole of a set, not just part of it. Here are some examples contrasting “lo”, “loi”, and “lo'i”:

<p>

<cx "lo, contrasted with loi and lo'i"><cx "loi, contrasted with lo and lo'i"><cx "lo'i, contrasted with lo and loi"><cx "rats are brown"><pre><a name=e4d1>4.1) lo ratcu cu bunre

One-or-more-of-those-which-really-are rats are-brown.

Some rats are brown.

<a name=e4d2>4.2) loi ratcu cu cmalu

Part-of-the-mass-of-those-which-really-are rats are-small.

Rats are small.

<a name=e4d3>4.3) lo'i ratcu cu barda

The-set-of rats is-large.

There are a lot of rats.

</pre><p>The mass of rats is small because at least one rat is small; the mass of rats is also large; the set of rats, though, is unquestionably large – it has billions of members. The mass of rats is also brown, since some of its components are; but it would be incorrect to call the set of rats brown — brown-ness is not the sort of property that sets pos­sess.

<p>

<cx "sets, use in Lojban place structure">Lojban speakers should generally think twice before employ­ing the set de­scriptors. However, certain predicates have places that require set sumti to fill them. For example, the place structure of “fadni” is:

fadni: <p>

<dl compact><dt><dd>x1 is ordinary/common/typical/usual in property x2

among the members of set x3

</dl><p>Why is it necessary for the x3 place of “fadni” to be a set? Because it makes no sense for an individual to be typical of another individual: an individual is typical of a group. In order to make sure that the bridi containing “fadni” is about an entire group, its x3 place must be filled with a set:

<p>

<ex "typical Lojban user"><pre><a name=e4d4>4.4) mi fadni zo’e lo'i lobypli

I am-ordinary among the-set-of Lojban-users.

I am a typical Lojban user.

</pre><p>Note that the x2 place has been omitted; I am not specifying in ex­actly which way I am typical — whether in language knowledge, or age, or interests, or something else. If “lo'i” were changed to “lo” in <a href=#e4d4>Example 4.4</a>, the meaning would be something like “I am typical of some Lojban user”, which is nonsense.

<p>

### <a name=s5><h3>Descriptors for typical objects</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> lo'e LE the typical

le'e LE the stereotypical

</pre><lx "lo'e">As promised in <a href=#s3>Section 3</a>, Lojban has a method for discrimi­nating between “the lion” who lives in Africa and “the Englishman” who, generally speaking, doesn't live in Africa even though some Englishmen do. The descriptor “lo'e” means “the typi­cal”, as in

<p>

<ex "lion in Africa"><pre><a name=e5d1>5.1) lo'e cinfo cu xabju le fi'ortu'a

The-typical lion dwells-in the African-land.

Typically, lions dwell in Africa.

The lion dwells in Africa.

</pre><cx "typical objects, determining characteristics of"><cx "typical objects, and instantiation">What is this “typical lion”? Surely it is not any particular lion, because no lion has all of the “typical” characteristics, and (worse yet) some characteristics that all real lions have can't be viewed as typical. For example, all real lions are either male or female, but it would be bi­zarre to suppose that the typical lion is either one. So the typical lion has no particular sex, but does have a color (golden brown), a resi­dence (Africa), a diet (game), and so on. Likewise we can say that

<p>

<ex "typical Englishman"><pre><a name=e5d2>5.2) lo'e glipre cu xabju le fi'ortu'a na.e

le gligugde

The-typical English-person dwells-in the African-land (Not!) and

the English-country.

The typical English person dwells not in Africa but in England.

</pre><cx "lo'e, relationship to lo'i"><cx "lo'i, relationship to lo'e"><cx "le'e, relationship to le'i"><cx "le'i, relationship to le'e">The relationship between “lo'e cinfo” and “lo'i cinfo” may be explained thus: the typical lion is an imaginary lion-abstraction which best exemplifies the set of lions. There is a similar relationship be­tween “le'e” and “le'i”:

<p>

<lx "le'e"><cx "stereotypical objects"><cx "Greek-Americans own restaurants"><pre><a name=e5d3>5.3) le'e xelso merko cu gusta ponse

The-stereotypical Greek-type-of American is-a-restaurant-type-of owner.

Lots of Greek-Americans own restaurants.

</pre><cx "stereotypical, as not derogatory in Lojban"><cx "typical, compared with stereotypical"><cx "stereotypical, compared with typical">Here we are concerned not with the actual set of Greek-Americans, but with the set of those the speaker has in mind, which is typified by one (real or imaginary) who owns a restaurant. The word “stereotypical” is often derogatory in English, but “le'e” need not be derogatory in Lojban: it simply suggests that the example is typical in the speaker's imagination rather than in some objectively agreed-upon way. Of course, different speak­ers may disagree about what the features of “the typical lion” are (some would include having a short intestine, whereas others would know nothing of lions' intes­tines), so the distinction between “lo'e cinfo” and “le'e cinfo” may be very fine.

<p>

Furthermore,

<p>

<ex "Hollywood"><pre><a name=e5d4>5.4) le'e skina cu se finti ne'i la xali,uyd.

The-stereotypical movie is-invented in Hollywood.

</pre>is probably true to an American, but might be false (not the stereo­type) to someone living in India or Russia.

<p>

<ex "typical Smith"><cx "name equivalent for “typical”, rationale for lack of">Note that there is no naming equivalent of “lo'e” and “le'e”, because there is no need, as a rule, for a “typical George” or a “typical Smith”. People or things who share a com­mon name do not, in general, have any other common attributes worth mention­ing.

<p>

### <a name=s6><h3>Quantified sumti</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> ro PA all of/each of

su'o PA at least (one of)

</pre><cx "quantifiers, with sumti"><cx "sumti, as having implicit quantifiers">Quantifiers tell us how many: in the case of quantifiers with sumti, how many things we are talking about. In Lojban, quantifiers are expressed by numbers and mathematical expressions: a large topic discussed in some detail in <a href=chap18.html>Chapter 18</a>. For the purposes of this chapter, a simplified treatment will suffice. Our examples will employ either the simple Lojban numbers “pa”, “re”, “ci”, “vo”, and “mu”, meaning “one”, “two”, “three”, “four”, “five” respectively, or else one of four special quantifiers, two of which are discussed in this section and listed above. These four quantifiers are im­portant because every Loj­ban sumti has either one or two of them implicitly present in it — which one or two depends on the particular kind of sumti. There is more explana­tion of implicit quantifiers later in this section. (The other two quantifiers, “piro” and “pisu'o”, are explained in <a href=#s7>Section 7</a>.)

<p>

<cx "sumti, with explicit quantifiers"><cx "quantifiers, explicit on sumti">Every Lojban sumti may optionally be preceded by an explicit quantifier. The pur­pose of this quantifier is to specify how many of the things referred to by the sumti are being talked about. Here are some simple examples contrasting sumti with and without explicit quantifi­ers:

<p>

<cx "sumti with explicit quantifier, contrasted with sumti without explicit quantifier"><pre><a name=e6d1>6.1) do cadzu le bisli

You walk-on the ice.

<a name=e6d2>6.2) re do cadzu le bisli

Two-of you walk-on the ice.

</pre><cx "number, meaning of when used as a quantifier"><cx "quantifiers on sumti, numbers as an exact amounts">The difference between <a href=#e6d1>Example 6.1 </a>and <a href=#e6d2>Example 6.2 </a>is the pres­ence of the explicit quantifier “re” in the latter example. Although “re” by itself means “two”, when used as a quantifier it means “two-of”. Out of the group of listeners (the number of which isn't stated), two (we are not told which ones) are asserted to be “walkers on the ice”. Im­plic­itly, the others (if any) are not walkers on the ice. In Lojban, you cannot say “I own three shoes” if in fact you own four shoes. Num­bers need never be specified, but if they are specified they must be correct.

<p>

<cx "quantifiers on sumti, expressing inexact amounts with">(This rule does not mean that there is no way to specify a number which is vague. The sentence

<p>

<pre><a name=e6d3>6.3) mi ponse su'o ci cutci

I possess at-least three shoes.

</pre><cx "vague numbers">is true if you own three shoes, or four, or indeed any larger number. More details on vague numbers appear in the discussion of mathe­matical expressions in <a href=chap18.html>Chapter 18</a>.)

<p>

Now consider <a href=#e6d1>Example 6.1 </a>again. How many of the listeners are claimed to walk on the ice? The answer turns out to be: all of them, however many that is. So <a href=#e6d1>Ex­ample 6.1 </a>and <a href=#e6d4>Example 6.4</a>:

<p>

<pre><a name=e6d4>6.4) ro do cadzu le bisli

All-of you walk-on the ice.

</pre><cx "implicit quantifier, on personal pro-sumti"><lx "ro"><cx "ro, as implicit quantifier on personal pro-sumti"><cx "personal pro-sumti, implicit quantifier for"><cx "implicit quantifier, definition">turn out to mean exactly the same thing. This is a safe strategy, be­cause if one of my lis­teners doesn't turn out to be walking on the ice, I can safely claim that I didn't intend that person to be a listener! And in fact, all of the personal pro-sumti such as “mi” and “mi'o” and “ko” obey the same rule. We say that personal pro-sumti have a so-called “implicit quantifier” of “ro” (all). This just means that if no quantifier is given explic­itly, the meaning is the same as if the implicit quantifier had been used.

<p>

<cx "implicit quantifier, on quotations, discussion of">Not all sumti have “ro” as the implicit quantifier, however. Consider the quo­tation in:

<p>

<pre><a name=e6d5>6.5) mi cusku lu do cadzu le bisli li'u

I express [quote] you walk-on the ice [unquote].

I say, “You walk on the ice.”

</pre><p>What is the implicit quantifier of the quotation “lu do cadzu le bisli li'u”? Surely not “ro”. If “ro” were supplied explicitly, thus:

<p>

<pre><a name=e6d6>6.6) mi cusku ro lu do cadzu le bisli li'u

I express all-of [quote] you walk-on the ice [unquote].

</pre>the meaning would be something like “I say every occurrence of the sentence 'You walk on the ice’”. Of course I don't say every occur­rence of it, only some occurrences. One might suppose that <a href=#e6d5>Example 6.5 </a>means that I express exactly one occurrence, but it is more Loj­banic to leave the number unspecified, as with other sumti. We can say defi­nitely, however, that I say it at least once.

<p>

<lx "su'o">The Lojban cmavo meaning “at least” is “su'o”, and if no ordi­nary number follows, “su'o” means “at least once”. (See <a href=#e6d3>Example 6.3 </a>for the use of “su'o” with an ordinary number). Therefore, the explicitly quantified version of <a href=#e6d5>Example 6.5 </a>is

<p>

<cx "su'o, as implicit quantifier for quotations"><cx "quotations, implicit quantifier for"><cx "implicit quantifier, for quotations"><pre><a name=e6d7>6.7) mi cusku su'o lu do cadzu le bisli li'u

I express at-least-one-of [quote] you walk-on the ice [unquote].

I say one or more instances of “You walk on the ice”.

I say “You walk on the ice”.

</pre><p>If an explicit ordinary number such as “re” were to appear, it would have to convey an exact expression, so

<p>

<pre><a name=e6d8>6.8) mi cusku re lu do cadzu le bisli li'u

I express two-of [quote] you walk-on the ice [unquote].

</pre>means that I say the sentence exactly twice, neither more nor less.

<p>

### <a name=s7><h3>Quantified descriptions</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> piro PA the whole of

pisu'o PA a part of

</pre><cx "quantification, before description sumti compared with before non-description sumti">Like other sumti, descriptions can be quantified. When a quantifier appears be­fore a description, it has the same meaning as one appearing before a non-description sumti: it specifies how many things, of all those referred to by the description, are being talked about in this particular bridi. Suppose that context tells us that “le gerku” refers to three dogs. Then we can say that exactly two of them are white as follows:

<p>

<ex "two dogs are white"><pre><a name=e7d1>7.1) re le gerku cu blabi

Two-of the dogs are-white.

Two of the dogs are white.

</pre><cx "outer quantifier, definition"><cx "inner quantifier, definition"><cx "outer quantifier, contrasted with inner quantifier"><cx "inner quantifier, contrasted with outer quantifier"><cx "outer quantifier, effect of on meaning"><cx "inner quantifier, effect of on meaning">When discussing descriptions, this ordinary quantifier is called an “outer quantifier”, since it appears outside the description. But there is another possible loca­tion for a quanti­fier: between the descriptor and the selbri. This quantifier is called an “inner quantifier”, and its meaning is quite different: it tells the listener how many ob­jects the description selbri characterizes.

<p>

For example, the context of <a href=#e7d1>Example 7.1 </a>supposedly told us that “le gerku” re­ferred to some three specific dogs. This assumption can be made certain with the use of an ex­plicit inner quantifier:

<p>

<pre><a name=e7d2>7.2) re le ci gerku cu blabi

Two-of the three dogs are-white.

Two of the three dogs are white.

</pre>(As explained in the discussion of <a href=#e6d3>Example 6.3</a>, simple numbers like those in <a href=#e7d2>Example 7.2 </a>must be exact: it therefore follows that the third dog cannot be white.)

<p>

<cx "inner quantifier, explicit">You may also specify an explicit inner quantifier and leave the outer quantifier im­plicit:

<p>

<pre><a name=e7d3>7.3) le ci gerku cu blabi

The three dogs are-white.

The three dogs are white.

</pre><cx "descriptors, implicit quantifiers for"><cx "inner quantifier, implicit on descriptors"><cx "outer quantifier, implicit on descriptors">There are rules for each of the 11 descriptors specifying what the implicit val­ues for the inner and outer quantifiers are. They are meant to provide sensible default values when context is absent, not necessarily to prescribe hard and fast rules. The fol­lowing table lists the implicit values:

<p>

<lx "le"><lx "ro"><lx "su'o"><dl compact><dt>le: <dd>ro le su'o

all of the at-least-one described as

</dl><lx "lo"><dl compact><dt>lo: <dd>su'o lo ro

at least one of all of those which really are

</dl><lx "la"><dl compact><dt>la: <dd>ro la su'o

all of the at least one named

</dl><lx "lei"><dl compact><dt>lei: <dd>pisu'o lei su'o

some part of the mass of the at-least-one described as

</dl><lx "loi"><dl compact><dt>loi: <dd>pisu'o loi ro

some part of the mass of all those that really are

</dl><lx "lai"><dl compact><dt>lai: <dd>pisu'o lai su'o

some part of the mass of the at-least-one named

</dl><lx "le'i"><dl compact><dt>le'i: <dd>piro le'i su'o

the whole of the set of the at-least-one described as

</dl><lx "lo'i"><dl compact><dt>lo'i: <dd>piro lo'i ro

the whole of the set of all those that really are

</dl><lx "la'i"><dl compact><dt>la'i: <dd>piro la'i su'o

the whole of the set of the at-least-one named

</dl><lx "le'e"><dl compact><dt>le'e: <dd>ro le'e su'o

all the stereotypes of the at-least-one described as

</dl><lx "lo'e"><dl compact><dt>lo'e: <dd>su'o lo'e ro

at least one of the types of all those that really are

</dl><cx "le-series descriptors, compared with la-series in implicit quantification"><cx "la-series descriptors, compared with le-series in implicit quantification"><cx "le-series cmavo, definition"><cx "le-series cmavo, as encompassing le-series and la-series descriptors for quantification discussion">When examined for the first time, this table looks dreadfully arbitrary. In fact, there are quite a few regularities in it. First of all, the la-series (that is, the descriptors “la”, “lai”, and “la'i”) and the le-series (that is, the descriptors “le”, “lei”, “le'i”, and “le'e”) always have corre­sponding implicit quantifiers, so we may subsume the la-series under the le-series for the rest of this discussion: “le-series cmavo” will refer to both the le-series proper and to the la-series.

<p>

<cx "lo-series cmavo, rule for implicit inner quantifier"><cx "le-series cmavo, rule for implicit inner quantifier">The rule for the inner quantifier is very simple: the lo-series cmavo (namely, “lo”, “loi”, “lo'i”, and “lo'e”) all have an implicit inner quantifier of “ro”, whereas the le-series cmavo all have an implicit in­ner quantifier of “su'o”.

<p>

<cx "lo-series cmavo, rationale for implicit inner quantifier"><cx "le-series cmavo, rationale for implicit inner quantifier">Why? Because lo-series descriptors always refer to all of the things which really fit into the x1 place of the selbri. They are not re­stricted by the speaker's inten­tion. Descrip­tors of the le-series, how­ever, are so restricted, and therefore talk about some number, defi­nite or indefinite, of objects the speaker has in mind — but never less than one.

<p>

<cx "sets, rule for implicit outer quantifier"><cx "masses, rule for implicit outer quantifier"><lx "piro">Understanding the implicit outer quantifier requires rules of greater subtlety. In the case of mass and set descriptors, a single rule suffices for each: reference to a mass is implicitly a reference to some part of the mass; reference to a set is implicitly a refer­ence to the whole set. Masses and sets are inherently singular objects: it makes no sense to talk about two distinct masses with the same components, or two distinct sets with the same members. Therefore, the largest possible outer quantifier for either a set de­scription or a mass description is “piro”, the whole of it.

<p>

<cx "plural masses, possible use for">(Pedantically, it is possible that the mass of water molecules composing an ice cube might be thought of as different from the same mass of water molecules in liquid form, in which case we might talk about “re lei djacu”, two masses of the water-bits I have in mind.)

<p>

<lx "pi"><cx "piro, explanation of meaning"><cx "pisu'o, explanation of meaning">Why “pi-”? It is the Lojban cmavo for the decimal point. Just as “pimu” means “.5”, and when used as a quantifier specifies a por­tion consisting of five tenths of a thing, “piro” means a portion con­sisting of the all-ness – the entirety — of a thing. Similarly, “pisu'o” specifies a portion consisting of at least one part of a thing, i.e. some of it.

<p>

<cx "subsets, expressing with outer quantifiers"><cx "outer quantifiers, for expressing subsets"><cx "portion, on set contrasted with on individual">Smaller quantifiers are possible for sets, and refer to subsets. Thus “pimu le'i nanmu” is a subset of the set of men I have in mind; we don't know precisely which elements make up this subset, but it must have half the size of the full set. This is the best way to say “half of the men”; saying “pimu le nanmu” would give us a half-portion of one of them instead! Of course, the result of “pimu le'i nanmu” is still a set; if you need to refer to the individuals of the subset, you must say so (see “lu'a” in <a href=#s10>Section 10</a>).

<p>

<cx "outer quantifiers on individual descriptors, rationale for differences in implicit quantifier"><cx "individual descriptors, different implicit outer quantifiers among"><cx "le, implicit outer quantifier for"><cx "lo, implicit outer quantifier for">The case of outer quantifiers for individual descriptors (including “le”, “lo”, “la”, and the typical descriptors “le'e” and “lo'e”) is special. When we refer to specific individuals with “le”, we mean to refer to all of those we have in mind, so “ro” is ap­propriate as the im­plicit quantifier, just as it is appropriate for “do”. Reference to non-specific individuals with “lo”, however, is typically to only some of the objects which can be correctly de­scribed, and so “su'o” is the appro­priate implicit quantifier, just as for quotations.

<p>

<cx "le, contrasted with lo in implicit quantification"><cx "lo, contrasted with le in implicit quantification">From the English-speaking point of view, the difference in structure between the following example using “le”:

<p>

<pre><a name=e7d4>7.4) [ro] le ci gerku cu blabi

[All-of] those-described-as three dogs are-white.

The three dogs are white.

</pre>and the corresponding form with “lo”:

<p>

<pre><a name=e7d5>7.5) ci lo [ro] gerku cu blabi

Three-of those-which-are [all] dogs are-white

Three dogs are white.

</pre>looks very peculiar. Why is the number “ci” found as an inner quanti­fier in <a href=#e7d4>Example 7.4 </a>and as an outer quantifier in <a href=#e7d5>Example 7.5</a>? The number of dogs is the same in either case. The answer is that the “ci” in <a href=#e7d4>Example 7.4 </a>is part of the specification: it tells us the actual num­ber of dogs in the group that the speaker has in mind. In <a href=#e7d5>Example 7.5</a>, however, the dogs referred to by “<dots>… </dots>lo gerku” are all the dogs that exist: the outer quantifier then re­stricts the number to three; which three, we cannot tell. The implicit quantifiers are cho­sen to avoid claiming too much or too little: in the case of “le”, the implicit outer quanti­fier “ro” says that each of the dogs in the restricted group is white; in the case of “lo”, the implicit inner quantifier simply says that three dogs, chosen from the group of all the dogs there are, are white.

<p>

<cx "lo-series description, caution on exact numbers as inner quantifiers on">Using exact numbers as inner quantifiers in lo-series descrip­tions is dangerous, be­cause you are stating that exactly that many things exist which really fit the descrip­tion. So examples like

<p>

<pre><a name=e7d67>7.6) [su'o] lo ci gerku cu blabi

[Some-of] those-which-really-are three dogs are-white

</pre>are semantically anomalous; <a href=#e7d7>Example 7.6 </a>claims that some dog (or dogs) is white, but also that there are just three dogs in the universe!

<p>

Nevertheless, inner quantifiers are permitted on “lo” descrip­tors for consis­tency's sake, and may occasionally be useful.

<p>

Note that the inner quantifier of “le”, even when exact, need not be truthful: “le ci nanmu” means “what I describe as three men”, not “three of what I describe as men”. This follows from the rule that what is described by a “le” description represents the speaker's view­point rather than the objective way things are.

<p>

### <a name=s8><h3>Indefinite descriptions</h3>

<p>

<cx "lo, omission of"><cx "descriptors, omission of">By a quirk of Lojban syntax, it is possible to omit the de­scriptor “lo”, but never any other descriptor, from a description like that of <a href=#e7d5>Example 7.5</a>; namely, one which has an explicit outer quanti­fier but no explicit inner quantifier. The following example:

<p>

<pre><a name=e8d1>8.1) ci gerku [ku] cu blabi

Three dogs are white.

</pre><cx "ku, effect on of omitting descriptor"><cx "omission of descriptor, effect on ku"><cx "indefinite description, definition">is equivalent in meaning to <a href=#e7d5>Example 7.5</a>. Even though the descriptor is not present, the elidable terminator “ku” may still be used. The name “indefinite description” for this syntactic form is historically based: of course, it is no more and no less indefinite than its counter­part with an explicit “lo”. Indefinite descriptions were introduced into the lan­guage in order to imitate the syntax of English and other natu­ral languages.

<p>

<cx "indefinite description, as needing explicit outer quantifier"><cx "indefinite description, as prohibiting explicit inner quantifier"><cx "outer quantifier, in indefinite description"><cx "inner quantifier, in indefinite description">Indefinite descriptions must fit this mold exactly: there is no way to make one which does not have an explicit outer quantifier (thus “\*gerku cu blabi” is ungrammati­cal), or which has an explicit in­ner quantifier (thus “\*reboi ci gerku cu blabi” is also ungram­matical — “re ci gerku cu blabi” is fine, but means “23 dogs are white”).

<p>

Note: <a href=#e6d3>Example 6.3 </a>also contains an indefinite description, namely “su'o ci cutci”; an­other version of that example using an ex­plicit “lo” would be:

<p>

<pre><a name=e8d2>8.2) mi ponse su'o ci lo cutci

I possess at-least three things-which-really-are shoes

I own three (or more) shoes.

### </pre><a name=s9><h3>sumti-based descriptions</h3>

<p>

As stated in <a href=#s2>Section 2</a>, most descriptions consist of just a de­scriptor and a sel­bri. (In this chapter, the selbri have always been single gismu, but of course any selbri, however complex, can be em­ployed in a description. The syntax and semantics of selbri are ex­plained in <a href=chap5.html>Chapter 5</a>.) In the intervening sections, inner and outer quantifiers have been added to the syntax. Now it is time to discuss a description of a radically different kind: the sumti-based description.

<p>

<cx "sumti-based description, definition"><cx "sumti-based description, inner quantifier on"><cx "sumti-based description, outer quantifier on">A sumti-based description has a sumti where the selbri would normally be, and the inner quantifier is required — it cannot be im­plicit. An outer quantifier is permitted but not required.

<p>

A full theory of sumti-based descriptions has yet to be worked out. One com­mon case, however, is well understood. Compare the following:

<p>

<pre><a name=e9d1>9.1) re do cu nanmu

Two-of you are-men.

</pre><ex "the two of you"><pre><a name=e9d2>9.2) le re do cu nanmu

The two-of you are men.

</pre><a href=#e9d1>Example 9.1 </a>simply specifies that of the group of listeners, size un­known, two are men. <a href=#e9d2>Example 9.2</a>, which has the sumti-based de­scription “le re do”, says that of the two lis­teners, all (the implicit outer quantifier “ro”) are men. So in effect the inner quantifier “re” gives the number of individuals which the inner sumti “do” refers to.

<p>

Here is another group of examples:

<p>

<ex "three bears"><pre><a name=e9d3>9.3) re le ci cribe cu bunre

Two-of the three bears are-brown.

<a name=e9d4>9.4) le re le ci cribe cu bunre

The two-of the three bears are-brown.

<a name=e9d5>9.5) pa le re le ci cribe cu bunre

One-of the two-of the three bears are-brown.

</pre><cx "sumti-based descriptions with le, as increasing restricting to in-mind">In each case, “le ci cribe” restricts the bears (or alleged bears) being talked of to some group of three which the speaker has in mind. <a href=#e9d3>Ex­ample 9.3 </a>says that two of them (which two is not stated) are brown. <a href=#e9d4>Example 9.4 </a>says that a specific pair of them are brown. <a href=#e9d5>Example 9.5 </a>says that of a specific pair chosen from the original three, one or the other of that pair is brown.

<p>

### <a name=s10><h3>sumti qualifiers</h3>

<p>

The following cmavo are discussed in this section:

<p>

<cx "sumti qualifiers, list of"><pre> la'e LAhE something referred to by

lu'e LAhE a reference to

tu'a LAhE an abstraction involving

lu'a LAhE an individual/member/component of

lu'i LAhE a set formed from

lu'o LAhE a mass formed from

vu'i LAhE a sequence formed from

na'ebo NAhE+BO something other than

to'ebo NAhE+BO the opposite of

no'ebo NAhE+BO the neutral form of

je'abo NAhE+BO that which indeed is

lu'u LUhU elidable terminator for LAhE and NAhE+BO

</pre><p>Well, that's quite a list of cmavo. What are they all about?

<p>

<cx "LAhE"><cx "NAhE"><lx "BO"><cx "sumti qualifiers, internal syntax of"><cx "sumti qualifiers, external syntax of"><cx "sumti qualifiers, elidable terminator for qualified sumti"><lx "lu'u"><cx "lu'u, as elidable terminator for qualified sumti">The above cmavo and compound cmavo are called the “sumti qualifiers”. All of them are either single cmavo of selma'o LAhE, or else compound cmavo involving a scalar negation cmavo of selma'o NAhE immediately followed by “bo” of selma'o BO. Syntacti­cally, you can prefix a sumti qualifier to any sumti and produce an­other simple sumti. (You may need to add the elidable terminator “lu'u” to show where the qualified sumti ends.)

<p>

<cx "sumti qualifiers, as short forms for common special cases">Semantically, sumti qualifiers represent short forms of certain common special cases. Suppose you want to say “I see 'The Red Pony’”, where “The Red Pony” is the title of a book. How about:

<p>

<cx "qualified sumti, contrasted with unqualified sumti"><cx "unqualified sumti, contrasted with qualified sumti"><ex "Red Pony"><pre><a name=e10d1>10.1) mi viska lu le xunre cmaxirma li'u

I see [quote] the red small-horse [unquote]

</pre><p>But <a href=#e10d1>Example 10.1 </a>doesn't work: it says that you see a piece of text “The Red Pony”. That might be all right if you were looking at the cover of the book, where the words “The Red Pony” are presumably written. (More precisely, where the words “le xunre cmaxirma” are written – but we may suppose the book has been translated into Loj­ban.)

<p>

What you really want to say is:

<p>

<pre><a name=e10d2>10.2) mi viska le selsinxa be lu le xunre cmaxirma li'u

I see the thing-represented-by [quote] the red small-horse [unquote]

</pre><p>The x2 place of “selsinxa” (the x1 place of “sinxa”) is a sign or sym­bol, and the x1 place of “selsinxa” (the x2 place of “sinxa”) is the thing represented by the sign. <a href=#e10d2>Exam­ple 10.2 </a>allows us to use a symbol (namely the title of a book) to represent the thing it is a symbol of (namely the book itself).

<p>

This operation turns out to be needed often enough that it's useful to be able to say:

<p>

<cx "la'e, as short for “le selsinxa be”"><pre><a name=e10d3>10.3) mi viska la'e lu le xunre cmaxirma li'u [lu'u]

I see the-referent-of [quote] the red small-horse [unquote].

</pre><cx "dereferencing a pointer, with la'e"><cx "la'e, effect of on meaning"><cx "referent, referring to with la'e"><lx "la'e">So when “la'e” is prefixed to a sumti referring to a symbol, it produces a sumti referring to the referent of that symbol. (In computer jargon, “la'e” dereferences a pointer.)

<p>

By introducing a sumti qualifier, we correct a false sentence (<a href=#e10d1>Example 10.1</a>), which too closely resembles its literal English equivalent, into a true sentence (<a href=#e10d3>Example 10.3</a>), without having to change it overmuch; in particular, the structure remains the same. Most of the uses of sumti qualifiers are of this general kind.

<p>

<lx "lu'e"><cx "lu'e, effect of on meaning"><cx "symbol, referring to with lu'e">The sumti qualifier “lu'e” provides the converse operation: it can be prefixed to a sumti referring to some thing to produce a sumti referring to a sign or symbol for the thing. For example,

<p>

<cx "lu'e, as short for “le sinxa be”"><ex "title of book"><pre><a name=e10d4>10.4) mi pu cusku lu'e le vi cukta

I [past] express a-symbol-for the nearby book.

I said the title of this book.

</pre><p>The equivalent form not using a sumti qualifier would be:

<p>

<pre><a name=e10d5>10.5) mi pu cusku le sinxa be le vi cukta

I [past] express the symbol-for the nearby book.

</pre>which is equivalent to <a href=#e10d4>Example 10.4</a>, but longer.

<p>

<lx "tu'a"><lx "lu'a"><lx "lu'i"><lx "lu'o"><lx "vu'i"><cx "tu'a, effect of on meaning"><cx "lu'a, effect of on meaning"><cx "lu'i, effect of on meaning"><cx "lu'o, effect of on meaning"><cx "vu'i, effect of on meaning"><cx "tu'a, use for forming abstractions"><cx "vu'i, use for creating sequence"><cx "sequence, contrasted with set">The other sumti qualifiers follow the same rules. The cmavo “tu'a” is used in forming abstractions, and is explained more fully in <a href=chap11.html>Chapter 11</a>. The triplet “lu'a”, “lu'i”, and “lu'o” convert between indi­viduals, masses, and sets; “vu'i” belongs to this group as well, but creates a sequence, which is similar to a set but has a definite order. (The set of John and Charles is the same as the set of Charles and John, but the se­quences are different.) Here are some examples:

<p>

<pre><a name=e10d6>10.6) mi troci tu'a le vorme

I try some-abstraction-about the door.

I try (to open) the door.

</pre><cx "tu'a, as being deliberately vague"><a href=#e10d6>Example 10.6 </a>might mean that I try to do something else involving the door; the form is deliberately vague.

<p>

Most of the following examples make use of the cmavo “ri”, belonging to sel­ma'o KOhA. This cmavo means “the thing last men­tioned”; it is equivalent to repeating the immediately previous sumti (but in its original context). It is explained in more de­tail in <a href=chap7.html>Chapter 7</a>.

<p>

<ex "set of rats"><pre><a name=e10d7>10.7) lo'i ratcu cu barda .iku'i lu'a ri cmalu

The-set-of rats is-large. But some-members-of it-last-mentioned is-small.

The set of rats is large, but some of its members are small.

<a name=e10d8>10.8) lo ratcu cu cmalu .iku'i lu'i ri barda

Some rats are-small. But the-set-of them-last-mentioned is-large.

Some rats are small, but the set of rats is large.

<a name=e10d9>10.9) mi ce do girzu

.i lu'o ri gunma

.i vu'i ri porsi

I in-a-set-with you are-a-set.

The-mass-of it-last-mentioned is-a-mass.

The-sequence-of it-last-mentioned is-a-sequence

The set of you and me is a set.

The mass of you and me is a mass.

The sequence of you and me is a sequence.

</pre>(Yes, I know these examples are a bit silly. This set was introduced for completeness, and practical examples are as yet hard to come by.)

<p>

<cx "sumti qualifiers, for negation"><cx "negation sumti qualifiers, meanings of">Finally, the four sumti qualifiers formed from a cmavo of NAhE and “bo” are all concerned with negation, which is discussed in detail in <a href=chap15.html>Chapter 15</a>. Here are a few ex­amples of negation sumti qualifiers:

<p>

<lx "na'ebo"><pre><a name=e10d10>10.10) mi viska na'ebo le gerku

I see something-other-than the dog.

</pre><p>This compound, “na'ebo”, is the most common of the four negation sumti qualifiers. The others usually only make sense in the context of repeating, with modifications, something already referred to:

<p>

<ex "lukewarm food"><pre><a name=e10d11>10.11) mi nelci loi glare cidja

.ije do nelci to'ebo ri

.ije la djein. nelci no'ebo ra

I like part-of-the-mass-of hot-type-of food.

And you like the-opposite-of the-last-mentioned.

And Jane likes the-neutral-value-of something-mentioned.

I like hot food, and you like cold food, and Jane likes lukewarm food.

</pre>(In <a href=#e10d11>Example 10.11</a>, the sumti “ra” refers to some previously men­tioned sumti other than that referred to by “ri”. We cannot use “ri” here, because it would signify “la djein.”, that being the most recent sumti available to “ri”. See more detailed explanations in <a href=chap7.html>Chapter 7</a>.)

<p>

### <a name=s11><h3>The syntax of vocative phrases</h3>

<p>

<cx "vocative phrases, as a “free modifier”">Vocative phrases are not sumti, but are explained in this chapter because their syntax is very similar to that of sumti. Gram­matically, a vocative phrase is one of the so-called “free modifiers” of Lojban, along with subscripts, parentheses, and various other con­structs explained in <a href=chap19.html>Chapter 19</a>. They can be placed after many, but not all, constructions of the grammar: in general, after any elidable terminator (which, how­ever, must not then be elided!), at the begin­nings and ends of sentences, and in many other places.

<p>

<cx "vocative phrase, purpose of"><lx "COI"><lx "DOI">The purpose of a vocative phrase is to indicate who is being addressed, or to indicate to that person that he or she ought to be listening. A vocative phrase begins with a cmavo of sel­ma'o COI or DOI, all of which are explained in more detail in <a href=chap13.html>Chapter 13</a>. Some­times that is all there is to the phrase:

<p>

<pre><a name=e11d1>11.1) coi

[greetings]

Hello.

<a name=e11d2>11.2) je'e

[acknowledgement]

Uh-huh.

Roger!

</pre><cx "vocative word, phrase following">In these cases, the person being addressed is obvious from the con­text. However, a voca­tive word (more precisely, one or more cmavo of COI, possibly followed by “doi”, or else just “doi” by itself) can be followed by one of several kinds of phrases, all of which are intended to indicate the addressee. The most common case is a name:

<p>

<lx "coi"><pre><a name=e11d2>11.2) coi. djan.

Hello, John.

</pre><p>A pause is required (for morphological reasons) between a member of COI and a name. You can use “doi” instead of a pause:

<p>

<lx "doi"><pre><a name=e11d3>11.3) coi doi djan.

Hello, John.

</pre>means exactly the same thing and does not require a pause. Using “doi” by itself is like just saying someone's name to attract his or her attention:

<p>

<pre><a name=e11d4>11.4) doi djan.

John!

</pre><cx "vocative phrase, forms of"><cx "vocative phrase, with sumti without descriptor"><cx "vocative phrase, implicit descriptor on">In place of a name, a description may appear, lacking its de­scriptor, which is under­stood to be “le”:

<p>

<pre><a name=e11d5>11.5) coi xunre pastu nixli

Hello, (red-type-of dress)-type-of girl.

Hello, girl with the red dress!

</pre><cx "vocative phrase, implicit quantifiers on"><cx "vocative phrase, explicit quantifiers prohibited on">The listener need not really be a “xunre pastu nixli”, as long as she understands herself correctly from the description. (Actually, only a bare selbri can appear; explicit quanti­fiers are forbidden in this form of vocative, so the implicit quantifiers “su'o le ro” are in effect.)

<p>

Finally, a complete sumti may be used, the most general case.

<p>

<cx "vocative phrase, with complete sumti"><pre><a name=e11d6>11.6) co'o la bab. .e la noras.

Goodbye, Bob and Nora.

</pre><a href=#e11d5>Example 11.5 </a>is thus the same as:

<p>

<pre><a name=e11d7>11.7) coi le xunre pastu nixli

Hello, the-one-described-as red-dress girl!

</pre>and <a href=#e11d4>Example 11.4 </a>is the same as:

<p>

<pre><a name=e11d8>11.8) doi la djan.

The-one-named John!

</pre><cx "vocative phrase, elidable terminator for"><lx "do'u"><lx "DOhU"><cx "vocative phrase terminator, elidability of">Finally, the elidable terminator for vocative phrases is “do'u” (of sel­ma'o DOhU), which is rarely needed except when a simple vocative word is being placed somewhere within a bridi. It may also be re­quired when a vocative is placed between a sumti and its rela­tive clause, or when there are a sequence of so-called “free modifiers” (vocatives, sub­scripts, utterance ordinals — see <a href=chap18.html>Chapter 18 </a>— metalinguistic comments — see <a href=chap19.html>Chap­ter 19 </a>— or reciprocals — see <a href=chap19.html>Chapter 19</a>) which must be properly separated.

<p>

<cx "vocative phrase, effect of position on meaning">The meaning of a vocative phrase that is within a sentence is not affected by its posi­tion in the sentence: thus <a href=#e11d9>Example 11.9 </a>and <a href=#e11d10>Example 11.10 </a>mean the same thing:

<p>

<pre><a name=e11d9>11.9) doi djan. ko klama mi

John, come to me!

<a name=e11d10>11.10) ko klama mi doi djan.

Come to me, John!

</pre><p>As usual for this chapter, the full syntax of vocative phrases has not been ex­plained: relative clauses, discussed in <a href=chap8.html>Chapter 8</a>, make for more possibilities.

<p>

### <a name=s12><h3>Lojban names</h3>

<p>

Names have been used freely as sumti throughout this chapter without too much ex­planation. The time for the explanation has now come.

<p>

<cx "names, two kinds of"><cx "name words, recognition of">First of all, there are two different kinds of things usually called “names” when talk­ing about Lojban. The naming predicates of <a href=#s2>Section 2 </a>are just ordinary predicates which are being used in a spe­cial sense. In addition, though, there is a class of Lojban words which are used only to name things: these can be recognized by the fact that they end in a consonant followed by a pause. Some examples:

<p>

<pre><a name=e12d1>12.1) djan. meris. djein. .alis.

John. Mary. Jane. Alice.

</pre>(Note that “.alis.” begins as well as ends with a pause, because all Lojban words begin­ning with a vowel must be preceded by a pause. See <a href=chap4.html>Chapter 4 </a>for more information.)

<p>

<cx "names, uses of"><cx "names, in vocative phrase"><cx "names, with LA descriptor">Names of this kind have two basic uses in Lojban: when used in a vocative phrase (see <a href=#s11>Section 11</a>) they indicate who the listener is or should be. When used with a de­scriptor of selma'o LA, namely “la”, “lai”, or “la'i”, they form sumti which refer to the persons or things known by the name.

<p>

<lx "la"><pre><a name=e12d2>12.2) la djonz. klama le zarci

Jones goes to-the store.

The Joneses go to-the store.

</pre><lx "lai"><pre><a name=e12d3>12.3) lai djonz. klama le zarci

The-mass-of Joneses go to-the store.

The Joneses go to the store.

</pre><p>In <a href=#e12d2>Example 12.2</a>, the significance is that all the persons (perhaps only one) I mean to refer to by the name “djonz.” are going to the store. In <a href=#e12d3>Example 12.3</a>, the Joneses are massi­fied, and only some part of them needs to be going. Of course, by “djonz.” I can mean whomever I want: that person need not use the name “djonz.” at all.

<p>

<cx "LE, contrasted with LA in use of name-words"><cx "LA, contrasted with LE in use of name-words">The sumti in <a href=#e12d2>Example 12.2 </a>and <a href=#e12d3>Example 12.3 </a>operate exactly like the similar uses of “la” and “lai” in <a href=#e2d{5}>Examples 2.5 </a>and <a href=#e3d6>3.6 </a>respec­tively. The only difference is that these de­scriptors are followed by Lojban name-words. And in fact, the only difference between de­scriptors of selma'o LA (these three) and of selma'o LE (all the other de­scriptors) is that the former can be followed by name-words, whereas the latter cannot.

<p>

<cx "name-words, limitations on"><cx "name-words, pause requirements before"><cx "LA, effect on necessity for pause before name-word"><cx "doi, effect on necessity for pause before name-word"><lx "doi"><lx "LA"><lx "la"><lx "lai"><lx "la'i">There are certain limitations on the form of name-words in Lojban. In particu­lar, they cannot contain the letter-sequences (or sound-sequences) “la”, “lai”, or “doi” unless a consonant immediately precedes within the name. Reciprocally, every name not preceded by “la”, “lai”, “la'i”, or “doi” must be preceded by a pause instead:

<p>

<pre><a name=e12d4>12.4) coi .djan.

Hello, John.

<a name=e12d5>12.5) zo .djan. cmene mi

The-word “John” is-the-name-of me.

My name is John.

</pre><p>In <a href=#e12d4>Example 12.4 </a>and <a href=#e12d5>Example 12.5</a>, “.djan.” appears with a pause before it as well as af­ter it, because the preceding word is not one of the four special cases. These rules force names to always be sepa­rable from the general word-stream.

<p>

<cx "names, multiple">Unless some other rule prevents it (such as the rule that “zo” is always fol­lowed by a single word, which is quoted), multiple names may appear wherever one name is permit­ted, each with its terminat­ing pause:

<p>

<ex "Newport News"><ex "John Paul Jones"><pre><a name=e12d6>12.6) doi djan. pol. djonz. le bloti cu klama fi la niuport. niuz.

John Paul Jones, the boat comes (to somewhere) from Newport News.

</pre><cx "name-words, permissible consonant combinations">A name may not contain any consonant combination that is illegal in Lojban words generally: the “impermissible consonant clus­ters” of Lojban morphology (explained in <a href=chap3.html>Chapter 3</a>). Thus “djeimz.” is not a valid version of “James” (because “mz” is invalid): “djeimyz” will suffice. Similarly, “la” may be replaced by “ly”, “lai” by “ly'i”, “doi” by “do'i” or “dai”. Here are a few examples:

<p>

<pre> English name invalid Lojban name valid Lojban names

</pre><ex "Lottie"><ex "Lyra"><ex "Doyle"><pre> Doyle \*doi,l do'il or dai,l

Lyra \*lairas ly'iras

Lottie \*latis LYtis. or lotis.

(American pronunciation)

</pre><cx "names, using rafsi">Names may be borrowed from other languages or created arbitrarily. Another com­mon practice is to use one or more rafsi, ar­ranged to end with a consonant, to form a name: thus the rafsi “loj-” for “logji” (logical) and “ban-” for “bangu” (language) unite to form the name of this language:

<p>

<pre><a name=e12d7>12.7) lojban.

Lojban

</pre><cx "names, borrowing from other languages"><cx "names from vowel-final base, commonly used consonant endings">When borrowing names from another language which end in a vowel, or when turn­ing a Lojban brivla (all of which end in vowels) into a name, the vowel may be re­moved or an arbitrary consonant added. It is common (but not required) to use the con­sonants “s” or “n” when borrowing vowel-final names from English; speakers of other languages may wish to use other consonant endings.

<p>

<cx "names with la, implicit quantifier for">The implicit quantifier for name sumti of the form “la” followed by a name is “su'o”, just as for “la” followed by a selbri.

<p>

### <a name=s13><h3>Pro-sumti summary</h3>

<p>

<cx "pro-sumti, classes of">The Lojban pro-sumti are the cmavo of selma'o KOhA. They fall into several classes: personal, definable, quantificational, reflex­ive, back-counting, indefinite, de­monstrative, metalinguistic, relative, question. More details are given in <a href=chap7.html>Chapter 7</a>; this section mostly du­plicates information found there, but adds material on the implicit quantifier of each pro-sumti.

<p>

<cx "pro-sumti, implicit quantifier for"><lx "ro">The following examples illustrate each of the classes. Unless otherwise noted below, the implicit quantification for pro-sumti is “ro” (all). In the case of pro-sumti which refer to other sumti, the “ro” signi­fies “all of those referred to by the other sumti”: thus it is possible to restrict, but not to extend, the quantification of the other sumti.

<p>

<cx "personal pro-sumti">Personal pro-sumti (“mi”, “do”, “mi'o”, “mi'a”, “ma'a”, “do'o”, “ko”) refer to the speaker or the listener or both, with or without third parties:

<p>

<pre><a name=e13d1>13.1) mi prami do

I love you.

</pre><cx "personal pro-sumti, implicit quantifier for">The personal pro-sumti may be interpreted in context as either repre­senting individuals or masses, so the implicit quantifier may be “pisu'o” rather than “ro”: in particular, “mi'o”, “mi'a”, “ma'a”, and “do'o” specifically represent mass combinations of the indi­viduals (you and I, I and others, you and I and others, you and others) that make them up.

<p>

<cx "definable pro-sumti">Definable pro-sumti (“ko'a”, “ko'e”, “ko'i”, “ko'o”, “ko'u”, “fo'a”, “fo'e”, “fo'i”, “fo'o”, “fo'u”) refer to whatever the speaker has explicitly made them refer to. This refer­ence is accomplished with “goi” (of selma'o GOI), which means “defined-as”.

<p>

<pre><a name=e13d2>13.2) le cribe goi ko'a cu xekri .i ko'a citka le smacu

The bear defined-as it-1 is-black. It-1 eats the mouse.

</pre><cx "quantificational pro-sumti">Quantificational pro-sumti (“da”, “de”, “di”) are used as vari­ables in bridi in­volving predicate logic:

<p>

<pre><a name=e13d3>13.3) ro da poi prenu cu prami pa de poi finpe

All somethings-1 which-are persons love one something-2 which-is a-fish.

All persons love a fish (each his/her own).

</pre><cx "quantificational pro-sumti, implicit quantification rules">(This is not the same as “All persons love a certain fish”; the differ­ence between the two is one of quantifier order.) The implicit quantifi­cation rules for quantificational pro-sumti are particular to them, and are discussed in detail in <a href=chap16.html>Chapter 16</a>. Roughly speaking, the quanti­fier is “su'o” (at least one) when the pro-sumti is first used, and “ro” (all) thereafter.

<p>

<cx "reflexive pro-sumti">Reflexive pro-sumti (“vo'a”, “vo'e”, “vo'i”, “vo'o”, “vo'u”) refer to the same referents as sumti filling other places in the same bridi, with the effect that the same thing is re­ferred to twice:

<p>

<pre><a name=e13d4>13.4) le cribe cu batci vo'a

The bear bites what-is-in-the-x1-place.

The bear bites itself.

</pre><cx "back-counting pro-sumti">Back-counting pro-sumti (“ri”, “ra”, “ru”) refer to the referents of previous sumti counted backwards from the pro-sumti:

<p>

<pre><a name=e13d5>13.5) mi klama la frankfurt. ri

I go to-Frankfurt from-the-referent-of-the-last-sumti

I go from Frankfurt to Frankfurt (by some unstated route).

</pre><cx "indefinite pro-sumti">Indefinite pro-sumti (“zo'e”, “zu'i”, “zi'o”) refer to something which is un­specified:

<p>

<pre><a name=e13d6>13.6) mi klama la frankfurt. zo'e zo'e zo'e

I go to-Frankfurt from-unspecified via-unspecified by-means-unspecified.

</pre><cx "indefinite pro-sumti, implicit quantifier for">The implicit quantifier for indefinite pro-sumti is, well, indefinite. It might be “ro” (all) or “su'o” (at least one) or conceivably even “no” (none), though “no” would require a very odd context indeed.

<p>

<cx "demonstrative pro-sumti">Demonstrative pro-sumti (“ti”, “ta”, “tu”) refer to things pointed at by the speaker, or when pointing is not possible, to things near or far from the speaker:

<p>

<pre><a name=e13d7>13.7) ko muvgau

ti ta tu

You [imperative] move

this-thing from-that-nearby-place to-that-further-away-place.

Move this from there to over there!

</pre><cx "metalinguistic pro-sumti">Metalinguistic pro-sumti (“di'u”, “de'u”, “da'u”, “di'e”, “de'e”, “da'e”, “dei”, “do'i”) refer to spoken or written utterances, either pre­ceding, following, or the same as the cur­rent utterance.

<p>

<pre><a name=e13d8>13.8) li re su'i re du li vo

.i la’edi'u jetnu

The-number two plus two equals the-number four.

The-previous-utterance is-true.

</pre><cx "metalinguistic pro-sumti, implicit quantifier for">The implicit quantifier for metalinguistic pro-sumti is “su'o” (at least one), because they are considered analogous to “lo” descriptions: they refer to things which really are pre­vious, current, or following utterances.

<p>

<cx "relative pro-sumti">The relative pro-sumti (“ke'a”) is used within relative clauses (see <a href=chap8.html>Chapter 8 </a>for a discussion of relative clauses) to refer to what­ever sumti the relative clause is at­tached to.

<p>

<pre><a name=e13d9>13.9) mi viska le mlatu ku poi zo'e zbasu ke'a

loi slasi

I see the cat(s) such-that something-unspecified makes it/them (the cats)

from-a-mass-of plastic.

I see the cat(s) made of plastic.

</pre><cx "question pro-sumti">The question pro-sumti (“ma”) is used to ask questions which request the lis­tener to supply a sumti which will make the question into a truth:

<p>

<pre><a name=e13d10>13.10) do klama ma

You go to-what-sumti?

Where are you going?

</pre><cx "question pro-sumti, implicit quantifier for">The implicit quantifier for the question pro-sumti is “su'o” (at least one), because the lis­tener is only being asked to supply a single an­swer, not all correct answers.

<p>

<cx "definable pro-sumti, sequences of lerfu words as">In addition, sequences of lerfu words (of selma'o BY and re­lated selma'o) can also be used as definable pro-sumti.

<p>

### <a name=s14><h3>Quotation summary</h3>

<p>

<cx "quotation, four kinds">There are four kinds of quotation in Lojban: text quotation, words quotation, single-word quotation, non-Lojban quotation. More information is provided in <a href=chap19.html>Chapter 19</a>.

<p>

<cx "text quotation, syntax of"><cx "text quotation, as internally grammatical"><lx "lu"><lx "li'u">Text quotations are preceded by “lu” and followed by “li'u”, and are an essen­tial part of the surrounding text: they must be grammatical Lojban texts.

<p>

<pre><a name=e14d1>14.1) mi cusku lu mi'e djan. li'u

I say the-text [quote] I-am John [unquote].

I say “I'm John”.

</pre><cx "word quotation, as morphologically valid"><cx "word quotation, internal grammar of">Words quotations are quotations of one or more Lojban words. The words need not mean anything, but they must be mor­phologically valid so that the end of the quo­tation can be discerned.

<p>

<lx "lo'u"><lx "le'u"><pre><a name=e14d2>14.2) mi cusku lo'u li mi le'u

I say the-words [quote] “li mi” [unquote].

I say “li mi”.

</pre><p>Note that the translation of <a href=#e14d2>Example 14.2 </a>does not translate the Loj­ban words, because they are not presumed to have any meaning (in fact, they are ungrammatical).

<p>

<cx "single-word quotation">Single-word quotation quotes a single Lojban word. Com­pound cmavo are not al­lowed.

<p>

<pre><a name=e14d3>14.3) mi cusku zo .ai

I say the-word “.ai”.

</pre><cx "non-Lojban quotation">Non-Lojban quotation can quote anything, Lojban or not, even non-speech such as drum talk, whistle words, music, or belch­ing. A Lojban word which does not appear within the quotation is used before and after it to set it off from the surrounding Lojban text.

<p>

<pre><a name=e14d4>14.4) mi cusku zoi kuot. I'm John .kuot

I say “I'm John”.

</pre><cx "quotation, implicit quantifier for">The implicit quantifier for all types of quotation is “su'o” (at least one), be­cause quotations are analogous to “lo” descriptions: they refer to things which actually are words or sequences of words.

<p>

### <a name=s15><h3>Number summary</h3>

<p>

<cx "number sumti, syntax of"><cx "number sumti, with li"><lx "li">The sumti which refer to numbers consist of the cmavo “li” (of selma'o LI) followed by an arbitrary Lojban mekso, or mathematical expression. This can be any­thing from a simple number up to the most complicated combination of numbers, vari­ables, operators, and so on. Much more information on numbers is given in <a href=chap18.html>Chapter 18</a>. Here are a few examples of increasing complexity:

<p>

<pre><a name=e15d1>15.1) li vo

the-number four

4

<a name=e15d2>15.2) li re su'i re

the-number two plus two

<math>2 + 2</math>

<a name=e15d3>15.3) li .abu bopi'i xy. bote'a re su'i by. bopi'i xy. su'i cy.

the-number a times x to-power 2 plus b times x plus c

<math>*a*x<sup>2</sup>+ *b*x + *c*</math>

</pre><cx "number sumti, with me'o"><cx "me'o"><cx "LI"><cx "number sumti, with me'o contrasted with li"><cx "number sumti, with li contrasted with me'o">An alternative to “li” is “me'o”, also of selma'o LI. Number ex­pressions begin­ning with “me'o” refer to the actual expression, rather than its value. Thus <a href=#e15d1>Example 15.1 </a>and <a href=#e15d2>Example 15.2 </a>above have the same meaning, the number four, whereas

<p>

<pre><a name=e15d4>15.4) me'o vo

the-expression four

“4”

</pre>and

<p>

<pre><a name=e15d5>15.5) me'o re su'i re

the-expression two plus two

“2+2”

</pre>refer to different pieces of text.

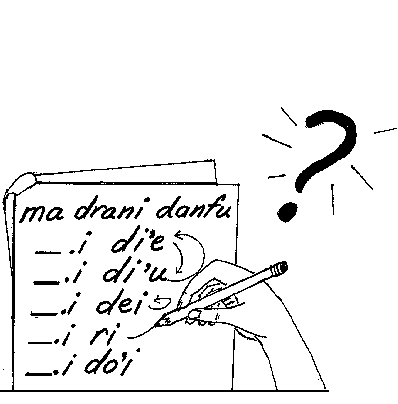
<p>

<cx "numbers, implicit quantifier for"><cx "mathematical expressions, implicit quantifier for">The implicit quantifier for numbers and mathematical expres­sions is “su'o”, because these sumti are analogous to “lo” descrip­tions: they refer to things which actu­ally are numbers or pieces of text. In the case of numbers (with “li”), this is a distinc­tion without a difference, as there is only one number which is 4; but there are many texts “4”, as many as there are documents in which that nu­meral appears.

<p>

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## <h2>Chapter 7

## <br>

## Brevity Is The Soul Of Language: Pro-sumti And Pro-bridi</h2>

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<p>

### <a name=s1><h3>What are pro-sumti and pro-bridi? What are they for?</h3>

<p>

<cx "pronouns in English, as noun abbreviations">Speakers of Lojban, like speakers of other languages, require mechanisms of abbre­viation. If every time we referred to something, we had to express a complete de­scription of it, life would be too short to say what we have to say. In English, we have words called “pronouns” which allow us to replace nouns or noun phrases with shorter terms. An Eng­lish with no pronouns might look something like this:

<p>

<pre><a name=e1d1>1.1) Speakers of Lojban, like speakers of other languages, require mechanisms of

abbreviation. If every time speakers of Lojban referred to a thing to which

speakers of Lojban refer, speakers of Lojban had to express a complete

description of what speakers of Lojban referred to, life would be too short to

say what speakers of Lojban have to say.

</pre><cx "pronouns in English, as independent of abbreviations">Speakers of this kind of English would get mightily sick of talking. Furthermore, there are uses of pronouns in English which are inde­pendent of abbreviation. There is all the difference in the world be­tween:

<p>

<ex "shook stick"><pre><a name=e1d2>1.2) John picked up a stick and shook it.

</pre>and

<p>

<pre><a name=e1d3>1.3) John picked up a stick and shook a stick.

</pre><a href=#e1d3>Example 1.3 </a>does not imply that the two sticks are necessarily the same, whereas <a href=#e1d2>Ex­am­ple 1.2 </a>requires that they are.

<p>

<cx "pronouns, compared to pro-sumti in usage as abbreviations"><cx "pro-sumti, compared to pronouns in usage as abbreviations"><cx "pro-sumti, definition"><cx "pro-bridi, definition"><lx "KOhA"><lx "GOhA"><cx "pro-bridi, compared to pro-sumti as means of abbreviation"><cx "pro-sumti, compared to pro-bridi as means of abbreviation"><cx "pro-sumti, series">In Lojban, we have sumti rather than nouns, so our equiva­lent of pronouns are called by the hybrid term “pro-sumti”. A purely Lojban term would be “sumti cmavo”: all of the pro-sumti are cmavo belonging to selma'o KOhA. In exactly the same way, Lojban has a group of cmavo (belonging to selma'o GOhA) which serve as selbri or full bridi. These may be called “pro-bridi” or “bridi cmavo”. This chap­ter explains the uses of all the members of selma'o KOhA and GOhA. They fall into a number of groups, known as se­ries: thus, in selma'o KOhA, we have among others the mi-series, the ko'a-series, the da-series, and so on. In each section, a series of pro-sumti is explained, and if there is a cor­responding series of pro-bridi, it is explained and contrasted. Many pro-sumti series don't have pro-bridi analogues, however.

<p>

<cx "referent of pro-sumti, definition"><cx "antecedent of pro-sumti, definition"><cx "referent of pro-bridi, definition"><cx "antecedent of pro-bridi, definition">A few technical terms: The term “referent” means the thing to which a pro-sumti (by extension, a pro-bridi) refers. If the speaker of a sentence is James, then the referent of the word “I” is James. On the other hand, the term “antecedent” refers to a piece of language which a pro-sumti (or pro-bridi) implicitly repeats. In

<p>

<pre><a name=e1d4>1.4) John loves himself

</pre>the antecedent of “himself” is “John”; not the person, but a piece of text (a name, in this case). John, the person, would be the referent of “himself”. Not all pro-sumti or pro-bridi have antecedents, but all of them have referents.

<p>

### <a name=s2><h3>Personal pro-sumti: the mi-series</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> mi KOhA mi-series I, me

do KOhA mi-series you

mi'o KOhA mi-series you and I

mi'a KOhA mi-series I and others,

we but not you

ma'a KOhA mi-series you and I and others

do'o KOhA mi-series you and others

ko KOhA mi-series you-imperative

</pre><ex "foreman of a jury"><cx "mi-series, of pro-sumti"><cx "pro-sumti, mi-series"><lx "mi"><lx "do"><cx "pro-sumti, for speaker(s)"><cx "pro-sumti, for listener(s)"><cx "personal pronouns, with mi-series for I/you">The mi-series of pro-sumti refer to the speaker, the listener, and others in vari­ous combinations. “mi” refers to the speaker and perhaps others for whom the speaker speaks; it may be a Lojbanic mass. “do” refers to the listener or listeners. Neither “mi” nor “do” is specific about the number of persons referred to; for example, the foreman of a jury may refer to the members of the jury as “mi”, since in speaking officially he represents all of them.

<p>

<cx "COI, effect on referent of “mi”"><cx "COI, effect on referent of “do”"><lx "mi'e"><lx "COI">The referents of “mi” and “do” are usually obvious from the context, but may be as­signed by the vocative words of selma'o COI, explained in <a href=chap13.html>Chapter 13</a>. The voca­tive “mi'e” assigns “mi”, whereas all of the other vocatives assign “do”.

<p>

<pre><a name=e2d1>2.1) mi'e djan. doi frank. mi cusku lu mi bajra li'u do

I-am John, O Frank, I express [quote] I run [unquote] to-you

I am John, Frank; I tell you “I run”.

</pre><lx "mi'o"><lx "mi'a"><lx "ma'a"><lx "do'o"><cx "pro-sumti, for listeners and/or speakers and/or others">The cmavo “mi'o”, “mi'a”, “ma'a”, and “do'o” express various combinations of the speaker and/or the listener and/or other people:

* <p>
* <dl compact><dt><dd>“mi'o” includes only the speaker and the listener but no one else;
* “mi'a” includes the speaker and others but excludes the listener;
* <p><dt><dd>“do'o” includes the listener and others but excludes the speaker;
* <p><dt><dd>“ma'a” includes all three: speaker, listener, others.

</dl><cx "pro-sumti for speaker/listener/others, relation to joi"><cx "pro-sumti for speaker/listener/others, as masses">All of these pro-sumti represent masses. For example, “mi'o” is the same as “mi joi do”, the mass of me and you considered jointly.

<p>

<cx "English “we”, contrasted with Lojban pro-sumti for “we”"><cx "pro-sumti for “we”, contrasted with English “we”">In English, “we” can mean “mi” or “mi'o” or “mi'a” or even “ma'a”, and Eng­lish-speakers often suffer because they cannot easily distinguish “mi'o” from “mi'a”:

<p>

<pre><a name=e2d2>2.2) We're going to the store.

</pre><p>Does this include the listener or not? There's no way to be sure.

<p>

<lx "ko"><cx "commands, with ko"><cx "imperatives, with ko"><cx "ko, use for imperatives"><cx "ko, use for commands">Finally, the cmavo “ko” is logically equivalent to “do”; its ref­erent is the lis­tener. However, its use alters an assertion about the listener into a command to the lis­tener to make the assertion true:

<p>

<pre><a name=e2d3>2.3) do klama le zarci

You go to-the store.

</pre>becomes:

<p>

<pre><a name=e2d4>2.4) ko klama le zarci

You [imperative] go to-the store.

Make “you go to the store” true!

Go to the store!

</pre><cx "imperatives, English contrasted with Lojban in presence of subject of command"><cx "ko, in later selbri place in imperative">In English, the subject of a command is omitted, but in Loj­ban, the word “ko” must be used. However, “ko” does not have to ap­pear in the x1 place:

<p>

<pre><a name=e2d5>2.5) mi viska ko

I see you [imperative]

Make “I see you” true!

Be seen by me!

</pre><cx "ko, in sub-clause of main bridi">In <a href=#e2d5>Example 2.5</a>, it is necessary to make the verb passive in English in order to convey the effect of “ko” in the x2 place. Indeed, “ko” does not even have to be a sumti of the main bridi:

<p>

<pre><a name=e2d6>2.6) mi viska le prenu poi prami ko

I see the person that loves you [imperative]

Make “I see the person that loves you” true!

Be such that the person who loves you is seen by me!

Show me the person who loves you!

</pre><cx "mi-series pro-sumti, lack of pro-bridi equivalent">As mentioned in <a href=#s1>Section 1</a>, some pro-sumti series have cor­responding pro-bridi se­ries. However, there is no equivalent of the mi-series among pro-bridi, since a person isn't a relationship.

<p>

### <a name=s3><h3>Demonstrative pro-sumti: the ti-series</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> ti KOhA ti-series this here, a nearby object

ta KOhA ti-series that there, a medium-distant object

tu KOhA ti-series that yonder, a far-distant object

</pre><cx "pointing, reference by"><cx "demonstrative pro-sumti"><cx "ti-series pro-sumti, compared with English this/that"><cx "this/that in English, compared with ti-series pro-sumti"><cx "ti-series pro-sumti, as pointing referents only"><cx "pro-sumti, ti-series"><lx "ti"><lx "ta"><lx "tu">It is often useful to refer to things by pointing to them or by some related non-lin­guistic mechanism. In English, the words “this” and “that” serve this function among oth­ers: “this” refers to something pointed at that is near the speaker, and “that” refers to something further away. The Lojban pro-sumti of the ti-series serve the same functions, but more narrowly. The cmavo “ti”, “ta”, and “tu” provide only the pointing function of “this” and “that”; they are not used to re­fer to things that cannot be pointed at.

<p>

<cx "yon, as archaic English equivalent of tu"><cx "tu, archaic English yon as equivalent of"><cx "ti-series pro-sumti, 3 degrees of distance with">There are three pro-sumti of the ti-series rather than just two because it is often use­ful to distinguish between objects that are at more than two different distances. Japanese, among other lan­guages, regularly does this. Until the 16th century, English did too; the pronoun “that” referred to something at a medium distance from the speaker, and the now-archaic pronoun “yon” to something far away.

<p>

<cx "ti-series pro-sumti, conversational convention for"><cx "ti-series pro-sumti, problems in written text">In conversation, there is a special rule about “ta” and “tu” that is often helpful in in­terpreting them. When used contrastingly, “ta” refers to something that is near the lis­tener, whereas “tu” refers to something far from both speaker and listener. This makes for a par­allelism between “ti” and “mi”, and “ta” and “do”, that is convenient when pointing is not possible; for example, when talking by tele­phone. In written text, on the other hand, the meaning of the ti-series is inherently vague; is the writer to be taken as pointing to something, and if so, to what? In all cases, what counts as “near” and “far away” is rela­tive to the current situation.

<p>

<cx "this, pronoun usage contrasted with adjective usage"><cx "this, adjective usage contrasted with pronoun usage"><cx "ti, as pronoun usage for “this”"><cx "this, pronoun usage with “ti”">It is important to distinguish between the English pronoun “this” and the Eng­lish ad­jective “this” as in “this boat”. The latter is not represented in Lojban by “ti”:

<p>

<ex "this boat"><pre><a name=e3d1>3.1) le ti bloti

the this boat

</pre><cx "vi, as adjective usage for “this”"><cx "this, adjective usage with “vi”">does not mean “this boat” but rather “this one's boat”, “the boat asso­ciated with this thing”, as explained in <a href=chap8.html>Chapter 8</a>. A correct Lojban translation of <a href=#e3d1>Example 3.1 </a>is

<p>

<pre><a name=e3d2>3.2) le vi bloti

the here boat

the nearby boat

</pre>using a spatial tense before the selbri “bloti” to express that the boat is near the speaker. (Tenses are explained in full in <a href=chap11.html>Chapter 11</a>.) An­other correct translation would be:

<p>

<cx "ti noi, as adjective usage for “this”"><cx "this, adjective usage with “ti noi”"><pre><a name=e3d3>3.3) ti noi bloti

this-thing which-incidentally is-a-boat

</pre><cx "ti-series pro-sumti, lack of pro-bridi equivalent">There are no demonstrative pro-bridi to correspond to the ti-series: you can't point to a relationship.

<p>

### <a name=s4><h3>Utterance pro-sumti: the di'u-series</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> di'u KOhA di'u-series the previous utterance

de'u KOhA di'u-series an earlier utterance

da'u KOhA di'u-series a much earlier utterance

di'e KOhA di'u-series the next utterance

de'e KOhA di'u-series a later utterance

da'e KOhA di'u-series a much later utterance

dei KOhA di'u-series this very utterance

do'i KOhA di'u-series some utterance

</pre><cx "pro-sumti for utterances"><cx "utterance pro-sumti (see also di'u-series pro-sumti)"><cx "di'u-series pro-sumti"><cx "this, as utterance reference in English"><cx "pro-sumti, di'u-series">The cmavo of the di'u-series enable us to talk about things that have been, are being, or will be said. In English, it is normal to use “this” and “that” for this (indeed, the imme­diately pre­ceding “this” is an example of such a usage):

<p>

<pre><a name=e4d1>4.1) You don't like cats.

That is untrue.

</pre><p>Here “that” does not refer to something that can be pointed to, but to the preceding sen­tence “You don't like cats”. In Lojban, therefore, <a href=#e4d1>Example 4.1 </a>is rendered:

<p>

<pre><a name=e4d2>4.2) do na nelci loi mlatu .i di'u jitfa jufra

You (Not!) like the-mass-of cats. The-previous-utterance is-a-false-sentence.

</pre><cx "ta, contrasted with di'u"><cx "di'u, contrasted with ta"><cx "ti-series pro-sumti, contrasted with di'u-series pro-sumti">Using “ta” instead of “di'u” would cause the listener to look around to see what the speaker of the second sentence was physically pointing to.

<p>

<lx "di'u"><lx "de'u"><lx "da'u">As with “ti”, “ta”, and “tu”, the cmavo of the di'u-series come in threes: a close utter­ance, a medium-distance utterance, and a distant utterance, either in the past or in the fu­ture. It turned out to be impossible to use the “i”/“a”/“u” vowel convention of the demon­stratives in <a href=#s3>Section 3 </a>without causing collisions with other cmavo, and so the di'u-series has a unique “i”/“e”/“a” convention in the first vowel of the cmavo.

<p>

<lx "di'e"><lx "de'e"><lx "da'e">Most references in speech are to the past (what has already been said), so “di'e”, “de'e”, and “da'e” are not very useful when speaking. In writing, they are fre­quently handy:

<p>

<ex "Simon says"><pre><a name=e4d3>4.3) la saimn. cusku di'e

Simon expresses the-following-utterance.

Simon says:

</pre><a href=#e4d3>Example 4.3 </a>would typically be followed by a quotation. Note that al­though presuma­bly the quotation is of something Simon has said in the past, the quotation utterance itself would appear after <a href=#e4d3>Example 4.3</a>, and so “di'e” is appropriate.

<p>

<lx "dei"><lx "do'i">The remaining two cmavo, “dei” and “do'i”, refer respectively to the very ut­terance that the speaker is uttering, and to some vague or unspecified utterance uttered by some­one at some time:

<p>

<pre><a name=e4d4>4.4) dei jetnu jufra

This-utterance is-a-true-sentence.

What I am saying (at this moment) is true.

<a name=e4d5>4.5) do'i jetnu jufra

Some-utterance is-a-true-sentence.

That's true (where “that” is not necessarily what was just said).

The cmavo of the di'u-series have a meaning that is relative to the context. The refer­ent of “dei” in the current utterance is the same as the referent of “di'u” in the next utter­ance. The term “utterance” is used rather than “sentence” because the amount of speech or written text referred to by any of these words is vague. Often, a single bridi is intended, but longer utterances may be thus referred to.

<p>

<lx "la'e"><lx "LAhE"><lx "la'edi'u">Note one very common construction with “di'u” and the cmavo “la'e” (of sel­ma'o LAhE; see <a href=chap6.html>Chapter 6</a>) which precedes a sumti and means “the thing referred to by (the sumti)”:

<p>

<pre><a name=e4d6>4.6) mi prami la djein. .i mi nelci la'e di'u

I love Jane. And I like the-referent-of the-last-utterance.

I love Jane, and I like that.

<cx "di'u, contrasted with la'edi'u"><cx "la'edi'u, contrasted with di'u">The effect of “la'e di'u” in <a href=#e4d6>Example 4.6 </a>is that the speaker likes, not the previous sen­tence, but rather the state of affairs referred to by the previous sentence, namely his lov­ing Jane. This cmavo compound is often written as a single word: “la'edi'u”. It is impor­tant not to mix up “di'u” and “la'edi'u”, or the wrong meaning will generally re­sult:

<p>

<pre><a name=e4d7>4.7) mi prami la djein. .i mi nelci di'u

I love Jane. And I like the-last-utterance.

</pre>says that the speaker likes one of his own sentences.

<p>

There are no pro-bridi corresponding to the di'u-series.

<p>

### <a name=s5><h3>Assignable pro-sumti and pro-bridi: the ko'a-series and the broda-series</h3>

<p>

The following cmavo and gismu are discussed in this section:

<p>

<pre> ko'a KOhA ko'a-series it-1

ko'e KOhA ko'a-series it-2

ko'i KOhA ko'a-series it-3

ko'o KOhA ko'a-series it-4

ko'u KOhA ko'a-series it-5

fo'a KOhA ko'a-series it-6

fo'e KOhA ko'a-series it-7

fo'i KOhA ko'a-series it-8

fo'o KOhA ko'a-series it-9

fo'u KOhA ko'a-series it-10

broda BRIVLA broda-series is-thing-1

brode BRIVLA broda-series is-thing-2

brodi BRIVLA broda-series is-thing-3

brodo BRIVLA broda-series is-thing-4

brodu BRIVLA broda-series is-thing-5

goi GOI pro-sumti assignment

cei CEI pro-bridi assignment

</pre><cx "personal pronouns, with ko'a-series for he/she/it/they"><cx "pro-sumti, ko'a-series"><cx "ko'a-series pro-sumti">The discussion of personal pro-sumti in <a href=#s2>Section 2 </a>may have seemed incom­plete. In English, the personal pronouns include not only “I” and “you” but also “he”, “she”, “it”, and “they”. Lojban does have equivalents of this latter group: in fact, it has more of them than English does. However, they are organized and used very differently.

<p>

<cx "personal pronouns for he/she/it/they, English contrasted with Lojban in organization"><cx "ko'a-series pro-sumti, as assignable">There are ten cmavo in the ko'a-series, and they may be as­signed freely to any sumti whatsoever. The English word “he” can refer only to males, “she” only to fe­males (and ships and a few other things), “it” only to inanimate things, and “they” only to plurals; the cmavo of the ko'a-series have no restrictions at all. Therefore, it is almost impossible to guess from the context what ko'a-series cmavo might refer to if they are just used freely:

<p>

<lx "ko'a"><pre><a name=e5d1>5.1) la .alis. klama le zarci .i ko'a blanu

Alice goes-to the store. It-1 is-blue.

</pre><p>The English gloss “it-1”, plus knowledge about the real world, would tend to make Eng­lish-speakers believe that “ko'a” refers to the store; in other words, that its antece­dent is “le zarci”. To a Lojbanist, how­ever, “la .alis.” is just as likely an antecedent, in which case <a href=#e5d1>Example 5.1 </a>means that Alice, not the store, is blue.

<p>

<lx "goi"><cx "ko'a-series pro-sumti, assigning with goi">To avoid this pitfall, Lojban employs special syntax, using the cmavo “goi”:

<p>

<pre><a name=e5d2>5.2) la .alis. klama le zarci .i ko'a goi la .alis. cu blanu

Alice goes-to the store. It-1, also-known-as Alice, is-blue.

</pre><cx "ko'a-series pro-sumti, assignment with goi as symmetrical">Syntactically, “goi la .alis.” is a relative phrase (relative phrases are explained in <a href=chap8.html>Chapter 8</a>). Semantically, it says that “ko'a” and “la .alis.” refer to the same thing, and furthermore that this is true because “ko'a” is being defined as meaning “la .alis.”. It is equally correct to say:

<p>

<pre><a name=e5d3>5.3) la .alis. klama le zarci .i la .alis. goi ko'a cu blanu

Alice goes-to the store. Alice, also-known-as it-1, is-blue.

</pre><lx "ge'u">in other words, “goi” is symmetrical. There is a terminator, “ge'u” (of selma'o GEhU), which is almost always elidable. The details are in <a href=chap8.html>Chapter 8</a>.

<p>

<cx "goi assignment of ko'a-series pro-sumti, use in speech contrasted with writing">The afterthought form of “goi” shown in <a href=#e5d2>Example 5.2 </a>and <a href=#e5d3>Ex­ample 5.3 </a>is probably most common in speech, where we do not know until part way through our utterance that we will want to refer to Alice again. In writing, though, “ko'a” may be assigned at the point where Alice is first mentioned. An example of this forethought form of “goi” is:

<p>

<pre><a name=e5d4>5.4) la .alis. goi ko'a klama le zarci .i ko'a cu blanu

Alice, also-known-as it-1, goes-to the store. It-1 is-blue.

</pre><ex "legal jargon"><ex "hereafter known as">Again, “ko'a goi la .alis.” would have been entirely acceptable in <a href=#e5d4>Ex­ample 5.4</a>. This last form is reminiscent of legal jargon: “The party of the first part, hereafter known as Buyer, <dots>…</dots>”.

<p>

<cx "broda-series pro-bridi"><cx "pro-bridi, broda-series"><cx "ko'a-series for pro-sumti, compared with broda-series for pro-bridi"><cx "broda-series for pro-bridi, compared with ko'a-series for pro-sumti"><cx "pro-bridi, as abbreviation for bridi">Just as the ko'a-series of pro-sumti allows a substitute for a sumti which is long or complex, or which for some other reason we do not want to repeat, so the broda-se­ries of pro-bridi allows a substitute for a selbri or even a whole bridi:

<p>

<ex "thingy"><lx "broda"><pre><a name=e5d5>5.5) ti slasi je mlatu bo cidja lante gacri cei broda

.i le crino broda cu barda .i le xunre broda cu cmalu

These are plastic cat-food can covers or thingies.

The green thingy is large. The red thingy is small.

</pre><cx "antecedent, for pro-bridi"><lx "cei"><cx "cei for broda-series assignment, compared with goi for ko'a-series assignment"><cx "goi for ko'a-series assignment, compared with cei for broda-series assignment"><cx "broda-series pro-bridi, assigning with cei"><cx "cei, for broda-series pro-bridi assignment"><cx "broda-series pro-bridi, word-form rationale">The pro-bridi “broda” has as its antecedent the selbri “slasi je mlatu bo cidja lante gacri”. The cmavo “cei” performs the role of “goi” in as­signing “broda” to this long phrase, and “broda” can then be used just like any other brivla. (In fact, “broda” and its relatives actu­ally <i>*are* </i>­brivla: they are gismu in morphology, although they behave ex­actly like the members of selma'o GOhA. The reasons for using gismu rather than cmavo are buried in the Loglan Project's history.)

<p>

<cx "antecedent, for pro-bridi as full bridi">Note that pro-bridi are so called because, even though they have the grammar of sel­bri, their antecedents are whole bridi. In the following rather contrived example, the ante­cedent of “brode” is the whole bridi “mi klama le zarci”:

<p>

<pre><a name=e5d6>5.6) mi klama cei brode le zarci .i do brode

I go-to (which-is claim-1) the store. You claim-1

I go to the store. You, too.

</pre><cx "pro-bridi, overriding sumti of antecedent bridi for">In the second bridi, “do brode” means “do klama le zarci”, because “brode” carries the x2 sumti of “mi klama le zarci” along with it. It also potentially carries the x1 sumti as well, but the explicit x1 sumti “do” overrides the “mi” of the antecedent bridi. Similarly, any tense or ne­gation that is present in the antecedent is also carried, and can be overridden by explicit tense or negation cmavo on the pro-bridi. These rules hold for all pro-bridi that have antecedents.

<p>

<cx "broda-series pro-bridi, use as sample gismu"><cx "broda-series pro-bridi, use as abstract pattern"><cx "broda-series pro-bridi, with no assignment">Another use of “broda” and its relatives, without assignment, is as “sample gismu”:

<p>

<pre><a name=e5d7>5.7) broda ke brode brodi

a thing-1 type of (thing-2 type-of thing-3)

</pre>represents an abstract pattern, a certain kind of tanru. (Historically, this use was the origi­nal one.)

<p>

<cx "lerfu, as assignable pro-sumti"><cx "pro-sumti, lerfu as"><cx "lerfu as pro-sumti, contrasted with ko'a-series in explicit assignment of"><cx "ko'a-series pro-sumti, contrasted with lerfu as pro-sumti in explicit assignment of"><cx "lerfu as pro-sumti, implicit assignment of antecedent">As is explained in <a href=chap17.html>Chapter 17</a>, the words for Lojban letters, belonging to sel­ma'o BY and certain related selma'o, are also usable as assignable pro-sumti. The main difference between letter pro-sumti and ko'a-series pro-sumti is that, in the absence of an explicit assignment, letters are taken to refer to the most recent name or de­scription sumti begin­ning with the same letter:

<p>

<pre><a name=e5d8>5.8) mi viska le gerku .i gy. cusku zo arf.

I see the dog. D expresses the-word “Arf!”.

</pre><cx "lerfu as pro-sumti, explicit assignment of antecedent"><cx "goi, use in assigning lerfu as pro-sumti">The Lojban word “gerku” begins with “g”, so the antecedent of “gy.”, the cmavo for the letter “g”, must be “le gerku”. In the English transla­tion, we use the same principle to refer to the dog as “D”. Of course, in case of ambiguity, “goi” can be used to make an explicit assign­ment.

<p>

<cx "goi, use in assigning name"><cx "name, assigning with goi">Furthermore, “goi” can even be used to assign a name:

<p>

<pre><a name=e5d9>5.9) le ninmu goi la sam. cu klama le zarci

The woman also-known-as Sam goes to-the store.

The woman, whom I'll call Sam, goes to the store.

</pre><p>This usage does not imply that the woman's name is Sam, or even that the speaker usu­ally calls the woman “Sam”. “Sam” is simply a name chosen, as if at random, for use in the current context only.

<p>

### <a name=s6><h3>Anaphoric pro-sumti and pro-bridi: the ri-series and the go'i-se­ries</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> ri KOhA ri-series (repeats last sumti)

ra KOhA ri-series (repeats previous sumti)

ru KOhA ri-series (repeats long-ago sumti)

go'i GOhA go'i-series (repeats last bridi)

go'a GOhA go'i-series (repeats previous bridi)

go'u GOhA go'i-series (repeats long-ago bridi)

go'e GOhA go'i-series (repeats last-but-one bridi)

go'o GOhA go'i-series (repeats future bridi)

nei GOhA go'i-series (repeats current bridi)

no'a GOhA go'i-series (repeats outer bridi)

ra'o RAhO pro-cmavo update

</pre><cx "anaphora, definition"><cx "pronouns, as anaphora"><cx "anaphora, pro-sumti ri-series as"><cx "anaphora, pro-bridi go'i-series as"><cx "ri-series pro-sumti"><cx "go'i-series pro-bridi"><cx "ri-series pro-sumti, compared with ti-series in word formation"><cx "go'i-series pro-bridi, compared with ri-series in word formation">The term “anaphora” literally means “repetition”, but is used in linguistics to refer to pronouns whose significance is the repetition of earlier words, namely their antecedents. Lojban provides three pro-sumti anaphora, “ri”, “ra”, and “ru”; and three corresponding pro-bridi anaphora, “go'i”, “go'a”, and “go'u”. These cmavo reveal the same vowel pat­tern as the ti-series, but the “distances” referred to are not physical dis­tances, but dis­tances from the anaphoric cmavo to its antecedent.

<p>

<lx "ri"><cx "ri, referent of">The cmavo “ri” is the simplest of these; it has the same refer­ent as the last complete sumti appearing before the “ri”:

<p>

<pre><a name=e6d1>6.1) la .alis. sipna le ri kumfa

Alice sleeps-in the of-[repeat last sumti] room.

Alice sleeps in her room.

</pre><cx "ri-series pro-sumti, effect of use on meaning">The “ri” in <a href=#e6d1>Example 6.1 </a>is equivalent to repeating the last sumti, which is “la .alis.”, so <a href=#e6d1>Example 6.1 </a>is equivalent to:

<p>

<pre><a name=e6d2>6.2) la .alis. sipna le la .alis. kumfa

Alice sleeps-in the of-Alice room.

Alice sleeps in Alice's room.

</pre><cx "ri, non-self-reference of"><cx "ri-series pro-sumti, and order of possible referents">Note that “ri” does not repeat “le ri kumfa”, because that sumti is not yet complete when “ri” appears. This prevents “ri” from getting entan­gled in paradoxes of self-refer­ence. (There are plenty of other ways to do that!) Note also that sumti within other sumti, as in quotations, abstractions, and the like, are counted in the order of their be­gin­nings; thus a lower level sumti like “la alis.” in <a href=#e6d2>Example 6.2 </a>is consid­ered to be more recent than a higher level sumti that contains it.

<p>

<cx "ri-series pro-sumti, possible referents of"><cx "ri-series pro-sumti, non-allowable referents of"><cx "ri-series pro-sumti, effect of ko'a-series pro-sumti on"><cx "ko'a-series pro-sumti, effect on ri-series pro-sumti"><cx "ri-series pro-sumti, effect of lerfu pro-sumti on"><cx "lerfu pro-sumti, effect on ri-series pro-sumti">Certain sumti are ignored by “ri”; specifically, most of the other cmavo of KOhA, and the almost-grammatically-equivalent lerfu words of selma'o BY. It is sim­pler just to repeat these directly:

<p>

<pre><a name=e6d3>6.3) mi prami mi

I love me.

I love myself.

</pre><cx "ri-series pro-sumti, effect of ti-series pro-sumti on"><cx "ti-series pro-sumti, effect on ri-series pro-sumti"><cx "ri-series pro-sumti, effect of other ri-series pro-sumti on"><cx "ri-series pro-sumti, effect on other ri-series pro-sumti">However, the cmavo of the ti-series can be picked up by “ri”, because you might have changed what you are pointing at, so re­peating “ti” may not be effective. Likewise, “ri” itself (or rather its an­tecedent) can be repeated by a later “ri”; in fact, a string of “ri” cmavo with no other intervening sumti always all repeat the same sumti:

<p>

<pre><a name=e6d4>6.4) la djan. viska le tricu .i ri se jadni le ri jimca

John sees the tree. [repeat last] is-adorned-by the of-[repeat last] branch

John sees the tree. It is adorned by its branches.

</pre><p>Here the second “ri” has as antecedent the first “ri”, which has as antecedent “le tricu”. All three refer to the same thing: a tree.

<p>

<cx "ri, subscripting for referring further back"><cx "subscripts, on ri">To refer to the next-to-last sumti, the third-from-last sumti, and so on, “ri” may be subscripted (subscripts are explained in <a href=chap19.html>Chapter 19</a>):

<p>

<pre><a name=e6d5>6.5) lo smuci .i lo forca .i la rik. pilno rixire

.i la .alis. pilno riximu

A spoon. A fork. Rick uses [repeat next-to-last].

Alice uses [repeat fifth-from-last].

</pre><p>Here “rixire”, or “ri-sub-2”, skips “la rik.” to reach “lo forca”. In the same way, “riximu”, or “ri-sub-5”, skips “la .alis.”, “rixire”, “la rik.”, and “lo forca” to reach “lo smuci”. As can clearly be seen, this procedure is barely practicable in writing, and would break down totally in speech.

<p>

<lx "ra"><lx "ru"><cx "ra, practical referent conventions"><cx "ru, practical referent conventions">Therefore, the vaguer “ra” and “ru” are also provided. The cmavo “ra” repeats a re­cently used sumti, and “ru” one that was fur­ther back in the speech or text. The use of “ra” and “ru” forces the listener to guess at the referent, but makes life easier for the speaker. Can “ra” refer to the last sumti, like “ri”? The answer is no if “ri” has also been used. If “ri” has not been used, then “ra” might be the last sumti. Likewise, if “ra” has been used, then any use of “ru” would re­peat a sumti earlier than the one “ra” is repeat­ing. A more reasonable version of Example 6.5, but one that depends more on context, is:

<p>

<pre><a name=e6d6>6.6) lo smuci .i lo forca .i la rik. pilno ra

.i la .alis. pilno ru

A spoon. A fork. Rick uses [some previous thing].

Alice uses [some more remote thing].

</pre><p>In <a href=#e6d6>Example 6.6</a>, the use of “ra” tells us that something other than “la rik.” is the antece­dent; “lo forca” is the nearest sumti, so it is probably the antecedent. Similarly, the an­tecedent of “ru” must be something even further back in the utterance than “lo forca”, and “lo smuci” is the obvious candidate.

<p>

<cx "ri-series pro-sumti, assigning for permanent reference"><lx "goi">The meaning of “ri” must be determined every time it is used. Since “ra” and “ru” are more vaguely defined, they may well retain the same meaning for a while, but the listener cannot count on this be­havior. To make a permanent reference to something re­peated by “ri”, “ra”, or “ru”, use “goi” and a ko'a-series cmavo:

<p>

<pre><a name=e6d7>6.7) la .alis. klama le zarci .i ri goi ko'a blanu

Alice goes-to the store. It-last-mentioned also-known-as it-1 is-blue.

</pre>allows the store to be referred to henceforth as “ko'a” without ambi­guity. <a href=#e6d7>Example 6.7 </a>is equivalent to <a href=#e5d1>Example 5.1 </a>and eliminates any possibility of “ko'a” being interpreted by the listener as referring to Alice.

<p>

<lx "go'i"><lx "go'a"><lx "go'u"><cx "go'i-series pro-bridi, compared with ri-series pro-sumti in rules of reference"><cx "go'i-series pro-bridi, referent of"><cx "go'i-series pro-bridi, effect of sub-clauses on"><cx "go'i-series pro-bridi, as main-bridi anaphora only"><cx "go'i-series pro-bridi, effect of sumti of referent bridi on"><cx "go'i, as affirmative answer to yes/no question"><cx "question, answering with go'i"><cx "answer, go'i for yes/no questions">The cmavo “go'i”, “go'a”, and “go'u” follow exactly the same rules as “ri”, “ra”, and “ru”, except that they are pro-bridi, and there­fore repeat bridi, not sumti — specifically, main sentence bridi. Any bridi that are embedded within other bridi, such as relative clauses or abstractions, are not counted. Like the cmavo of the broda-series, the cmavo of the go'i-series copy all sumti with them. This makes “go'i” by itself con­venient for an­swering a question affirmatively, or for re­peating the last bridi, possibly with new sumti:

<p>

<pre><a name=e6d8>6.8) xu zo djan. cmene do .i go'i

[True-false?] The-word “John” is-the-name of you? [repeat last bridi].

Is John your name? Yes.

<a name=e6d9>6.9) mi klama le zarci .i do go'i

I go-to the store. You [repeat last bridi].

I go to the store. You, too.

</pre><cx "go'i-series pro-sumti, assigning for permanent reference"><lx "cei">Note that <a href=#e6d9>Example 6.9 </a>means the same as <a href=#e5d6>Example 5.6</a>, but without the bother of as­sign­ing an actual broda-series word to the first bridi. For long-term reference, use “go'i cei broda” or the like, analogously to “ri goi ko'a” in <a href=#e6d7>Example 6.7</a>.

<p>

<lx "go'ixire"><lx "go'e">The remaining four cmavo of the go'i-series are provided for convenience or for achieving special effects. The cmavo “go'e” means the same as “go'ixire”: it repeats the last bridi but one. This is useful in conversation:

<p>

<pre><a name=e6d10>6.10) A: mi ba klama le zarci

B: mi nelci le si'o mi go'i

A: do go'e

A: I [future] go-to the store.

B: I like the concept-of I [repeat last bridi].

A: You [repeat last bridi but one].

A: I am going to the store.

B: I like the idea of my going.

A: You'll go, too.

</pre><p>Here B's sentence repeats A's within an abstraction (explained in Chapter 11): “le si'o mi go'i” means “le si'o mi klama le zarci”. Why must B use the word “mi” explicitly to re­place the x1 of “mi klama le zarci”, even though it looks like “mi” is replacing “mi”? Because B's “mi” refers to B, whereas A's “mi” refers to A. If B said:

<p>

<pre><a name=e6d11>6.11) mi nelci le si'o go'i

</pre>that would mean:

<p>

<dl compact><dt> <dd>I like the idea of your going to the store.

</dl><cx "go'i-series pro-bridi, as repeating referent concept">The repetition signalled by “go'i” is not literally of words, but of con­cepts. Finally, A repeats her own sentence, but with the x1 changed to “do”, meaning B. Note that in <a href=#e6d10>Ex­ample 6.10</a>, the tense “ba” (future time) is carried along by both “go'i” and “go'e”.

<p>

<cx "go'i-series pro-bridi, as basis for description"><cx "descriptions, based on go'i-series pro-bridi">Descriptions based on go'i-series cmavo can be very useful for repeating spe­cific sumti of previous bridi:

<p>

<ex "black cat"><pre><a name=e6d12>6.12) le xekri mlatu cu klama le zarci

.i le go'i cu cadzu le bisli

The black cat goes-to the store.

That-described-as-the-x1-place-of [repeat last bridi] walks-on the ice.

The black cat goes to the store. It walks on the ice.

</pre><p>Here the “go'i” repeats “le xekri mlatu cu klama le zarci”, and since “le” makes the x1 place into a description, and the x1 place of this bridi is “le xekri mlatu”, “le go'i” means “le xekri mlatu”.

<p>

<lx "go'o"><lx "nei"><lx "no'a"><cx "no'a, contrasted with other members of go'i-series in possible referents"><cx "go'i-series pro-bridi, no'a as exception to only main-bridi anaphora"><cx "go'i-series pro-bridi, as main-bridi anaphora only, exception">The cmavo “go'o”, “nei”, and “no'a” have been little used so far. They repeat respec­tively some future bridi, the current bridi, and the bridi that encloses the current bridi (“no'a”, unlike the other mem­bers of the go'i- series, can repeat non-sentence bridi). Here are a few examples:

<p>

<pre><a name=e6d13>6.13) mi nupre le nu mi go'o

.i ba dunda le djini le bersa

.i ba dunda le zdani le tixnu

I promise the event-of I [repeat future bridi]

[Future] give the money to-the son

[Future] give the house to-the daughter

I promise to do the following:

Give the money to my son.

Give the house to my daughter.

</pre>(Note: The Lojban does not contain an equivalent of the “my” in the colloquial English; it leaves the fact that it is the speaker's son and daughter that are referred to implicit. To make the fact explicit, use “le bersa/tixnu be mi”.)

<p>

For good examples of “nei” and “no'a”, we need nested bridi contexts:

<p>

<pre><a name=e6d14>6.14) mi se pluka le nu do pensi

le nu nei kei pu le nu do zukte

I am-pleased-by the event-of (you think-about

(the event-of [main bridi]) before the-event of (your acting).

I am pleased that you thought about whether I

would be pleased (about <dots>…</dots>) before you acted.

<a name=e6d15>6.15) mi ba klama ca le nu do no'a

I [future] go [present] the event-of you [repeats outer bridi]

I will go when you do.

</pre><lx "ra'o"><cx "go'i-series pro-bridi, reinterpreting sumti references with ra'o"><cx "ra'o, for reinterpreting go'i-series pro-bridi sumti references"><cx "go'i, contrasted with go'i ra'o"><cx "go'i ra'o, contrasted with go'i">Finally, “ra'o” is a cmavo that can be appended to any go'i-se­ries cmavo, or in­deed any cmavo of selma'o GOhA, to signal that pro-sumti or pro-bridi cmavo in the antece­dent are to be repeated literally and reinterpreted in their new context. Normally, any pro-sumti used within the antecedent of the pro-bridi keep their meanings intact. In the pres­ence of “ra'o”, however, their meanings must be reinterpreted with reference to the new environment. If someone says to you:

<p>

<pre><a name=e6d16>6.16) mi ba lumci lemi karca

I will wash my car.

</pre>you might reply either:

<p>

<pre><a name=e6d17>6.17) mi go'i

I will wash your car.

</pre>or:

<p>

<pre><a name=e6d18>6.18) mi go'i ra'o

I will wash my car.

</pre><p>The “ra'o” forces the second “mi” from the original bridi to mean the new speaker rather than the former speaker. This means that “go'e ra'o” would be an acceptable al­ternative to “do go'e” in B's statement in <a href=#e6d10>Example 6.10</a>.

<p>

<cx "ri-series pro-sumti, in quotations"><cx "go'i-series pro-sumti, in quotations">The anaphoric pro-sumti of this section can be used in quota­tions, but never re­fer to any of the supporting text outside the quota­tion, since speakers presumably do not know that they may be quoted by someone else.

<p>

<cx "ri-series pro-sumti, in quotation series"><cx "go'i-series pro-sumti, in quotation series">However, a “ri”-series or “go'a”-series reference within a quotation can refer to something mentioned in an earlier quotation if the two quotations are closely related in time and context. This allows a quotation to be broken up by narrative material without interfering with the pro-sumti within it. Here's an example:

<p>

<pre><a name=e6d19>6.19) la djan. cusku lu mi klama le zarci li'u

.i la .alis. cusku lu mi go'i li'u

John says [quote] I go-to the store [unquote].

Alice says [quote] I [repeat] [unquote].

John says, “I am going to the store.” Alice says, “Me too.”

</pre><cx "ri-series pro-sumti, in narrative about quotation"><cx "go'i-series pro-sumti, in narrative about quotation">Of course, there is no problem with narrative material refer­ring to something within a quotation: people who quote, unlike people who are quoted, are aware of it.

<p>

### <a name=s7><h3>Indefinite pro-sumti and pro-bridi: the zo'e-series and the co'e-se­ries</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> zo'e KOhA zo'e-series the obvious value

zu'i KOhA zo'e-series the typical value

zi'o KOhA zo'e-series the nonexistent value

co'e GOhA co'e-series has the obvious relationship

</pre><cx "zo'e-series pro-sumti"><cx "co'e-series pro-bridi"><cx "indefinite pro-sumti"><cx "elliptical pro-sumti"><cx "pro-sumti, unspecified"><cx "indefinite pro-bridi"><cx "elliptical pro-bridi"><lx "zo'e"><cx "zo'e, as place-holder for sumti"><cx "elliptical sumti"><cx "elliptical value, contrasted with typical value for sumti"><cx "typical value, contrasted with elliptical value for sumti">The cmavo of the zo'e-series represent indefinite, unspecified sumti. The cmavo “zo'e” represents an elliptical value for this sumti place; it is the optional spoken place holder when a sumti is skipped without being specified. Note that the elliptical value is not always the typical value. The properties of ellipsis lead to an elliptical sumti being defined as “whatever I want it to mean but haven't bothered to figure out, or figure out how to express”.

<p>

<lx "zu'i"><cx "pro-sumti, typical"><cx "typical sumti">The cmavo “zu'i”, on the other hand, represents the typical value for this place of this bridi:

<p>

<pre><a name=e7d1>7.1) mi klama le bartu be le zdani le nenri be le zdani

zu'i zu'i

I go to-the outside of the house from-the inside of the house

[by-typical-route] [by-typical-means]

</pre><p>In <a href=#e7d1>Example 7.1</a>, the first “zu'i” probably means something like “by the door”, and the second “zu'i” probably means something like “on foot”, those being the typical route and means for leaving a house. On the other hand, if you are at the top of a high rise during a fire, neither “zu'i” is appropriate. It's also common to use “zu'i” in “by stan­dard” places.

<p>

<cx "zi'o"><cx "sumti, irrelevant to relationship"><cx "irrelevant, specifying of sumti place">Finally, the cmavo “zi'o” represents a value which does not even exist. When a bridi fills one of its places with “zi'o”, what is really meant is that the selbri has a place which is irrelevant to the true re­lationship the speaker wishes to express. For example, the place structure of “zbasu” is

<p>

<dl compact><dt>zbasu: <dd>actor x1 makes x2 from materials x3

</dl><ex "living things">Consider the sentence

<p>

<dl compact><dt> <dd>Living things are made from cells.

</dl><p>This cannot be correctly expressed as:

<p>

<pre><a name=e7d2>7.2) loi jmive cu se zbasu [zo'e] fi loi selci

The-mass-of living-things is-made [by-something] from the-mass-of cells

</pre>because the “zo'e”, expressed or understood, in <a href=#e7d2>Example 7.2 </a>indi­cates that there is still a “maker” in this relationship. We do not gen­erally suppose, however, that someone “makes” living things from cells. The best answer is probably to find a different selbri, one which does not imply a “maker”: however, an alternative strategy is to use “zi'o” to eliminate the maker place:

<p>

<pre><a name=e7d3>7.3) loi jmive cu se zbasu zi'o loi selci

The-mass-of living-things is-made [without-maker] from the-mass-of cells.

</pre><cx "zi'o, as creating new selbri">Note: The use of “zi'o” to block up, as it were, one place of a selbri actually creates a new selbri with a different place structure. Consider the following examples:

<p>

<pre><a name=e7d4>7.4) mi zbasu le dinju loi mudri

I make the building from-some-of-the-mass-of wood.

I make the building out of wood.

<a name=e7d5>7.5) zi'o zbasu le dinju loi mudri

[without-maker] makes the building from-some-of-the-mass-of wood.

The building is made out of wood.

<a name=e7d6>7.6) mi zbasu zi'o loi mudri

I make [without-thing-made] from-some-of-the-mass-of wood.

I build using wood.

<a name=e7d7>7.7) mi zbasu loi mudri zi'o

I make the building [without-material].

I make the building.

</pre><p>If <a href=#e7d4>Example 7.4 </a>is true, then <a href=#e7d{5}>Examples 7.5 </a>through <a href=#e7d7>7.7 </a>must be true also. However, <a href=#e7d3>Ex­ample 7.3 </a>does not correspond to any sentence with three regular (non-“zi'o”) sumti.

<p>

<lx "co'e"><cx "selbri, omitting with co'e"><cx "co'e, as selbri place-holder">The pro-bridi “co'e” (which by itself constitutes the co'e-series of selma'o GOhA) represents the elliptical selbri. Lojban grammar does not allow the speaker to merely omit a selbri from a bridi, al­though any or all sumti may be freely omitted. Be­ing vague about a relationship requires the use of “co'e” as a selbri place-holder:

<p>

<pre><a name=e7d8>7.8) mi troci le nu mi co'e le vorme

I try the event-of my [doing-the-obvious-action] to-the door.

I try the door.

</pre><p>The English version means, and the Lojban version probably means, that I try to open the door, but the relationship of opening is not actu­ally specified; the Lojbanic listener must guess it from context. Loj­ban, unlike English, makes it clear that there is an im­plicit ac­tion that is not being expressed.

<p>

<cx "co'e, rationale for word form">The form of “co'e” was chosen to resemble “zo'e”; the cmavo “do'e” of sel­ma'o BAI (see <a href=chap9.html>Chapter 9</a>) also belongs to the same group of cmavo.

<p>

<cx "do'i, compared with zo'e-series as indefinite pro-sumti"><cx "zo'e-series, compared with do'i as indefinite pro-sumti">Note that “do'i”, of the di'u-series, is also a kind of indefinite pro-sumti: it is indefi­nite in referent, but is restricted to referring only to an utterance.

<p>

### <a name=s8><h3>Reflexive and reciprocal pro-sumti: the vo'a-series</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> vo'a KOhA vo'a-series x1 of this bridi

vo'e KOhA vo'a-series x2 of this bridi

vo'i KOhA vo'a-series x3 of this bridi

vo'o KOhA vo'a-series x4 of this bridi

vo'u KOhA vo'a-series x5 of this bridi

soi SOI reciprocity

se'u SEhU soi terminator

</pre><cx "anaphora, pro-sumti vo'a-series as"><cx "pro-sumti, vo'a-series"><cx "pro-sumti, referring to place of same bridi with vo'a-series"><cx "reflexive pro-sumti"><cx "reciprocal pro-sumti">The cmavo of the vo'a-series are pro-sumti anaphora, like those of the ri-series, but have a specific function. These cmavo refer to the other places of the same bridi; the five of them represent up to five places. The same vo'a-series cmavo mean different things in different bridi. Some examples:

<p>

<lx "vo'a"><ex "wash self"><pre><a name=e8d1>8.1) mi lumci vo'a

I wash myself

</pre><lx "vo'e"><pre><a name=e8d2>8.2) mi klama le zarci vo'e

I go to the store from itself [by some route unspecified].

</pre><cx "pro-sumti, referring to place of different bridi with go'i-series">To refer to places of neighboring bridi, constructions like “le se go'i ku” do the job: this refers to the 2nd place of the previous main bridi, as explained in <a href=#s6>Section 6</a>.

<p>

<lx "soi"><lx "SOI"><cx "reciprocity, expressing with vo'a-series pro-sumti and soi"><cx "soi, use in expressing reciprocity with vo'a-series pro-sumti"><cx "vo'a-series pro-sumti, use in expressing reciprocity with soi"><cx "“vice versa”, expressing with vo'a-series pro-sumti and soi">The cmavo of the vo'a-series are also used with “soi” (of sel­ma'o SOI) to pre­cisely express reciprocity, which in English is impre­cisely expressed with a discursive phrase like “vice versa”:

<p>

<ex "vice versa"><pre><a name=e8d3>8.3) mi prami do soi vo'a vo'e

I love you [reciprocity] [x1 of this bridi] [x2 of this bridi].

I love you and vice versa (swapping “I” and “you”).

</pre><cx "soi with one following sumti, convention">The significance of “soi vo'a vo'e” is that the bridi is still true even if the x1 (specified by “vo'a”) and the x2 (specified by “vo'e”) places are interchanged. If only a single sumti follows “soi”, then the sumti im­mediately preceding “soi” is understood to be one of those involved:

<p>

<pre><a name=e8d4>8.4) mi prami do soi vo'a

I love you [reciprocity] [x1 of this bridi].

</pre>again involves the x1 and x2 places.

<p>

<cx "reciprocity, expressing with soi"><cx "soi, use in expressing reciprocity">Of course, other places can be involved, and other sumti may be used in place of vo'a-series cmavo, provided those other sumti can be reasonably understood as refer­ring to the same things men­tioned in the bridi proper. Here are several examples that mean the same thing:

<p>

<pre><a name=e8d5>8.5) mi bajykla ti ta soi vo'e

mi bajykla ti ta soi vo'e vo'i

soi vo'e vo'i mi bajra ti ta

I runningly-go to this from that and vice versa (to that from this).

</pre><lx "se'u"><lx "SEhU"><cx "se'u, as elidable terminator for soi"><cx "se'u, elidability considerations">The elidable terminator for “soi” is “se'u” (selma'o SEhU), which is normally needed only if there is just one sumti after the “soi”, and the “soi” construction is not at the end of the bridi. Constructions using “soi” are free modifiers, and as such can go almost any­where. Here is an example where “se'u” is required:

<p>

<pre><a name=e8d6>8.6) mi bajykla ti soi vo'i se'u ta

I runningly-go to-this [reciprocity] [x3 of this bridi] from-that

I runningly-go to this from that and vice versa.

### </pre><a name=s9><h3>sumti and bridi questions: “ma” and “mo”</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> ma KOhA sumti question

mo GOhA bridi question

</pre><lx "ma"><cx "ma, as sumti question"><cx "questions, sumti">Lojban questions are more fully explained in <a href=chap19.html>Chapter 19 </a>, but “ma” and “mo” are listed in this chapter for completeness. The cmavo “ma” asks for a sumti to make the bridi true:

<p>

<pre><a name=e9d1>9.1) do klama ma

You go to-what-destination?

Where are you going?

</pre><lx "mo"><cx "mo, as selbri question"><cx "questions, selbri"><cx "mo, compared with go'i in overriding of arguments"><cx "go'i, compared with mo in overriding of arguments">The cmavo “mo”, on the other hand, asks for a selbri which makes the question bridi true. If the answer is a full bridi, then the arguments of the answer override the arguments in the question, in the same manner as the go'i-series cmavo. A simple ex­ample is:

<p>

<pre><a name=e9d2>9.2) do mo

What predicate is true as applied to you?

How are you?

What are you doing?

What are you?

</pre><a href=#e9d2>Example 9.2 </a>is a truly pregnant question that will have several meanings depending on context.

<p>

(One thing it probably does not mean is “Who are you?” in the sense “What is your name/identity?”, which is better expressed by:

<p>

<ex "what is your name"><pre><a name=e9d3>9.3) ma cmene do

What sumti is-the-name-of you?

What is your name?

</pre>or even

<p>

<pre><a name=e9d4>9.4) doi ma

O [what sumti?]

</pre>which uses the vocative “doi” to address someone, and simultane­ously asks who the someone is.)

<p>

A further example of “mo”:

<p>

<pre><a name=e9d5>9.5) lo mo prenu cu darxi do .i barda

A [what selbri?] type-of person hit you? (Observative:) A big thing.

Which person hit you? The big one.

</pre><cx "multiple questions in one bridi, expressing"><cx "multiple ma, as multiple questions"><cx "multiple mo, as multiple questions">When “ma” or “mo” is repeated, multiple questions are being asked simulta­neously:

<p>

<ex "who knows what"><pre><a name=e9d6>9.6) ma djuno ma

[What sumti] knows [what sumti]?

Who knows what?

### </pre><a name=s10><h3>Relativized pro-sumti: “ke'a”</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> ke'a KOhA relativized sumti

</pre><lx "ke'a"><cx "pro-sumti, for relativized sumti in relative clauses"><cx "ke'a, for relativized sumti in relative clauses"><cx "relative clauses, use of ke'a for referral to relativized sumti in">This pro-sumti is used in relative clauses (explained in <a href=chap8.html>Chapter 8</a>) to indicate how the sumti being relativized fits within the clause. For example:

<p>

<ex "cat of plastic"><pre><a name=e10d1>10.1) mi catlu lo mlatu poi [zo'e] zbasu

ke'a lei slasi

I see a cat such-that something-unspecified makes

the-thing-being-relativized [the cat] from-some-mass-of plastic.

I see a cat made of plastic.

</pre><cx "ke'a, ambiguity when omitted">If “ke'a” were omitted from <a href=#e10d1>Example 10.1</a>, it might be confused with:

<p>

<pre><a name=e10d2>10.2) mi catlu lo mlatu poi [ke'a]

zbasu lei slasi

I see a cat such-that the-thing-being-relativized

[the cat] makes a-mass-of plastic

I see a cat that makes plastic.

</pre><cx "ke'a, contrasted with ri in relative clauses"><cx "ri, contrasted with ke'a in relative clauses">The anaphora cmavo “ri” cannot be used in place of “ke'a” in <a href=#e10d1>Example 10.1 </a>and <a href=#e10d2>Exam­ple 10.2</a>, because the relativized sumti is not yet com­plete when the “ke'a” appears.

<p>

<cx "ke'a, and abstract descriptions"><cx "ke'a, subscripting for nested relative clauses"><cx "subscripts, on ke'a for nested relative clauses">Note that “ke'a” is used only with relative clauses, and not with other embed­ded bridi such as abstract descriptions. In the case of relative clauses within relative clauses, “ke'a” may be subscripted to make the difference clear (see <a href=chap8.html>Chapter 8</a>).

<p>

### <a name=s11><h3>Abstraction focus pro-sumti: “ce'u”</h3>

<p>

The following cmavo is discussed in this section:

<p>

<pre> ce'u KOhA abstraction focus

</pre><lx "ce'u">The cmavo “ce'u” is used within abstraction bridi, particularly property ab­stractions introduced by the cmavo “ka”. Abstractions, including the uses of “ce'u”, are discussed in full in <a href=chap11.html>Chapter 11</a>.

<p>

<cx "property abstraction, specifying sumti place of property with ce'u"><cx "ce'u, use in specifying sumti place of property in abstraction">In brief: Every property abstraction specifies a property of one of the sumti in it; that sumti place is filled by using “ce'u”. This convention enables us to distinguish clearly between:

<p>

<ex "happiness"><pre><a name=e11d1>11.1) le ka ce'u gleki

the property-of (X being-happy)

the property of being happy

happiness

</pre>and

<p>

<pre><a name=e11d2>11.2) le ka gleki ce'u

the property-of (being-happy about-X)

the property of being that which someone is happy about

### </pre><a name=s12><h3>Bound variable pro-sumti and pro-bridi: the da-series and the bu'a-series</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> da KOhA da-series something-1

de KOhA da-series something-2

di KOhA da-series something-3

bu'a GOhA bu'a-series some-predicate-1

bu'e GOhA bu'a-series some-predicate-2

bu'i GOhA bu'a-series some-predicate-3

</pre><cx "da-series pro-sumti, for bound variables"><cx "bu'a-series pro-sumti, for bound variables">Bound variables belong to the predicate-logic part of Lojban, and are listed here for completeness only. Their semantics is ex­plained in <a href=chap16.html>Chapter 16</a>. It is worth mentioning that the Lojban transla­tion of <a href=#e1d2>Example 1.2 </a>is:

<p>

<ex "shook stick"><lx "da"><pre><a name=e12d1>12.1) la djan. cu lafti da poi grana ku'o gi'e desygau da

John raised something-1 which is-a-stick and shake-did something-1

John picked up a stick and shook it.

### </pre><a name=s13><h3>Pro-sumti and pro-bridi cancelling</h3>

<p>

The following cmavo is discussed in this section:

<p>

<pre> da'o DAhO cancel all pro-sumti/pro-bridi

</pre><cx "pro-sumti assignment, stability of"><cx "pro-bridi assignment, stability of">How long does a pro-sumti or pro-bridi remain stable? In other words, once we know the referent of a pro-sumti or pro-bridi, how long can we be sure that future uses of the same cmavo have the same referent? The answer to this question depends on which series the cmavo belongs to.

<p>

<cx "personal pro-sumti, implicit cancellation of by change of speaker/listener"><cx "personal pro-sumti, stability of"><cx "assignable pro-sumti, stability of"><cx "assignable pro-sumti, explicit cancellation of by rebinding"><lx "goi"><lx "cei"><cx "bound variable pro-sumti, stability of">Personal pro-sumti are stable until there is a change of speaker or listener, pos­sibly signaled by a vocative. Assignable pro-sumti and pro-bridi last indefinitely or un­til re­bound with “goi” or “cei”. Bound variable pro-sumti and pro-bridi also generally last until re-bound; details are available in <a href=chap16.html>Chapter 16</a>.

<p>

<cx "utterance pro-sumti, stability of"><cx "reflexive pro-sumti, stability of"><cx "ke'a, stability of"><cx "anaphoric pro-sumti, stability of"><cx "anaphoric pro-bridi, stability of">Utterance pro-sumti are stable only within the utterance in which they appear; simi­larly, reflexive pro-sumti are stable only within the bridi in which they appear; and “ke'a” is stable only within its rela­tive clause. Anaphoric pro-sumti and pro-bridi are stable only within narrow limits depending on the rules for the particular cmavo.

<p>

<cx "demonstrative pro-sumti, stability of"><cx "indefinite pro-sumti, stability of"><cx "indefinite pro-bridi, stability of">Demonstrative pro-sumti, indefinite pro-sumti and pro-bridi, and sumti and bridi questions potentially change referents every time they are used.

<p>

<cx "pro-sumti assignment, explicit cancellation of with da'o"><cx "pro-bridi assignment, explicit cancellation of with da'o"><lx "da'o"><lx "DAhO"><cx "cancellation of pro-sumti/pro-bridi assignment, with da'o"><cx "da'o, for cancellation of pro-sumti/pro-bridi assignment"><cx "da'o, syntax of">However, there are ways to cancel all pro-sumti and pro-bridi, so that none of them have known referents. (Some, such as “mi”, will acquire the same referent as soon as they are used again after the cancellation.) The simplest way to cancel everything is with the cmavo “da'o” of selma'o DAhO, which is used solely for this purpose; it may appear anywhere, and has no effect on the grammar of texts containing it. One use of “da'o” is when entering a conversation, to indicate that one's pro-sumti assignments have nothing to do with any assignments already made by other participants in the con­versation.

<p>

<cx "ni'o, effect on pro-sumti/pro-bridi assignments"><cx "no'i, effect on pro-sumti/pro-bridi assignments"><cx "pro-sumti assignments, no'i effect on"><cx "pro-bridi assignments, no'i effect on">In addition, the cmavo “ni'o” and “no'i” of selma'o NIhO, which are used pri­marily to indicate shifts in topic, may also have the effect of canceling pro-sumti and pro-bridi as­signments, or of reinstating ones formerly in effect. More explanations of NIhO can be found in <a href=chap19.html>Chapter 19</a>.

<p>

### <a name=s14><h3>The identity predicate: du</h3>

<p>

The following cmavo is discussed in this section:

<p>

<pre> du GOhA identity

</pre><cx "identity predicate"><lx "du">The cmavo “du” has the place structure:

<p>

<dl compact><dt>du: <dd>x1 is identical with x2, x3, <dots>…</dots>

</dl><cx "du, rationale for selection of selma'o for">and appears in selma'o GOhA for reasons of convenience: it is not a pro-bridi. “du” serves as mathematical “=”, and outside mathematical contexts is used for defining or identifying. Mathematical examples may be found in <a href=chap18.html>Chapter 18</a>.

<p>

<cx "du, contrasted with mintu"><cx "mintu, contrasted with du">The main difference between

<p>

<pre><a name=e14d1>14.1) ko'a du le nanmu

It-1 is-identical-to the man

</pre>and

<p>

<pre><a name=e14d2>14.2) ko'a mintu le nanmu

It-1 is-the-same-as the man

</pre><cx "du, meaning of">is this defining nature. <a href=#e14d1>Example 14.1 </a>presumes that the speaker is responding to a re­quest for information about what “ko'a” refers to, or that the speaker in some way feels the need to define “ko'a” for later reference. A bridi with “du” is an identity sentence, somewhat metal­inguistically saying that all attached sumti are representations for the same referent. There may be any number of sumti associated with “du”, and all are said to be identical.

<p>

<a href=#e14d2>Example 14.2</a>, however, predicates; it is used to make a claim about the iden­tity of “ko'a”, which presumably has been defined previously.

<p>

<cx "du, derivation of"><cx "du, contrasted with dunli"><cx "dunli, contrasted with du">Note: “du” historically is derived from “dunli”, but “dunli” has a third place which “du” lacks: the standard of equality.

<p>

### <a name=s15><h3>lujvo based on pro-sumti</h3>

<p>

<cx "rafsi, based on pro-sumti"><cx "pro-sumti, rafsi for">There exist rafsi allocated to a few cmavo of selma'o KOhA, but they are rarely used. (See <a href=#s16>Section 16 </a>for a complete list.) The obvious way to use them is as in­ternal sumti, filling in an appropriate place of the gismu or lujvo to which they are at­tached; as such, they usually stand as the first rafsi in their lujvo.

<p>

<ex "you-talk"><cx "lujvo, pro-sumti rafsi effect on place structure of"><cx "pro-sumti rafsi, effect of on place structure of lujvo">Thus “donta'a”, meaning “you-talk”, would be interpreted as “tavla be do”, and would have the place structure

<p>

<pre><a name=e15d1>15.1) t1 talks to you about subject t3 in language t4

</pre>since t2 (the addressee) is already known to be “do”.

<p>

<ex "you-cmavo">On the other hand, the lujvo “donma'o”, literally “you-cmavo”, which means “a sec­ond person personal pronoun”, would be inter­preted as “cmavo be zo do”, and have the place structure:

<p>

<pre><a name=e15d2>15.2) c1 is a second person pronoun in language c4

</pre>since both the c2 place (the grammatical class) and the c3 place (the meaning) are ob­vi­ous from the context “do”.

<p>

<cx "pro-sumti rafsi, anticipated use of for abbreviating inconvenient forms"><lx "fo'a">An anticipated use of rafsi for cmavo in the “fo'a” series is to express lujvo which can't be expressed in a convenient rafsi form, because they are too long to ex­press, or are formally inconvenient (fu'ivla, cmene, and so forth.) An example would be:

<p>

<pre><a name=e15d3>15.3) fo'a goi le kulnrsu,omi .i lo fo'arselsanga

x6 stands for Finnish-culture. An x6-song.

</pre><ex "beverage"><lx "zi'o"><cx "lujvo, zi'o rafsi effect on place structure of"><cx "zi'o rafsi, effect of on place structure of lujvo">Finally, lujvo involving “zi'o” are also possible, and are fully discussed in <a href=chap12.html>Chapter 12</a>. In brief, the convention is to use the rafsi for “zi'o” as a prefix immediately followed by the rafsi for the number of the place to be deleted. Thus, if we consider a beverage (something drunk without considering who, if anyone, drinks it) as a “se pinxe be zi'o”, the lujvo corresponding to this is “zilrelselpinxe” (deleting the second place of “se pinxe”). Deleting the x1 place in this fashion would move all remaining places up by one. This would mean that “zilpavypinxe” has the same place structure as “zilrelselpinxe”, and “lo zilpavypinxe”, like “lo zilrelselpinxe”, refers to a beverage, and not to a non-existent drinker.

<p>

<cx "pro-bridi rafsi, as producing context-dependent meanings"><lx "co'e"><lx "du"><lx "bu'a">The pro-bridi “co'e”, “du”, and “bu'a” also have rafsi, which can be used just as if they were gismu. The resulting lujvo have (except for “du”-based lujvo) highly context-dependent meanings.

<p>

### <a name=s16><h3>KOhA cmavo by series</h3>

<p>

<cx "pro-sumti, list by series"><cx "pro-sumti, mi-series list"><dl compact><dt> <dd>mi-series:

mi I (rafsi: “mib”)

do you (rafsi: “don” and “doi”)

mi'o you and I

mi'a I and others, we but not you

ma'a you and I and others

do'o you and others

ko you-imperative

</dl><cx "pro-sumti, ti-series list"><dl compact><dt> <dd>ti-series:

ti this here; something nearby (rafsi: “tif”)

ta that there; something distant (rafsi: “taz”)

tu that yonder; something far distant (rafsi: “tuf”)

</dl><cx "pro-sumti, di'u-series list"><dl compact><dt> <dd>di'u-series:

di'u the previous utterance

de'u an earlier utterance

da'u a much earlier utterance

di'e the next utterance

de'e a later utterance

da'e a much later utterance

dei this very utterance

do'i some utterance

</dl><cx "pro-sumti, ko'a-series list"><dl compact><dt> <dd>ko'a-series:

ko'a it-1; 1st assignable pro-sumti

ko'e it-2; 2nd assignable pro-sumti

ko'i it-3; 3rd assignable pro-sumti

ko'o it-4; 4th assignable pro-sumti

ko'u it-5; 5th assignable pro-sumti

fo'a it-6; 6th assignable pro-sumti (rafsi: “fo'a”)

fo'e it-7; 7th assignable pro-sumti (rafsi: “fo'e”)

fo'i it-8; 8th assignable pro-sumti (rafsi: “fo'i”)

fo'o it-9; 9th assignable pro-sumti

fo'u it-10; 10th assignable pro-sumti

</dl><cx "pro-sumti, ri-series list"><dl compact><dt> <dd>ri-series:

ri (repeats the last sumti)

ra (repeats a previous sumti)

ru (repeats a long-ago sumti)

</dl><cx "pro-sumti, zo'e-series list"><dl compact><dt> <dd>zo'e-series:

zo'e the obvious value

zu'i the typical value

zi'o the nonexistent value (rafsi: “zil”)

</dl><cx "pro-sumti, vo'a-series list"><dl compact><dt> <dd>vo'a-series:

vo'a x1 of this bridi

vo'e x2 of this bridi

vo'i x3 of this bridi

vo'o x4 of this bridi

vo'u x5 of this bridi

</dl><cx "pro-sumti, da-series list"><dl compact><dt> <dd>da-series:

da something-1 (rafsi: “dav”/“dza”)

de something-2

di something-3

</dl><cx "pro-sumti, miscellaneous list"><dl compact><dt> <dd>others:

ke'a relativized sumti

ma sumti question

ce'u abstraction focus

### </dl><a name=s17><h3>GOhA and other pro-bridi by series</h3>

<p>

<cx "pro-bridi, list by series"><cx "pro-bridi, broda-series list"><dl compact><dt> <dd>broda-series (not GOhA):

broda is-1; 1st assignable pro-bridi

brode is-2; 2nd assignable pro-bridi

brodi is-3; 3rd assignable pro-bridi

brodo is-4; 4th assignable pro-bridi

brodu is-5; 5th assignable pro-bridi

</dl><cx "pro-bridi, go'i-series list"><dl compact><dt> <dd>go'i-series:

go'i (repeats the last bridi)

go'a (repeats a previous bridi)

go'u (repeats a long-ago bridi)

go'e (repeats the last-but-one bridi)

go'o (repeats a future bridi)

nei (repeats the current bridi)

no'a (repeats the next outer bridi)

</dl><cx "pro-bridi, bu'a-series list"><dl compact><dt> <dd>bu'a-series:

bu'a some-predicate-1 (rafsi: “bul”)

bu'e some-predicate-2

bu'i some-predicate-3

</dl><cx "pro-bridi, miscellaneous list"><dl compact><dt> <dd>others:

co'e has the obvious relationship (rafsi: “com”/“co'e”)

mo bridi question

du identity: x1 is identical to x2, x3 <dots>…</dots> (rafsi: “dub”/“du'o”)

### </dl><a name=s18><h3>Other cmavo discussed in this chapter</h3>

<p>

<cx "pro-bridi, list of miscellaneous cmavo used with"><cx "pro-sumti, list of miscellaneous cmavo used with"><pre> goi GOI pro-sumti assignment (ko'a-series)

cei CEI pro-bridi assignment (broda-series)

ra'o RAhO pro-sumti/pro-bridi update

soi SOI reciprocity

se'u SEhU soi terminator

da'o DAhO cancel all pro-sumti/pro-bridi

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## <h2>Chapter 8

## <br>

## Relative Clauses, Which Make sumti Even More Complicated</h2>

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<p>

### <a name=s1><h3>What are you pointing at?</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> poi NOI restrictive relative clause introducer

ke'a GOhA relative pro-sumti

ku'o KUhO relative clause terminator

</pre><lx "ti"><lx "ta"><lx "tu">Let us think about the problem of communicating what it is that we are point­ing at when we are pointing at something. In Lojban, we can refer to what we are pointing at by using the pro-sumti “ti” if it is nearby, or “ta” if it is somewhat further away, or “tu” if it is distant. (Pro-sumti are explained in full in <a href=chap7.html>Chapter 7</a>.)

<p>

<cx "reference, ambiguity of ti/ta/tu">However, even with the assistance of a pointing finger, or pointing lips, or whatever may be appropriate in the local culture, it is often hard for a listener to tell just what is being pointed at. Suppose one is pointing at a person (in particular, in the direction of his or her face), and says:

<p>

<pre><a name=e1d1>1.1) ti cu barda

This-one is-big.

</pre><p>What is the referent of “ti”? Is it the person? Or perhaps it is the per­son's nose? Or even (for “ti” can be plural as well as singular, and mean “these ones” as well as “this one”) the pores on the person's nose?

<p>

<cx "relative clause, use for reference"><cx "reference, use of relative clause for"><lx "NOI"><lx "ku'o"><lx "KUhO"><lx "poi">To help solve this problem, Lojban uses a construction called a “relative clause”. Relative clauses are usually attached to the end of sumti, but there are other places where they can go as well, as ex­plained later in this chapter. A relative clause begins with a word of selma'o NOI, and ends with the elidable terminator “ku'o” (of selma'o KUhO). As you might suppose, “noi” is a cmavo of selma'o NOI; however, first we will discuss the cmavo “poi”, which also belongs to selma'o NOI.

<p>

<cx "poi, syntax of"><lx "ke'a"><cx "relativized sumti, definition"><cx "reference, to relativized sumti with ke'a"><cx "ke'a, as referent for relativized sumti">In between the “poi” and the “ku'o” appears a full bridi, with the same syntax as any other bridi. Anywhere within the bridi of a relative clause, the pro-sumti “ke'a” (of sel­ma'o KOhA) may be used, and it stands for the sumti to which the relative clause is at­tached (called the “relativized sumti”). Here are some examples before we go any further:

<p>

<ex "big person"><pre><a name=e1d2>1.2) ti poi ke'a prenu ku'o cu barda

This-thing such-that-(IT is-a-person) is-large.

This thing which is a person is big.

This person is big.

</pre><ex "big nose"><pre><a name=e1d3>1.3) ti poi ke'a nazbi ku'o cu barda

This-thing such-that-(IT is-a-nose) is-large.

This thing which is a nose is big.

This nose is big.

</pre><ex "big nose-pores"><pre><a name=e1d4>1.4) ti poi ke'a nazbi kapkevna ku'o cu barda

This-thing such-that-(IT is-a-nose-type-of skin-hole) is-big.

These things which are nose-pores are big.

These nose-pores are big.

</pre><cx "IT, as notation convention in relative clause chapter">In the literal translations throughout this chapter, the word “IT”, capi­talized, is used to represent the cmavo “ke'a”. In each case, it serves to represent the sumti (in <a href=#e1d{2}>Examples 1.2 </a>through <a href=#e1d4>1.4</a>, the cmavo “ti”) to which the relative clause is attached.

<p>

<cx "ke'a, non-initial place use in relative clause">Of course, there is no reason why “ke'a” needs to appear in the x1 place of a relative clause bridi; it can appear in any place, or indeed even in a sub-bridi within the relative clause bridi. Here are two more examples:

<p>

<pre><a name=e1d5>1.5) tu poi le mlatu pu lacpu ke'a ku'o cu ratcu

That-distant-thing such-that (the cat [past] drags IT) is-a-rat.

That thing which the cat dragged is a rat.

What the cat dragged is a rat.

<a name=e1d6>1.6) ta poi mi djica le nu mi ponse ke'a [kei] ku'o cu bloti

That-thing such-that (I desire the event-of (I own IT) ) is-a-boat.

That thing that I want to own is a boat.

</pre><p>In <a href=#e1d6>Example 1.6</a>, “ke'a” appears in an abstraction clause (abstractions are explained in <a href=chap11.html>Chapter 11</a>) within a relative clause.

<p>

<cx "ke'a, effect of omission of"><cx "relative clause, effect of omission of “ke'a” on">Like any sumti, “ke'a” can be omitted. The usual presumption in that case is that it then falls into the x1 place:

<p>

<pre><a name=e1d7>1.7) ti poi nazbi cu barda

This-thing which is-a-nose is-big.

</pre>almost certainly means the same thing as <a href=#e1d3>Example 1.3</a>. However, “ke'a” can be omitted if it is clear to the listener that it belongs in some place other than x1:

<p>

<pre><a name=e1d8>1.8) tu poi le mlatu pu lacpu cu ratcu

That-distant-thing which the cat [past] drags is-a-rat

</pre>is equivalent to <a href=#e1d4>Example 1.4</a>.

<p>

<cx "ku'o, elidability for relative clauses">As stated before, “ku'o” is an elidable terminator, and in fact it is almost al­ways eli­dable. Throughout the rest of this chapter, “ku'o” will not be written in any of the exam­ples unless it is absolutely re­quired: thus, <a href=#e1d2>Example 1.2 </a>can be written:

<p>

<pre><a name=e1d9>1.9) ti poi prenu cu barda

That which is-a-person is-big.

That person is big.

</pre><cx "poi, discussion of translation">without any change in meaning. Note that “poi” is translated “which” rather than “such-that” when “ke'a” has been omitted from the x1 place of the relative clause bridi. The word “which” is used in English to introduce English relative clauses: other words that can be used are “who” and “that”, as in:

<p>

<pre><a name=e1d10>1.10) I saw a man who was going to the store.

</pre>and

<p>

<pre><a name=e1d11>1.11) The building that the school was located in is large.

</pre><p>In <a href=#e1d10>Example 1.10 </a>the relative clause is “who was going to the store”, and in <a href=#e1d11>Example 1.11 </a>it is “that the school was located in”. Sometimes “who”, “which”, and “that” are used in literal translations in this chap­ter in order to make them read more smoothly.

<p>

### <a name=s2><h3>Incidental relative clauses</h3>

<p>

The following cmavo is discussed in this section:

<p>

<pre> noi NOI incidental relative clause introducer

</pre><cx "relative clauses, kinds of"><cx "relative clause, restrictive (see also restrictive relative clause)"><cx "restrictive relative clause, definition"><cx "incidental relative clause, definition"><cx "non-restrictive relative clause, definition (see also incidental relative clause)"><cx "relative clauses, restricted contrasted with incidental"><lx "noi">There are two basic kinds of relative clauses: restrictive rela­tive clauses intro­duced by “poi”, and incidental (sometimes called simply “non-restrictive”) relative clauses in­troduced by “noi”. The dif­ference between restrictive and incidental relative clauses is that re­strictive clauses provide information that is essential to identifying the referent of the sumti to which they are attached, whereas incidental relative clauses provide addi­tional information which is helpful to the listener but is not essential for identifying the referent of the sumti. All of the examples in <a href=#s1>Section 1 </a>are restrictive relative clauses: the in­formation in the relative clause is essential to identification. (The title of this chapter, though, uses an incidental relative clause.)

<p>

Consider the following examples:

<p>

<pre><a name=e2d1>2.1) le gerku poi blanu cu barda

The dog which is-blue is-large.

The dog which is blue is large.

<a name=e2d2>2.2) le gerku noi blanu cu barda

The dog incidentally-which is-blue is-large.

The dog, which is blue, is large.

</pre><p>In <a href=#e2d1>Example 2.1</a>, the information conveyed by “poi blanu” is essential to identifying the dog in question: it restricts the possible referents from dogs in general to dogs that are blue. This is why “poi” relative clauses are called restrictive. In <a href=#e2d2>Example 2.2</a>, on the other hand, the dog which is referred to has presumably already been identified clearly, and the relative clause “noi blanu” just provides additional in­formation about it. (If in fact the dog hasn't been identified clearly, then the relative clause does not help identify it further.)

<p>

<cx "relative clauses, restricted contrasted with incidental in English expression"><cx "relative clauses, effect of commas in English"><cx "comma, effect on relative clause in English"><cx "incidental relative clause, as a parenthetical device">In English, the distinction between restrictive and incidental relative clauses is ex­pressed in writing by surrounding incidental, but not restrictive, clauses with com­mas. These commas are functioning as parentheses, because incidental relative clauses are es­sentially parenthetical. This distinction in punctuation is represented in speech by a dif­ference in tone of voice. In addition, English restrictive relative clauses can be in­troduced by “that” as well as “which” and “who”, whereas incidental relative clauses cannot begin with “that”. Lojban, however, always uses the cmavo “poi” and “noi” rather than punc­tua­tion or intonation to make the distinction.

<p>

Here are more examples of incidental relative clauses:

<p>

<pre><a name=e2d3>2.3) mi noi jdice cu zvati

I who-incidentally am-a-judge am-at [some-place].

I, a judge, am present.

</pre><p>In this example, “mi” is already sufficiently restricted, and the addi­tional information that I am a judge is being provided solely for the listener's edification.

<p>

<pre><a name=e2d4>2.4) xu do viska le mi karce noi blabi

[True?] You see my car incidentally-which is-white.

Do you see my car, which is white?

</pre><p>In <a href=#e2d4>Example 2.4</a>, the speaker is presumed to have only one car, and is providing inci­dental information that it is white. (Alternatively, he or she might have more than one car, since “le karce” can be plural, in which case the incidental information is that each of them is white.) Contrast <a href=#e2d5>Example 2.5 </a>with a restrictive relative clause:

<p>

<pre><a name=e2d5>2.5) xu do viska le mi karce poi blabi

[True?] You see my car which is-white.

Do you see my car that is white?

Do you see my white car?

</pre><cx "relative clause, compared with tanru">Here the speaker probably has several cars, and is restricting the referent of the sumti “le mi karce” (and thereby the listener's atten­tion) to the white one only. <a href=#e2d5>Example 2.5 </a>means much the same as <a href=#e2d6>Example 2.6</a>, which does not use a relative clause:

<p>

<pre><a name=e2d6>2.6) xu do viska le mi blabi karce

[True?] You see my white car.

Do you see my car, the white one?

</pre><cx "relative clause, contrasted with tanru">So a restrictive relative clause attached to a description can often mean the same as a de­scription involving a tanru. However, “blabi karce”, like all tanru, is somewhat vague: in principle, it might refer to a car which carries white things, or even express some more compli­cated concept involving whiteness and car-ness; the restrictive rela­tive clause of <a href=#e2d5>Example 2.5 </a>can only refer to a car which is white, not to any more com­plex or extended concept.

<p>

### <a name=s3><h3>Relative phrases</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> pe GOI restrictive association

po GOI restrictive possession

po'e GOI restrictive intrinsic possession

po'u GOI restrictive identification

ne GOI incidental association

no'u GOI incidental identification

ge'u GEhU relative phrase terminator

</pre><cx "relative phrase, rationale for"><lx "GOI"><cx "relative phrase, syntax of"><cx "relative phrase, as an abbreviation of a common relative clause">There are types of relative clauses (those which have a cer­tain selbri) which are fre­quently wanted in Lojban, and can be ex­pressed using a shortcut called a relative phrase. Relative phrases are introduced by cmavo of selma'o GOI, and consist of a GOI cmavo followed by a single sumti.

<p>

<lx "pe"><cx "pe, compared with “poi ke'a srana”"><cx "pe, as loose association"><cx "loose association, expressing with pe">Here is an example of “pe”, plus an equivalent sentence us­ing a relative clause:

<p>

<pre><a name=e3d1>3.1) le stizu pe mi cu blanu

The chair associated-with me is-blue.

My chair is blue.

<a name=e3d2>3.2) le stizu poi ke'a srana mi cu blanu

The chair such-that (IT is-associated-with me) is-blue.

</pre><p>In <a href=#e3d1>Example 3.1 </a>and <a href=#e3d2>Example 3.2</a>, the link between the chair and the speaker is of the loosest kind.

<p>

<lx "po"><cx "po, compared with “poi ke'a se steci srana”"><cx "po, as restrictive possession"><cx "possession, expressing with po"><cx "specificity, expressing with po">Here is an example of “po”:

<p>

<pre><a name=e3d3>3.3) le stizu po mi cu xunre

The chair specific-to me is red.

<a name=e3d4>3.4) le stizu poi ke'a se steci srana mi cu xunre

The chair such-that (IT is-specifically associated-with me) is-red.

</pre><cx "pe, contrasted with po"><cx "po, contrasted with pe"><a href=#e3d3>Example 3.3 </a>and <a href=#e3d4>Example 3.4 </a>contrast with <a href=#e3d1>Example 3.1 </a>and <a href=#e3d2>Exam­ple 3.2</a>: the chair is more permanently connected with the speaker. A plausible (though not the only possi­ble) contrast between <a href=#e3d1>Example 3.1 </a>and <a href=#e3d3>Example 3.3 </a>is that “pe mi” would be appropri­ate for a chair the speaker is currently sitting on (whether or not the speaker owned that chair), and “po mi” for a chair owned by the speaker (whether or not he or she was cur­rently occu­pying it).

<p>

<cx "po, contrasted with English “possession”">As a result, the relationship expressed between two sumti by “po” is usually called “possession”, although it does not necessarily imply ownership, legal or other­wise. The central concept is that of specificity (“steci” in Lojban).

<p>

<lx "po'e"><cx "po'e, compared with “poi ke'a jinzi ke se steci srana”"><cx "po'e, as intrinsic possession"><cx "possession, intrinsic, expressing with po'e"><cx "intrinsic possession, expressing with po'e"><cx "inalienable possession, expressing with po'e">Here is an example of “po'e”, as well as another example of “po”:

<p>

<ex "person's arm"><pre><a name=e3d5>3.5) le birka po'e mi cu spofu

The arm intrinsically-possessed-by me is-broken

<a name=e3d6>3.6) le birka poi jinzi ke se steci srana mi cu spofu

The arm which is-intrinsically (specifically associated-with) me is-broken.

<a name=e3d7>3.7) le botpi po mi cu spofu

The bottle specific-to me is-broken

</pre><cx "po'e, contrasted with po"><cx "po, contrasted with po'e"><cx "intrinsic possession, definition"><cx "inalienable possession, definition"><cx "extrinsic possession, definition"><cx "alienable possession, definition"><a href=#e3d5>Example 3.5 </a>and <a href=#e3d6>Example 3.6 </a>on the one hand, and <a href=#e3d7>Example 3.7 </a>on the other, illustrate the contrast between two types of possession called “intrinsic” and “extrinsic”, or some­times “inalienable” and “alienable”, respectively. Something is intrinsically (or inaliena­bly) possessed by someone if the possession is part of the possessor, and cannot be changed without changing the possessor. In the case of <a href=#e3d5>Example 3.5</a>, people are usu­ally taken to intrinsically possess their arms: even if an arm is cut off, it remains the arm of that person. (If the arm is transplanted to another person, however, it becomes in­trinsi­cally possessed by the new user, though, so intrinsic possession is a matter of degree.)

<p>

<cx "inalienable, distinguishing from alienable">By contrast, the bottle of <a href=#e3d7>Example 3.7 </a>can be given away, or thrown away, or lost, or stolen, so it is possessed extrinsically (alienably). The exact line between intrin­sic and extrinsic possession is culturally dependent. The U.S. Declaration of Independ­ence speaks of the “inalienable rights” of men, but just what those rights are, and even whether the concept makes sense at all, varies from culture to culture.

<p>

Note that <a href=#e3d5>Example 3.5 </a>can also be expressed without a rela­tive clause:

<p>

<pre><a name=e3d8>3.8) le birka be mi cu spofu

The arm of-body me is broken

</pre><cx "intrinsic possession, expressing by using place in some selbri">reflecting the fact that the gismu “birka” has an x2 place representing the body to which the arm belongs. Many, but not all, cases of intrin­sic possession can be thus covered without using “po'e” by placing the possessor into the appropriate place of the descrip­tion selbri.

<p>

<lx "po'u">Here is an example of “po'u”:

<p>

<pre><a name=e3d9>3.9) le gerku po'u le mi pendo cu cinba mi

The dog which-is my friend kisses me.

<a name=e3d10>3.10) le gerku poi du le mi pendo cu cinba mi

The dog which = my friend kisses me.

</pre><cx "po'u, compared with “poi ke'a du”"><cx "po'u, as identity"><cx "identity, expressing with po'u">The cmavo “po'u” does not represent possession at all, but rather identity. (Note that it means “poi du” and its form was chosen to sug­gest the relationship.)

<p>

In <a href=#e3d9>Example 3.9 </a>, the use of “po'u” tells us that “le gerku” and “le mi pendo” represent the same thing. Consider the contrast be­tween <a href=#e3d9>Example 3.9 </a>and:

<p>

<pre><a name=e3d11>3.11) le mi pendo po'u le gerku cu cinba mi

My friend which-is the dog kisses me.

</pre><cx "po'u, relative phrase of contrasted with relativized sumti of">The facts of the case are the same, but the listener's knowledge about the situation may not be. In <a href=#e3d9>Example 3.9</a>, the listener is pre­sumed not to understand which dog is meant by “le gerku”, so the speaker adds a relative phrase clarifying that it is the particular dog which is the speaker's friend.

<p>

<a href=#e3d11>Example 3.11</a>, however, assumes that the listener does not know which of the speaker's friends is referred to, and specifies that it is the friend that is the dog (which dog is taken to be obvious). Here is another example of the same contrast:

<p>

<ex "New York city"><ex "New York state"><pre><a name=e3d12>3.12) le tcadu po'u la nu,iork

The city of New York [not another city].

<a name=e3d13>3.13) la nu,iork po'u le tcadu

New York the city (not the state or some other New York)

</pre><cx "possessor in relative phrases, compared with possessed"><cx "possessed in relative phrases, compared with possessor">The principle that the possessor and the possessed may change places applies to all the GOI cmavo, and allows for the possi­bility of odd effects:

<p>

<ex "friend's cup"><pre><a name=e3d14>3.14) le kabri pe le mi pendo cu cmalu

The cup associated-with my friend is small.

My friend's cup is small

</pre><ex "cup's friend"><pre><a name=e3d15>3.15) le mi pendo pe le kabri cu cmalu

My friend associated-with the cup is small.

My friend, the one with the cup, is small.

</pre><a href=#e3d14>Example 3.14 </a>is useful in a context which is about my friend, and states that his or her cup is small, whereas <a href=#e3d15>Example 3.15 </a>is useful in a context that is primarily about a cer­tain cup, and makes a claim about “my friend of the cup”, as opposed to some other friend of mine. Here the cup appears to “possess” the person! English can't even express this rela­tionship with a possessive — “the cup's friend of mine” looks like nonsense — but Loj­ban has no trouble doing so.

<p>

<lx "ne"><lx "no'u"><cx "ne, compared with pe"><cx "no'u, compared with po'u"><cx "pe, compared with ne"><cx "po'u, compared with no'u"><cx "incidental association, expressing with ne"><cx "incidental identification, expressing with no'u">Finally, the cmavo “ne” and “no'u” stand to “pe” and “po'u”, respectively, as “noi” does to “poi” — they provide incidental informa­tion:

<p>

<pre><a name=e3d16>3.16) le blabi gerku ne mi cu batci do

The white dog, incidentally-associated-with me, bites you.

The white dog, which is mine, bites you.

</pre><p>In <a href=#e3d16>Example 3.16</a>, the white dog is already fully identified (after all, presumably the lis­tener know which dog bit him or her!). The fact that it is yours is merely incidental to the main bridi claim.

<p>

<cx "no'u, contrasted with po'u"><cx "po'u, contrasted with no'u">Distinguishing between “po'u” and “no'u” can be a little tricky. Consider a room with several men in it, one of whom is named Jim. If you don't know their names, I might say:

<p>

<pre><a name=e3d17>3.17) le nanmu no'u la djim. cu terpemci

The man, incidentally-who-is Jim, is-a-poet.

The man, Jim, is a poet.

</pre><p>Here I am saying that one of the men is a poet, and incidentally telling you that he is Jim. But if you do know the names, then

<p>

<pre><a name=e3d18>3.18) le nanmu po'u la djim. cu terpemci

The man who-is Jim is-a-poet.

The man named Jim is a poet.

</pre>is appropriate. Now I am using the fact that the man I am speaking of is Jim in order to pick out which man I mean.

<p>

<cx "possession, Lojban usage contrasted with English in omission/inclusion"><cx "possession, Lojban usage compared with French and German in omission/inclusion">It is worth mentioning that English sometimes over-specifies possession from the Lojban point of view (and the point of view of many other languages, including ones closely related to English). The idiomatic English sentence

<p>

<pre><a name=e3d19>3.19) The man put his hands in his pockets.

</pre>seems strange to a French- or German-speaking person: whose pockets would he put his hands into? and even odder, whose hands would he put into his pockets? In Lojban, the sentence

<p>

<ex "hands in pockets"><pre><a name=e3d20>3.20) le nanmu cu punji le xanci le daski

The man puts the hand at-locus-the pocket.

</pre>is very natural. Of course, if the man is in fact putting his hands into another's pockets, or another's hands into his pockets, the fact can be specified.

<p>

<lx "ge'u"><lx "GEhU"><cx "ge'u, elidability of from relative phrases"><cx "logical connective, effect on elidability of ge'u from preceding relative phrase"><cx "ge'u, effect of following logical connective on elidability"><cx "goi, rationale for non-inclusion in relative clause chapter">Finally, the elidable terminator for GOI cmavo is “ge'u” of selma'o GEhU; it is al­most never required. However, if a logical con­nective immediately follows a sumti modi­fied by a relative phrase, then an explicit “ge'u” is needed to allow the connective to af­fect the relativized sumti rather than the sumti of the relative phrase. (What about the cmavo after which selma'o GOI is named? It is discussed in <a href=chap7.html>Chapter 7</a>, as it is not seman­tically akin to the other kinds of relative phrases, although the syntax is the same.)

<p>

### a name=s4><h3>Multiple relative clauses: “zi'e”</h3>

The following cmavo is discussed in this section:

<p>

<pre> zi'e ZIhE relative clause joiner

</pre><cx "multiple relative clauses, attaching with zi'e"><lx "zi'e"><lx "ZIhE">Sometimes it is necessary or useful to attach more than one relative clause to a sumti. This is made possible in Lojban by the cmavo “zi'e” (of selma'o ZIhE), which is used to join one or more rela­tive clauses together into a single unit, thus making them apply to the same sumti. For example:

<p>

<pre><a name=e4d1>4.1) le gerku poi blabi zi'e poi batci le nanmu cu klama

The dog which is white and which bites the man goes.

</pre><cx "zi'e, contrasted with logical connectives"><cx "zi'e, compared with “and”">The most usual translation of “zi'e” in English is “and”, but “zi'e” is not really a logi­cal connective: unlike most of the true logical connectives (which are explained in <a href=chap14.html>Chap­ter 14</a>), it cannot be con­verted into a logical connection between sentences.

<p>

<cx "multiple relative clauses, connecting different kinds with zi'e"><cx "relative clause, connecting to relative phrase with zi'e"><cx "relative phrase, connecting to relative clause with zi'e">It is perfectly correct to use “zi'e” to connect relative clauses of different kinds:

<p>

<pre><a name=e4d2>4.2) le gerku poi blabi zi'e noi le mi pendo cu ponse ke'a cu klama

The dog that-is (white) and incidentally-such-that (my friend owns IT) goes.

The dog that is white, which my friend owns, is going.

</pre><p>In <a href=#e4d2>Example 4.2</a>, the restrictive clause “poi blabi” specifies which dog is referred to, but the incidental clause “noi le mi pendo cu ponse” is mere incidental information: the lis­tener is supposed to already have identified the dog from the “poi blabi”. Of course, the meaning (though not necessarily the emphasis) is the same if the incidental clause ap­pears first.

<p>

<cx "zi'e, use in connecting relative phrase/clause to relative phrase/clause">It is also possible to connect relative phrases with “zi'e”, or a relative phrase with a relative clause:

<p>

<pre><a name=e4d3>4.3) le botpi po mi zi'e poi blanu cu spofu

The bottle specific-to me and which-is blue is-broken.

My blue bottle is broken.

</pre><p>Note that if the colloquial translation of <a href=#e4d3>Example 4.3 </a>were “My bottle, which is blue, is broken”, then “noi” rather than “poi” would have been correct in the Lojban version, since that version of the English implies that you do not need to know the bottle is blue. As written, <a href=#e4d3>Example 4.3 </a>suggests that I probably have more than one bottle, and the one in question needs to be picked out as the blue one.

<p>

<ex "my chair"><pre><a name=e4d4>4.4) mi ba zutse le stizu pe mi zi'e po do

zi'e poi xunre

I [future] sit-in the chair associated-with me and specific-to you

and which-is red.

I will sit in my chair (really yours), the red one.

</pre><a href=#e4d4>Example 4.4 </a>illustrates that more than two relative phrases or clauses can be connected with “zi'e”. It almost defies colloquial translation because of the very un-English con­trast between “pe mi”, implying that the chair is temporarily connected with me, and “po do”, implying that the chair has a more permanent association with you. (Perhaps I am a guest in your house, in which case the chair would naturally be your property.)

<p>

Here is another example, mixing a relative phrase and two relative clauses, a restric­tive one and a non-restrictive one:

<p>

<ex "beans"><pre><a name=e4d5>4.5) mi ba citka le dembi pe mi

zi'e poi cpana le mi palta

zi'e noi do dunda ke'a mi

I [future] eat the beans associated-with me

and which are-upon my plate

and which-incidentally you gave IT to-me.

I'll eat my beans that are on my plate, the ones you gave me.

### </pre><a name=s5><h3>Non-veridical relative clauses: “voi”</h3>

The following cmavo is discussed in this section:

<p>

<pre> voi NOI non-veridical relative clause introducer

</pre><lx "voi"><cx "voi, contrasted with poi in veridicality"><cx "poi, contrasted with voi in veridicality"><cx "restrictive relative clauses, non-veridical using voi"><cx "restrictive relative clauses, veridical using poi">There is another member of selma'o NOI which serves to in­troduce a third kind of relative clause: “voi”. Relative clauses intro­duced by “voi” are restrictive, like those in­troduced by “poi”. However, there is a fundamental difference between “poi” and “voi” relative clauses. A “poi” relative clause is said to be veridical, in the same sense that a description using “lo” or “loi” is: it is essential to the in­terpretation that the bridi actually be true. For example:

<p>

<pre><a name=e5d1>5.1) le gerku poi blabi cu klama

The dog which is-white goes.

</pre>it must actually be true that the dog is white, or the sentence consti­tutes a miscommuni­cation. If there is a white dog and a brown dog, and the speaker uses “le gerku poi blabi” to refer to the brown dog, then the listener will not understand correctly. How­ever,

<p>

<pre><a name=e5d2>5.2) le gerku voi blabi cu klama

The dog which-I-describe-as white goes

</pre>puts the listener on notice that the dog in question may not actually meet objective stan­dards (whatever they are) for being white: only the speaker can say exactly what is meant by the term. In this way, “voi” is like “le”; the speaker's intention determines the mean­ing.

<p>

As a result, the following two sentences

<p>

<ex "man is woman"><pre><a name=e5d3>5.3) le nanmu cu ninmu

That-which-I-describe-as a-man is-a-woman.

The “guy” is actually a gal.

<a name=e5d4>5.4) ti voi nanmu cu ninmu

This-thing which-I-describe-as a-man is-a-woman.

</pre>mean essentially the same thing (except that <a href=#e5d5>Example 5.5 </a>involves pointing thanks to the use of “ti”, whereas <a href=#e5d4>Example 5.4 </a>doesn't), and neither one is self-contradictory: it is per­fectly all right to describe something as a man (although perhaps confusing to the lis­tener) even if it actually is a woman.

<p>

### <a name=s6><h3>Relative clauses and descriptors</h3>

<p>

<cx "relative clause after sumti, as common placement in sentence">So far, this chapter has described the various kinds of rela­tive clauses (including relative phrases). The list is now complete, and the rest of the chapter will be concerned with the syntax of sumti that include relative clauses. So far, all relative clauses have ap­peared directly after the sumti to which they are attached. This is the most common posi­tion (and originally the only one), but a variety of other placements are also possible which produce a variety of semantic effects.

<p>

<cx "relative clauses, placement in sentence"><cx "relative clauses, effect of elided “ku” of relativized sumti"><lx "ku"><lx "le">There are actually three places where a relative clause can be attached to a de­scrip­tion sumti: after the descriptor (“le”, “lo”, or whatever), after the embedded selbri but before the elidable termina­tor (which is “ku”), and after the “ku”. The relative clauses attached to descriptors that we have seen have occupied the second position. Thus <a href=#e5d1>Exam­ple 5.1</a>, if written out with all elidable terminators, would appear as:

<p>

<pre><a name=e6d1>6.1) le gerku poi blabi ku'o ku cu klama vau

The (dog which (is-white) ) goes.

The dog which is white is going.

</pre><lx "ku'o"><lx "vau">Here “ku'o” is the terminator paired with “poi” and “ku” with “le”, and “vau” is the ter­minator of the whole bridi.

<p>

<cx "relative clause placement, on sumti with simple descriptor">When a simple descriptor using “le”, like “le gerku”, has a relative clause at­tached, it is purely a matter of style and emphasis where the relative clause should go. Therefore, the following exam­ples are all equivalent in meaning to <a href=#e6d1>Example 6.1</a>:

<p>

<pre><a name=e6d2>6.2) le poi blabi ku'o gerku cu klama

The such-that (it-is-white) dog goes.

<a name=e6d3>6.3) le gerku ku poi blabi cu klama

The (dog) which is-white goes.

</pre><cx "relative clause placement, English contrasted with Chinese and Finnish"><cx "relative clause after descriptor, effect on elidability of ku'o"><cx "ku'o, effect of relative clause after descriptor on elidability"><a href=#e6d1>Example 6.1 </a>will seem most natural to speakers of languages like English, which al­ways puts relative clauses after the noun phrases they are attached to; <a href=#e6d2>Example 6.2</a>, on the other hand, may seem more natural to Finnish or Chinese speakers, who put the relative clause first. Note that in <a href=#e6d2>Example 6.2</a>, the elidable terminator “ku'o” must ap­pear, or the selbri of the relative clause (“blabi”) will merge with the selbri of the de­scription (“gerku”), re­sulting in an ungram­matical sentence. The purpose of the form appearing in <a href=#e6d3>Example 6.3 </a>will be apparent shortly.

<p>

<cx "inner quantifier of sumti, meaning of"><cx "outer quantifier of sumti, meaning of">As is explained in detail in <a href=chap6.html>Chapter 6</a>, two different numbers (known as the “inner quantifier” and the “outer quantifier”) can be at­tached to a description. The inner quanti­fier specifies how many things the descriptor refers to: it appears between the descriptor and the description selbri. The outer quantifier appears before the de­scriptor, and speci­fies how many of the things referred to by the de­scriptor are involved in this particular bridi. In the following example,

<p>

<ex "five people"><pre><a name=e6d4>6.4) re le mu prenu cu klama le zarci

Two-of the five persons go to-the market.

Two of the five people [that I have in mind] are going to the market.

</pre><cx "relative clauses, effect of relativized sumti quantifiers on"><cx "quantifiers on sumti, effect on relative clauses for sumti"><cx "relative clause placement, effect on scope">““mu” is the inner quantifier and “re” is the outer quantifier. Now what is meant by at­tach­ing a relative clause to the sumti “re le mu prenu”? Suppose the relative clause is “poi ninmu” (meaning “who are women”). Now the three possible attachment points discussed previ­ously take on significance.

<p>

<cx "relative clause before inner quantifier, meaning"><pre><a name=e6d5>6.5) re le poi ninmu ku'o mu prenu cu klama le zarci

Two of the such-that ([they] are-women) five persons go to-the market.

Two women out of the five persons go to the market.

</pre><cx "relative clause before relativized sumti ku, meaning"><ex "five women"><pre><a name=e6d6>6.6) re le mu prenu poi ninmu [ku] cu klama le zarci

Two of the (five persons which are-women) go to-the market.

Two of the five women go to the market.

</pre><cx "relative clause after relativized sumti ku, meaning"><pre><a name=e6d7>6.7) re le mu prenu ku poi ninmu cu klama le zarci

(Two of the five persons ) which are-women go to-the market.

Two women out of the five persons go to the market.

</pre><cx "relative clause scope, with quantified relativized sumti"><cx "quantified sumti, relative clause scope with"><cx "relative clauses and quantified sumti, placement considerations">As the parentheses show, <a href=#e6d6>Example 6.6 </a>means that all five of the per­sons are women, whereas <a href=#e6d7>Example 6.7 </a>means that the two who are going to the market are women. How do we remember which is which? If the relative clause comes after the explicit “ku”, as in <a href=#e6d7>Ex­ample 6.7</a>, then the sumti as a whole is qualified by the relative clause. If there is no “ku”, or if the relative clause comes before an explicit “ku”, then the relative clause is understood to apply to every­thing which the underlying selbri applies to.

<p>

What about <a href=#e6d5>Example 6.5</a>? By convention, it means the same as <a href=#e6d7>Example 6.7</a>, and it requires no “ku”, but it does typically require a “ku'o” instead. Note that the rela­tive clause comes before the inner quantifier.

<p>

<cx "relative clause placement considerations, for simple descriptors contrasted with for quantified sumti"><cx "relative clause placement considerations, for “lo” sumti contrasted with “le” sumti"><cx "lo contrasted with le, for relative clause placement considerations"><cx "le contrasted with lo, for relative clause placement considerations"><cx "relative clauses, impact of le on placement"><cx "relative clauses, impact of lo on placement"><cx "relative clauses and “le” sumti, placement considerations"><cx "relative clauses and “lo” sumti, placement considerations">When “le” is the descriptor being used, and the sumti has no explicit outer quantifier, then the outer quantifier is understood to be “ro” (meaning “all”), as is ex­plained in <a href=chap6.html>Chapter 6</a>. Thus “le gerku” is taken to mean “all of the things I refer to as dogs”, possibly all one of them. In that case, there is no difference between a relative clause after the “ku” or before it. However, if the descriptor is “lo”, the differ­ence is quite important:

<p>

<pre><a name=e6d8>6.8) lo prenu ku noi blabi cu klama le zarci

(Some persons) incidentally-which are-white go to-the market.

Some people, who are white, go to the market.

<a name=e6d9>6.9) lo prenu noi blabi [ku] cu klama le zarci

Some (persons incidentally-which are-white) go to-the market.

Some of the people, who by the way are white, go to the market.

</pre><p>Both <a href=#e6d{8}>Examples 6.8 </a>and <a href=#e6d9>6.9 </a>tell us that one or more persons are going to the market. How­ever, they make very different incidental claims. Now, what does “lo prenu noi blabi” mean? Well, the default inner quantifier is “ro” (meaning “all”), and the default outer quantifier is “su'o” (meaning “at least one”). Therefore, we must first take all per­sons, then choose at least one of them. That one or more people will be going.

<p>

In <a href=#e6d8>Example 6.8</a>, the relative clause described the sumti once the outer quanti­fier was applied: one or more people, who are white, are going. But in <a href=#e6d9>Example 6.9</a>, the relative clause actually describes the sumti before the outer quantification is applied, so that it ends up meaning “First take all persons — by the way, they're all white”. But not all peo­ple are white, so the incidental claim being made here is false.

<p>

<cx "relative clauses on lo, syntax suggestion">The safe strategy, therefore, is to always use “ku” when at­taching a “noi” rela­tive clause to a “lo” descriptor. Otherwise we may end up claiming far too much.

<p>

<cx "relative clauses, impact of la on placement"><cx "relative clauses, as part of name"><cx "relative clauses, on names"><cx "relative clauses and names, placement considerations">When the descriptor is “la”, indicating that what follows is a selbri used for naming, then the positioning of relative clauses has a different significance. A relative clause in­side the “ku”, whether before or after the selbri, is reckoned part of the name; a relative clause out­side the “ku” is not. Therefore,

<p>

<ex "afraid of horse"><pre><a name=e6d10>6.10) mi viska la nanmu poi terpa le ke'a xirma [ku]

I see that-named (“man which fears the of-IT horse”).

I see Man Afraid Of His Horse.

</pre>says that the speaker sees a person with a particular name, who does not necessarily fear any horses, whereas

<p>

<pre><a name=e6d11>6.11) mi viska la nanmu ku poi terpa le ke'a xirma.

I see that-named(“Man” ) which fears the of-IT horse.

I see the person named “Man” who is afraid of his horse.

</pre>refers to one (or more) of those named “Man”, namely the one(s) who are afraid of their horses.

<p>

<cx "relative clauses, impact of indefinite sumti on placement"><cx "relative clauses and indefinite sumti, placement considerations">Finally, so-called indefinite sumti like “re karce”, which means almost the same as “re lo karce” (which in turn means the same as “re lo ro karce”), can have rela­tive clauses attached; these are taken to be of the outside-the-“ku” variety. Here is an example:

<p>

<pre><a name=e6d12>6.12) mi ponse re karce [ku] poi xekri

I possess two cars which-are black.

</pre><cx "relative clauses, syntax with indefinite sumti"><cx "relative clauses on indefinite sumti, syntax considerations">The restrictive relative clause only affects the two cars being affected by the main bridi, not all cars that exist. It is ungrammatical to try to place a relative clause within an in­definite sumti (that is, before an explicitly expressed terminating “ku”.) Use an explicit “lo” instead.

<p>

### <a name=s7><h3>Possessive sumti</h3>

<p>

<cx "sumti, between descriptor and description selbri"><lx "pe"><cx "relative phrase, compared with possessor sumti"><cx "possessor sumti, compared with relative phrase">In <a href=#e2d{4}>Examples 2.4 </a>through <a href=#e2d6>2.6</a>, the sumti “le mi karce” appears, glossed as “my car”. Although it might not seem so, this sumti actu­ally contains a relative phrase. When a sumti appears between a de­scriptor and its description selbri, it is actually a “pe” relative phrase. So

<p>

<ex "my"><pre><a name=e7d1>7.1) le mi karce cu xunre

My car is-red.

</pre>and

<p>

<pre><a name=e7d2>7.2) le pe mi karce cu xunre

The (associated-with me) car is-red.

</pre>mean exactly the same thing. Furthermore, since there are no special considerations of quantifiers here,

<p>

<pre><a name=e7d3>7.3) le karce pe mi cu xunre

The car associated-with me is-red.

</pre><cx "possessive sumti, definition"><cx "possessor sumti, definition">means the same thing as well. A sumti like the one in <a href=#e7d1>Example 7.1 </a>is called a “possessive sumti”. Of course, it does not really indicate pos­session in the sense of ownership, but like “pe” relative phrases, indi­cates only weak association; you can say “le mi karce” even if you've only borrowed it for the night. (In English, “my car” usu­ally means “le karce po mi”, but we do not have the same sense of possession in “my seat on the bus”; Lojban simply makes the weaker sense the standard one.) The inner sumti, “mi” in <a href=#e7d1>Ex­ample 7.1</a>, is correspond­ingly called the “possessor sumti”.

<p>

<cx "possessive sumti and relative clauses, development history"><cx "relative clauses and possessive sumti, development history">Historically, possessive sumti existed before any other kind of relative phrase or clause, and were retained when the machinery of relative phrases and clauses as de­tailed in this chapter so far was slowly built up. When preposed relative clauses of the <a href=#e7d2>Example 7.2 </a>type were devised, possessive sumti were most easily viewed as a special case of them.

<p>

<cx "possessor sumti, syntax allowed"><cx "possessor sumti, contrasted with relative phrases in complexity allowed"><cx "relative phrases, contrasted with possessor sumti in complexity allowed"><cx "pro-sumti, as possessor sumti"><cx "names, as possessor sumti"><cx "descriptions, as possessor sumti"><cx "quotations, as possessor sumti"><cx "numbers, as possessor sumti">Although any sumti, however complex, can appear in a full-fledged relative phrase, only simple sumti can appear as possessor sumti, without a “pe”. Roughly speaking, the legal possessor sumti are: pro-sumti, quotations, names and descriptions, and numbers. In addition, the possessor sumti may not be preceded by a quantifier, as such a form would be interpreted as the unusual “descriptor + quanti­fier + sumti” type of description. All these sumti forms are explained in full in <a href=chap6.html>Chapter 6</a>.

<p>

Here is an example of a description used in a possessive sumti:

<p>

<pre><a name=e7d4>7.4) le le nanmu ku karce cu blanu

The (associated-with-the man) car is blue.

The man's car is blue.

<cx "ku, effect of possessor sumti on elidability of"><cx "possessor sumti, effect on elidability of ku">Note the explicit “ku” at the end of the possessor sumti, which pre­vents the selbri of the possessor sumti from merging with the selbri of the main description sumti. Because of the need for this “ku”, the most common kind of possessor sumti are pro-sumti, espe­cially per­sonal pro-sumti, which require no elidable terminator. Descriptions are more likely to be attached with relative phrases.

</pre><p>And here is a number used as a possessor sumti:

<p>

<ex "juror 5"><pre><a name=e7d5>7.5) le li mu jdice se bende

The of-the-number-five judging team-member

Juror number 5

</pre>which is not quite the same as “the fifth juror”; it simply indicates a weak association between the particular juror and the number 5.

<p>

<cx "relative clauses, on possessor sumti"><cx "possessor sumti, relative clauses on"><cx "possessive sumti, with relative clauses on possessor sumti"><cx "relative clauses with possessive sumti, effect of placement"><cx "possessive sumti with relative clauses, effect of placement">A possessive sumti may also have regular relative clauses attached to it. This would need no comment if it were not for the fol­lowing special rule: a relative clause immedi­ately following the pos­sessor sumti is understood to affect the possessor sumti, not the possessive. For example:

<p>

<pre><a name=e7d6>7.6) le mi noi sipna vau karce cu na klama

The of-me incidentally-which-(is-sleeping) car isn't going.

</pre>means that my car isn't going; the incidental claim of “noi sipna” ap­plies to me, not my car, however. If I wanted to say that the car is sleeping (whatever that might mean) I would need:

<p>

<pre><a name=e7d7>7.7) le mi karce poi sipna cu na klama

The of-me car which sleeps isn't going.

</pre><cx "vau, effect on elidability ku'o"><cx "ku'o, effect of vau on elidability">Note that <a href=#e7d6>Example 7.6 </a>uses “vau” rather than “ku'o” at the end of the relative clause: this terminator ends every simple bridi and is almost always elidable; in this case, though, it is a syllable shorter than the equally valid alternative, “ku'o”.

<p>

### <a name=s8><h3>Relative clauses and complex sumti: “vu'o”</h3>

The following cmavo is discussed in this section:

<p>

<pre> vu'o VUhO relative clause attacher

</pre><p>Normally, relative clauses attach only to simple sumti or parts of sumti: pro-sumti, names and descriptions, pure numbers, and quotations. An example of a relative clause attached to a pure num­ber is:

<p>

<cx "relative clause, on number"><ex "irrational number"><pre><a name=e8d1>8.1) li pai noi na'e frinu namcu

The-number pi, incidentally-which is-a-non- fraction number

The irrational number pi

</pre><cx "relative clause, on quotation">And here is an incidental relative clause attached to a quotation:

<p>

<pre><a name=e8d2>8.2) lu mi klama le zarci li'u

noi mi cusku ke'a cu jufra

[quote] I go to-the market [unquote]

incidentally-which-(I express IT) is-a-sentence.

“I'm going to the market”, which I'd said, is a sentence.

</pre>which may serve to identify the author of the quotation or some other relevant, but sub­sidiary, fact about it. All such relative clauses appear only after the simple sumti, never before it.

<p>

<lx "LAhE"><lx "NAhE"><cx "relative clauses, impact of LAhE on placement"><cx "relative clauses and LAhE, placement considerations"><cx "relative clauses, impact of NAhE on placement"><cx "relative clauses and NAhE, placement considerations"><cx "LAhE, effect of relative clause placement with"><cx "NAhE, effect of relative clause placement with">In addition, sumti with attached sumti qualifiers of selma'o LAhE or NAhE+BO (which are explained in detail in <a href=chap6.html>Chapter 6</a>) can have a relative clause ap­pearing after the qualifier and before the qualified sumti, as in:

<p>

<ex "red pony"><lx "la'e"><pre><a name=e8d3>8.3) la'e poi tolcitno vau lu le xunre cmaxirma li'u

cu zvati le vu kumfa

A-referent-of (which is-old) [quote] The Red Small-horse [unquote]

is-at the [far distance] room.

An old “The Red Pony” is in the far room.

</pre><a href=#e8d3>Example 8.3 </a>is a bit complex, and may need some picking apart. The quotation “lu le xunre cmaxirma li'u” means the string of words “The Red Pony”. If the “la'e” at the be­ginning of the sentence were omitted, <a href=#e8d3>Example 8.3 </a>would claim that a certain string of words is in a room distant from the speaker. But obviously a string of words can't be in a room! The effect of the “la'e” is to modify the sumti so that it refers not to the words themselves, but to the referent of those words, a novel by John Steinbeck (presumably in Lojban translation). The par­ticular copy of “The Red Pony” is identified by the restrictive relative clause. <a href=#e8d3>Example 8.3 </a>means exactly the same as:

<p>

<pre><a name=e8d4>8.4) la'e lu le xunre cmaxirma li'u lu'u

poi to'ercitno cu zvati le vu kumfa

A-referent-of ([quote] The Red Small-horse [unquote])

which is-old is-at the [far distance] room.

</pre>and the two sentences can be considered stylistic variants. Note the required “lu'u” ter­minator, which prevents the relative clause from at­taching to the quotation itself: we do not wish to refer to an old quota­tion!

<p>

<cx "relative clauses, on connected sumti">Sometimes, however, it is important to make a relative clause apply to the whole of a more complex sumti, one which involves logi­cal or non-logical connection (explained in <a href=chap14.html>Chapter 14</a>). For example,

<p>

<pre><a name=e8d5>8.5) la frank. .e la djordj. noi nanmu cu klama le zdani

Frank and George incidentally-who is-a-man go to-the house.

Frank and George, who is a man, go to the house.

</pre><p>The incidental claim in <a href=#e8d5>Example 8.5 </a>is not that Frank and George are men, but only that George is a man, because the incidental relative clause attaches only to “la djordj”, the immediately preceding simple sumti.

<p>

<lx "vu'o"><lx "VUhO"><cx "relative clause scope, extending to preceding sumti with vu'o">To make a relative clause attach to both parts of the logically connected sumti in <a href=#e8d5>Ex­ample 8.5</a>, a new cmavo is needed, “vu'o” (of selma'o VUhO). It is placed be­tween the sumti and the relative clause, and extends the sphere of influence of that relative clause to the entire preceding sumti, including however many logical or non-logical connectives there may be.

<p>

<pre><a name=e8d6>8.6) la frank. .e la djordj. vu'o noi nanmu cu klama le zdani

Frank and George incidentally-who are-men go to-the house.

Frank and George, who are men, go to the house.

</pre><p>The presence of “vu'o” here means that the relative clause “noi nanmu” extends to the entire logically connected sumti “la frank. .e la djordj.”; in other words, both Frank and George are claimed to be men, as the colloquial translation shows.

<p>

<cx "relative clauses on complex sumti, Lojban contrasted with English">English is able to resolve the distinction correctly in the case of <a href=#e8d5>Example 8.5 </a>and <a href=#e8d6>Ex­ample 8.6 </a>by making use of number: “who is” rather than “who are”. Lojban doesn't dis­tinguish between singular and plural verbs: “nanmu” can mean “is a man” or “are men”, so an­other means is required. Furthermore, Lojban's mechanism works cor­rectly in gen­eral: if “nanmu” (meaning “is-a-man”) were replaced with “pu bajra” (“ran”), English would have to make the distinction some other way:

<p>

<pre><a name=e8d7>8.7) la frank. .e la djordj. noi pu bajra cu klama le zdani

Frank and (George who [past] runs) go to-the house.

Frank and George, who ran, go to the house.

<a name=e8d8>8.8) la frank. .e la djordj. vu'o noi pu bajra cu klama le zdani

(Frank and George) who [past] runs go to-the house.

Frank and George, who ran, go to the house.

</pre><p>In spoken English, tone of voice would serve; in written English, one or both sentences would need rewriting.

<p>

### <a name=s9><h3>Relative clauses in vocative phrases</h3>

<p>

<lx "COI"><lx "DOI">Vocative phrases are explained in more detail in <a href=chap6.html>Chapter 6</a>. Briefly, they are a method of indicating who a sentence or discourse is addressed to: of identifying the in­tended listener. They take three general forms, all beginning with cmavo from sel­ma'o COI or DOI (called “vocative words”; there can be one or many), followed by ei­ther a name, a selbri, or a sumti. Here are three examples:

<p>

<pre><a name=e9d1>9.1) coi. frank.

Hello, Frank.

<a name=e9d2>9.2) co'o xirma

Goodbye, horse.

<a name=e9d3>9.3) fi'i la frank. .e la djordj.

Welcome, Frank and George!

</pre><p>Note that <a href=#e9d2>Example 9.2 </a>says farewell to something which doesn't really have to be a horse, something that the speaker simply thinks of as being a horse, or even might be something (a person, for exam­ple) who is named “Horse”. In a sense, <a href=#e9d2>Example 9.2 </a>is ambiguous between “co'o le xirma” and “co'o la xirma”, a relatively safe semantic am­biguity, since names are ambiguous in general: saying “George” doesn't distinguish between the possi­ble Georges.

<p>

Similarly, <a href=#e9d1>Example 9.1 </a>can be thought of as an abbreviation of:

<p>

<pre><a name=e9d4>9.4) coi la frank.

Hello, the-one-named “Frank”.

</pre><p>Syntactically, vocative phrases are a kind of free modifier, and can appear in many places in Lojban text, generally at the begin­ning or end of some complete con­struct; or, as in <a href=#e9d{1}>Examples 9.1 </a>to <a href=#e9d3>9.3</a>, as sentences by themselves.

<p>

<cx "relative clauses, on vocative phrases"><cx "vocative phrases, relative clauses on"><cx "relative clauses, placement with vocative phrases"><cx "vocative phrase with name, placement of relative clause on">As can be seen, the form of vocative phrases is similar to that of sumti, and as you might expect, vocative phrases allow rela­tive clauses in various places. In vocative phrases which are simple names (after the vocative words), any relative clauses must come just after the names:

<p>

<pre><a name=e9d5>9.5) coi. frank. poi xunre se bende

Hello, Frank who is-a-red team-member

Hello, Frank from the Red Team!

</pre><p>The restrictive relative clause in <a href=#e9d5>Example 9.5 </a>suggests that there is some other Frank (perhaps on the Green Team) from whom this Frank, the one the speaker is greeting, must be distinguished.

<p>

<cx "vocative phrase with selbri, placement of relative clause on">A vocative phrase containing a selbri can have relative clauses either before or after the selbri; both forms have the same meaning. Here are some examples:

<p>

<pre><a name=e9d6>9.6) co'o poi mi zvati ke'a ku'o xirma

Goodbye, such-that-(I am-at IT) horse

Goodbye, horse where I am!

<a name=e9d7>9.7) co'o xirma poi mi zvati

Goodbye, horse such-that-(I am-at-it).

</pre><a href=#e9d6>Example 9.6 </a>and <a href=#e9d7>Example 9.7 </a>mean the same thing. In fact, relative clauses can appear in both places.

<p>

### <a name=s10><h3>Relative clauses within relative clauses</h3>

<p>

<cx "relative clauses, relative clauses within">For the most part, these are straightforward and uncompli­cated: a sumti that is part of a relative clause bridi may itself be modi­fied by a relative clause:

<p>

<pre><a name=e10d1>10.1) le prenu poi zvati le kumfa poi blanu cu masno

The person who is-in the room which is-blue is-slow.

</pre><cx "ke'a, meaning in relative clause inside relative clause"><cx "relativized sumti, in relative clauses within relative clauses"><cx "outer sumti, referring to from within relative clause within relative clause"><cx "inner sumti, referring to from within relative clause within relative clause"><cx "subscripts, use with ke'a for outer sumti reference"><cx "ke'a with subscript, use for outer sumti reference">However, an ambiguity can exist if “ke'a” is used in a relative clause within a relative clause: does it refer to the outermost sumti, or to the sumti within the outer relative clause to which the inner relative clause is attached? The latter. To refer to the former, use a sub­script on “ke'a”:

<p>

<ex "room which he built"><pre><a name=e10d2>10.2) le prenu poi zvati le kumfa poi ke'axire zbasu ke'a cu masno

The person who is-in the room which IT-sub-2 built IT is-slow.

The person who is in the room which he built is slow.

</pre><lx "ke'axipa">Here, the meaning of “IT-sub-2” is that sumti attached to the second relative clause, counting from the innermost, is used. Therefore, “ke'axipa” (IT-sub-1) means the same as plain “ke'a”.

<p>

<cx "outer sumti, prenex for referring to from within relative clause within relative clause"><cx "prenex, use for outer sumti reference">Alternatively, you can use a prenex (explained in full in <a href=chap16.html>Chapter 16</a>), which is syn­tactically a series of sumti followed by the special cmavo “zo'u”, prefixed to the relative clause bridi:

<p>

<pre><a name=e10d3>10.3) le prenu poi ke'a goi ko'a zo'u ko'a zvati le kumfa

poi ke'a goi ko'e zo'u ko'a zbasu ke'a cu masno

The man who (IT = it1 : it1 is-in the room

which (IT = it2 : it1 built it2) is-slow.

</pre><a href=#e10d3>Example 10.3 </a>is more verbose than <a href=#e10d2>Example 10.2</a>, but may be clearer, since it explicitly spells out the two “ke'a” cmavo, each on its own level, and assigns them to the assign­able cmavo “ko'a” and “ko'e” (explained in Chapter 6).

<p>

### <a name=s11><h3>Index of relative clause cmavo</h3>

<p>

<cx "relative clauses, list of cmavo for">Relative clause introducers (selma'o NOI):

<pre>noi incidental clauses

poi restrictive clauses

voi restrictive clauses (non-veridical)

</pre><p>Relative phrase introducers (selma'o GOI):

<pre> goi pro-sumti assignment

pe restrictive association

ne incidental association

po extrinsic (alienable) possession

po'e intrinsic (inalienable) possession

po'u restrictive identification

no'u incidental identification

</pre><p>Relativizing pro-sumti (selma'o KOhA): <pre>

ke'a pro-sumti for relativized sumti

</pre><p>Relative clause joiner (selma'o ZIhE): <pre>

zi'e joins relative clauses applying to a single sumti

</pre><p>Relative clause associator (selma'o VUhO): <pre>

vu'o causes relative clauses to apply to all of a complex sumti

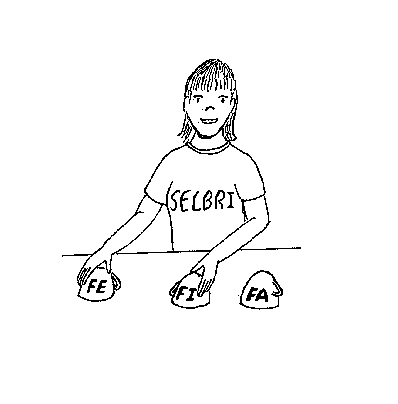
</pre><p>Elidable terminators (each its own selma'o): <pre>

ku'o relative clause elidable terminator

ge'u relative phrase elidable terminator

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## <h2>Chapter 9

## <br>

## To Boston Via The Road Go I, With An Excur­sion Into The Land Of Modals</h2>

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<p>

### <a name=s1><h3>Introductory</h3>

<p>

<cx "sumti, definition"><cx "selbri, definition"><cx "bridi", definition"><cx "sentence, basic Lojban"><cx "relationship, as basis of sentence"><cx "relationship, objects of">The basic type of Lojban sentence is the bridi: a claim by the speaker that cer­tain objects are related in a certain way. The objects are ex­pressed by Lojban gram­matical forms called “sumti”; the rela­tionship is expressed by the Lojban grammatical form called a “selbri”.

<p>

<cx "selbri, place structure of"><cx "place structure, definition"><cx "place structure, empty slots in"><cx "sumti, as objects in place structure slots">The sumti are not randomly associated with the selbri, but according to a sys­tematic pattern known as the “place structure” of the selbri. This chapter describes the various ways in which the place structure of Lojban bridi is expressed and by which it can be ma­nipu­lated. The place structure of a selbri is a sequence of empty slots into which the sumti associated with that selbri are placed. The sumti are said to occupy the places of the sel­bri.

<p>

<cx "place structure of selbri, determining">For our present purposes, every selbri is assumed to have a well-known place struc­ture. If the selbri is a brivla, the place structure can be looked up in a dictionary (or, if the brivla is a lujvo not in any dic­tionary, inferred from the principles of lujvo construction as ex­plained in <a href=chap12.html>Chapter 12</a>); if the selbri is a tanru, the place structure is the same as that of the final component in the tanru.

<p>

<lx "klama"><cx "klama, place structure of"><cx "place structure, notation conventions"><cx "x1, in place structure notation"><ex "go">The stock example of a place structure is that of the gismu “klama”:

klama: <p>

<dl compact><dt><dd>x1 comes/goes to destination x2 from origin x3 via route x4

employing means of transport x5

</dl><p>The “x1 <dots>…</dots>x5” indicates that “klama” is a five-place predicate, and show the natural order (as assigned by the language engineers) of those places: agent, destination, origin, route, means.

<p>

<cx "place structure, instability of">The place structures of brivla are not absolutely stable as­pects of the language. The work done so far has attempted to estab­lish a basic place structure on which all users can, at first, agree. In the light of actual experience with the individual selbri of the lan­guage, there will inevitably be some degree of change to the brivla place struc­tures.

<p>

### <a name=s2><h3>Standard bridi form: “cu”</h3>

<p>

The following cmavo is discussed in this section:

<p>

<pre> cu CU prefixed selbri separator

</pre><cx "bridi, building from selbri and sumti">The most usual way of constructing a bridi from a selbri such as “klama” and an ap­propriate number of sumti is to place the sumti in­tended for the x1 place before the selbri, and all the other sumti in order after the selbri, thus:

<p>

<ex "Boston from Atlanta"><ex "go to Boston from Atlanta"><pre><a name=e2d1>2.1) mi cu klama la bastn. la .atlantas. le dargu le karce

I go to-Boston from-Atlanta via-the road using-the car.

</pre><p>Here the sumti are assigned to the places as follows:

<p>

<pre> x1 agent mi

x2 destination la bastn.

x3 origin la .atlantas.

x4 route le dargu

x5 means le karce

</pre>(Note: Many of the examples in the rest of this chapter will turn out to have the same meaning as <a href=#e2d1>Example 2.1</a>; this fact will not be reiter­ated.)

<p>

<cx "bridi, standard form of"><cx "standard bridi form, definition"><cx "bridi, non-standard form">This ordering, with the x1 place before the selbri and all other places in natural order after the selbri, is called “standard bridi form”, and is found in the bulk of Lojban bridi, whether used in main sen­tences or in subordinate clauses. However, many other forms are possible, such as:

<p>

<pre><a name=e2d2>2.2) mi la bastn. la .atlantas. le dargu le karce cu klama

I, to-Boston from-Atlanta via-the road using-the car, go.

</pre><cx "bridi, effect of alternate form on sumti order">Here the selbri is at the end; all the sumti are placed before it. How­ever, the same order is maintained.

<p>

Similarly, we may split up the sumti, putting some before the selbri and others after it:

<p>

<pre><a name=e2d3>2.3) mi la bastn. cu klama la .atlantas. le dargu le karce

I to-Boston go from-Atlanta via-the road using-the car.

</pre><cx "bridi, effect of using non-standard form"><cx "emphasis, changing by using non-standard form of bridi">All of the variant forms in this section and following sections can be used to place em­phasis on the part or parts which have been moved out of their standard places. Thus, <a href=#e2d2>Ex­ample 2.2 </a>places emphasis on the selbri (because it is at the end); <a href=#e2d3>Example 2.3 </a>em­pha­sizes “la bastn.”, because it has been moved before the selbri. Moving more than one component may dilute this emphasis. It is permitted, but no stylistic significance has yet been established for drastic reordering.

<p>

<lx "cu"><lx "CU"><cx "cu, as selbri separator"><cx "cu, necessity of"><cx "cu, usefulness of"><cx "cu, effect on elidable terminators">In all these examples, the cmavo “cu” (belonging to selma'o CU) is used to separate the selbri from any preceding sumti. It is never absolutely necessary to use “cu”. How­ever, providing it helps the reader or listener to locate the selbri quickly, and may make it possible to place a complex sumti just before the selbri, allowing the speaker to omit eli­dable terminators, possibly a whole stream of them, that would oth­erwise be necessary.

<p>

<cx "sumti, order in selbri"><cx "sumti, order in selbri-first bridi"><cx "sumti, omitted first place in selbri-first bridi"><cx "selbri-first bridi, effect on sumti places"><cx "bridi, selbri-first as exceptional">The general rule, then, is that the selbri may occur anywhere in the bridi as long as the sumti maintain their order. The only excep­tion (and it is an important one) is that if the selbri appears first, the x1 sumti is taken to have been omitted:

<p>

<pre><a name=e2d4>2.4) klama la bastn. la .atlantas. le dargu le karce

A-goer to-Boston from-Atlanta via-the road using-the car.

Goes to-Boston from-Atlanta via-the road using-the car.

Look: a goer to Boston from Atlanta via the road using the car!

</pre><cx "bridi, omitting the first sumti place"><cx "bridi, exception to sumti place structure in"><cx "observative, definition"><cx "observative form, contrasted with command"><cx "command, contrasted with observative form">Here the x1 place is empty: the listener must guess from context who is going to Bos­ton. In <a href=#e2d4>Example 2.4</a>, “klama” is glossed “a goer” rather than “go” because “Go” at the begin­ning of an English sentence would suggest a command: “Go to Boston!”. <a href=#e2d4>Example 2.4 </a>is not a command, simply a normal statement with the x1 place unspecified, causing the emphasis to fall on the selbri “klama”. Such a bridi, with empty x1, is called an “observative”, because it usually calls on the listener to observe something in the envi­ronment which would belong in the x1 place. The third translation above shows this ob­servative nature. Sometimes it is the relationship itself which the listener is asked to ob­serve.

<p>

(There is a way to both provide a sumti for the x1 place and put the selbri first in the bridi: see <a href=#e3d7>Example 3.7</a>.)

<p>

<cx "unspecified trailing sumti, dropping"><cx "sumti, dropping trailing unspecified"><cx "bridi, leaving end sumti places unspecified in">Suppose the speaker desires to omit a place other than the x1 place? (Presumably it is obvious or, for one reason or another, not worth saying.) Places at the end may simply be dropped:

<p>

<ex "unspecified route"><pre><a name=e2d5>2.5) mi klama la bastn. la .atlantas.

I go to-Boston from-Atlanta (via an unspecified route, using an unspecified

means).

</pre><cx "unspecified sumti, non-trailing"><a href=#e2d5>Example 2.5 </a>has empty x4 and x5 places: the speaker does not specify the route or the means of transport. However, simple omis­sion will not work for a place when the places around it are to be specified: in

<p>

<pre><a name=e2d6>2.6) mi klama la bastn. la .atlantas. le karce

I go to-Boston from-Atlanta via-the car.

</pre>“le karce” occupies the x4 place, and therefore <a href=#e2d6>Example 2.6 </a>means:

<p>

<dl compact><dt> <dd>I go to Boston from Atlanta, using the car as a route.

</dl><p>This is nonsense, since a car cannot be a route. What the speaker presumably meant is expressed by:

<p>

<pre><a name=e2d7>2.7) mi klama la bastn. la .atlantas. zo'e le karce

I go to-Boston from-Atlanta via-something-unspecified using-the car.

</pre><lx "zo'e"><cx "unspecified sumti, using zo'e as place-holder for"><cx "zo'e, as place-holder for unspecified sumti"><cx "bridi, leaving a sumti place unspecified in with zo'e"><cx "place structure, leaving a sumti place unspecified in with zo'e"><cx "place structures, omitting places with zo'e">Here the sumti cmavo “zo'e” is used to explicitly fill the x4 place; “zo'e” means “the un­specified thing” and has the same meaning as leaving the place empty: the listener must infer the correct meaning from context.

<p>

### <a name=s3><h3>Tagging places: FA</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> fa FA tags x1 place

fe FA tags x2 place

fi FA tags x3 place

fo FA tags x4 place

fu FA tags x5 place

fi'a FA place structure question

</pre><lx "FA"><lx "fa"><lx "fe"><lx "fi"><lx "fo"><lx "fu"><cx "FA, syntax of">In sentences like <a href=#e2d1>Example 2.1</a>, it is easy to get lost and forget which sumti falls in which place, especially if the sumti are more complicated than simple names or de­scrip­tions. The place structure tags of selma'o FA may be used to help clarify place structures. The five cmavo “fa”, “fe”, “fi”, “fo”, and “fu” may be inserted just before the sumti in the x1 to x5 places respectively:

<p>

<pre><a name=e3d1>3.1) fa mi cu klama fe la bastn. fi la .atlantas. fo le dargu fu le karce

x1= I go x2= Boston x3= Atlanta x4= the road x5= the car.

I go to Boston from Atlanta via the road using the car.

</pre><cx "FA, effect on place structure"><cx "place structure, effect of FA on"><cx "place structure, explicitly mapping sumti to place with FA"><cx "sumti, explicitly mapping into place structure with FA"><cx "FA, for accessing a selbri place explicitly by relative number">In <a href=#e3d1>Example 3.1</a>, the tag “fu” before “le karce” clarifies that “le karce” occupies the x5 place of “klama”. The use of “fu” tells us nothing about the purpose or meaning of the x5 place; it simply says that “le karce” occupies it.

<p>

In <a href=#e3d1>Example 3.1</a>, the tags are overkill; they serve only to make <a href=#e2d1>Example 2.1 </a>even longer than it is. Here is a better illustration of the use of FA tags for clarification:

<p>

<pre><a name=e3d2>3.2) fa mi klama fe le zdani be mi be'o poi nurma vau fi la nu,IORK.

x1= I go x2= (the house of me) which is-rural x3= New York.

</pre><p>In <a href=#e3d2>Example 3.2</a>, the place structure of “klama” is as follows:

<p>

<pre> x1 agent mi

x2 destination le zdani be mi be'o poi nurma vau

x3 origin la nu,IORK.

x4 route (empty)

x5 means (empty)

</pre><cx "FA, as a reminder of place in place structure">The “fi” tag serves to remind the hearer that what follows is in the x3 place of “klama”; after listening to the complex sumti occupying the x2 place, it's easy to get lost.

<p>

<cx "FA, effect on place structure order"><cx "place structure order, effect of FA on"><cx "selbri-first bridi, specifying first sumti place in with fa"><cx "sumti, re-ordering with FA">Of course, once the sumti have been tagged, the order in which they are speci­fied no longer carries the burden of distinguishing the places. Therefore, it is perfectly all right to scramble them into any order desired, and to move the selbri to anywhere in the bridi, even the beginning:

<p>

<pre><a name=e3d3>3.3) klama fa mi fi la .atlantas. fu le karce fe la bastn. fo le dargu

go x1= I x3= Atlanta x5= the car x2= Boston x4= the road.

Go I from Atlanta using the car to Boston via the road.

</pre><lx "cu"><cx "cu, effect of selbri-first bridi on"><cx "selbri-first bridi, effect on use of cu">Note that no “cu” is permitted before the selbri in <a href=#e3d3>Example 3.3</a>, be­cause “cu” separates the selbri from any preceding sumti, and <a href=#e3d3>Exam­ple 3.3 </a>has no such sumti.

<p>

<pre><a name=e3d4>3.4) fu le karce fo le dargu fi la .atlantas. fe la bastn. cu klama fa mi

x5= the car x4= the road x3= Atlanta x2= Boston go x1=I

Using the car, via the road, from Atlanta to Boston go I.

</pre><a href=#e3d4>Example 3.4 </a>exhibits the reverse of the standard bridi form seen in <a href=#e2d{1}>Examples 2.1 </a>and <a href=#e3d1>3.1</a>, but still means exactly the same thing. If the FA tags were left out, however, pro­ducing:

<p>

<pre><a name=e3d5>3.5) le karce le dargu la .atlantas. la bastn. cu klama mi

The car to-the road from-Atlanta via-Boston goes using-me.

The car goes to the road from Atlanta, with Boston as the route, using me

as a means of transport.

</pre>the meaning would be wholly changed, and in fact nonsensical.

<p>

<cx "place structures, omitting places with FA"><cx "FA, compared with zo'e for omitting places"><cx "zo'e, compared with FA for omitting places">Tagging places with FA cmavo makes it easy not only to re­order the places but also to omit undesirable ones, without any need for “zo'e” or special rules about the x1 place:

<p>

<pre><a name=e3d6>3.6) klama fi la .atlantas. fe la bastn. fu le karce

A-goer x3= Atlanta x2= Boston x5 = the car.

A goer from Atlanta to Boston using the car.

</pre><p>Here the x1 and x4 places are empty, and so no sumti are tagged with “fa” or “fo”; in ad­dition, the x2 and x3 places appear in reverse order.

<p>

<cx "FA, effect on subsequent non-tagged places">What if some sumti have FA tags and others do not? The rule is that after a FA-tagged sumti, any sumti following it occupy the places numerically succeeding it, subject to the proviso that an al­ready-filled place is skipped:

<p>

<pre><a name=e3d7>3.7) klama fa mi la bastn. la .atlantas. le dargu le karce

Go x1= I x2= Boston x3= Atlanta x4= the road x5= the car.

Go I to Boston from Atlanta via the road using the car.

</pre><p>In <a href=#e3d7>Example 3.7</a>, the “fa” causes “mi” to occupy the x1 place, and then the following un­tagged sumti occupy in order the x2 through x5 places. This is the mechanism by which Lojban allows placing the selbri first while specifying a sumti for the x1 place.

<p>

Here is a more complex (and more confusing) example:

<p>

<pre><a name=e3d8>3.8) mi klama fi la .atlantas. le dargu fe la bastn. le karce

I go x3= Atlanta, the road x2= Boston, the car.

I go from Atlanta via the road to Boston using the car.

</pre><p>In <a href=#e3d8>Example 3.8</a>, “mi” occupies the x1 place because it is the first sumti in the sentence (and is before the selbri). The second sumti, “la .atlantas.”, occupies the x3 place by vir­tue of the tag “fi”, and “le dargu” occupies the x4 place as a result of following “la .atlantas.”. Finally, “la bastn.” occupies the x2 place because of its tag “fe”, and “le karce” skips over the already-occupied x3 and x4 places to land in the x5 place.

<p>

<cx "FA, avoidance of complex usage of">Such a convoluted use of tags should probably be avoided except when trying for a literal translation of some English (or other natural-language) sentence; the rules stated here are merely given so that some standard interpretation is possible.

<p>

<cx "FA, for putting more than one sumti in a single place"><cx "sumti, multiple in one place with FA"><cx "multiple sumti in one place, meaning">It is grammatically permitted to tag more than one sumti with the same FA cmavo. The effect is that of making more than one claim:

<p>

<ex "to movie, house, office"><pre><a name=e3d9>3.9) [fa] la rik. fa la djein. klama [fe] le skina fe le zdani fe le zarci

[x1=] Rick x1= Jane goes-to x2= the movie x2= the house x2= the office

</pre><cx "multiple sumti in one place, avoiding">may be taken to say that both Rick and Jane go to the movie, the house, and the office, merging six claims into one. More likely, how­ever, it will simply confuse the listener. There are better ways, in­volving logical connectives (explained in <a href=chap14.html>Chapter 14</a>), to say such things in Lojban. In fact, putting more than one sumti into a place is odd enough that it can only be done by explicit FA usage: this is the motivation for the proviso above, that already-occupied places are skipped. In this way, no sumti can be forced into a place al­ready oc­cupied unless it has an explicit FA cmavo tagging it.

<p>

<lx "fi'a"><cx "place structure questions"><cx "questions, place structure position">The cmavo “fi'a” also belongs to selma'o FA, and allows Loj­ban users to ask ques­tions about place structures. A bridi containing “fi'a” is a question, asking the lis­tener to supply the appropriate other member of FA which will make the bridi a true statement:

<p>

<ex "give or receive?"> <pre><a name=e3d10>3.10) fi'a do dunda [fe] le vi rozgu

[what place]? you give x2= the nearby rose

In what way are you involved in the giving of this rose?

Are you the giver or the receiver of this rose?

</pre><p>In <a href=#e3d10>Example 3.10</a>, the speaker uses the selbri “dunda”, whose place structure is:

<p>

<dl compact><dt>dunda: <dd>x1 gives x2 to x3

</dl><cx "answer, to place structure question">The tagged sumti “fi'a do” indicates that the speaker wishes to know whether the sumti “do” falls in the x1 or the x3 place (the x2 place is already occupied by “le rozgu”). The listener can reply with a sen­tence consisting solely of a FA cmavo: “fa” if the listener is the giver, “fi” if he/she is the receiver.

<p>

<cx "fi'a, effect on subsequent untagged sumti">I have inserted the tag “fe” in brackets into <a href=#e3d10>Example 3.10</a>, but it is actually not neces­sary, because “fi'a” does not count as a nu­meric tag; therefore, “le vi rozgu” would neces­sarily be in the x2 place even if no tag were present, because it immedi­ately follows the selbri.

<p>

There is also another member of FA, namely “fai”, which is discussed in <a href=#s12>Sec­tion 12</a>.

<p>

### <a name=s4><h3>Conversion: SE</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> se SE 2nd place conversion

te SE 3rd place conversion

ve SE 4th place conversion

xe SE 5th place conversion

</pre><cx "converted selbri, definition"><cx "converted selbri, forming with SE"><cx "converted selbri, place structure of"><cx "converted selbri, as different selbri from unconverted"><lx "SE"><cx "SE, effect on selbri place structure"><lx "se"><cx "SE, for converting place structure">So far we have seen ways to move sumti around within a bridi, but the actual place structure of the selbri has always remained untouched. The conversion cmavo of selma'o SE are incorporated within the selbri itself, and produce a new selbri (called a converted selbri) with a different place structure. In particular, after the applica­tion of any SE cmavo, the number and purposes of the places remain the same, but two of them have been exchanged, the x1 place and another. Which place has been exchanged with x1 de­pends on the cmavo chosen. Thus, for example, when “se” is used, the x1 place is swapped with the x2 place.

<p>

<cx "SE, rationale for no 1st place conversion"><cx "SE, word formation of cmavo in">Note that the cmavo of SE begin with consecutive conso­nants in alphabetical order. There is no “1st place conversion” cmavo, because exchanging the x1 place with itself is a pointless maneuver.

<p>

<cx "se klama, place structure of">Here are the place structures of “se klama”:

<p>

<dl compact><dt><dd>x1 is the destination of x2's going from x3 via x4 using x5

</dl><lx "te">and “te klama”:

<p>

<dl compact><dt><dd>x1 is the origin and x2 the destination of x3 going via x4 using x5

</dl><lx "ve">and “ve klama”:

<p>

<dl compact><dt><dd>x1 is the route to x2 from x3 used by x4 going via x5

</dl><lx "xe">and “xe klama”:

<p>

<dl compact><dt><dd>x1 is the means in going to x2 from x3 via x4 employed by x5

</dl><cx "SE, effect on place structure numbering">Note that the place structure numbers in each case continue to be listed in the usual or­der, x1 to x5.

<p>

Consider the following pair of examples:

<p>

<pre><a name=e4d1>4.1) la bastn. cu se klama mi

Boston is-the-destination of-me.

Boston is my destination.

Boston is gone to by me.

<a name=e4d2>4.2) fe la bastn. cu klama fa mi

x2= Boston go x1=I.

To Boston go I.

</pre><cx "converted selbri, contrasted with selbri with FA in structure"><cx "FA in selbri, contrasted converted selbri with in structure"><cx "converted selbri, compared with selbri with FA in meaning"><cx "FA in selbri, compared with converted selbri in meaning"><cx "converted selbri, as resetting standard order"><a href=#e4d1>Example 4.1 </a>and <a href=#e4d2>Example 4.2 </a>mean the same thing, in the sense that there is a relation­ship of going with the speaker as the agent and Boston as the destination (and with un­specified origin, route, and means). Structurally, however, they are quite different. <a href=#e4d1>Ex­ample 4.1 </a>has “la bastn.” in the x1 place and “mi” in the x2 place of the selbri “se klama”, and uses standard bridi order; <a href=#e4d2>Example 4.2 </a>has “mi” in the x1 place and “la bastn.” in the x2 place of the selbri “klama”, and uses a non-standard order.

<p>

<cx "converted selbri, in descriptions"><lx "LA"><lx "LE">The most important use of conversion is in the construction of descriptions. A de­scription is a sumti which begins with a cmavo of selma'o LA or LE, called the de­scrip­tor, and contains (in the simplest case) a selbri. We have already seen the descrip­tions “le dargu” and “le karce”. To this we could add:

<p>

<ex "the go-er"><pre><a name=e4d3>4.3) le klama

the go-er, the one who goes

</pre><cx "descriptions, as based on first place of following selbri"><cx "descriptions, use of SE in"><cx "converted selbri, to access non-first place in description">In every case, the description is about something which fits into the x1 place of the selbri. In order to get a description of a desti­nation (that is, something fitting the x2 place of “klama”), we must convert the selbri to “se klama”, whose x1 place is a desti­nation. The result is

<p>

<ex "the destination"><pre><a name=e4d4>4.4) le se klama

the destination gone to by someone

</pre><p>Likewise, we can create three more converted descriptions:

<p>

<pre><a name=e4d5>4.5) le te klama

the origin of someone's going

<a name=e4d6>4.6) le ve klama

the route of someone's going

<a name=e4d7>4.7) le xe klama

the means by which someone goes

</pre><ex "Mars road"><cx "converted selbri, contrasted with other similar selbri"><cx "converted selbri, retention of basic meaning in"><cx "ve klama, contrasted with pluta"><cx "pluta, contrasted with ve klama"><lx "ve klama"><lx "pluta"><a href=#e4d6>Example 4.6 </a>does not mean “the route” plain and simple: that is “le pluta”, using a dif­ferent selbri. It means a route that is used by some­one for an act of “klama”; that is, a journey with origin and destination. A “road” on Mars, on which no one has traveled or is ever likely to, may be called “le pluta”, but it cannot be “le ve klama”, since there exists no one for whom it is “le ve klama be fo da” (the route taken in an actual journey by someone [da]).

<p>

<cx "SE, scope of"><cx "SE, extending scope of"><cx "conversion, scope of"><cx "conversion, extending scope of"><lx "ke"><lx "ke'e">When converting selbri that are more complex than a single brivla, it is im­portant to realize that the scope of a SE cmavo is only the following brivla (or equiva­lent unit). In order to convert an entire tanru, it is necessary to enclose the tanru in “ke<dots>…</dots>ke'e” brack­ets:

<p>

<ex "blue house"><pre><a name=e4d8>4.8) mi se ke blanu zdani [ke'e] ti

I [2nd conversion] blue house this-thing

</pre><p>The place structure of “blanu zdani” (blue house) is the same as that of “zdani”, by the rule given in <a href=#s1>Section 1</a>. The place structure of “zdani” is:

zdani: <p>

<dl compact><dt><dd>x1 is a house/nest/lair/den for inhabitant x2

</dl><p>The place structure of “se ke blanu zdani [ke'e]” is therefore:

<p>

<dl compact><dt><dd>x1 is the inhabitant of the blue house (etc.) x2

</dl><p>Consequently, <a href=#e4d8>Example 4.8 </a>means:

<p>

<dl compact><dt><dd>I am the inhabitant of the blue house which is this thing.

</dl><p>Conversion applied to only part of a tanru has subtler effects which are ex­plained in <a href=chap5.html>Chapter 5</a>.

<p>

<cx "SE, effect of multiple on a selbri"><cx "multiple SE, effect of ordering"><cx "conversion, effect of multiple on a selbri"><cx "multiple conversion, effect of ordering">It is grammatical to convert a selbri more than once with SE; later (inner) con­ver­sions are applied before earlier (outer) ones. For example, the place structure of “se te klama” is achieved by ex­changing the x1 and x2 place of “te klama”, producing:

<p>

<lx "se te"><dl compact><dt><dd>x1 is the destination and x2 is the origin of x3 going via x4 using x5

</dl><p>On the other hand, “te se klama” has a place structure derived from swapping the x1 and x3 places of “se klama”:

<p>

<dl compact><dt><dd>x1 is the origin of x2's going to x3 via x4 using x5

</dl><cx "multiple conversion, avoiding">which is quite different. However, multiple conversions like this are never necessary. Ar­bitrary scrambling of places can be achieved more easily and far more intelligibly with FA tags, and only a single conversion is ever needed in a description.

<p>

<cx "conversion, swapping non-first places"><lx "setese">(Although no one has made any real use of it, it is perhaps worth noting that com­pound conversions of the form “setese”, where the first and third cmavo are the same, effectively swap the two given places while leaving the others, including x1, alone: “setese” (or equivalently “tesete”) swap the x2 and x3 places, whereas “texete” (or “xetexe”) swap the x3 and x5 places.)

<p>

### <a name=s5><h3>Modal places: FIhO, FEhU</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> fi'o FIhO modal place prefix

fe'u FEhU modal terminator

</pre><p>Sometimes the place structures engineered into Lojban are inadequate to meet the needs of actual speech. Consider the gismu “viska”, whose place structure is:

<p>

<lx "viska"><dl compact><dt><dd>viska: x1 sees x2 under conditions x3

</dl><p>Seeing is a threefold relationship, involving an agent (le viska), an object of sight (le se viska), and an environment that makes seeing possible (le te viska). Seeing is done with one or more eyes, of course; in general, the eyes belong to the entity in the x1 place.

<p>

<ex "see with left eye"><cx "fi'o, as modal tag"><cx "place structure, adding new places to with modal sumti"><cx "fi'o, use in adding places to place structure"><lx "fi'o"><lx "FIhO"><lx "fe'u"><lx "FEhU">Suppose, however, that you are blind in one eye and are talking to someone who doesn't know that. You might want to say, “I see you with the left eye.” There is no place in the place structure of “viska” such as “with eye x4” or the like. Lojban al­lows you to solve the problem by adding a new place, changing the relationship:

<p>

<pre><a name=e5d1>5.1) mi viska do fi'o kanla [fe'u] le zunle

I see you [modal] eye: the left-thing

I see you with the left eye.

</pre><cx "fi'o, effect on following selbri"><cx "modal tag, fi'o with selbri as"><cx "fi'o with selbri, meaning of">The three-place relation “viska” has now acquired a fourth place specifying the eye used for seeing. The combination of the cmavo “fi'o” (of selma'o FIhO) followed by a selbri, in this case the gismu “kanla”, forms a tag which is prefixed to the sumti filling the new place, namely “le zunle”. The semantics of “fi'o kanla le zunle” is that “le zunle” fills the x1 place of “kanla”, whose place structure is

<p>

<dl compact><dt><dd>kanla: x1 is an/the eye of body x2

</dl><cx "modal place, relation of to selbri"><cx "fi'o tag, relation of modal sumti following to selbri"><cx "modal place relation, importance of first place in"><cx "modal sumti, as first place of modal tag selbri">Thus “le zunle” is an eye. The x2 place of “kanla” is unspecified and must be inferred from the context. It is important to remember that even though “le zunle” is placed fol­lowing “fi'o kanla”, semantically it belongs in the x1 place of “kanla”. The selbri may be terminated with “fe'u” (of selma'o FEhU), an elidable terminator which is rarely re­quired unless a non-logical connective follows the tag (omitting “fe'u” in that case would make the connective affect the selbri).

<p>

<cx "modal place, definition"><cx "modal place, rationale for term name"><cx "modal tag, definition (see also sumti tcita)"><cx "modal sumti, definition (see also seltcita sumti)"><cx "sumti tcita, definition (see also modal tag)"><cx "seltcita sumti, definition (see also modal sumti)"><cx "modal sumti, position in bridi"><cx "modal sumti, effect on place structure"><cx "modal sumti, and FA marking">The term for such an added place is a “modal place”, as dis­tinguished from the regu­lar numbered places. (This use of the word “modal” is specific to the Loglan Proj­ect, and does not agree with the standard uses in either logic or linguistics, but is now too en­trenched to change easily.) The “fi'o” construction marking a modal place is called a “modal tag”, and the sumti which follows it a “modal sumti”; the purely Loj­ban terms “sumti tcita” and “seltcita sumti”, respectively, are also commonly used. Modal sumti may be placed anywhere within the bridi, in any order; they have no effect whatever on the rules for assigning unmarked bridi to numbered places, and they may not be marked with FA cmavo.

<p>

Consider <a href=#e5d1>Example 5.1 </a>again. Another way to view the situa­tion is to consider the speaker's left eye as a tool, a tool for seeing. The relevant selbri then becomes “pilno”, whose place structure is

<p>

<dl compact><dt><dd>pilno: x1 uses x2 as a tool for purpose x3

</dl>and we can rewrite <a href=#e5d1>Example 5.1 </a>as

<p>

<pre><a name=e5d2>5.2) mi viska do fi'o se pilno le zunle kanla

I see you [modal] [conversion] use: the left eye

I see you using my left eye.

</pre><p>Here the selbri belonging to the modal is “se pilno”. The conversion of “pilno” is nec­essary in order to get the “tool” place into x1, since only x1 can be the modal sumti. The “tool user” place is the x2 of “se pilno” (because it is the x1 of “pilno”) and re­mains un­specified. The tag “fi'o pilno” would mean “with tool user”, leaving the tool unspeci­fied.

<p>

### <a name=s6><h3>Modal tags: BAI</h3>

<p>

There are certain selbri which seem particularly useful in constructing modal tags. In particular, “pilno” is one of them. The place structure of “pilno” is:

<p>

pilno: x1 uses x2 as a tool for purpose x3

</dl><lx "sepi'o"><cx "BAI modal tags, rationale for">and almost any selbri which represents an action may need to specify a tool. Having to say “fi'o se pilno” frequently would make many Loj­ban sentences unnecessarily verbose and clunky, so an abbreviation is provided in the language design: the compound cmavo “sepi'o”.

<p>

<lx "pi'o"><lx "BAI"><cx "BAI, as short forms for fi'o constructs"><cx "fi'o constructs, short forms as BAI cmavo"><cx "modal tags, short forms as BAI cmavo"><cx "conversion, of BAI cmavo"><lx "SE">Here “se” is used before a cmavo, namely “pi'o”, rather than before a brivla. The meaning of this cmavo, which belongs to selma'o BAI, is exactly the same as that of “fi'o pilno fe'u”. Since what we want is a tag based on “se pilno” rather than “pilno” — the tool, not the tool user — the grammar allows a BAI cmavo to be converted using a SE cmavo. <a href=#e5d2>Example 5.2 </a>may therefore be rewritten as:

<p>

<pre><a name=e6d1>6.1) mi viska do sepi'o le zunle kanla

I see you with-tool: the left eye

I see you using my left eye.

</pre><p>The compound cmavo “sepi'o” is much shorter than “fi'o se pilno [fe'u]” and can be thought of as a single word meaning “with-tool”. The modal tag “pi'o”, with no “se”, similarly means “with-tool-user”, probably a less useful concept. Nevertheless, the paral­lelism with the place structure of “pilno” makes the additional syllable worthwhile.

<p>

<lx "ka'a"><cx "BAI, effect of conversion on"><cx "conversion, effect on BAI">Some BAI cmavo make sense with as well as without a SE cmavo; for exam­ple, “ka'a”, the BAI corresponding to the gismu “klama”, has five usable forms corre­sponding to the five places of “klama” respectively:

<p>

<pre> ka'a with-goer

seka'a with-destination

teka'a with-origin

veka'a with-route

xeka'a with-means-of-transport

</pre><p>Any of these tags may be used to provide modal places for bridi, as in the following ex­amples:

<p>

<ex "traveling salesperson"><ex "Avon"><pre><a name=e6d2>6.2) la .eivn. cu vecnu loi flira cinta ka'a mi

Avon sells a-mass-of face paint with-goer me.

I am a traveling cosmetics salesperson for Avon.

</pre>(<a href=#e6d2>Example 6.2 </a>may seem a bit strained, but it illustrates the way in which an existing sel­bri, “vecnu” in this case, may have a place added to it which might otherwise seem utterly unrelated.)

<p>

<pre><a name=e6d3>6.3) mi cadzu seka'a la bratfyd.

I walk with-destination Bradford.

I am walking to Bradford.

<a name=e6d4>6.4) bloti teka'a la nu,IORK.

[Observative:] is-a-boat with-origin New York

A boat from New York!

<a name=e6d5>6.5) do bajra veka'a lo djine

You run with-route a circle.

You are running in circles.

<a name=e6d6>6.6) mi citka xeka'a le vinji

I eat with-means-of-transport the airplane.

I eat in the airplane.

</pre><cx "BAI cmavo, rationale for selection"><cx "modal tags, contrasted with English prepositions in preciseness"><cx "English prepositions, contrasted with modal tags in preciseness">There are sixty-odd cmavo of selma'o BAI, based on selected gismu that seemed use­ful in a variety of settings. The list is some­what biased toward English, be­cause many of the cmavo were se­lected on the basis of corresponding English preposi­tions and prepo­sition compounds such as “with”, “without”, and “by means of”. The BAI cmavo, how­ever, are far more precise than English prepositions, because their meanings are fixed by the place structures of the cor­responding gismu.

<p>

<cx "BAI, form of cmavo in">All BAI cmavo have the form CV'V or CVV. Most of them are CV'V, where the C is the first consonant of the corresponding gismu and the two Vs are the two vow­els of the gismu. The table in <a href=#s16>Section 16 </a>shows the exceptions.

<p>

<cx "modal tag, for vague relationship"><cx "vague relationship, modal tag for"><lx "do'e">There is one additional BAI cmavo that is not derived from a gismu: “do'e”. This cmavo is used when an extra place is needed, but it seems useful to be vague about the semantic implications of the extra place:

<p>

<pre><a name=e6d7>6.7) lo nanmu be do'e le berti cu klama le tcadu

Some man [related to] the north came to-the city.

A man of the north came to the city.

</pre><cx "do'e, compared with English “of”"><cx "“of” in English, compared with do'e"><cx "modal place, on description selbri"><lx "be">Here “le berti” is provided as a modal place of the selbri “nanmu”, but its exact signifi­cance is vague, and is paralleled in the colloquial translation by the vague English prepo­sition “of”. <a href=#e6d7>Example 6.7 </a>also illustrates a modal place bound into a selbri with “be”. This construc­tion is useful when the selbri of a description requires a modal place; this and other uses of “be” are more fully explained in <a href=chap5.html>Chapter 5</a>.

<p>

### <a name=s7><h3>Modal sentence connection: the causals</h3>

<p>

The following cmavo are discussed in this section:

<p>

<lx "ri'a"><lx "ki'u"><lx "mu'i"><lx "ni'i"><pre> ri'a BAI rinka modal: physical cause

ki'u BAI krinu modal: justification

mu'i BAI mukti modal: motivation

ni'i BAI nibli modal: logical entailment

</pre><p>This section has two purposes. On the one hand, it explains the grammatical con­struct called “modal sentence connection”. On the other, it exemplifies some of the more useful BAI cmavo: the causals. (There are other BAI cmavo which have causal implica­tions: “ja'e” means “with result”, and so “seja'e” means “with cause of un­speci­fied na­ture”; likewise, “gau” means “with agent” and “tezu'e” means “with purpose”. These other modal cmavo will not be further discussed here, as my purpose is to explain modal sentence connec­tion rather than Lojbanic views of causation.)

<p>

<cx "causals, gismu">There are four causal gismu in Lojban, distinguishing different versions of the rela­tionships lumped in English as “causal”:

<p>

<dl compact><dt><dd>rinka: event x1 physically causes event x2

krinu: event x1 is the justification for event x2

mukti: event x1 is the (human) motive for event x2

nibli: event x1 logically entails event x2

</dl><cx "modals, for causal gismu"><cx "causals, modal"><cx "modal causals, implication differences">Each of these gismu has a related modal: “ri'a”, “ki'u”, “mu'i”, and “ni'i” respectively. Using these gismu and these modals, we can create various causal sentences with dif­fer­ent implications:

<p>

<ex "plant grows"><pre><a name=e7d1>7.1) le spati cu banro ri'a le nu do djacu dunda

fi le spati

The plant grows with-physical-cause the event-of you water give

to the plant.

The plant grows because you water it.

<a name=e7d2>7.2) la djan. cpacu le pamoi se jinga ki'u le nu la djan. jinga

John gets the first prize with-justification the event-of John wins.

John got the first prize because he won.

<a name=e7d3>7.3) mi lebna le cukta mu'i le nu mi viska le cukta

I took the book with-motivation the event-of I saw the book.

I took the book because I saw it.

</pre><ex "Socrates"><pre><a name=e7d4>7.4) la sokrates. morsi binxo ni'i le nu la sokrates. remna

Socrates dead-became with-logical-justification Socrates is-human.

Socrates died because Socrates is human.

</pre><cx "“because”, four varieties of">In <a href=#e7d{1}>Examples 7.1 </a>through <a href=#e7d4>7.4</a>, the same English word “because” is used to translate all four modals, but the types of cause being ex­pressed are quite different. Let us now fo­cus on <a href=#e7d1>Example 7.1</a>, and explore some variations on it.

<p>

<cx "abstraction bridi, effect on claim of bridi"><cx "causals, claiming the relation contrasted with claiming cause and/or effect and/or relation">As written, <a href=#e7d1>Example 7.1 </a>claims that the plant grows, but only refers to the event of watering it in an abstraction bridi (abstractions are explained in <a href=chap11.html>Chapter 11</a>) without actu­ally making a claim. If I ex­press <a href=#e7d1>Example 7.1</a>, I have said that the plant in fact grows, but I have not said that you actually water it, merely that there is a causal rela­tionship be­tween watering and growing. This is semantically asym­metrical. Suppose I wanted to claim that the plant was being watered, and only mention its growth as an­cillary informa­tion? Then we could reverse the main bridi and the abstraction bridi, saying:

<p>

<pre><a name=e7d5>7.5) do djacu dunda fi le spati seri'a le nu ri banro

You water-give to the plant with-physical-effect it grows.

You water the plant; therefore, it grows.

</pre>with the “ri'a” changed to “seri'a”. In addition, there are also symmet­rical forms:

<p>

<pre><a name=e7d6>7.6) le nu do djacu dunda fi le spati cu rinka

le nu le spati cu banro

The event-of (you water-give to the plant) causes

the event-of (the plant grows).

Your watering the plant causes its growth.

If you water the plant, then it grows.

</pre>does not claim either event, but asserts only the causal relationship between them. So in <a href=#e7d6>Example 7.6</a>, I am not saying that the plant grows nor that you have in fact watered it. The second colloquial translation shows a form of “if-then” in English quite distinct from the logical connective “if-then” explained in <a href=chap14.html>Chapter 14</a>.

<p>

Suppose we wish to claim both events as well as their causal relationship? We can use one of two methods:

<p>

<lx ".iri'abo"><lx ".i"><lx "bo"><cx "modal sentence connection"><pre><a name=e7d7>7.7) le spati cu banro .iri'abo do djacu dunda fi le spati

The plant grows. Because you water-give to the plant.

The plant grows because you water it.

<a name=e7d8>7.8) do djacu dunda fi le spati .iseri'abo le spati cu banro

You water-give to the plant. Therefore it grows.

You water the plant; therefore, it grows.

</pre><p>The compound cmavo “.iri'abo” and “.iseri'abo” serve to connect two bridi, as the ini­tial “.i” indicates. The final “bo” is necessary to prevent the modal from “taking over” the following sumti. If the “bo” were omitted from <a href=#e7d7>Example 7.7 </a>we would have:

<p>

<pre><a name=e7d9>7.9) le spati cu banro .i ri'a do djacu dunda fi le spati

The plant grows. Because of you, [something] water-gives to the plant.

The plant grows. Because of you, water is given to the plant.

</pre><p>Because “ri'a do” is a modal sumti in <a href=#e7d9>Example 7.9</a>, there is no longer an explicit sumti in the x1 place of “djacu dunda”, and the translation must be changed.

<p>

<cx "modal sentence connection, effect on modal"><cx "modal sentence connection, relation to modal of first sentence in"><cx "modal sentence connection, relation to modal of second sentence in">The effect of sentences like <a href=#e7d7>Example 7.7 </a>and <a href=#e7d8>Example 7.8 </a>is that the modal, “ri'a” in this example, no longer modifies an explicit sumti. Instead, the sumti is im­plicit, the event given by a full bridi. Furthermore, there is a second implication: that the first bridi fills the x2 place of the gismu “rinka”; it specifies an event which is the effect. I am therefore claiming three things: that the plant grows, that you have watered it, and that there is a cause-and-effect relationship be­tween the two.

<p>

<cx "modal sentence connection, with other than causals">In principle, any modal tag can appear in a sentence connec­tive of the type ex­empli­fied by <a href=#e7d7>Example 7.7 </a>and <a href=#e7d8>Example 7.8</a>. How­ever, it makes little sense to use any modals which do not expect events or other abstractions to fill the places of the corre­sponding gismu. The sentence connective “.ibaubo” is perfectly grammatical, but it is hard to imagine any two sentences which could be connected by an “in-language” mo­dal. This is because a sentence describes an event, and an event can be a cause or an effect, but not a language.

<p>

### <a name=s8><h3>Other modal connections</h3>

<p>

Like many Lojban grammatical constructions, sentence mo­dal connection has both forethought and afterthought forms. (See <a href=chap14.html>Chapter 14 </a>for a more detailed discussion of Lojban connectives.) <a href=#s7>Section 7 </a>exemplifies only afterthought modal connection, il­lus­trated here by:

<p>

<ex "grasp water"><pre><a name=e8d1>8.1) mi jgari lei djacu .iri'abo mi jgari le kabri

I grasp the-mass-of water with-physical-cause I grasp the cup.

Causing the mass of water to be grasped by me, I grasped the cup.

I grasp the water because I grasp the cup.

</pre><cx "afterthought connection, definition"><cx "forethought connection, definition">An afterthought connection is one that is signaled only by a cmavo (or a compound cmavo, in this case) between the two constructs being connected. Forethought connec­tion uses a signal both before the first construct and between the two: the use of “both” and “and” in the first half of this sentence represents a forethought connection (though not a modal one).

<p>

<cx "forethought modal sentence connection"><cx "modal sentence connection, forethought"><lx "gi">To make forethought modal sentence connections in Lojban, place the modal plus “gi” before the first bridi, and “gi” between the two. No “.i” is used within the con­struct. The forethought equivalent of <a href=#e8d1>Example 8.1 </a>is:

<p>

<pre><a name=e8d2>8.2) ri'agi mi jgari le kabri gi mi jgari lei djacu

With-physical-cause I grasp the cup, I grasp the-mass-of water.

Because I grasp the cup, I grasp the water.

</pre><cx "forethought modal sentence connection for causals, order of cause and effect"><cx "forethought modal sentence connection, relation to modal of first bridi in"><cx "forethought modal sentence connection, relation to modal of second bridi in">Note that the cause, the x1 of “rinka” is now placed first. To keep the two bridi in the original order of <a href=#e8d1>Example 8.1</a>, we could say:

<p>

<pre><a name=e8d3>8.3) seri'agi mi jgari lei djacu gi mi jgari le kabri

With-physical-effect I grasp the-mass-of water, I grasp the cup.

</pre><p>In English, the sentence “\*Therefore I grasp the water, I grasp the cup” is ungrammati­cal, because “therefore” is not grammatically equivalent to “because”. In Lojban, “seri'agi” can be used just like “ri'agi”.

<p>

<cx "modal sentence connection, condensing">When the two bridi joined by a modal connection have one or more elements (selbri or sumti or both) in common, there are various condensed forms that can be used in place of full modal sentence connection with both bridi completely stated.

<p>

<cx "modal sumti connection"><cx "sumti modal connection">When the bridi are the same except for a single sumti, as in Examples 8.1 through 8.3, then a sumti modal connection may be employed:

<p>

<pre><a name=e8d4>8.4) mi jgari ri'agi le kabri gi lei djacu

I grasp because the cup, the-mass-of water.

</pre><a href=#e8d4>Example 8.4 </a>means exactly the same as <a href=#e8d{1}>Examples 8.1 </a>through <a href=#e8d3>8.3</a>, but there is no idio­matic English translation that will distinguish it from them.

<p>

<cx "modal termset connection"><cx "termset modal connection">If the two connected bridi are different in more than one sumti, then a termset may be employed. Termsets are explained more fully in <a href=chap14.html>Chapter 14</a>, but are essentially a mecha­nism for creating connections between multiple sumti simultaneously.

<p>

<pre><a name=e8d5>8.5) mi dunda le cukta la djan. .imu'ibo la djan. dunda lei jdini mi

I gave the book to John. Motivated-by John gave the-mass-of money to-me.

I gave the book to John, because John gave money to me.

</pre>means the same as:

<p>

<lx "nu'i"><lx "nu'u"><pre><a name=e8d6>8.6) nu'i mu'igi mi le cukta la djan. gi la djan. lei jdini mi nu'u dunda

[start] because I, the book, John; John, the-mass-of money, me [end] gives.

</pre><p>Here there are three sumti in each half of the termset, because the two bridi share only their selbri.

<p>

<cx "modal connection of selbri, using bridi-tail modal connection"><cx "modal bridi-tail connection"><cx "bridi-tail modal connection">There is no modal connection between selbri as such: bridi which differ only in the selbri can be modally connected using bridi-tail modal connection. The bridi-tail con­struct is more fully explained in <a href=chap14.html>Chapter 14</a>, but essentially it consists of a selbri with optional sumti following it. <a href=#e7d3>Example 7.3 </a>is suitable for bridi-tail connection, and could be shortened to:

<p>

<pre><a name=e8d7>8.7) mi mu'igi viska le cukta gi lebna le cukta

I, because saw the book, took the book.

</pre><p>Again, no straightforward English translation exists. It is even possi­ble to shorten <a href=#e8d7>Ex­am­ple 8.7 </a>further to:

<p>

<lx "vau"><pre><a name=e8d8>8.8) mi mu'igi viska gi lebna vau le cukta

I because saw, therefore took, the book.

</pre>where “le cukta” is set off by the non-elidable “vau” and is made to belong to both bridi-tails — see <a href=chap14.html>Chapter 14 </a>for more explanations.

<p>

<cx "vau for shared bridi-tail sumti, avoiding"><cx "shared bridi-tail sumti, avoiding">Since this is a chapter on rearranging sumti, it is worth point­ing out that <a href=#e8d8>Ex­ample 8.8 </a>can be further rearranged to:

<p>

<pre><a name=e8d9>8.9) mi le cukta mu'igi viska gi lebna

I, the book, because saw, therefore took

</pre>which doesn't require the extra “vau”; all sumti before a conjunction of bridi-tails are shared.

<p>

<cx "modal operand connection"><cx "operand modal connection">Finally, mathematical operands can be modally connected.

<p>

<pre><a name=e8d10>8.10) li ny. du li vo

.ini'ibo li ny. du li re su'i re

The number *n* = the-number 4.

Entailed-by the-number *n* = the-number 2 + 2.

*n* = 4 because *n* = 2 + 2.

</pre>can be reduced to:

<p>

<pre><a name=e8d11>8.11) li ny. du li ni'igi vei re su'i re [ve'o] gi vo

The-number *n* = the-number because ( 2 + 2 ) therefore 4.

*n* is 2 + 2, and is thus 4.

</pre><lx "vei"><lx "ve'o">The cmavo “vei” and “ve'o” represent mathematical parentheses, and are required so that “ni'igi” affects more than just the immediately fol­lowing operand, namely the first “re”. (The right parenthesis, “ve'o”, is an elidable terminator.) As usual, no English translation does <a href=#e8d11>Exam­ple 8.11 </a>justice.

<p>

<cx "fi'o, restriction on use"><cx "modal connectives, fi'o prohibited in">Note: Due to restrictions on the Lojban parsing algorithm, it is not possible to form modal connectives using the “fi'o”-plus-selbri form of modal. Only the predefined modals of selma'o BAI can be compounded as shown in <a href=#s7>Sections 7 </a>and <a href=#s8>8</a>.

<p>

### <a name=s9><h3>Modal selbri</h3>

<p>

Consider the example:

<p>

<ex "under compulsion"><lx "bai"><pre><a name=e9d1>9.1) mi tavla bau la lojban. bai tu'a la frank.

I speak in-language Lojban with-compeller some-act-by Frank.

I speak in Lojban, under compulsion by Frank.

</pre><cx "modal sumti, leaving vague"><cx "modal sumti, unspecified"><a href=#e9d1>Example 9.1 </a>has two modal sumti, using the modals “bau” and “bai”. Suppose we wanted to specify the language explicitly but be vague about who's doing the compel­ling. We can simplify <a href=#e9d1>Example 9.1 </a>to:

<p>

<lx "ku"><pre><a name=e9d2>9.2) mi tavla bau la lojban. bai [ku].

I speak in-language Lojban under-compulsion.

</pre><p>In <a href=#e9d2>Example 9.2</a>, the elidable terminator “ku” has taken the place of the sumti which would normally follow “bai”. Alternatively, we could spec­ify the one who compels but keep the language vague:

<p>

<pre><a name=e9d3>9.3) mi tavla bau [ku] bai tu'a la frank.

I speak in-some-language under-compulsion-by some-act-by Frank.

</pre><p>We are also free to move the modal-plus-“ku” around the bridi:

<p>

<pre><a name=e9d4>9.4) bau [ku] bai ku mi tavla

In-some-language under-compulsion I speak.

</pre><cx "modal followed by selbri, effect on eliding cu">An alternative to using “ku” is to place the modal cmavo right before the sel­bri, fol­lowing the “cu” which often appears there. When a modal is present, the “cu” is almost never necessary.

<p>

<pre><a name=e9d5>9.5) mi bai tavla bau la lojban.

I compelledly speak in-language Lojban.

</pre><cx "modal followed by selbri, compared with tanru modification in meaning"><cx "modal followed by selbri, contrasted with tanru modification in grammar">In this use, the modal is like a tanru modifier semantically, although grammatically it is quite distinct. <a href=#e9d5>Example 9.5 </a>is very similar in mean­ing to:

<p>

<pre><a name=e9d6>9.6) mi se bapli tavla bau la lojban.

I compelledly-speak in-language Lojban.

</pre><p>The “se” conversion is needed because “bapli tavla” would be a “com­peller type of speaker” rather than a “compelled [by someone] type of speaker”, which is what a “bai tavla” is.

<p>

<cx "fi'o modal followed by selbri, effect on eliding fe'u">If the modal preceding a selbri is constructed using “fi'o”, then “fe'u” is re­quired to prevent the main selbri and the modal selbri from colliding:

<p>

<ex "see with eye"><pre><a name=e9d7>9.7) mi fi'o kanla fe'u viska do

I with-eye see you.

I see you with my eye(s).

</pre><cx "modal, expanding scope over logical connection with ke…ke'e"><cx "modal, expanding scope over non-logical connection"><cx "modal, expanding scope over inner modal connection"><lx "bai ke">There are two other uses of modals. A modal can be at­tached to a pair of bridi-tails that have already been connected by a logical, non-logical, or modal connec­tion (see <a href=chap14.html>Chapter 14 </a>for more on logical and non-logical connections):

<p>

<pre><a name=e9d8>9.8) mi bai ke ge klama le zarci gi cadzu le bisli [ke'e]

I under-compulsion ( both go to-the market and walk on-the ice ).

Under compulsion, I both go to the market and walk on the ice.

</pre><p>Here the “bai” is spread over both “klama le zarci” and “cadzu le bisli”, and the “ge <dots>…</dots>gi” represents the logical connection “both-and” be­tween the two.

<p>

<cx "modal, expanding scope over multiple sentences with tu'e…tu'u"><lx "tu'e"><lx "tu'u">Similarly, a modal can be attached to multiple sentences that have been com­bined with “tu'e” and “tu'u”, which are explained in more detail in <a href=chap19.html>Chapter 19</a>:

<p>

<pre><a name=e9d9>9.9) bai tu'e mi klama le zarci .i mi cadzu le bisli [tu'u]

Under-compulsion [start] I go to-the market. I walk on-the ice [end].

</pre>means the same thing as <a href=#e9d8>Example 9.8</a>.

<p>

Note: Either BAI modals or “fi'o”-plus-selbri modals may cor­rectly be used in any of the constructions discussed in this section.

<p>

### <a name=s10><h3>Modal relative phrases; Comparison</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> pe GOI restrictive relative phrase

ne GOI incidental relative phrase

mau BAI zmadu modal

me'a BAI mleca modal

</pre><p>Relative phrases and clauses are explained in much more detail in <a href=chap8.html>Chapter 8</a>. How­ever, there is a construction which combines a modal with a relative phrase which is rele­vant to this chapter. Con­sider the following examples of relative clauses:

<p>

<ex "Appassionata"><ex "Artur Rubenstein"><ex "Beethoven"><pre><a name=e10d1>10.1) la .apasionatas. poi se cusku la .artr. rubnstain. cu se nelci mi

The Appassionata which is-expressed-by Artur Rubenstein is-liked-by me.

<a name=e10d2>10.2) la .apasionatas. noi se finti la betovn. cu se nelci mi

The Appassionata, which is-created-by Beethoven, is-liked-by me.

</pre><lx "poi">In <a href=#e10d1>Example 10.1</a>, “la .apasionatas.” refers to a particular performance of the sonata, namely the one performed by Rubenstein. Therefore, the relative clause “poi se cusku” uses the cmavo “poi” (of selma'o NOI) to restrict the meaning of “la .apasionatas” to the performance in question.

<p>

<lx "noi">In <a href=#e10d2>Example 10.2</a>, however, “la .apasionatas.” refers to the sonata as a whole, and the information that it was composed by Beethoven is merely incidental. The cmavo “noi” (also of selma'o NOI) expresses the incidental nature of this relationship.

<p>

<lx "pe"><lx "ne">The cmavo “pe” and “ne” (of selma'o GOI) are roughly equivalent to “poi” and “noi” respectively, but are followed by sumti rather than full bridi. We can abbreviate <a href=#e10d1>Example 10.1 </a>and <a href=#e10d2>Example 10.2 </a>to:

<p>

<pre><a name=e10d3>10.3) la .apasionatas pe la .artr. rubnstain. se nelci mi

The Appassionata of Artur Rubenstein is-liked-by me.

<a name=e10d4>10.4) la .apasionatas ne la betovn. se nelci mi

The Appassionata, which is of Beethoven, is-liked-by me.

</pre><cx "relative phrases, contrasted with relative clauses in preciseness">Here the precise selbri of the relative clauses is lost: all we can tell is that the Appas­sionata is connected in some way with Rubenstein (in <a href=#e10d3>Example 10.3</a>) and Beethoven (in <a href=#e10d4>Example 10.4</a>), and that the rela­tionships are respectively restrictive and incidental.

<p>

<lx "cu'u"><lx "fi'e">It happens that both “cusku” and “finti” have BAI cmavo, namely “cu'u” and “fi'e”. We can recast <a href=#e10d3>Example 10.3 </a>and <a href=#e10d4>Example 10.4 </a>as:

<p>

<pre><a name=e10d5>10.5) la .apasionatas pe cu'u la .artr. rubnstain. cu se nelci mi

The Appassionata expressed-by Artur Rubenstein is-liked-by me.

<a name=e10d6>10.6) la .apasionatas ne fi'e la betovn. cu se nelci mi

The Appassionata, invented-by Beethoven, is-liked-by me.

</pre><cx "relative phrases with modals, compared to relative clauses in preciseness"><cx "relative phrases, improving preciseness with modals"><cx "modals, improving relative phrase preciseness with "><a href=#e10d5>Example 10.5 </a>and <a href=#e10d6>Example 10.6 </a>have the full semantic content of <a href=#e10d1>Example 10.1 </a>and <a href=#e10d2>Ex­ample 10.2 </a>respectively.

<p>

<lx "mau"><lx "me'a"><cx "“more”, expressing with relative phrases"><cx "“less”, expressing with relative phrases">Modal relative phrases are often used with the BAI cmavo “mau” and “me'a”, which are based on the comparative gismu “zmadu” (more than) and “mleca” (less than) respec­tively. The place structures are:

<p>

<pre>zmadu: x1 is more than x2 in property/quantity x3 by amount x4

mleca: x1 is less than x2 in property/quantity x3 by amount x4

</pre><p>Here are some examples:

<p>

<ex "likes more than"><pre><a name=e10d7>10.7) la frank. nelci la betis. ne semau la meiris.

Frank likes Betty, which-is more-than Mary.

Frank likes Betty more than (he likes) Mary.

</pre><a href=#e10d7>Example 10.7 </a>requires that Frank likes Betty, but adds the informa­tion that his liking for Betty exceeds his liking for Mary. The modal appears in the form “semau” because the x2 place of “zmadu” is the basis for comparison: in this case, Frank's liking for Mary.

<p>

<pre><a name=e10d8>10.8) la frank. nelci la meiris. ne seme'a la betis.

Frank likes Mary, which-is less-than Betty.

Frank likes Mary less than (he likes) Betty.

</pre><cx "mau, avoiding in favor of seme'a"><cx "me'a, avoiding in favor of semau">Here we are told that Frank likes Mary less than he likes Betty; the information about the comparison is the same. It would be possible to rephrase <a href=#e10d7>Example 10.7 </a>using “me'a” rather than “semau”, and <a href=#e10d8>Exam­ple 10.8 </a>using “mau” rather than “seme'a”, but such us­age would be unnecessarily confusing. Like many BAI cmavo, “mau” and “me'a” are more useful when converted with “se”.

<p>

<cx "“more”, importance of relative phrase to"><cx "“less”, importance of relative phrase to">If the “ne” were omitted in <a href=#e10d7>Example 10.7 </a>and <a href=#e10d8>Example 10.8</a>, the modal sumti (“la meiris.” and “la betis.” respectively) would be­come attached to the bridi as a whole, pro­ducing a very different translation. <a href=#e10d8>Example 10.8 </a>would become:

<p>

<pre><a name=e10d9>10.9) la frank. nelci la meiris. seme'a la betis.

Frank likes Mary is-less-than Betty.

Frank's liking Mary is less than Betty.

</pre>which compares a liking with a person, and is therefore nonsense.

<p>

<cx "comparison, claims related to based on form"><cx "comparison with relative phrase, contrasted with bridi-based comparison, in claims about parts"><cx "bridi-based comparison, contrasted with comparison with relative phrase, in claims about parts">Pure comparison, which states only the comparative informa­tion but says nothing about whether Frank actually likes either Mary or Betty (he may like neither, but dislike Betty less), would be ex­pressed differently, as:

<p>

<pre><a name=e10d10>10.10) le ni la frank. nelci la betis. cu zmadu

le ni la frank. nelci la meiris.

The quantity-of Frank's liking Betty is-more-than

the quantity-of Frank's liking Mary.

</pre><cx "modals often attached with relative phrases, list"><lx "semau"><lx "seme'a"><lx "seba'i"><lx "ci'u"><lx "de'i"><lx "du'i">The mechanisms explained in this section are appropriate to many modals other than “semau” and “seme'a”. Some other modals that are often associated with relative phrases are: “seba'i” (“instead of”), “ci'u” (“on scale”), “de'i” (“dated”), “du'i” (“as much as”). Some BAI tags can be used equally well in relative phrases or attached to bridi; others seem useful only attached to bridi. But it is also possible that the useful­ness of particular BAI modals is an English-speaker bias, and that speakers of other languages may find other BAIs useful in divergent ways.

<p>

<cx "fi'o modals, usage in relative phrases">Note: The uses of modals discussed in this section are appli­cable both to BAI modals and to “fi'o”-plus-selbri modals.

<p>

### <a name=s11><h3>Mixed modal connection</h3>

<p>

It is possible to mix logical connection (explained in <a href=chap14.html>Chapter 14</a>) with modal con­nection, in a way that simultaneously asserts the logical connection and the modal rela­tionship. Consider the sen­tences:

<p>

<pre><a name=e11d1>11.1) mi nelci do .ije mi nelci la djein.

I like you. And I like Jane

</pre>which is a logical connection, and

<p>

<pre><a name=e11d2>11.2) mi nelci do .iki'ubo mi nelci la djein.

I like you. Justified-by I like Jane.

</pre><cx "connection, simultaneously modal and logical"><cx "modal connection, simultaneous with logical"><cx "mixed modal connection, of sentences">The meanings of <a href=#e11d1>Example 11.1 </a>and <a href=#e11d2>Example 11.2 </a>can be si­multaneously ex­pressed by combining the two compound cmavo, thus:

<p>

<pre><a name=e11d3>11.3) mi nelci do .ijeki'ubo mi nelci la djein.

I like you. And justified-by I like Jane.

</pre><cx "mixed modal connection, definition">Here the two sentences “mi nelci do” and “mi nelci la djein.” are si­multaneously as­serted, their logical connection is asserted, and their causal relationship is asserted. The logical connective “je” comes before the modal “ki'u” in all such mixed connections.

<p>

Since “mi nelci do” and “mi nelci la djein.” differ only in the fi­nal sumti, we can transform <a href=#e11d3>Example 11.3 </a>into a mixed sumti con­nection:

<p>

<cx "mixed modal connection, of sumti"><pre><a name=e11d4>11.4) mi nelci do .eki'ubo la djein.

I like you and/because Jane.

</pre><cx "mixed modal connection, afterthought"><cx "mixed modal connection, as proscribed in forethought">Note that this connection is an afterthought one. Mixed connectives are always after­thought; forethought connectives must be either logi­cal or modal.

<p>

<cx "mixed modal connection, of bridi-tails">There are numerous other afterthought logical and non-logi­cal connectives that can have modal information planted within them. For example, a bridi-tail connected version of <a href=#e11d4>Example 11.4 </a>would be:

<p>

<pre><a name=e11d5>11.5) mi nelci do gi'eki'ubo nelci la djein.

I like you and/because like Jane.

</pre><p>The following three complex examples all mean the same thing.

<p>

<ex "carry sack"><pre><a name=e11d6>11.6) mi bevri le dakli

.ijeseri'abo tu'e mi bevri le gerku .ijadu'ibo mi bevri le mlatu [tu'u]

I carry the sack.

And [effect] (I carry the dog. And/or [equal] I carry the cat.)

I carry the sack. As a result I carry the dog or I carry the cat, equally.

<a name=e11d7>11.7) mi bevri le dakli

gi'eseri'ake bevri le gerku gi'adu'ibo bevri le mlatu [ke'e]

I carry the sack

and [effect] (carry the dog and/or [equal] carry the cat ).

I carry the sack and as a result carry the dog or carry the cat equally.

<a name=e11d8>11.8) mi bevri le dakli .eseri'ake le gerku .adu'ibo le mlatu [ke'e]

I carry the sack and [effect] (the cat and/or [equal] the dog).

I carry the sack, and as a result the cat or the dog equally.

</pre><lx "tu'e"><lx "tu'u"><lx "ke"><lx "ke'e">In <a href=#e11d6>Example 11.6</a>, the “tu'e <dots>…</dots>tu'u” brackets are the equivalent of the “ke <dots>…</dots>ke'e” brack­ets in <a href=#e11d7>Example 11.7 </a>and <a href=#e11d8>Example 11.8</a>, because “ke <dots>…</dots>ke'e” cannot extend across more than one sentence. It would also be possible to change the “.ijeseri'abo” to “.ije seri'a”, which would show that the “tu'e <dots>…</dots>tu'u” portion was an effect, but would not pin down the “mi bevri le dakli” portion as the cause. It is legal for a modal (or a tense; see <a href=chap10.html>Chapter 10</a>) to modify the whole of a “tu'e <dots>…</dots>tu'u” construct.

<p>

<cx "fi'o, mixed modal connection with">Note: The uses of modals discussed in this section are appli­cable both to BAI modals and to “fi'o”-plus-selbri modals.

<p>

### <a name=s12><h3>Modal conversion: JAI</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> jai JAI modal conversion

fai FA modal place structure tag

</pre><cx "conversion, swapping with modal place"><lx "SE"><lx "BAI">So far, conversion of numbered bridi places with SE and the addition of modal places with BAI have been two entirely separate operations. However, it is possible to convert a selbri in such a way that, rather than exchanging two numbered places, a mo­dal place is made into a numbered place. For example,

<p>

<pre><a name=e12d1>12.1) mi cusku bau la lojban.

I express [something] in-language Lojban.

</pre><lx "jai"><lx "JAI"><cx "modal conversion, grammar of"><cx "modal conversion, place structure of"><cx "conversion, modal"><cx "place structure, effect of modal conversion on"><lx "fai"><lx "FA">has an explicit x1 place occupied by “mi” and an explicit “bau” place occupied by “la lojban.” To exchange these two, we use a modal con­version operator consisting of “jai” (of selma'o JAI) followed by the modal cmavo. Thus, the modal conversion of <a href=#e12d1>Example 12.1 </a>is:

<p>

<pre><a name=e12d2>12.2) la lojban. jai bau cusku fai mi

Lojban is-the-language-of-expression used-by me.

</pre><cx "modal conversion, access to original first place with fai"><cx "fai, as allowing access to original first place in modal conversion">In <a href=#e12d2>Example 12.2</a>, the modal place “la lojban.” has become the x1 place of the new sel­bri “jai bau cusku”. What has happened to the old x1 place? There is no numbered place for it to move to, so it moves to a special “unnumbered place” marked by the tag “fai” of selma'o FA.

<p>

<cx "fai, effect on numbering of place structure places">Note: For the purposes of place numbering, “fai” behaves like “fi'a”; it does not af­fect the numbering of the other places around it.

<p>

<cx "modal conversions, in descriptions">Like SE conversions, JAI conversions are especially con­venient in descrip­tions. We may refer to “the language of an expres­sion” as “le jai bau cusku”, for exam­ple.

<p>

<cx "jai without modal, meaning"><cx "modal conversion, with no modal specified">In addition, it is grammatical to use “jai” without a following modal. This us­age is not related to modals, but is explained here for completeness. The effect of “jai” by itself is to send the x1 place, which should be an abstraction, into the “fai” position, and to raise one of the sumti from the abstract sub-bridi into the x1 place of the main bridi. This fea­ture is discussed in more detail in <a href=chap11.html>Chapter 11</a>. The following two exam­ples mean the same thing:

<p>

<pre><a name=e12d3>12.3) le nu mi lebna le cukta cu se krinu le nu mi viska le cukta

The event-of (I take the book) is-justified-by the event-of (I see the book).

My taking the book is justified by my seeing it.

<a name=e12d4>12.4) mi jai se krinu le nu mi viska le cukta kei

[fai le nu mi lebna le cukta]

I am-justified by the event-of (I see the book)

[namely, the event-of (I take the book)].

I am justified in taking the book by seeing the book.

</pre><cx "modal conversion without modal, as vague"><a href=#e12d4>Example 12.4</a>, with the bracketed part omitted, allows us to say that “I am justified” whereas in fact it is my action that is justified. This con­struction is vague, but useful in representing natural-language meth­ods of expression.

<p>

<cx "modal conversion with fi'o"><cx "fi'o, and modal conversion">Note: The uses of modals discussed in this section are appli­cable both to BAI modals and to “fi'o”-plus-selbri modals.

<p>

### <a name=s13><h3>Modal negation</h3>

<p>

<cx "negation of modals"><cx "modals, negation of">Negation is explained in detail in <a href=chap15.html>Chapter 15</a>. There are two forms of negation in Lojban: contradictory and scalar negation. Con­tradictory negation expresses what is false, whereas scalar negation says that some alternative to what has been stated is true. A sim­ple example is the difference between “John didn't go to Paris” (contradictory negation) and “John went to (somewhere) other than Paris” (scalar negation).

<p>

<cx "negation of modals, contradictory"><lx "nai"><cx "modals, contradictory negation of">Contradictory negation involving BAI cmavo is performed by appending “-nai” (of selma'o NAI) to the BAI. A common use of mo­dals with “-nai” is to deny a causal rela­tionship:

<p>

<pre><a name=e13d1>13.1) mi nelci do mu'inai le nu do nelci mi

I like you, but not because you like me.

</pre><cx "contradictory negation of modals, explanation of meaning"><a href=#e13d1>Example 13.1 </a>denies that the relationship between my liking you (which is asserted) and your liking me (which is not asserted) is one of motivation. Nothing is said about whether you like me or not, merely that that hypothetical liking is not the motivation for my liking you.

<p>

<cx "negation of modals, scalar"><lx "na'e"><cx "modals, scalar negation of">Scalar negation is achieved by prefixing “na'e” (of selma'o NAhE), or any of the other cmavo of NAhE, to the BAI cmavo.

<p>

<ex "plant grows"><pre><a name=e13d2>13.2) le spati cu banro na'emu'i le nu

do djacu dunda fi le spati

The plant grows other-than-motivated-by the event-of

you water-give to the plant.

</pre><cx "scalar negation of modals, explanation of meaning"><a href=#e13d2>Example 13.2 </a>says that the relationship between the plant's growth and your watering it is not one of motivation: the plant is not moti­vated to grow, as plants are not something which can have motivation as a rule. Implicitly, some other relationship between wa­tering and growth exists, but <a href=#e13d2>Example 13.2 </a>doesn't say what it is (presumably “ri'a”).

<p>

<cx "negation of fi'o modals, by negating selbri"><cx "fi'o modals, negation of by negating selbri">Note: Modals made with “fi'o” plus a selbri cannot be negated directly. The selbri can itself be negated either with contradictory or with scalar negation, however.

<p>

### <a name=s14><h3>Sticky modals</h3>

<p>

The following cmavo is discussed in this section:

<p>

<pre> ki KI stickiness flag

</pre><cx "sticky modals, definition"><cx "modals, making long-scope"><lx "ki"><cx "modals, making sticky">Like tenses, modals can be made persistent from the bridi in which they appear to all following bridi. The effect of this “stickiness” is to make the modal, along with its fol­lowing sumti, act as if it ap­peared in every successive bridi. Stickiness is put into effect by fol­lowing the modal (but not any following sumti) with the cmavo “ki” of selma'o KI. For example,

<p>

<pre><a name=e14d1>14.1) mi tavla bau la lojban. bai ki tu'a la frank.

.ibabo mi tavla bau la gliban.

I speak in-language Lojban compelled-by some-property-of Frank.

Afterward, I speak in-language English.

</pre>means the same as:

<p>

<pre><a name=e14d2>14.2) mi tavla bau la lojban. bai tu'a la frank.

.ibabo mi tavla bau la gliban.

bai tu'a la frank.

I speak in-language Lojban compelled-by some-property-of Frank.

Afterward, I speak in-language English

compelled-by some-property-of Frank.

</pre><p>In <a href=#e14d1>Example 14.1</a>, “bai” is made sticky, and so Frank's compelling is made applicable to every following bridi. “bau” is not sticky, and so the language may vary from bridi to bridi, and if not specified in a par­ticular bridi, no assumption can safely be made about its value.

<p>

<cx "sticky modal, canceling">To cancel stickiness, use the form “BAI ki ku”, which stops any modal value for the specified BAI from being passed to the next bridi. To cancel stickiness for all modals simultaneously, and also for any sticky tenses that exist (“ki” is used for both modals and tenses), use “ki” by itself, either before the selbri or (in the form “ki ku”) any­where in the bridi:

<p>

<pre><a name=e14d3>14.3) mi ki tavla

I speak (no implication about language or compulsion).

</pre><cx "sticky modals, fi'o proscribed from"><cx "fi'o, proscribed for sticky modals">Note: Modals made with “fi'o”-plus-selbri cannot be made sticky. This is an unfortu­nate, but unavoidable, restriction.

<p>

### <a name=s15><h3>Logical and non-logical connection of modals</h3>

<p>

<cx "logical connection, of modals"><cx "non-logical connection, of modals">Logical and non-logical connectives are explained in detail in <a href=chap14.html>Chapter 14</a>. For the purposes of this chapter, it suffices to point out that a logical (or non-logical) con­nection between two bridi which dif­fer only in a modal can be reduced to a single bridi with a connective between the modals. As a result, <a href=#e15d1>Example 15.1 </a>and <a href=#e15d2>Example 15.2 </a>mean the same thing:

<p>

<pre><a name=e15d1>15.1) la frank. bajra seka'a le zdani .ije la frank. bajra

teka'a le zdani

Frank runs with-destination the house. And Frank runs

with-origin the house.

Frank runs to the house, and Frank runs from the house.

</pre><lx "je"><pre><a name=e15d2>15.2) la frank. bajra seka'a je teka'a le zdani

Frank runs with-destination and with-origin the house.

Frank runs to and from the house.

</pre><lx "ce'e">Neither example implies whether a single act, or two acts, of running is referred to. To compel the sentence to refer to a single act of run­ning, you can use the form:

<p>

<pre><a name=e15d3>15.3) la frank. bajra seka'a le zdani ce'e teka'a le zdani

Frank runs with-destination the house [joined-to] with-origin the-house.

</pre><p>The cmavo “ce'e” creates a termset containing two terms (termsets are ex­plained in <a href=chap14.html>Chapter 14 </a>and <a href=chap16.html>Chapter 16</a>). When a termset contains more than one modal tag derived from a single BAI, the convention is that the two tags are derived from a common event.

<p>

### <a name=s16><h3>CV'V cmavo of selma'o BAI with irregular forms</h3>

<p>

<cx "modal cmavo, regular form for derivation">There are 65 cmavo of selma'o BAI, of which all but one (“do'e”, discussed in <a href=#s6>Sec­tion 6</a>), are derived directly from selected gismu. Of these 64 cmavo, 36 are entirely regular and have the form CV'V, where C is the first consonant of the corresponding gismu, and the Vs are the two vowels of the gismu. The remaining BAI cmavo, which are irregular in one way or another, are listed in the table be­low. The table is divided into sub-tables according to the nature of the exception; some cmavo appear in more than one sub-table, and are so noted.

<p>

<cx "modal cmavo, list of irregular derivation"><pre> cmavo gismu comments

Monosyllables of the form CVV:

bai bapli

bau bangu

cau claxu

fau fasnu

gau gasnu

kai ckaji uses 2nd consonant of gismu

mau zmadu uses 2nd consonant of gismu

koi korbi

rai traji uses 2nd consonant of gismu

sau sarcu

tai tamsmi based on lujvo, not gismu

zau zanru

Second consonant of the gismu as the C:

(the gismu is always of the form CCVCV)

ga'a zgana

kai ckaji has CVV form (monosyllable)

ki'i ckini

la'u klani has irregular 2nd V

le'a klesi has irregular 2nd V

mau zmadu has CVV form (monosyllable)

me'e cmene

ra'a srana

ra'i krasi

rai traji has CVV form (monosyllable)

ti'i stidi

tu'i stuzi

Irregular 2nd V:

fi'e finti

la'u klani uses 2nd consonant of gismu

le'a klesi uses 2nd consonant of gismu

ma'e marji

mu'u mupli

ti'u tcika

va'o vanbi

Special cases:

ri'i lifri uses 3rd consonant of gismu

tai tamsmi based on lujvo, not gismu

va'u xamgu CV'V cmavo can't begin with “x”

### </pre><a name=s17><h3>Complete table of BAI cmavo with rough English equivalents</h3>

<p>

<cx "modal cmavo, table with English equivalents"><cx "modal cmavo table, format of">The following table shows all the cmavo belonging to selma'o BAI, and has five col­umns. The first column is the cmavo itself; the second column is the gismu linked to it. The third column gives an English phrase which indicates the meaning of the cmavo; and the fourth column indicates its meaning when preceded by “se”.

<p>

For those cmavo with meaningful “te”, “ve”, and even “xe” conversions (depending on the number of places of the underlying gismu), the meanings of these are shown on one or two extra rows following the primary row for that cmavo.

<p>

<cx "modal cmavo, basis in gismu place structure">It should be emphasized that the place structures of the gismu control the meanings of the BAI cmavo. The English phrases shown here are only suggestive, and are often too broad or too nar­row to correctly specify what the acceptable range of uses for the modal tag are.

<p>

<pre> ba'i basti replaced by instead of

bai bapli compelled by compelling

bau bangu in language in language of

be'i benji sent by transmitting

te=sent to ve=with transmit origin

xe=transmitted via

ca'i catni by authority of with authority over

cau claxu lacked by without

ci'e ciste in system with system function

te=of system components

ci'o cinmo felt by feeling emotion

ci'u ckilu on the scale on scale measuring

cu'u cusku as said by expressing

te=as told to ve=expressed in medium

de'i detri dated on the same date as

di'o diklo at the locus of at specific locus

do'e — vaguely related to

du'i dunli as much as equal to

du'o djuno according to knowing facts

te=knowing about

ve=under epistemology

fa'e fatne reverse of in reversal of

fau fasnu in the event of

fi'e finti created by creating work

te=created for purpose

ga'a zgana to observer observing

te=observed by means

ve=observed under conditions

gau gasnu with agent as agent in doing

ja'e jalge resulting in results because of

ja'i javni by rule by rule prescribing

ji'e jimte up to limit as a limit of

ji'o jitro under direction controlling

ji'u jicmu based on supporting

ka'a klama gone to by with destination

te=with origin ve=via route

xe=by transport mode

ka'i krati represented by on behalf of

kai ckaji characterizing with property

ki'i ckini as relation of related to

te=with relation

ki'u krinu justified by with justified result

koi korbi bounded by as boundary of

te=bordering

ku'u kulnu in culture in culture of

la'u klani as quantity of in quantity

le'a klesi in category as category of

te=defined by quality

li'e lidne led by leading

ma'e marji of material made from material

te=in material form of

ma'i manri in ref. frame as a standard for

mau zmadu exceeded by more than

me'a mleca undercut by less than

me'e cmene with name as a name for

te=as a name to

mu'i mukti motivated by motive therefore

mu'u mupli exemplified by as an example of

ni'i nibli entailed by entails

pa'a panra in addition to similar to

te=similar in pattern

ve=similar by standard

pa'u pagbu with component as a part of

pi'o pilno used by using tool

po'i porsi in the sequence sequenced by rule

pu'a pluka pleased by in order to please

pu'e pruce by process processing from

te=processing into

ve=passing through stages

ra'a srana pertained to by concerning

ra'i krasi from source as an origin of

rai traji with superl. superlative in

te=at extreme ve=superlative among

ri'a rinka caused by causing

ri'i lifri experienced by experiencing

sau sarcu requiring necessarily for

te=necessarily under conditions

si'u sidju aided by assisting in

ta'i tadji by method as a method for

tai tamsmi as a form of in form

te=in form similar to

ti'i stidi suggested by suggesting

te=suggested to

ti'u tcika with time at the time of

tu'i stuzi with site as location of

va'o vanbi under conditions as conditions for

va'u xamgu benefiting from with beneficiary

zau zanru approved by approving

zu'e zukte with actor with means to goal

te=with goal

</pre><p>The lujvo “tamsmi” on which “tai” is based is derived from the tanru “tarmi simsa” and has the place structure:

<p>

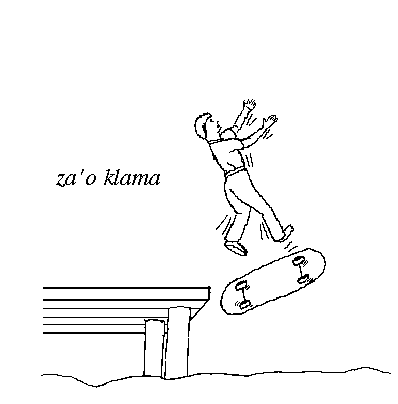
<dl compact><dt><dd>tamsmi: x1 has form x2, similar in form to x3 in property/quality x4

</dl><p>This lujvo is employed because “tarmi” does not have a place struc­ture useful for the mo­dal's purpose.

<p>

</body></html>

<img src=chap10.gif alt=[Cartoon] align=center width=405 height=405>



## <h2>Chapter 10

## <br>

## Imaginary Journeys: The Lojban Space/Time Tense System</h2>

###### <h6>$Revision: 4.0 $<br> mkhtml: 1.1</h6></p></center>

<p>

### <a name=s1><h3>Introductory</h3>

<p>

<cx "tense, explanation of presentation method">This chapter attempts to document and explain the space/time tense system of Loj­ban. It does not attempt to answer all questions of the form “How do I say such-and-such (an English tense) in Lojban?” Instead, it explores the Lojban tense system from the in­side, attempting to educate the reader into a Lojbanic viewpoint. Once the overall system is understood and the resources that it makes available are familiar, the reader should have some hope of using appropriate tense constructs and being correctly under­stood.

<p>

<cx "tense, Lojban contrasted with native languages">The system of Lojban tenses presented here may seem really complex because of all the pieces and all the options; indeed, this chapter is the longest one in this book. But tense is in fact com­plex in every language. In your native language, the subtleties of tense are intuitive. In foreign languages, you are seldom taught the entire system until you have reached an advanced level. Lojban tenses are extremely systematic and productive, al­lowing you to ex­press subtleties based on what they mean rather than on how they act similarly to English tenses. This chapter concentrates on pre­senting an intuitive approach to the meaning of Lojban tense words and how they may be crea­tively and productively combined.

<p>

<cx "temporal tense, historical definition"><cx "temporal tense, real relationship to time in English"><cx "temporal tense, as mandatory in English"><cx "temporal tense, Lojban contrasted with English in necessity">What is “tense”? Historically, “tense” is the attribute of verbs in English and related languages that expresses the time of the ac­tion. In English, three tenses are tra­ditionally recognized, convention­ally called the past, the present, and the future. There are also a vari­ety of compound tenses used in English. However, there is no simple re­lationship between the form of an English tense and the time actu­ally expressed:

<p>

<dl compact><dt> <dd>I go to London tomorrow.

I will go to London tomorrow.

I am going to London tomorrow.

</dl>all mean the same thing, even though the first sentence uses the pre­sent tense; the sec­ond, the future tense; and the third, a compound tense usually called “present progres­sive”. Likewise, a newspaper headline says “JONES DIES”, although it is obvious that the time re­ferred to must be in the past. Tense is a mandatory category of Eng­lish: every sentence must be marked for tense, even if in a way con­trary to logic, because every main verb has a tense marker built into to it. By contrast, Lojban brivla have no implicit tense marker attached to them.

<p>

<cx "tense, selbri types applicable to"><cx "tense system, and space location"><cx "tense system, and space location"><cx "time, as part of tense system (see also tense, temporal tense)"><cx "space location, as part of tense system (see also tense, spatial tense)"><cx "elided tense, meaning of">In Lojban, the concept of tense extends to every selbri, not merely the verb-like ones. In addition, tense structures provide infor­mation about location in space as well as in time. All tense informa­tion is optional in Lojban: a sentence like:

<p>

<ex "go to market"><pre><a name=e1d1>1.1) mi klama le zarci

I go-to the market.

</pre>can be understood as:

<p>

<dl compact><dt> <dd>I went to the market.

I am going to the market.

I have gone to the market.

I will go to the market.

I continually go to the market.

</dl>as well as many other possibilities: context resolves which is correct.

<p>

<cx "tense, position of in sentence"><lx "cu"><cx "tense specification, effect on “cu”"><cx "tense specification, effect on elidability of terminators"><cx "cu, effect of tense specification">The placement of a tense construct within a Lojban bridi is easy: right before the sel­bri. It goes immediately after the “cu”, and can in fact always replace the “cu” (although in very complex sen­tences the rules for eliding terminators may be changed as a result). In the following examples, “pu” is the tense marker for “past time”:

<p>

<pre><a name=e1d2>1.2) mi cu pu klama le zarci

mi pu klama le zarci

I in-the-past go-to the market.

I went to the market.

</pre><cx "tense, position in sentence alternative"><cx "tense, with ku"><lx "ku"><cx "ku, with tense">It is also possible to put the tense somewhere else in the bridi by adding “ku” after it. This “ku” is an elidable terminator, but it's al­most never possible to actually elide it ex­cept at the end of the bridi:

<p>

<pre><a name=e1d3>1.3) puku mi klama le zarci

In-the-past I go-to the market.

Earlier, I went to the market.

<a name=e1d4>1.4) mi klama puku le zarci

I go-to in-the-past the market.

I went earlier to the market.

<a name=e1d5>1.5) mi klama le zarci pu [ku]

I go-to the market in-the-past.

I went to the market earlier.

</pre><cx "tense, effect of different position in sentence"><cx "tense, emphasizing by position in sentence"><a href=#e1d{2}>Examples 1.2 </a>through <a href=#e1d5>1.5 </a>are different only in emphasis. Abnormal order, such as <a href=#e1d{3}>Ex­amples 1.3 </a>through <a href=#e1d5>1.5 </a>exhibit, adds emphasis to the words that have been moved; in this case, the tense cmavo “pu”. Words at either end of the sentence tend to be more notice­able.

<p>

### <a name=s2><h3>Spatial tenses: FAhA and VA</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> vi VA short distance

va VA medium distance

vu VA long distance

zu'a FAhA left

ri'u FAhA right

ga'u FAhA up

ni'a FAhA down

ca'u FAhA front

ne'i FAhA within

be'a FAhA north of

</pre>(The complete list of FAhA cmavo can be found in <a href=#s28>Section 28</a>.)

<p>

Why is this section about spatial tenses rather than the more familiar time tenses of <a href=#s1>Section 1</a>, asks the reader? Because the model to be used in explaining both will be easier to grasp for space than for time. The explanation of time tenses will re­sume in <a href=#s4>Section 4</a>.

<p>

<cx "spatial tense, as optional in English"><cx "spatial tense, compared with temporal tense in elidability"><cx "temporal tense, compared with spatial tense in elidability"><cx "temporal tense elision, compared with spatial tense elision in meaning">English doesn't have mandatory spatial tenses. Although there are plenty of ways in English of showing where an event hap­pens, there is absolutely no need to do so. Consid­ering this fact may give the reader a feel for what the optional Lojban time tenses are like. From the Lojban point of view, space and time are interchange­able, al­though they are not treated identically.

<p>

<cx "spatial tense, definition"><cx "imaginary journey, and spatial tense"><cx "spatial tense, as an imaginary journey"><cx "VA, and distance"><cx "distance, specification with VA"><lx "FAhA"><lx "VA"><cx "spatial tense, distance">Lojban specifies the spatial tense of a bridi (the place at which it occurs) by using words from selma'o FAhA and VA to de­scribe an imaginary journey from the speaker to the place referred to. FAhA cmavo specify the direction taken in the journey, whereas VA cmavo specify the distance gone. For example:

<p>

<cx "man biting dog"><pre><a name=e2d1>2.1) le nanmu va batci le gerku

The man [medium distance] bites the dog.

Over there the man is biting the dog.

</pre><cx "imaginary journey, starting point"><cx "imaginary journey, ending point"><cx "spatial tense, referent of"><cx "spatial tense, reference frame"><lx "va">What is at a medium distance? The event referred to by the bridi: the man biting the dog. What is this event at a medium distance from? The speaker's location. We can un­derstand the “va” as saying: “If you want to get from the speaker's location to the loca­tion of the bridi, journey for a medium distance (in some direction unspecified).” This “imaginary journey” can be used to understand not only <a href=#e2d1>Example 2.1</a>, but also every other spatial tense construct.

<p>

<cx "spatial tense, direction"><cx "FAhA, and direction"><cx "direction, specification with FAhA">Suppose you specify a direction with a FAhA cmavo, rather than a distance with a VA cmavo:

<p>

<lx "zu'a"><pre><a name=e2d2>2.2) le nanmu zu'a batci le gerku

The man [left] bites the dog.

</pre><p>Here the imaginary journey is again from the speaker's location to the location of the bridi, but it is now performed by going to the left (in the speaker's reference frame) for an unspecified distance. So a reason­able translation is:

<p>

<dl compact><dt> <dd>To my left, the man bites the dog.

</dl><p>The “my” does not have an explicit equivalent in the Lojban, because the speaker's lo­cation is understood as the starting point.

<p>

<cx "zu'a, derivation of word"><cx "VA, relation of words to ti, ta, tu"><lx "zu'a"><lx "VA"><lx "vi"><lx "va"><lx "vu">(Etymologically, by the way, “zu'a” is derived from “zunle”, the gismu for “left”, whereas “vi”, “va”, and “vu” are intended to be remi­niscent of “ti”, “ta”, and “tu”, the demonstrative pronouns “this-here”, “that-there”, and “that-yonder”.)

<p>

<cx "tense, order of direction specification in"><cx "tense, order of distance specification in"><cx "spatial tenses, order of direction and distance specifications"><cx "direction, order of relative to distance in spatial tenses"><cx "distance, order of relative to direction in spatial tenses">What about specifying both a direction and a distance? The rule here is that the di­rection must come before the distance:

<p>

<pre><a name=e2d3>2.3) le nanmu zu'avi batci le gerku

The man [left] [short distance] bites the dog.

Slightly to my left, the man bites the dog.

</pre><p>As explained in <a href=#s1>Section 1</a>, it would be perfectly correct to use “ku” to move this tense to the beginning or the end of the sentence to em­phasize it:

<p>

<pre><a name=e2d4>2.4) zu'aviku le nanmu cu batci le gerku

[Left] [short distance] the man bites the dog.

Slightly to my left, the man bites the dog.

### </pre><a name=s3><h3>Compound spatial tenses</h3>

<p>

<cx "compound tense, definition">Humph, says the reader: this talk of “imaginary journeys” is all very well, but what's the point of it? — “zu'a” means “on the left” and “vi” means “nearby”, and there's no more to be said. The imagi­nary-journey model becomes more useful when so-called compound tenses are involved. A compound tense is exactly like a simple tense, but has several FAhAs run together:

<p>

<ex "manhole"><pre><a name=e3d1>3.1) le nanmu ga'u zu'a batci le gerku

The man [up] [left] bites the dog.

</pre><cx "compound spatial tense, explanation of"><cx "imaginary journey, stages of in compound tenses">The proper interpretation of <a href=#e3d1>Example 3.1 </a>is that the imaginary journey has two stages: first move from the speaker's location upward, and then to the left. A translation might read:

<p>

<dl compact><dt> <dd>Left of a place above me, the man bites the dog.

</dl>(Perhaps the speaker is at the bottom of a manhole, and the dog-bit­ing is going on at the edge of the street.)

<p>

<cx "compound tense, Lojban contrasted with English in order of specification"><cx "compound tense ordering, Lojban contrasted with English">In the English translation, the keywords “left” and “above” oc­cur in reverse order to the Lojban order. This effect is typical of what happens when we “unfold” Loj­ban com­pound tenses into their English equivalents, and shows why it is not very useful to try to memorize a list of Lojban tense constructs and their colloquial English equiva­lents.

<p>

The opposite order also makes sense:

<p>

<pre><a name=e3d2>3.2) le nanmu zu'a ga'u batci le gerku

The man [left] [up] bites the dog.

Above a place to the left of me, the man bites the dog.

</pre><cx "compound spatial tense, effect of different ordering">In ordinary space, the result of going up and then to the left is the same as that of going left and then up, but such a simple relationship does not apply in all environments or to all directions: going south, then east, then north may return one to the starting point, if that point is the North Pole.

<p>

<cx "compound spatial tense, with direction and distance">Each direction can have a distance following:

<p>

<pre><a name=e3d3>3.3) le nanmu zu'avi ga'uvu batci le gerku

The man [left] [short distance] [up] [long distance] bites the dog.

Far above a place slightly to the left of me, the man bites the dog.

</pre><cx "compound spatial tense, beginning with distance only">A distance can also come at the beginning of the tense con­struct, without any speci­fied direction. (<a href=#e2d1>Example 2.1</a>, with VA alone, is really a special case of this rule when no directions at all follow.)

<p>

<pre><a name=e3d4>3.4) le nanmu vi zu'a batci le gerku

The man [short distance] [left] bites the dog.

Left of a place near me, the man bites the dog.

</pre><cx "compound spatial tense, as direction with-or-without distance">Any number of directions may be used in a compound tense, with or without speci­fied distances for each:

<p>

<pre><a name=e3d5>3.5) le nanmu ca'uvi ni'ava ri'uvu ne'i

batci le gerku

The man [front] [short] [down] [medium] [right] [long] [within]

bites the dog.

Within a place a long distance to the right of a place which is a medium

distance downward from a place a short distance in front of me,

the man bites the dog.

</pre><p>Whew! It's a good thing tense constructs are optional: having to say all that could cer­tainly be painful. Note, however, how much shorter the Lojban version of <a href=#e3d5>Example 3.5 </a>is than the English version.

<p>

### <a name=s4><h3>Temporal tenses: PU and ZI</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> pu PU past

ca PU present

ba PU future

zi ZI short time distance

za ZI medium time distance

zu ZI long time distance

</pre><cx "temporal tenses, compared with spatial tenses"><cx "PU, compared with FAhA"><cx "ZI, compared with VA"><lx "PU"><lx "ZI"><cx "tense, order of temporal and spatial in"><cx "tense, rationale for relative order of temporal and spatial in"><cx "spatial tense, order relative to temporal"><cx "temporal tense, order relative to spatial">Now that the reader understands spatial tenses, there are only two main facts to un­derstand about temporal tenses: they work exactly like the spatial tenses, with sel­ma'o PU and ZI standing in for FAhA and VA; and when both spatial and temporal tense cmavo are given in a single tense construct, the temporal tense is expressed first. (If space could be expressed before or after time, then certain constructions would be ambiguous.)

<p>

<pre><a name=e4d1>4.1) le nanmu pu batci le gerku

The man [past] bites the dog.

The man bit the dog.

</pre>means that to reach the dog-biting, you must take an imaginary jour­ney through time, moving towards the past an unspecified distance. (Of course, this journey is even more imaginary than the ones talked about in the previous sections, since time-travel is not an available option.)

<p>

<lx "pu"><lx "ca"><lx "ba"><cx "time, contrasted with space in number of directions"><cx "space, contrasted with time in number of directions">Lojban recognizes three temporal directions: “pu” for the past, “ca” for the present, and “ba” for the future. (Etymologically, these derive from the corresponding gismu “purci”, “cabna”, and “balvi”. See <a href=#s23>Section 23 </a>for an explanation of the exact relationship between the cmavo and the gismu.) There are many more spatial directions, since there are FAhA cmavo for both absolute and relative directions as well as “direction-like rela­tionships” like “surrounding”, “within”, “touching”, etc. (See <a href=#s28>Sec­tion 28 </a>for a complete list.) But there are really only two directions in time: forward and backward, toward the future and toward the past. Why, then, are there three cmavo of sel­ma'o PU?

<p>

<cx "ca, rational for"><cx "ca, compared with bu'u"><cx "bu'u, compared with ca"><cx "tense, as subjective perception"><lx "ca"><lx "bu'u">The reason is that tense is subjective: human beings per­ceive space and time in a way that does not necessarily agree with objective measurements. We have a sense of “now” which includes part of the objective past and part of the objective future, and so we natu­rally segment the time line into three parts. The Lojban design recognizes this human reality by providing a separate time-direction cmavo for the “zero direction”, Similarly, there is a FAhA cmavo for the zero space direction: “bu'u”, which means something like “coinciding”.

<p>

<cx "relativity theory, relation to Lojban tense system"><cx "tense, as observer-based">(Technical note for readers conversant with relativity theory: The Lojban time tenses reflect time as seen by the speaker, who is assumed to be a “point-like observer” in the relativistic sense: they do not say anything about physical relationships of rela­tivistic in­terval, still less about implicit causality. The nature of tense is not only sub­jective but also observer-based.)

<p>

Here are some examples of temporal tenses:

<p>

<pre><a name=e4d2>4.2) le nanmu puzi batci le gerku

The man [past] [short distance] bites the dog.

A short time ago, the man bit the dog.

<a name=e4d3>4.3) le nanmu pu pu batci le gerku

The man [past] [past] bites the dog.

Earlier than an earlier time than now, the man bit the dog.

The man had bitten the dog.

The man had been biting the dog.

<a name=e4d4>4.4) le nanmu ba puzi batci le gerku

The man [future] [past] [short] bites the dog.

Shortly earlier than some time later than now, the man will bite the dog.

Soon before then, the man will have bitten the dog.

The man will have just bitten the dog.

The man will just have been biting the dog.

</pre><cx "compound temporal tense, beginning with distance only">What about the analogue of an initial VA without a direction? Lojban does al­low an initial ZI with or without following PUs:

<p>

<pre><a name=e4d5>4.5) le nanmu zi pu batci le gerku

The man [short] [past] bites the dog.

Before a short time from or before now, the man bit or will bite the dog.

<a name=e4d6>4.6) le nanmu zu batci le gerku

The man [long] bites the dog.

A long time from or before now, the man will bite or bit the dog.

</pre><cx "unspecified direction, temporal contrasted with in spatial"><a href=#e4d5>Example 4.5 </a>and <a href=#e4d6>Example 4.6 </a>are perfectly legitimate, but may not be very much used: “zi” by itself signals an event that happens at a time close to the present, but without saying whether it is in the past or the future. A rough translation might be “about now, but not exactly now”.

<p>

<ex "nearby in time">Because we can move in any direction in space, we are comfortable with the idea of events happening in an unspecified space direction (“nearby” or “far away”), but we live only from past to future, and the idea of an event which happens “nearby in time” is a peculiar one. Lojban provides lots of such possibilities that don't seem all that useful to English-speakers, even though you can put them together productively; this fact may be a limitation of English.

<p>

<cx "tense, with both temporal and spatial">Finally, here are examples which combine temporal and spa­tial tense:

<p>

<ex "long ago and far away"><pre><a name=e4d7>4.7) le nanmu puzu vu batci le gerku

The man [past] [long time] [long space] bites the dog.

Long ago and far away, the man bit the dog.

</pre><p>Alternatively,

<p>

<pre><a name=e4d8>4.8) le nanmu batci le gerku puzuvuku

The man bites the dog [past] [long time] [long space].

The man bit the dog long ago and far away.

### </pre><a name=s5><h3>Interval sizes: VEhA and ZEhA</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> ve'i VEhA short space interval

ve'a VEhA medium space interval

ve'u VEhA long space interval

ze'i ZEhA short time interval

ze'a ZEhA medium time interval

ze'u ZEhA long time interval

</pre><cx "tense, point contrasted with interval"><cx "tense, interval contrasted with point"><lx "VEhA"><lx "ZEhA">So far, we have considered only events that are usually thought of as happen­ing at a particular point in space and time: a man biting a dog at a specified place and time. But Lojbanic events may be much more “spread out” than that: “mi vasxu” (I breathe) is something which is true during the whole of my life from birth to death, and over the en­tire part of the earth where I spend my life. The cmavo of VEhA (for space) and ZEhA (for time) can be added to any of the tense constructs we have already stud­ied to specify the size of the space or length of the time over which the bridi is claimed to be true.

<p>

<ex "child on ice"><pre><a name=e5d1>5.1) le verba ve'i cadzu le bisli

The child [small space interval] walks-on the ice.

In a small space, the child walks on the ice.

The child walks about a small area of the ice.

</pre>means that her walking was done in a small area. Like the distances, the interval sizes are classified only roughly as “small, medium, large”, and are relative to the context: a small part of a room might be a large part of a table in that room.

<p>

Here is an example using a time interval:

<p>

<pre><a name=e5d2>5.2) le verba ze'a cadzu le bisli

The child [medium time interval] walks-on the ice.

For a medium time, the child walks/walked/will walk on the ice.

</pre><cx "tense, order of direction, distance and interval in"><cx "interval, relative order with direction and distance in tense">Note that with no time direction word, <a href=#e5d2>Example 5.2 </a>does not say when the walking hap­pened: that would be determined by context. It is possible to specify both directions or distances and an interval, in which case the interval always comes afterward:

<p>

<pre><a name=e5d3>5.3) le verba pu ze'a cadzu le bisli

The child [past] [medium time interval] walks-on the ice.

For a medium time, the child walked on the ice.

The child walked on the ice for a while.

</pre><cx "interval, relation to point specified by direction and distance"><cx "tense, relation of interval to point specified by direction and distance"><cx "tense, relation of point specified by direction and distance to interval"><cx "interval, specifying relation to point specified by direction and distance"><cx "tense, specifying relation of interval to point specified by direction and distance"><cx "interval, followed by direction in tense construct"><cx "direction, following interval in tense construct"><cx "ca, meaning when following interval specification"><cx "interval direction, specifying">In <a href=#e5d3>Example 5.3</a>, the relationship of the interval to the speci­fied point in time or space is indeterminate. Does the interval start at the point, end at the point, or is it cen­tered on the point? By adding an additional direction cmavo after the interval, this question can be con­clusively answered:

<p>

<pre><a name=e5d4>5.4) mi ca ze'ica cusku dei

I [present] [short time interval – present] express this-utterance.

I am now saying this sentence.

</pre><cx "interval size, as context-dependent">means that for an interval starting a short time in the past and ex­tending to a short time in the future, I am expressing the utterance which is <a href=#e5d4>Example 5.4</a>. Of course, “short” is rela­tive, as always in tenses. Even a long sentence takes up only a short part of a whole day; in a geological context, the era of *Homo sapiens* would only be a “ze'i” interval.

<p>

By contrast,

<p>

<cx "pu, meaning when following interval specification"><pre><a name=e5d5>5.5) mi ca ze'ipu cusku dei

I [present] [short time interval – past] express this-utterance.

I have just been saying this sentence.

</pre><cx "imaginary journey, with interval direction">means that for a short time interval extending from the past to the present I have been expressing <a href=#e5d5>Example 5.5</a>. Here the imaginary journey starts at the present, lays down one end point of the interval, moves into the past, and lays down the other endpoint. An­other ex­ample:

<p>

<pre><a name=e5d6>5.6) mi pu ze'aba citka le mi sanmi

I [past] [medium time interval - future] eat my meal.

For a medium time afterward, I ate my meal.

I ate my meal for a while.

</pre><p>With “ca” instead of “ba”, <a href=#e5d6>Example 5.6 </a>becomes <a href=#e5d7>Example 5.7</a>,

<p>

<pre><a name=e5d7>5.7) mi pu ze'aca citka le mi sanmi

I [past] [medium time interval - present] eat my meal

For a medium time before and afterward, I ate my meal.

I ate my meal for a while.

</pre>because the interval would then be centered on the past moment rather than oriented to­ward the future of that moment. The colloquial English translations are the same — Eng­lish is not well-suited to rep­resenting this distinction.

<p>

Here are some examples of the use of space intervals with and without speci­fied di­rections:

<p>

<ex "fish on right"><pre><a name=e5d8>5.8) ta ri'u ve'i finpe

That-there [right] [short space interval] is-a-fish.

That thing on my right is a fish.

</pre><p>In <a href=#e5d8>Example 5.8</a>, there is no equivalent in the colloquial English trans­lation of the “small interval” which the fish occupies. Neither the Loj­ban nor the English expresses the ori­entation of the fish. Compare <a href=#e5d9>Example 5.9</a>:

<p>

<pre><a name=e5d9>5.9) ta ri'u ve'ica'u finpe

That-there [right] [short space interval - front] is-a-fish.

That thing on my right extending forwards is a fish.

</pre><p>Here the space interval occupied by the fish extends from a point on my right to another point in front of the first point.

<p>

### <a name=s6><h3>Vague intervals and non-specific tenses</h3>

<p>

<cx "interval size, unspecified"><cx "interval size, vague">What is the significance of failing to specify an interval size of the type dis­cussed in <a href=#s5>Section 5</a>? The Lojban rule is that if no interval size is given, the size of the space or time interval is left vague by the speaker. For example:

<p>

<pre><a name=e6d1>6.1) mi pu klama le zarci

I [past] go-to the market.

</pre>really means:

<p>

<dl compact><dt> <dd>At a moment in the past, and possibly other moments as well, the event

“I went to the market” was in progress.

</dl><cx "past event, possible extension into present"><cx "tense direction, implications on scope of event">The vague or unspecified interval contains an instant in the speaker's past. However, there is no indication whether or not the whole interval is in the speaker's past! It is en­tirely possible that the interval during which the going-to-the-market is happening stretches into the speaker's present or even future.

<p>

<cx "tense, Lojban contrasted with English in implications of completeness"><a href=#e6d1>Example 6.1 </a>points up a fundamental difference between Lojban tenses and English tenses. An English past-tense sentence like “I went to the market” generally signifies that the going-to-the-market is entirely in the past; that is, that the event is complete at the time of speaking. Lojban “pu” has no such implication.

<p>

<cx "Classical Greek aorist tense, compared with Lojban tense"><cx "aorist, definition"><cx "tense, aorist">This property of a past tense is sometimes called “aorist”, in reference to a similar concept in the tense system of Classical Greek. All of the Lojban tenses have the same property, however:

<p>

<cx "future event, possible extension into present"><pre><a name=e6d2>6.2) le tricu ba crino

The tree [future] is-green.

The tree will be green.

</pre>does not imply (as the colloquial English translation does) that the tree is not green now. The vague interval throughout which the tree is, in fact, green may have already started.

<p>

This general principle does not mean that Lojban has no way of indicating that a tree will be green but is not yet green. Indeed, there are several ways of expressing that con­cept: see <a href=#s10>Section 10 </a>(event contours) and <a href=#s20>Section 20 </a>(logical connection be­tween tenses).

<p>

### <a name=s7><h3>Dimensionality: VIhA</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> vi'i VIhA on a line

vi'a VIhA in an area

vi'u VIhA through a volume

vi'e VIhA throughout a space/time interval

</pre><cx "spatial tense, contrasted with temporal in dimensionality"><cx "spatial tense, linear"><cx "spatial tense, planar"><cx "spatial tense, one-dimensional"><cx "spatial tense, two-dimensional"><cx "spatial tense, three-dimensional">The cmavo of ZEhA are sufficient to express time intervals. One fundamental differ­ence between space and time, however, is that space is multi-dimensional. Some­times we want to say not only that something moves over a small interval, but also per­haps that it moves in a line. Lojban allows for this. I can specify that a motion “in a small space” is more specifically “in a short line”, “in a small area”, or “through a small volume”.

<p>

<lx "VIhA">What about the child walking on the ice in <a href=#e5d{1}>Examples 5.1 </a>through <a href=#e5d3>5.3</a>? Given the na­ture of ice, probably the area interpretation is most sensible. I can make this as­sumption explicit with the appro­priate member of selma'o VIhA:

<p>

<lx "vi'a"><pre><a name=e7d1>7.1) le verba ve'a vi'a cadzu le bisli

The child [medium space interval] [2-dimensional] walks-on the ice.

In a medium-sized area, the child walks on the ice.

</pre><cx "spatial tense intervals, order of VEhA and VIhA in"><cx "spatial tense intervals, order of size and dimensionality in"><cx "dimensionality, order with size in spatial tense intervals"><cx "size, order with dimensionality in spatial tense intervals">Space intervals can contain either VEhA or VIhA or both, but if both, VEhA must come first, as <a href=#e7d1>Example 7.1 </a>shows.

<p>

<cx "dimensionality of interval, as subjective"><cx "dimensionality, of walking">The reader may wish to raise a philosophical point here. (Readers who don't wish to, should skip this paragraph.) The ice may be two-dimensional, or more accu­rately its sur­face may be, but since the child is three-dimensional, her walking must also be. The sub­jec­tive nature of Lojban tense comes to the rescue here: the action is essen­tially planar, and the third dimension of height is simply irrele­vant to walking. Even walking on a mountain could be called “vi'a”, because relatively speaking the mountain is associated with an es­sentially two-dimensional surface. Motion which is not confined to such a sur­face (e.g., flying, or walking through a three-dimensional network of tun­nels, or climbing among mountains rather than on a single mountain) would be properly described with “vi'u”. So the cog­nitive, rather than the physical, dimensionality controls the choice of VIhA cmavo.

<p>

<cx "Einsteinian, space-time intervals with 4 dimensions"><lx "vi'e"><cx "spatial tense, four-dimensional"><cx "tense, space-time dimension for intervals"><cx "pastward, as a spatial tense"><cx "futureward, as a spatial tense"><cx "temporal tense, interaction with 4-dimensional spatial tense"><cx "spatial tense, 4-dimensional interaction with temporal tense">VIhA has a member “vi'e” which indicates a 4-dimensional interval, one that in­volves both space and time. This allows the spa­tial tenses to invade, to some degree, the temporal tenses; it is pos­sible to make statements about space-time considered as an Ein­steinian whole. (There are presently no cmavo of FAhA assigned to “pastward” and “futureward” considered as space rather than time directions — they could be added, though, if Lojbanists find space-time expression useful.) If a temporal tense cmavo is used in the same tense construct with a “vi'e” interval, the resulting tense may be self-contradictory.

<p>

### <a name=s8><h3>Movement in space: MOhI</h3>

<p>

The following cmavo is discussed in this section:

<p>

<pre> mo'i MOhI movement flag

</pre><cx "tense, static contrasted with moving"><lx "mo'i"><lx "MOhI"><cx "tense, expressing movement in"><cx "direction, interaction with movement specification in tenses"><cx "movement specification, interaction with direction in tenses">All the information carried by the tense constructs so far pre­sented has been pre­sumed to be static: the bridi is occurring some­where or other in space and time, more or less remote from the speaker. Suppose the truth of the bridi itself depends on the result of a movement, or represents an action being done while the speaker is mov­ing? This too can be represented by the tense system, using the cmavo “mo'i” (of sel­ma'o MOhI) plus a spatial direction and optional distance; the direction now refers to a direction of motion rather than a static direction from the speaker.

<p>

<cx "toward right, contrasted with on right"><cx "on right, contrasted with toward right"><ex "toward my right"><pre><a name=e8d1>8.1) le verba mo'i ri'u cadzu le bisli

The child [movement] [right] walks-on the ice.

The child walks toward my right on the ice.

</pre><p>This is quite different from:

<p>

<pre><a name=e8d2>8.2) le verba ri'u cadzu le bisli

The child [right] walks-on the ice.

To the right of me, the child walks on the ice.

</pre><cx "reference frame for directions in tenses"><cx "direction, reference frame for"><cx "reference frame, specifying for direction tenses"><lx "ma'i"><lx "BAI">In either case, however, the reference frame for defining “right” and “left” is the speaker's, not the child's. This can be changed thus:

<p>

<ex "toward her right"><pre><a name=e8d3>8.3) le verba mo'i ri'u cadzu le bisli

ma'i vo'a

The child [movement] [right] walks on the ice

in-reference-frame the-x1-place.

The child walks toward her right on the ice.

</pre><a href=#e8d3>Example 8.3 </a>is analogous to <a href=#e8d1>Example 8.1</a>. The cmavo “ma'i” belongs to selma'o BAI (explained in <a href=chap9.html>Chapter 9</a>), and allows specifying a ref­erence frame.

<p>

<cx "movement, order in tense constructs"><cx "tense, order of movement specification in">Both a regular and a “mo'i”-flagged spatial tense can be com­bined, with the “mo'i” construct coming last:

<p>

<pre><a name=e8d4>8.4) le verba zu'avu mo'i ri'uvi cadzu le bisli

The child [left] [long] [movement] [right] [short] walks-on the ice.

Far to the left of me, the child walks a short distance toward my right

on the ice.

</pre><cx "complex movements, expressing"><cx "directions, multiple with movement"><cx "movement, with multiple directions">It is not grammatical to use multiple directions like “zu'a ca'u” after “mo'i”, but com­plex movements can be expressed in a separate bridi.

<p>

Here is an example of a movement tense on a bridi not in­herently involving move­ment:

<p>

<ex "eat in airplane"><pre><a name=e8d5>8.5) mi mo'i ca'uvu citka le mi sanmi

I [movement] [front] [long] eat my meal.

While moving a long way forward, I eat my meal.

</pre>(Perhaps I am eating in an airplane.)

<p>

<cx "movement, time"><cx "time travel">There is no parallel facility in Lojban at present for expressing movement in time — time travel — but one could be added easily if it ever becomes useful.

<p>

### <a name=s9><h3>Interval properties: TAhE and “roi”</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> di'i TAhE regularly

na'o TAhE typically

ru'i TAhE continuously

ta'e TAhE habitually

di'inai TAhE irregularly

na'onai TAhE atypically

ru'inai TAhE intermittently

ta'enai TAhE contrary to habit

roi ROI “n” times

roinai ROI other than “n” times

ze'e ZEhA whole time interval

ve'e VEhA whole space interval

</pre><cx "continuous, of tense intervals"><cx "discrete, of tense intervals"><lx "TAhE"><cx "intervals, spread of actions over">Consider Lojban bridi which express events taking place in time. Whether a very short interval (a point) or a long interval of time is involved, the event may not be spread consistently throughout that interval. Lojban can use the cmavo of selma'o TAhE to ex­press the idea of continuous or non-continuous actions.

<p>

<ex "attend school"><pre><a name=e9d1>9.1) mi puzu ze'u velckule

I [past] [long distance] [long interval] am-a-school-attendee (pupil).

Long ago I attended school for a long time.

</pre>probably does not mean that I attended school continuously through­out the whole of that long-ago interval. Actually, I attended school every day, except for school holi­days. More explicitly,

<p>

<ex "regularly"><pre><a name=e9d2>9.2) mi puzu ze'u di'i velckule

I [past] [long distance] [long interval] [regularly] am-a-pupil.

Long ago I regularly attended school for a long time.

</pre><lx "ru'i"><lx "di'i"><lx "na'o"><lx "ta'e"><cx "interval spread, mutually contrasted">The four TAhE cmavo are differentiated as follows: “ru'i” cov­ers the entirety of the interval, “di'i” covers the parts of the interval which are systematically spaced subinter­vals; “na'o” covers part of the interval, but exactly which part is determined by context; “ta'e” covers part of the interval, selected with reference to the behavior of the actor (who often, but not always, appears in the x1 place of the bridi).

<p>

<cx "interval spread, with unspecified interval">Using TAhE does not require being so specific. Either the time direction or the time interval or both may be omitted (in which case they are vague). For example:

<p>

<pre><a name=e9d3>9.3) mi ba ta'e klama le zarci

I [future] [habitually] go-to the market.

I will habitually go to the market.

I will make a habit of going to the market.

</pre>specifies the future, but the duration of the interval is indefinite. Simi­larly,

<p>

<pre><a name=e9d4>9.4) mi na'o klama le zarci

I [typically] go-to the market

I typically go/went/will go to the market

</pre>illustrates an interval property in isolation. There are no distance or direction cmavo, so the point of time is vague; likewise, there is no interval cmavo, so the length of the in­terval during which these go­ings-to-the-market take place is also vague. As always, con­text will determine these vague values.

<p>

<ex "intermittently"><cx "interval spread, expressing “intermittently”"><lx "nai">““Intermittently” is the polar opposite notion to “continuously”, and is expressed not with its own cmavo, but by adding the negation suffix “-nai” (which belongs to selma'o NAI) to “ru'i”. For example:

<p>

<pre><a name=e9d5>9.5) le verba ru'inai cadzu le bisli

The child [continuously-not] walks-on the ice.

The child intermittently walks on the ice.

</pre><cx "interval spread, negation with nai">As shown in the cmavo table above, all the cmavo of TAhE may be negated with “-nai”; “ru'inai” and “di'inai” are probably the most useful.

<p>

<cx "quantified temporal tense, definition"><cx "tense, quantified"><ex "once"><lx "roi"><lx "ROI">An intermittent event can also be specified by counting the number of times during the interval that it takes place. The cmavo “roi” (which belongs to selma'o ROI) can be appended to a number to make a quantified tense. Quantified tenses are common in Eng­lish, but not so commonly named: they are exemplified by the adverbs “never”, “once”, “twice”, “thrice”, <dots>…</dots>“always”, and by the related phrases “many times”, “a few times”, “too many times”, and so on. All of these are handled in Lojban by a number plus “-roi”:

<p>

<pre><a name=e9d6>9.6) mi paroi klama le zarci

I [one time] go-to the market.

I go to the market once.

<a name=e9d7>9.7) mi du'eroi klama le zarci

I [too-many times] go-to the market.

I go to the market too often.

</pre><cx "temporal tense, quantified with direction">With the quantified tense alone, we don't know whether the past, the present, or the future is intended, but of course the quanti­fied tense need not stand alone:

<p>

<pre><a name=e9d8>9.8) mi pu reroi klama le zarci

I [past] [two times] go-to the market.

I went to the market twice.

</pre><cx "quantified temporal tense with direction, Lojban contrasted with English in implications">The English is slightly over-specific here: it entails that both goings-to- the-market were in the past, which may or may not be true in the Lojban sentence, since the im­plied inter­val is vague. Therefore, the interval may start in the past but extend into the present or even the future.

<p>

<cx "quantified temporal tense, negating with nai">Adding “-nai” to “roi” is also permitted, and has the meaning “other than (the num­ber specified)”:

<p>

<ex "rat eats cheese"><pre><a name=e9d9>9.9) le ratcu reroinai citka le cirli

The rat [twice-not] eats the cheese.

The rat eats the cheese other than twice

</pre><p>This may mean that the rat eats the cheese fewer times, or more times, or not at all.

<p>

<ex "only once"><cx "quantified temporal tenses, caveat on implication of"><cx "quantified temporal tenses, “once” contrasted with “only once”"><lx "ze'e"><cx "whole time interval, expressing">It is necessary to be careful with sentences like <a href=#e9d6>Example 9.6 </a>and <a href=#e9d8>Example 9.8</a>, where a quantified tense appears without an inter­val. What <a href=#e9d8>Example 9.8 </a>really says is that dur­ing an interval of un­specified size, at least part of which was set in the past, the event of my going to the market happened twice. The example says nothing about what happened outside that vague time interval. This is often less than we mean. If we want to nail down that I went to the market once and only once, we can use the cmavo “ze'e” which repre­sents the “whole time interval”: conceptually, an interval which stretches from time's be­ginning to its end:

<p>

<pre><a name=e9d10>9.10) mi ze'e paroi klama le zarci

I [whole interval] [once] go-to the market.

</pre><p>Since specifying no ZEhA leaves the interval vague, <a href=#e9d8>Example 9.8 </a>might in appropriate context mean the same as <a href=#e9d10>Example 9.10 </a>after all — but <a href=#e9d10>Example 9.10 </a>allows us to be specific when specificity is nec­essary.

<p>

<lx "PU"><cx "temporal direction, exception in meaning when following ze'e"><cx "ze'e, effect on following PU direction"><lx "ze'epu"><lx "ze'eba"><lx "ze'eca"><ex "have never"><cx "ze'epu, meaning of"><cx "ze'eba, meaning of"><cx "ze'eca, meaning of">A PU cmavo following “ze'e” has a slightly different meaning from one that follows another ZEhA cmavo. The compound cmavo “ze'epu” signifies the interval stretching from the infinite past to the reference point (wherever the imaginary journey has taken you); “ze'eba” is the interval stretching from the reference point to the infi­nite future. The remaining form, “ze'eca”, makes specific the “whole of time” interpretation just given. These compound forms make it possible to assert that something has never happened without as­serting that it never will.

<p>

<pre><a name=e9d11>9.11) mi ze'epu noroi klama le zarci

I [whole interval] [past] [never] go-to the market.

I have never gone to the market.

</pre>says nothing about whether I might go in future.

<p>

<cx "quantified space"><lx "ve'e">The space equivalent of “ze'e” is “ve'e”, and it can be used in the same way with a quantified space tense: see <a href=#s11>Section 11 </a>for an explanation of space interval modi­fiers.

<p>

### <a name=s10><h3>Event contours: ZAhO and “re'u”</h3>

<p>

The following cmavo are discussed in this section:

<p>

<cx "inchoative event contour"><cx "continuitive event contour"><cx "perfective event contour"><cx "initiative event contour"><cx "cessitive event contour"><cx "completitive event contour"><cx "superfective event contour"><cx "achievative event contour"><cx "pausative event contour"><cx "resumptive event contour"><pre> pu'o ZAhO inchoative

ca'o ZAhO continuitive

ba'o ZAhO perfective

co'a ZAhO initiative

co'u ZAhO cessitive

mo'u ZAhO completitive

za'o ZAhO superfective

co'i ZAhO achievative

de'a ZAhO pausative

di'a ZAhO resumptive

re'u ROI ordinal tense

</pre><cx "aspect, expressing"><lx "ZAhO"><cx "aspect, natural languages compared with respect to">The cmavo of selma'o ZAhO express the Lojban version of what is tradition­ally called “aspect”. This is not a notion well ex­pressed by English tenses, but many lan­guages (including Chinese and Russian among Lojban's six source languages) con­sider it more important than the specification of mere position in time.

<p>

<cx "event contours, definition"><cx "events, considered as a process"><cx "event contours, syntax of"><cx "event contours, order with respect to TAhE and ROI">The “event contours” of selma'o ZAhO, with their bizarre keywords, represent the natural portions of an event considered as a process, an occurrence with an internal structure including a begin­ning, a middle, and an end. Since the keywords are scarcely self-ex­planatory, each ZAhO will be explained in detail here. Note that from the view­point of Lojban syntax, ZAhOs are interval modifiers like TAhEs or ROI compounds; if both are found in a single tense, the TAhE/ROI comes first and the ZAhO afterward. The imaginary jour­ney described by other tense cmavo moves us to the portion of the event-as-process which the ZAhO specifies.

<p>

<cx "event contours, as timeless in perspective"><cx "PU tenses, contrasted with ZAhO tenses in viewpoint"><cx "tenses, viewpoint of PU contrasted with viewpoint of ZAhO"><cx "event-relative viewpoint, contrasted with speaker-relative viewpoint"><cx "speaker-relative viewpoint, contrasted with event-relative viewpoint"><cx "event contours, as characteristic portions of events">It is important to understand that ZAhO cmavo, unlike the other tense cmavo, specify characteristic portions of the event, and are seen from an essentially timeless perspective. The “beginning” of an event is the same whether the event is in the speaker's present, past, or future. It is especially important not to confuse the speaker-relative viewpoint of the PU tenses with the event-relative viewpoint of the ZAhO tenses.

<p>

<lx "pu'o"><lx "ca'o"><lx "ba'o"><cx "pu'o, derivation of word"><cx "ba'o, derivation of word"><cx "ca'o, derivation of word">The cmavo “pu'o”, “ca'o”, and “ba'o” (etymologically derived from the PU cmavo) refer to an event that has not yet begun, that is in progress, or that has ended, respectively:

<p>

<cx "event contour, inchoative"><ex "on verge"><pre><a name=e10d1>10.1) mi pu'o damba

I [inchoative] fight.

I'm on the verge of fighting.

</pre><ex "continues"><cx "event contour, continuitive"><pre><a name=e10d2>10.2) la stiv. ca'o bacru

Steve [continuitive] utters.

Steve continues to talk.

</pre><ex "finished"><cx "event contour, perfective"><pre><a name=e10d3>10.3) le verba ba'o cadzu le bisli

The child [perfective] walks-on the ice.

The child is finished walking on the ice.

</pre><cx "event contours, implications on scope of event"><cx "event contours, contrasted with tense direction in implication of extent"><cx "tense direction, contrasted with event contours in implication of extent">As discussed in <a href=#s6>Section 6</a>, the simple PU cmavo make no assumptions about whether the scope of a past, present, or future event extends into one of the other tenses as well. <a href=#e10d{1}>Examples 10.1 </a>through <a href=#e10d3>10.3 </a>illustrate that these ZAhO cmavo do make such as­sumptions possible: the event in 10.1 has not yet begun, definitively; likewise, the event in 10.3 is definitely over.

<p>

<cx "pu'o, explanation of derivation"><cx "ba'o, explanation of derivation"><cx "pu'o, as pastward of event"><cx "ba'o, as futureward of event">Note that in <a href=#e10d1>Example 10.1 </a>and <a href=#e10d3>Example 10.3</a>, “pu'o” and “ba'o” may appear to be re­versed: “pu'o”, although etymologically connected with “pu”, is referring to a fu­ture event; whereas “ba'o”, connected with “ba”, is referring to a past event. This is the natural result of the event-centered view of ZAhO cmavo. The inchoative, or “pu'o”, part of an event, is in the “pastward” portion of that event, when seen from the perspec­tive of the event itself. It is only by infer­ence that we suppose that <a href=#e10d1>Example 10.1 </a>refers to the speaker's fu­ture: in fact, no PU tense is given, so the inchoative part of the event need not be coincident with the speaker's present: “pu'o” is not nec­essarily, though in fact often is, the same as “ca pu'o”.

<p>

<cx "event contours, points associated with"><cx "event contours, division of the event into"><cx "event contour, initiative"><cx "event contour, cessative">The cmavo in <a href=#e10d{1}>Examples 10.1 </a>through <a href=#e10d3>10.3 </a>refer to spans of time. There are also two points of time that can be usefully associ­ated with an event: the beginning, marked by “co'a”, and the end, marked by “co'u”. Specifically, “co'a” marks the bound­ary between the “pu'o” and “ca'o” parts of an event, and “co'u” marks the boundary between the “ca'o” and “ba'o” parts:

<p>

<pre><a name=e10d4>10.4) mi ba co'a citka le mi sanmi

I [future] [initiative] eat my meal.

I will begin to eat my meal.

<a name=e10d5>10.5) mi pu co'u citka le mi sanmi

I [past] [cessitive] eat my meal.

I ceased eating my meal.

</pre><p>Compare <a href=#e10d4>Example 10.4 </a>with:

<p>

<pre><a name=e10d6>10.6) mi ba di'i co'a bajra

I [future] [regularly] [initiative] run.

I will regularly begin to run.

</pre>which illustrates the combination of a TAhE with a ZAhO.

<p>

<cx "natural end, contrasted with actual stop"><cx "actual stop, contrasted with natural end"><cx "finish, contrasted with stop"><cx "stop, contrasted with finish"><cx "event contour, completitive">A process can have two end points, one reflecting the “natural end” (when the proc­ess is complete) and the other reflecting the “actual stopping point” (whether com­plete or not). <a href=#e10d5>Example 10.5 </a>may be contrasted with:

<p>

<pre><a name=e10d7>10.7) mi pu mo'u citka le mi sanmi

I [past] [completitive] eat my meal.

I finished eating my meal.

</pre><p>In <a href=#e10d7>Example 10.7</a>, the meal has reached its natural end; in <a href=#e10d5>Example 10.5</a>, the meal has merely ceased, without necessarily reaching its natural end.

<p>

<cx "stop, contrasted with pause"><cx "pause, contrasted with stop"><cx "resume, contrasted with begin"><cx "begin, contrasted with resume"><cx "event contours, interruption"><cx "event contours, resumption"><lx "de'a"><lx "di'a"><cx "event contour, pausative"><cx "event contour, resumptive">A process such as eating a meal does not necessarily pro­ceed uninterrupted. If it is interrupted, there are two more relevant point events: the point just before the inter­rup­tion, marked by “de'a”, and the point just after the interruption, marked by “di'a”. Some ex­amples:

<p>

<pre><a name=e10d8>10.8) mi pu de'a citka le mi sanmi

I [past] [pausative] eat my meal.

I stopped eating my meal (with the intention of resuming).

<a name=e10d9>10.9) mi ba di'a citka le mi sanmi

I [future] [resumptive] eat my meal.

I will resume eating my meal.

</pre><cx "natural end, continuing beyond"><lx "za'o"><cx "event contour, superfective">In addition, it is possible for a process to continue beyond its natural end. The span of time between the natural and the actual end points is represented by “za'o”:

<p>

<ex "keeps on"><pre><a name=e10d10>10.10) le ctuca pu za'o ciksi le cmaci seldanfu

le tadgri

The teacher [past] [superfective] explained the mathematics problem

to the student-group.

The teacher kept on explaining the mathematics problem to the class

too long.

That is, the teacher went on explaining after the class already understood the problem.</pre>

<p>

<cx "event contour, achievative"><cx "point, event considered as"><lx "co'i">An entire event can be treated as a single moment using the cmavo “co'i”:

<p>

<pre><a name=e10d11>10.11) la djan. pu co'i catra la djim

John [past] [achievative] kills Jim.

John was at the point in time where he killed Jim.

</pre><cx "ordinal tense"><lx "re'u"><lx "ROI"><cx "cycles">Finally, since an activity is cyclical, an individual cycle can be referred to using a num­ber followed by “re'u”, which is the other cmavo of selma'o ROI:

<p>

<pre><a name=e10d12>10.12) mi pare'u klama le zarci

I [first time] go-to the store.

I go to the store for the first time (within a vague interval).

</pre><p>Note the difference between:

<p>

<pre><a name=e10d13>10.13) mi pare'u paroi klama le zarci

I [first time] [one time] go-to the store.

For the first time, I go to the store once.

</pre>and

<p>

<pre><a name=e10d14>10.14) mi paroi pare'u klama le zarci

I [one time] [first time] go-to the store.

There is one occasion on which I go to the store for the first time.

### </pre><a name=s11><h3>Space interval modifiers: FEhE</h3>

<p>

The following cmavo is discussed in this section:

<p>

<pre> fe'e FEhE space interval modifier flag

</pre><cx "space intervals, compared with time intervals in continuity"><lx "fe'e"><lx "FEhE"><cx "spatial intervals, expressing degree of continuity over"><cx "spatial interval modifiers, order in tense"><cx "tense, order of spatial interval modifiers in ">Like time intervals, space intervals can also be continuous, discontinuous, or repeti­tive. Rather than having a whole separate set of selma'o for space interval proper­ties, we instead prefix the flag “fe'e” to the cmavo used for time interval properties. A space inter­val property would be placed just after the space interval size and/or di­men­sionality cmavo:

<p>

<ex "sow grain"><pre><a name=e11d1>11.1) ko vi'i fe'e di'i sombo le gurni

You-imperative [1-dimensional] [space:] [regularly] sow the grain.

Sow the grain in a line and evenly!

</pre><ex "salad ingredients"><pre><a name=e11d2>11.2) mi fe'e ciroi tervecnu lo selsalta

I [space:] [three places] buy those-which-are salad-ingredients.

I buy salad ingredients in three locations.

</pre><ex "always and everywhere"><pre><a name=e11d3>11.3) ze'e roroi ve'e fe'e roroi ku

li re su'i re du li vo

[whole time] [all times] [whole space] [space:] [all places]

The-number 2 + 2 = the-number 4.

Always and everywhere, two plus two is four.

</pre><p>As shown in <a href=#e11d3>Example 11.3</a>, when a tense comes first in a bridi, rather than in its normal position before the selbri (in this case “du”), it is emphasized.

<p>

<lx "fe'e"><lx "ZAhO"><cx "spatial contours, expressing"><lx "be'a">The “fe'e” marker can also be used for the same purpose before members of ZAhO. (The cmavo “be'a” belongs to selma'o FAhA; it is the space direction meaning “north of”.)

<p>

<ex "south face"><ex "rock face"><pre><a name=e11d4>11.4) tu ve'abe'a fe'e co'a rokci

That-yonder [medium space interval - north] [space] [initiative] is-a-rock.

That is the beginning of a rock extending to my north.

That is the south face of a rock.

</pre><cx "beginning point, spatial"><cx "spatial contours, contrasted with temporal event contours"><cx "event contours, temporal contrasted with spatial">Here the notion of a “beginning point” represented by the cmavo “co'a” is transferred from “beginning in time” to “beginning in space” under the influence of the “fe'e” flag. Space is not inherently oriented, unlike time, which flows from past to future: therefore, some indica­tion of orientation is necessary, and the “ve'abe'a” provides an orien­tation in which the south face is the “beginning” and the north face is the “end”, since the rock extends from south (near me) to north (away from me).

<p>

<cx "time, as space-based metaphor"><cx "space, as time-based metaphor"><cx "space/time metaphor, expressing direction mapping for"><cx "FAhA, use in specifying space/time mapping direction">Many natural languages represent time by a space-based metaphor: in English, what is past is said to be “behind us”. In other languages, the metaphor is reversed. Here, Loj­ban is representing space (or space interval modifiers) by a time-based meta­phor: the choice of a FAhA cmavo following a VEhA cmavo indicates which direction is mapped onto the future. (The choice of future rather than past is arbitrary, but con­venient for English-speakers.)

<p>

<cx "TAhE, effect of ZAhO on fe'e flag"><cx "ROI, effect of ZAhO on fe'e flag"><cx "ZAhO, effect on fe'e flag for TAhE and ROI"><cx "fe'e, effect of TAhE/ROI with ZAhO on">If both a TAhE (or ROI) and a ZAhO are present as space interval modifiers, the “fe'e” flag must be prefixed to each.

<p>

### <a name=s12><h3>Tenses as sumti tcita</h3>

<p>

<cx "tenses, use as sumti tcita"><cx "spatial information, adding to a sentence with tense sumti tcita"><cx "temporal information, adding to a sentence with tense sumti tcita"><cx "sumti tcita, based on tenses"><cx "argument tags, based on tenses (see also sumti tcita)">So far, we have seen tenses only just before the selbri, or (equivalently in meaning) floating about the bridi with “ku”. There is another major use for tenses in Lojban: as sumti tcita, or argument tags. A tense may be used to add spatial or temporal information to a bridi as, in effect, an additional place:

<p>

<pre><a name=e12d1>12.1) mi klama le zarci ca le nu do klama le zdani

I go-to the market [present] the event-of you go-to the house.

I go to the market when you go to the house.

</pre><lx "ca"><cx "ca, meaning as a sumti tcita"><cx "tense direction, as sumti tcita"><cx "sumti tcita, based on tense direction">Here “ca” does not appear before the selbri, nor with “ku”; instead, it governs the fol­lowing sumti, the “le nu” construct. What <a href=#e12d1>Example 12.1 </a>asserts is that the action of the main bridi is happening at the same time as the event mentioned by that sumti. So “ca”, which means “now” when used with a selbri, means “simultaneously-with” when used with a sumti. Consider another example:

<p>

<lx "pu"><cx "pu, meaning as a sumti tcita"><pre><a name=e12d2>12.2) mi klama le zarci pu le nu do pu klama le zdani

I go-to the market [past] the event-of you [past] go-to the house.

</pre><p>The second “pu” is simply the past tense marker for the event of your going to the house, and says that this event is in the speaker's past. How are we to understand the first “pu”, the sumti tcita?

<p>

<cx "imaginary journey, starting point"><cx "imaginary journey, starting at a different point">All of our imaginary journeys so far have started at the speaker's location in space and time. Now we are specifying an imaginary journey that starts at a different location, namely at the event of your going to the house. <a href=#e12d2>Example 12.2 </a>then says that my going to the market is in the past, relative not to the speaker's present moment, but instead relative to the moment when you went to the house. <a href=#e12d2>Example 12.2 </a>can therefore be translated:

<p>

<dl compact><dt> <dd>I had gone to the market before you went to the house.

</dl><cx "spatial tenses, as sumti tcita"><cx "tense distance, as sumti tcita"><cx "sumti tcita, based on tense distance">(Other translations are possible, depending on the ever-present con­text.) Spatial direc­tion and distance sumti tcita are exactly analogous:

<p>

<ex "near the park"><ex "rat eats cheese"><pre><a name=e12d3>12.3) le ratcu cu citka le cirla vi le panka

The rat eats the cheese [short distance] the park.

The rat eats the cheese near the park.

<a name=e12d4>12.4) le ratcu cu citka le cirla vi le vu panka

The rat eats the cheese [short distance] the [long distance] park

The rat eats the cheese near the faraway park.

<a name=e12d5>12.5) le ratcu cu citka le cirla vu le vi panka

The rat eats the cheese [long distance] the [short distance] park

The rat eats the cheese far away from the nearby park.

</pre><cx "event contours, as sumti tcita"><cx "sumti tcita, based on event contours"><cx "spatial contours, as sumti tcita"><cx "sumti tcita, based on spatial contours"><lx "fe'e"><cx "ZAhO"><cx "event contours as sumti tcita, contrasted with direction and distance"><cx "tense direction/distance as sumti tcita, contrasted with event contours"><cx "sumti tcita, event contours contrasted with direction/distance as basis for"><cx "sumti tcita based on event contours, relation of main bridi to sumti process in">The event contours of selma'o ZAhO (and their space equivalents, prefixed with “fe'e”) are also useful as sumti tcita. The interpretation of ZAhO tcita differs from that of FAhA, VA, PU, and ZI tcita, however. The event described in the sumti is viewed as a proc­ess, and the action of the main bridi occurs at the phase of the proc­ess which the ZAhO specifies, or at least some part of that phase. The action of the main bridi itself is seen as a point event, so that there is no issue about which phase of the main bridi is in­tended. For example:

<p>

<ex "die after living"><ex "in the aftermath"><pre><a name=e12d6>12.6) mi morsi ba'o le nu mi jmive

I am-dead [perfective] the event-of I live.

I die in the aftermath of my living.

</pre><p>Here the (point-)event of my being dead is the portion of my living-process which oc­curs after the process is complete. Contrast <a href=#e12d6>Exam­ple 12.6 </a>with:

<p>

<pre><a name=e12d7>12.7) mi morsi ba le nu mi jmive

I am-dead [future] the event-of I live.

</pre><p>As explained in <a href=#s6>Section 6</a>, <a href=#e12d7>Example 12.7 </a>does not exclude the possi­bility that I died be­fore I ceased to live!

<p>

Likewise, we might say:

<p>

<pre><a name=e12d8>12.8) mi klama le zarci pu'o le nu mi citka

I go-to the store [inchoative] the event-of I eat

</pre>which indicates that before my eating begins, I go to the store, whereas

<p>

<pre><a name=e12d9>12.9) mi klama le zarci ba'o le nu mi citka

I go-to the store [perfective] the event-of I eat

</pre>would indicate that I go to the store after I am finished eating.

<p>

Here is an example which mixes temporal ZAhO (as a tense) and spatial ZAhO (as a sumti tcita):

<p>

<ex "boat sailed"><ex "too long"><pre><a name=e12d10>12.10) le bloti pu za'o xelklama

fe'e ba'o le lalxu

The boat [past] [superfective] is-a-transport-mechanism

[space] [perfective] the lake.

The boat sailed for too long and beyond the lake.

</pre><p>Probably it sailed up onto the dock. One point of clarification: al­though “xelklama” ap­pears to mean simply “is-a-mode-of-transport”, it does not – the bridi of <a href=#e12d10>Example 12.10 </a>has four omitted arguments, and thus has the (physical) journey which goes on too long as part of its meaning.

<p>

<cx "interval size, meaning as sumti tcita"><cx "sumti tcita based on interval size"><cx "dimension, meaning as sumti tcita"><cx "sumti tcita based on dimension"><cx "interval continuousness, meaning as sumti tcita"><cx "sumti tcita based on interval continuousness"><cx "interval properties, meaning as sumti tcita"><cx "sumti tcita based on interval properties"><cx "quantified tenses, as sumti tcita"><cx "sumti tcita based on quantified tenses">The remaining tense cmavo, which have to do with interval size, dimension, and continuousness (or lack thereof) are interpreted to let the sumti specify the particu­lar in­terval over which the main bridi operates:

<p>

<ex "twice today"><pre><a name=e12d11>12.11) mi klama le zarci reroi le ca djedi

I go-to the market [twice] the [present] day

I go/went/will go to the market twice today.

</pre><cx "tense as sumti tcita, contrasted with tense inside sumti"><cx "tense inside sumti, contrasted with tense as sumti tcita">Be careful not to confuse a tense used as a sumti tcita with a tense used within a sel­tci­ta sumti:

<p>

<ex "snow falls"><pre><a name=e12d12>12.12) loi snime cu carvi ze'u le ca dunra

Some-of-the-mass-of snow rains [long time interval] the [present] winter.

Snow falls during this winter.

</pre>claims that the interval specified by “this winter” is long, as events of snowfall go, whereas

<p>

<pre><a name=e12d13>12.13) loi snime cu carvi ca le ze'u dunra

Some-of-the-mass-of snow rains [present] the [long time] winter.

Snow falls in the long winter.

</pre>claims that during some part of the winter, which is long as winters go, snow falls.

<p>

### <a name=s13><h3>Sticky and multiple tenses: KI</h3>

<p>

The following cmavo is discussed in this section:

<p>

<pre> ki KI sticky tense set/reset

</pre><cx "tense, scope of"><cx "sticky tenses, definition"><cx "sticky tense, effect on future tense meaning"><cx "imaginary journey origin, with sticky tenses">So far we have only considered tenses in isolated bridi. Loj­ban provides sev­eral ways for a tense to continue in effect over more than a single bridi. This property is known as “stickiness”: the tense gets “stuck” and remains in effect until explicitly “unstuck”. In the metaphor of the imaginary journey, the place and time set by a sticky tense may be thought of as a campsite or way-station: it provides a permanent origin with respect to which other tenses are understood. Later imaginary journeys start from that point rather than from the speaker.

<p>

<lx "ki"><lx "KI">To make a tense sticky, suffix “ki” to it:

<p>

<pre><a name=e13d1>13.1) mi puki klama le zarci .i le nanmu cu batci le gerku

I [past] [sticky] go-to the market. The man bites the dog.

I went to the market. The man bit the dog.

</pre><p>Here the use of “puki” rather than just “pu” ensures that the tense will affect the next sentence as well. Otherwise, since the second sen­tence is tenseless, there would be no way of determining its tense; the event of the second sentence might happen before, after, or si­multaneously with that of the first sentence.

<p>

(The last statement does not apply when the two sentences form part of a nar­rative. See <a href=#s14>Section 14 </a>for an explanation of “story time”, which employs a different set of con­ventions.)

<p>

What if the second sentence has a tense anyway?

<p>

<cx "tense, effect of sticky tense on"><ex "had earlier"><pre><a name=e13d2>13.2) mi puki klama le zarci .i le nanmu pu batci le gerku

I [past] sticky go-to the market. The man [past] bites the dog.

</pre><p>Here the second “pu” does not replace the sticky tense, but adds to it, in the sense that the starting point of its imaginary journey is taken to be the previously set sticky time. So the translation of <a href=#e13d2>Example 13.2 </a>is:

<p>

<pre><a name=e13d3>13.3) I went to the market. The man had earlier bitten the dog.

</pre><cx "tense in scope of sticky tense, compared with compound tense"><cx "compound tense, compared with tense in scope of sticky tense">and it is equivalent in meaning (when considered in isolation from any other sentences) to:

<p>

<pre><a name=e13d4>13.4) mi pu klama le zarci .i le nanmu pupu batci le gerku

I [past] go-to the market. The man [past] [past] bites the dog.

</pre><cx "tenses, multiple in sentence"><cx "tenses, multiple in sentence compared with compound tense"><cx "compound tense, compared with multiple tenses in sentence">The point has not been discussed so far, but it is perfectly grammatical to have more than one tense construct in a sentence:

<p>

<pre><a name=e13d5>13.5) puku mi ba klama le zarci

[past] I [future] go-to the market.

Earlier, I was going to go to the market.

</pre><p>Here there are two tenses in the same bridi, the first floating free and specified by “puku”, the second in the usual place and specified by “ba”. They are considered cu­mulative in the same way as the two tenses in separate sentences of <a href=#e13d4>Example 13.4</a>. <a href=#e13d5>Ex­ample 13.5 </a>is therefore equivalent in meaning, except for emphasis, to:

<p>

<pre><a name=e13d6>13.6) mi puba klama le zarci

I [past] [future] go-to the market.

I was going to go to the market.

</pre><cx "multiple tenses, effect of order in sentence">Compare <a href=#e13d7>Example 13.7 </a>and <a href=#e13d8>Example 13.8</a>, which have a different meaning from <a href=#e13d5>Ex­ample 13.5 </a>and <a href=#e13d6>Example 13.6</a>:

<p>

<pre><a name=e13d7>13.7) mi ba klama le zarci puku

I [future] go-to the market [past].

I will have gone to the market earlier.

<a name=e13d8>13.8) mi bapu klama le zarci

I [future] [past] go-to the market.

I will have gone to the market.

</pre><p>So when multiple tense constructs in a single bridi are involved, order counts — the tenses cannot be shifted around as freely as if there were only one tense to worry about.

<p>

<cx "sticky tenses, from part of a multiple tense">But why bother to allow multiple tense constructs at all? They specify separate por­tions of the imaginary journey, and can be useful in order to make part of a tense sticky. Consider <a href=#e13d9>Example 13.9</a>, which adds a second bridi and a “ki” to <a href=#e13d5>Example 13.5</a>:

<p>

<dl compact><dt>13.9) <dd>pukiku mi ba klama le zarci .i le nanmu cu batci le gerku

[past] [sticky] I [future] go-to the market. The man bites the dog.

</dl><p>What is the implied tense of the second sentence? Not “puba”, but only “pu”, since only “pu” was made sticky with “ki”. So the translation is:

<p>

<dl compact><dt> <dd>I was going to go to the market. The man bit the dog.

</dl><cx "tense, on embedded bridi"><cx "tense on main bridi, effect on embedded bridi tenses"><cx "tense on main bridi, effect on embedded sumti with tenses"><cx "embedded bridi tenses, effect of main bridi tense on"><cx "sumti with tense, effect of main bridi tense on">Lojban has several ways of embedding a bridi within another bridi: descrip­tions, ab­stractors, relative clauses. (Technically, de­scriptions contain selbri rather than bridi.) Any of the selbri of these subordinate bridi may have tenses attached. These tenses are inter­preted relative to the tense of the main bridi:

<p>

<ex "former market"><pre><a name=e13d10>13.10) mi pu klama le ba'o zarci

I [past] go-to the [perfective] market

I went to the former market.

</pre><p>The significance of the “ba'o” in <a href=#e13d10>Example 13.10 </a>is that the speaker's destination is de­scribed as being “in the aftermath of being a market”; that is, it is a market no longer. In particular, the time at which it was no longer a market is in the speaker's past, be­cause the “ba'o” is in­terpreted relative to the “pu” tense of the main bridi.

<p>

Here is an example involving an abstraction bridi:

<p>

<pre><a name=e13d11>13.11) mi ca jinvi le du'u mi ba morsi

I now opine the fact-that I will-be dead.

I now believe that I will be dead.

</pre><p>Here the event of being dead is said to be in the future with respect to the opinion, which is in the present.

<p>

<cx "sticky tense, canceling"><cx "ki, with no tense">“ki” may also be used as a tense by itself. This cancels all stickiness and re­turns the bridi and all following bridi to the speaker's location in both space and time.

<p>

</pre><cx "subscript, for sticky tense"><cx "tense, subscripting"><cx "tense, handling multiple episodes">In complex descriptions, multiple tenses may be saved and then used by adding a subscript to “ki”. A time made sticky with “kixipa” (ki-sub-1) can be returned to by specifying “kixipa” as a tense by itself. In the case of written expression, the writer's here-and-now is often different from the reader's, and a pair of subscripted “ki” tenses could be used to distinguish the two.

<p>

### <a name=s14><h3>Story time</h3>

<p>

<cx "story time, definition"><cx "story time, rationale for"><cx "stories, flow of time in">Making strict use of the conventions explained in <a href=#s13>Section 13 </a>would be intol­erably awkward when a story is being told. The time at which a story is told by the nar­rator is usually unimportant to the story. What matters is the flow of time within the story itself. The term “story” in this section refers to any series of statements related in more-or-less time-sequential order, not just a fictional one.

<p>

<cx "story time, as a convention for inferring tense"><cx "tenseless sentences in story time"><cx "story time, tenseless sentences in">Lojban speakers use a different set of conventions, com­monly called “story time”, for inferring tense within a story. It is pre­sumed that the event described by each sentence takes place some time more or less after the previous ones. Therefore, tense­less sen­tences are implicitly tensed as “what happens next”. In particular, any sticky time setting is ad­vanced by each sentence.

<p>

The following mini-story illustrates the important features of story time. A sentence-by-sentence explication follows:

<p>

<ex "cave"><pre><a name=e14d1>14.1) puzuki ku ne'iki le kevna

le ninmu goi ko'a zutse le rokci

[past] [long] [sticky] [,] [inside] [sticky] the cave,

the woman defined-as she-1 sat-on the rock

Long ago, in a cave, a woman sat on a rock.

<a name=e14d2>14.2) .i ko'a citka loi kanba rectu

She-1 [tenseless] eat some-of-the-mass-of goat flesh.

She was eating goat's meat.

<a name=e14d3>14.3) .i ko'a pu jukpa ri le mudyfagri

She [past] cook the-last-mentioned by-method the wood-fire.

She had cooked the meat over a wood fire.

<a name=e14d4>14.4) .i lei rectu cu zanglare

The-mass-of flesh is-(favorable)-warm.

The meat was pleasantly warm.

<a name=e14d5>14.5) .i le labno goi ko'e bazaki nenri klama le kevna

The wolf defined-as it-2 [future] [medium] [sticky] within-came to-the cave.

A while later, a wolf came into the cave.

<a name=e14d6>14.6) .i ko'e lebna lei rectu ko'a

It-2 [tenseless] takes the-mass-of flesh from-her-1.

It took the meat from her.

<a name=e14d7>14.7) .i ko'e bartu klama

It-2 out ran

It ran out.

</pre><cx "story tense, Lojban convention contrasted with English convention"><a href=#e14d1>Example 14.1 </a>sets both the time (long ago) and the place (in a cave) using “ki”, just like the sentence sequences in <a href=#s13>Section 13</a>. No further space cmavo are used in the rest of the story, so the place is assumed to remain unchanged. The English transla­tion of <a href=#e14d1>Exam­ple 14.1 </a>is marked for past tense also, as the conventions of English sto­rytelling require: consequently, all other English translation sentences are also in the past tense. (We don't notice how strange this is; even stories about the future are written in past tense!) This conventional use of past tense is not used in Lojban narratives.

<p>

<a href=#e14d2>Example 14.2 </a>is tenseless. Outside story time, it would be assumed that its event happens simultaneously with that of <a href=#e14d1>Example 14.1</a>, since a sticky tense is in ef­fect; the rules of story time, however, imply that the event occurs afterwards, and that the story time has advanced (changing the sticky time set in <a href=#e14d1>Example 14.1</a>).

<p>

<a href=#e14d3>Example 14.3 </a>has an explicit tense. This is taken relative to the latest setting of the sticky time; therefore, the event of <a href=#e14d3>Example 14.3 </a>happens before that of <a href=#e14d2>Example 14.2</a>. It cannot be determined if <a href=#e14d3>Example 14.3 </a>happens before or after <a href=#e14d1>Example 14.1</a>.

<p>

<ex "flashbacks in story time"><a href=#e14d4>Example 14.4 </a>is again tenseless. Story time was not changed by the flashback in <a href=#e14d3>Ex­ample 14.3</a>, so <a href=#e14d4>Example 14.4 </a>happens after <a href=#e14d2>Example 14.2</a>.

<p>

<a href=#e14d5>Example 14.5 </a>specifies the future (relative to <a href=#e14d4>Example 14.4</a>) and makes it sticky. So all further events happen after <a href=#e14d5>Example 14.5</a>.

<p>

<a href=#e14d6>Example 14.6 </a>and <a href=#e14d7>Example 14.7 </a>are again tenseless, and so happen after <a href=#e14d5>Ex­ample 14.5</a>. (Story time is changed.)

<p>

So the overall order is 14.1 - 14.3 - 14.2 - 14.4 - (medium in­terval) - 14.5 - 14.6 - 14.7. It is also possible that 14.3 happens be­fore 14.1.

<p>

<cx "story time, with no initial sticky time">If no sticky time (or space) is set initially, the story is set at an unspecified time (or space): the effect is like that of choosing an arbi­trary reference point and mak­ing it sticky. This style is common in stories that are jokes. The same convention may be used if the con­text specifies the sticky time sufficiently.

<p>

<p>

### <a name=s15><h3>Tenses in subordinate bridi</h3>

<p>

<cx "subordinate clauses, tense usage rules in English">English has a set of rules, formally known as “sequence of tense rules”, for deter­mining what tense should be used in a subordi­nate clause, depending on the tense used in the main sentence. Here are some examples:

<p>

<pre><a name=e15d1>15.1) John says that George is going to the market.

<a name=e15d2>15.2) John says that George went to the market.

<a name=e15d3>15.3) John said that George went to the market.

<a name=e15d4>15.4) John said that George had gone to the market.

</pre><p>In <a href=#e15d1>Example 15.1 </a>and <a href=#e15d2>Example 15.2</a>, the tense of the main sentence is the pres­ent: “says”. If George goes when John speaks, we get the present tense “is going” (“goes” would be unidiomatic); if George goes before John speaks, we get the past tense “went”. But if the tense of the main sentence is the past, with “said”, then the tense required in the subordinate clause is different. If George goes when John speaks, we get the past tense “went”; if George goes before John speaks, we get the past-perfect tense “had gone”.

<p>

The rule of English, therefore, is that both the tense of the main sentence and the tense of the subordinate clause are under­stood relative to the speaker of the main sentence (not John, but the person who speaks <a href=#e15d{1}>Examples 15.1 </a>through <a href=#e15d4>15.4</a>).

<p>

<cx "sequence of tense rules, Lojban contrasted with English"><cx "subordinate clause tense, Lojban contrasted with English"><cx "subordinate clause tense, Lojban compared with Russian"><cx "subordinate clause tense, Lojban compared with Esperanto"><cx "subordinate clause tense, effect of main bridi tense on">Lojban, like Russian and Esperanto, uses a different conven­tion. A tense in a subor­dinate bridi is understood to be relative to the tense already set in the main bridi. Thus <a href=#e15d{1}>Examples 15.1 </a>through <a href=#e15d4>15.4 </a>can be expressed in Lojban respectively thus:

<p>

<ex "John says that George goes to market"><pre><a name=e15d5>15.5) la djan. ca cusku le se du'u la djordj. ca klama le zarci

John [present] says the statement-that George [present] goes-to the market.

<a name=e15d6>15.6) la djan. ca cusku le se du'u la djordj. pu klama le zarci

John [present] says the statement-that George [past] goes-to the market.

<a name=e15d7>15.7) la djan. pu cusku le se du'u la djordj. ca klama le zarci

John [past] says the statement-that George [present] goes-to the market.

<a name=e15d8>15.8) la djan. pu cusku le se du'u la djordj. pu klama le zarci

John [past] says the statement-that George [past] goes-to the market.

</pre><p>Probably the most counterintuitive of the Lojban examples is <a href=#e15d7>Example 15.7</a>. The “ca” looks quite odd, as if George were going to the market right now, rather than back when John spoke. But this “ca” is really a “ca” with respect to a reference point specified by the outer “pu”. This behavior is the same as the additive behavior of multi­ple tenses in the same bridi, as explained in <a href=#s13>Section 13</a>.

<p>

<lx "nau"><lx "CUhE"><cx "tense, speaker's current"><cx "tense, overriding to speaker's current"><cx "nau, syntax">There is a special cmavo “nau” (of selma'o CUhE) which can be used to over­ride these rules and get to the speaker's current ref­erence point. (Yes, it sounds like English “now”.) It is not grammatical to combine “nau” with any other cmavo in a tense, except by way of a logical or non-logical connection (see <a href=#s20>Section 20</a>). Here is a convo­luted sen­tence with several nested bridi which uses “nau” at the low­est level:

<p>

<pre><a name=e15d9>15.9) la djan. pu cusku le se du'u la .alis pu cusku le se du'u

la djordj. pu cusku le se du'u la maris. nau klama le zarci

John [past] says the statement-that Alice [past] says the statement-that

George [past] says the statement that Mary [now] goes-to the market.

John said that Alice had said that George had earlier said that Mary is now

going to the market.

</pre><cx "nau, effect on sticky tenses"><cx "sticky tenses, effect of nau on">The use of “nau” does not affect sticky tenses.

<p>

### <a name=s16><h3>Tense relations between sentences</h3>

<p>

<cx "tense with sumti tcita, asymmetry of">The sumti tcita method, explained in <a href=#s12>Section 12</a>, of asserting a tense relation­ship between two events suffers from asymmetry. Specifically,

<p>

<pre><a name=e16d1>16.1) le verba cu cadzu le bisli zu'a le nu le nanmu cu batci le gerku

The child walks-on the ice [left] the event-of the man bites the dog.

The child walks on the ice to the left of where the man bites the dog.

</pre><lx ".i"><lx "bo"><cx "tense, connecting sentences in with"><cx "sentences, connecting with tense">which specifies an imaginary journey leftward from the man biting the dog to the child walking on the ice, claims only that the child walks on the ice. By the nature of “le nu”, the man's biting the dog is merely referred to without being claimed. If it seems desir­able to claim both, each event can be expressed as a main sentence bridi, with a special form of “.i” connecting them:

<p>

<pre><a name=e16d2>16.2) le nanmu cu batci le gerku .izu'abo le verba cu cadzu le bisli

The man bites the dog. [Left] the child walks-on the ice.

The man bites the dog. To the left, the child walks on the ice.

</pre>“.izu'abo” is a compound cmavo: the “.i” separates the sentences and the “zu'a” is the tense. The “bo” is required to prevent the “zu'a” from gobbling up the following sumti, namely “le verba”.

<p>

<cx "tense connection of sentences, order of"><cx "imaginary journey, origin of in tense-connected sentences"><cx "tense connection of sentences, contrasted with sumti tcita form"><cx "tense, sumti tcita form contrasted with connected sentences">Note that the bridi in <a href=#e16d2>Example 16.2 </a>appear in the reverse or­der from their ap­pearance in <a href=#e16d1>Example 16.1</a>. With “.izu'abo” (and all other afterthought tense connec­tives) the sen­tence specifying the origin of the journey comes first. This is a natural order for sen­tences, but requires some care when converting between this form and the sumti tcita form.

<p>

<a href=#e16d2>Example 16.2 </a>means the same thing as:

<p>

<pre><a name=e16d3>16.3) le nanmu cu batci le gerku

.i zu'a la'edi'u le verba cu cadzu le bisli

The man bites the dog.

[Left] the-referent-of-the-last-sentence the child walks-on the ice.

The man bites the dog. Left of what I just mentioned, the child walks on

the ice.

</pre><cx "tense connected sentences, importance of “bo” in">If the “bo” in Example 16.2 is omitted, the meaning changes:

<p>

<pre><a name=e16d4>16.4) le nanmu cu batci le gerku .i zu'a le verba cu cadzu le bisli

The man bites the dog. [Left] the child [something] walks-on the ice.

The man bites the dog. To the left of the child, something walks on the ice.

</pre><p>Here the first place of the second sentence is unspecified, because “zu'a” has absorbed the sumti “le verba”.

<p>

Do not confuse either <a href=#e16d2>Example 16.2 </a>or <a href=#e16d4>Example 16.4 </a>with the following:

<p>

<cx "tense connected sentences, contrasted with separately tensed sentences"><cx "separately tensed sentences, contrasted with tense connected sentences"><pre><a name=e16d5>16.5) le nanmu cu batci le gerku .i zu'aku le verba cu cadzu le bisli

The man bites the dog. [Left] the child walks-on the ice.

The man bites the dog. Left of me, the child walks on the ice.

</pre><p>In <a href=#e16d5>Example 16.5</a>, the origin point is the speaker, as is usual with “zu'aku”. <a href=#e16d2>Example 16.2 </a>makes the origin point of the tense the event described by the first sentence.

<p>

<cx "tense connected sentences, forethought mode">Two sentences may also be connected in forethought by a tense relationship. Just like afterthought tense connection, fore­thought tense connection claims both sen­tences, and in addition claims that the time or space relationship specified by the tense holds between the events the two sentences describe.

<p>

<cx "forethought tense connection of sentences, order of"><cx "sentences, forethought tense connection of"><cx "imaginary journey, origin in tense forethought sentence connection"><lx "gi">The origin sentence is placed first, preceded by a tense plus “gi”. Another “gi” is used to separate the sentences:

<p>

<pre><a name=e16d6>16.6) pugi mi klama le zarci gi mi klama le zdani

[past] I go-to the market [,] I go-to the house.

Before I go to the market, I go to the house.

</pre><p>A parallel construction can be used to express a tense relationship between sumti:

<p>

<cx "forethought tense connection of sumti, order of"><cx "imaginary journey, origin in tense forethought sumti connection"><cx "sumti, forethought tense connection of"><lx "gi"><pre><a name=e16d7>16.7) mi klama pugi le zarci gi le zdani

I go-to [past] the market [,] the house.

</pre><p>Because English does not have any direct way of expressing a tense-like rela­tionship between nouns, <a href=#e16d7>Example 16.7 </a>cannot be expressed in English without para­phrasing it either into <a href=#e16d6>Example 16.6 </a>or else into “I go to the house before the market”, which is am­biguous — is the market going?

<p>

<cx "forethought tense connection of bridi-tails, order of"><cx "imaginary journey, origin in tense forethought bridi-tail connection"><cx "bridi-tails, forethought tense connection of"><lx "gi">Finally, a third forethought construction expresses a tense relationship between bridi-tails rather than whole bridi. (The construct known as a “bridi-tail” is explained fully in <a href=chap14.html>Chapter 14</a>; roughly speak­ing, it is a selbri, possibly with following sumti.) <a href=#e16d8>Example 16.8 </a>is equivalent in meaning to <a href=#e16d6>Example 16.6 </a>and <a href=#e16d7>Example 16.7</a>:

<p>

<pre><a name=e16d8>16.8) mi pugi klama le zarci gi klama le zdani

I [past] go-to the market [,] go-to the house.

I, before going to the market, go to the house.

</pre><cx "tense connection of sumti, meaning of"><cx "tense connection of bridi-tails, meaning of">In both <a href=#e16d7>Example 16.7 </a>and <a href=#e16d8>Example 16.8</a>, the underlying sentences “mi klama le zarci” and “mi klama le zdani” are not claimed; only the relationship in time between them is claimed.

<p>

<cx "tense forethought connection forms, selma'o allowed"><cx "tense afterthought connection forms, selma'o allowed">Both the forethought and the afterthought forms are appro­priate with PU, ZI, FAhA, VA, and ZAhO tenses. In all cases, the equivalent forms are (where X and Y stand for sentences, and TENSE for a tense cmavo):

<p>

<cx "tense connection, equivalent meanings"><cx "tense connection, expansions of"><dl compact><dt> <dd>subordinate: X TENSE le nu Y

afterthought coordinate: Y .i+TENSE+bo X

forethought coordinate: TENSE+gi X gi Y

### </dl><a name=s17><h3>Tensed logical connectives</h3>

<p>

<cx "logical connectives, tensed"><cx "tensed logical connectives">The Lojban tense system interacts with the Lojban logical connective system. That system is a separate topic, explained in <a href=chap14.html>Chapter 14 </a>and touched on only in sum­mary here. By the rules of the logical connective system, <a href=#e17d1>Example 17.1 </a>through 17.3 are equivalent in meaning:

<p>

<pre><a name=e17d1>17.1) la teris. satre le mlatu .ije la teris. satre le ractu

Terry strokes the cat. And Terry strokes the rabbit.

<a name=e17d2>17.2) la teris. satre le mlatu gi'e satre le ractu

Terry strokes the cat and strokes the rabbit.

<a name=e17d3>17.3) la teris. satre le mlatu .e le ractu

Terry strokes the cat and the rabbit.

</pre><lx "bo"><ex "and then"><ex "stoke cat then rabbit">Suppose we wish to add a tense relationship to the logical connective “and”? To say that Terry strokes the cat and later strokes the rabbit, we can combine a logical connective with a tense connec­tive by placing the logical connective first, then the tense, and then the cmavo “bo”, thus:

<p>

<cx "tensed logically connected sentences"><pre><a name=e17d4>17.4) la teris. satre le mlatu .ijebabo la teris. satre le ractu

Terry strokes the cat. And then Terry strokes the rabbit.

</pre><cx "tensed logically connected bridi-tails"><pre><a name=e17d5>17.5) la teris. satre le mlatu gi'ebabo satre le ractu

Terry strokes the cat, and then strokes the rabbit.

</pre><cx "tensed logically connected sumti"><pre><a name=e17d6>17.6) la teris. satre le mlatu .ebabo le ractu

Terry strokes the cat and then the rabbit.

</pre><a href=#e17d4>Example 17.4 </a>through 17.6 are equivalent in meaning. They are also analogous to <a href=#e17d{1}>Ex­am­ples 17.1 </a>through <a href=#e17d3>17.3 </a>respectively. The “bo” is required for the same reason as in <a href=#e16d2>Exam­ple 16.2</a>: to prevent the “ba” from functioning as a sumti tcita for the following sumti (or, in <a href=#e17d5>Exam­ple 17.5</a>, from being attached to the following selbri).

<p><cx "tensed logical connectives, with ke…ke'e"><cx "tensed logical connectives, with tu'e…tu'u">In addition to the “bo” construction of <a href=#e17d{4}>Examples 17.4 </a>through <a href=#e17d6>17.6</a>, there is also a form of tensed logical connective with “ke…ke'e” (“tu'e…tu'u” for sentences). The logi­cal connective system makes <a href=#e17d{7}>Examples 17.7 </a>through <a href=#e17d9>17.9 </a>equivalent in mean­ing:

<p>

<ex "carry sack and dog"><pre><a name=e17d7>17.7) mi bevri le dakli .ije tu'e mi bevri le gerku .ija mi bevri le mlatu tu'u

I carry the sack. And (I carry the dog. And/or I carry the cat).

I carry the sack. And I carry the dog, or I carry the cat, or I carry both.

<a name=e17d8>17.8) mi bevri le dakli gi'eke bevri le gerku gi'a bevri le mlatu

I carry the sack and (carry the dog and/or carry the cat).

I carry the sack, and also carry the dog or carry the cat or carry both.

<a name=e17d9>17.9) mi bevri le dakli .eke le gerku .a le mlatu

I carry the sack and (the dog or the cat)

I carry the sack and also the dog or the cat or both.

</pre><p>Note the uniformity of the Lojban, as contrasted with the variety of ways in which the English provides for the correct grouping. In all cases, the meaning is that I carry the sack in any case, and either the cat or the dog or both.

<p>

To express that I carry the sack first (earlier in time), and then the dog or the cat or both simultaneously, I can insert tenses to form <a href=#e17d{10}>Examples 17.10 </a>through <a href=#e17d12>17.12</a>:

<p>

<cx "tensed logically connected sentences, with grouping"><pre><a name=e17d10>17.10) mi bevri le dakli .ije ba tu'e mi bevri le gerku

.ijacabo mi bevri le mlatu tu'u

I carry the sack. And [future] (I carry the dog.

And/or [present] I carry the cat.)

I carry the sack. And then I will carry the dog or I will carry the cat or

I will carry both at once.

</pre><cx "tensed logically connected bridi-tails, with grouping"><pre><a name=e17d11>17.11) mi bevri le dakli gi'ebake bevri le gerku gi'acabo bevri le mlatu

I carry the sack and [future] (carry the dog and/or [present] carry the cat).

I carry the sack and then will carry the dog or carry the cat or carry both

at once.

</pre><cx "tensed logically connected sumti, with grouping"><pre><a name=e17d12>17.12) mi bevri le dakli .ebake bevri le gerku .acabo le mlatu

I carry the sack and [future] (the cat and/or [present] the dog).

I carry the sack, and then the cat or the dog or both at once.

</pre><a href=#e17d{10}>Examples 17.10 </a>through <a href=#e17d12>17.12 </a>are equivalent in meaning to each other, and correspond to the tenseless <a href=#e17d{7}>Examples 17.7 </a>through <a href=#e17d9>17.9 </a>respectively.

<p>

### <a name=s18><h3>Tense negation</h3>

<p>

<cx "tenses, negating"><cx "negation, of tenses"><lx "nai"><cx "PU, contradictory negation of"><cx "FAhA, contradictory negation of"><cx "ZAhO, contradictory negation of">Any bridi which involves tenses of selma'o PU, FAhA, or ZAhO can be con­tradicted by a “-nai” suffixed to the tense cmavo. Some examples:

<p>

<pre><a name=e18d1>18.1) mi punai klama le zarci

I [past] [not] go-to the market.

I didn't go to the market.

</pre><cx "tenses, contradictory negation of with nai"><cx "negation of tenses, meaning of"><lx "nai">As a contradictory negation, <a href=#e18d1>Example 18.1 </a>implies that the bridi as a whole is false with­out saying anything about what is true. When the negated tense is a sumti tcita, “nai” ne­gation indicates that the stated relationship does not hold:

<p>

<pre><a name=e18d2>18.2) mi klama le zarci canai le nu do klama le zdani

I go-to the market [present] [not] the event-of you go-to the house.

It is not true that I went to the market at the same time that you went to

the house.

<a name=e18d3>18.3) le nanmu batci le gerku ne'inai le kumfa

The man bites the dog [within] [not] the room.

The man didn't bite the dog inside the room.

<a name=e18d4>18.4) mi morsi ca'onai le nu mi jmive

I am-dead [continuitive - negated] the event-of I live.

It is false that I am dead during my life.

</pre><cx "tense, scalar negation of with NAhE"><lx "NAhE"><cx "tense, scalar negation contrasted with contradictory negation of"><cx "tense, contradictory negation contrasted with scalar negation of">It is also possible to perform scalar negation of whole tense constructs by placing a member of NAhE before them. Unlike contra­dictory negation, scalar negation asserts a truth: that the bridi is true with some tense other than that specified. The fol­lowing exam­ples are scalar negation analogues of <a href=#e18d{1}>Examples 18.1 </a>to <a href=#e18d3>18.3</a>:

<p>

<pre><a name=e18d5>18.5) mi na'e pu klama le zarci

I [non-] [past] go-to the market.

I go to the market other than in the past.

<a name=e18d6>18.6) le nanmu batci le gerku to'e ne'i le kumfa

The man bites the dog [opposite-of] [within] the room.

The man bites the dog outside the room.

<a name=e18d7>18.7) mi klama le zarci na'e ca le nu do klama le zdani

I go-to the market [non-] [present] the event-of you go-to the house.

I went to the market at a time other than the time at which you went to

the house.

<a name=e18d8>18.8) mi morsi na'e ca'o le nu mi jmive

I am-dead [non-] [continuitive] the event-of I live.

I am dead other than during my life.

</pre><cx "contradictory negation of tenses, selma'o allowed with"><cx "scalar negation of tenses, selma'o allowed with"><lx "PU"><lx "FAhA">Unlike “-nai” contradictory negation, scalar negation of tenses is not limited to PU and FAhA:

<p>

<pre><a name=e18d9>18.9) le verba na'e ri'u cadzu le bisli

The child [non-] [right] walks-on the ice

The child walks on the ice other than to my right.

</pre><cx "TAhE, scalar negation of"><cx "ROI, scalar negation of">The use of “-nai” on cmavo of TAhE and ROI has already been discussed in <a href=#s9>Section 9</a>; this use is also a scalar negation.

<p>

### <a name=s19><h3>Actuality, potentiality, capability: CAhA</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> ca'a CAhA actually is

ka'e CAhA is innately capable of

nu'o CAhA can but has not

pu'i CAhA can and has

</pre><cx "potential events, expressing implicitly"><cx "innate capabilities, expressing implicitly">Lojban bridi without tense markers may not necessarily refer to actual events: they may also refer to capabilities or potential events. For example:

<p>

<ex "ducks swim"><pre><a name=e19d1>19.1) ro datka cu flulimna

All ducks are-float-swimmers

All ducks swim by floating.

</pre><cx "tense, Lojban contrasted with English in implying actuality"><cx "actuality, Lojban contrasted with English in implying">is a Lojban truth, even though the colloquial English translation is false or at best am­biguous. This is because the tenseless Lojban bridi doesn't necessarily claim that every duck is swimming or floating now or even at a specific time or place. Even if we add a tense marker to <a href=#e19d1>Example 19.1</a>,

<p>

<pre><a name=e19d2>19.2) ro datka ca flulimna

All ducks [present] are-float-swimmers.

All ducks are now swimming by floating.

</pre>the resulting <a href=#e19d2>Example 19.2 </a>might still be considered a truth, even though the colloquial English seems even more likely to be false. All ducks have the potential of swimming even if they are not exercising that potential at present. To get the full flavor of “All ducks are now swimming”, we must append a marker from selma'o CAhA to the tense, and say:

<p>

<cx "actual events, explicitly expressing"><lx "ca'a"><pre><a name=e19d3>19.3) ro datka ca ca'a flulimna

All ducks [present] [actual] are-float-swimmers

All ducks are now actually swimming by floating.

</pre><cx "CAhA, order in tense construct"><lx "CAhA"><lx "ki"><cx "CAhA, making sticky"><cx "sticky tenses, and CAhA">A CAhA cmavo is always placed after any other tense cmavo, whether for time or for space. However, a CAhA cmavo comes before “ki”, so that a CAhA condition can be made sticky.

<p>

<a href=#e19d3>Example 19.3 </a>is false in both Lojban and English, since it claims that the swimming is an actual, present fact, true of every duck that exists, whereas in fact there is at least one duck that is not swimming now.

<p>

<cx "innate capability, expressing explicitly"><lx "ka'e">Furthermore, some ducks are dead (and therefore sink); some ducks have just hatched (and do not know how to swim yet), and some ducks have been eaten by preda­tors (and have ceased to exist as separate objects at all). Nevertheless, all these ducks have the innate capability of swimming — it is part of the nature of duck­hood. The cmavo “ka'e” expresses this notion of innate capability:

<p>

<pre><a name=e19d4>19.4) ro datka ka'e flulimna

All ducks [capable] are-float-swimmers.

All ducks are innately capable of swimming.

</pre><cx "innate properties, extension of from mass to individuals">Under some epistemologies, innate capability can be ex­tended in order to ap­ply the innate properties of a mass to which certain individuals belong to the individuals them­selves, even if those individuals are themselves not capable of fulfilling the claim of the bridi. For example:

<p>

<ex "can see"><pre><a name=e19d5>19.5) la djan. ka'e viska

John [capable] sees.

John is innately capable of seeing.

John can see.

</pre><cx "innate properties, extension to individuals not actually capable">might be true about a human being named John, even though he has been blind since birth, because the ability to see is innately built into his nature as a human being. It is theoretically possible that condi­tions might occur that would enable John to see (an op­eration, for example). On the other hand,

<p>

<pre><a name=e19d6>19.6) le cukta ka'e viska

The book [capable] sees.

The book can see.

</pre>is not true in most epistemologies, since the ability to see is not part of the innate nature of a book.

<p>

<cx "undemonstrated potential, expressing">Consider once again the newly hatched ducks mentioned earlier. They have the po­tential of swimming, but have not yet dem­onstrated that potential. This may be ex­pressed using “nu'o”, the cmavo of CAhA for undemonstrated potential:

<p>

<ex "infant ducks"><lx "nu'o"><pre><a name=e19d7>19.7) ro cifydatka nu'o flulimna

All infant-ducks [can but has not] are-float-swimmers.

All infant ducks have an undemonstrated potential for swimming by floating.

Baby ducks can swim but haven't yet.

</pre><cx "demonstrated potential, expressing">Contrariwise, if Frank is not blind from birth, then “pu'i” is appropriate:

<p>

<lx "pu'i"><pre><a name=e19d8>19.8) la frank. pu'i viska

Frank [can and has] sees.

Frank has demonstrated a potential for seeing.

Frank can see and has seen.

</pre><cx "potential, expressing in past/future"><cx "actuality, expressing in past/future">Note that the glosses given at the beginning of this section for “ca'a”, “nu'o”, and “pu'i” incorporate “ca” into their meaning, and are really correct for “ca ca'a”, “ca nu'o”, and “ca pu'i”. However, the CAhA cmavo are perfectly meaningful with other tenses than the pre­sent:

<p>

<pre><a name=e19d9>19.9) mi pu ca'a klama le zarci

I [past] [actual] go-to the store.

I actually went to the store.

<a name=e19d10>19.10) la frank. ba nu'o klama le zdani

Frank [future] [can but has not] goes-to the store.

Frank could have, but will not have, gone to the store (at some understood

moment in the future).

</pre><cx "tenses with elided CAhA, meaning">As always in Lojban tenses, a missing CAhA can have an in­determinate meaning, or the context can be enough to disambiguate it. Saying

<p>

<pre><a name=e19d11>19.11) ta jelca

That burns/is-burning/might-burn/will-burn.

</pre><ex "inflammable">with no CAhA specified can translate the two very different English sentences “That is on fire” and “That is inflammable.” The first de­mands immediate action (usually), whereas the second merely de­mands caution. The two cases can be disambiguated with:

<p>

<pre><a name=e19d12>19.12) ta ca ca'a jelca

That [present] [actual] burns.

That is on fire.

</pre>and

<p>

<pre><a name=e19d13>19.13) ta ka'e jelca

That [capable] burns.

That is capable of burning.

That is inflammable.

</pre><cx "observative with elided CAhA, convention">When no indication is given, as in the simple observative

<p>

<pre><a name=e19d14>19.14) jelca

It burns!

</pre>the prudent Lojbanist will assume the meaning “Fire!”

<p>

### <a name=s20><h3>Logical and non-logical connections between tenses</h3>

<p>

Like many things in Lojban, tenses may be logically con­nected; logical con­nection is explained in more detail in <a href=chap14.html>Chapter 14</a>. Some of the terminology in this sec­tion will be clear only if you al­ready understand logical connectives.

<p>

<lx "JA"><cx "logically connected tenses, with JA"><cx "tenses, logically connected with JA"><cx "logically connected tenses, expansion to sentences">The appropriate logical connectives belong to selma'o JA. A logical connective be­tween tenses can always be expanded to one between sentences:

<p>

<pre><a name=e20d1>20.1) mi pu je ba klama le zarci

I [past] and [future] go-to the market.

I went and will go to the market.

</pre>means the same as:

<p>

<pre><a name=e20d2>20.2) mi pu klama le zarci .ije mi ba klama le zarci

I [past] go-to the market. And I [future] go-to the market.

I went to the market, and I will go to the market.

</pre><cx "tenses, connected, with negation">Tense connection and tense negation are combined in:

<p>

<pre><a name=e20d3>20.3) mi punai je canai je ba klama le zarci

I [past] [not] and [present] [not] and [future] go-to the market.

I haven't yet gone to the market, but I will in future.

</pre><a href=#e20d3>Example 20.3 </a>is far more specific than

<p>

<pre><a name=e20d4>20.4) mi ba klama le zarci

I [future] go-to the market.

</pre>which only says that I will go, without claiming anything about my past or present. “ba” does not imply “punai” or “canai”; to compel that in­terpretation, either a logical con­nec­tion or a ZAhO is needed.

<p>

<cx "connected tenses, negation of compared with negation in connective">Tense negation can often be removed in favor of negation in the logical con­nective itself. The following examples are equivalent in meaning:

<p>

<pre><a name=e20d5>20.5) mi mo'izu'anai je mo'iri'u cadzu

I [motion] [left-not] and [motion] [right] walk.

I walk not leftward but rightward.

<a name=e20d6>20.6) mi mo'izu'a naje mo'iri'u cadzu

I [motion] [left] not-and [motion] [right] walk.

I walk not leftward but rightward.

</pre><cx "tenses, forethought logical connections"><cx "tenses, possible groupings of">There are no forethought logical connections between tenses allowed by the gram­mar, to keep tenses simpler. Nor is there any way to override simple left-grouping of the connectives, the Lojban default.

<p>

<cx "tenses, non-logical connection of"><lx "JOI"><lx "BIhI"><lx "GAhO"><cx "intervals, expressing by endpoints with bi'o">The non-logical connectives of selma'o JOI, BIhI, and GAhO are also permit­ted be­tween tenses. One application is to specify in­tervals not by size, but by their end-points (“bi'o” belongs to selma'o BIhI, and connects the end-points of an ordered inter­val, like English “from <dots>…</dots>to”):

<p>

<pre><a name=e20d7>20.7) mi puza bi'o bazu vasxu

I [past] [medium] from <dots>…</dots>to [future] [long] breathe.

I breathe from a medium time ago till a long time to come.

</pre>(It is to be hoped that I have a long life ahead of me.)

<p>

One additional use of non-logical connectives within tenses is discussed in <a href=#s21>Section 21</a>. Other uses will probably be identified in fu­ture.

<p>

### <a name=s21><h3>Sub-events</h3>

<p>

<ex "six-shooter"><cx "tenses, non-logical connection of for sub-events">Another application of non-logical tense connection is to talk about sub-events of events. Consider a six-shooter: a gun which can fire six bullets in succession before re­loading. If I fire off the entire magazine twice, I can express the fact in Lojban thus:

<p>

<ex "on two occasions"><pre><a name=e21d1>21.1) mi reroi pi'u xaroi cecla le seldanti

I [twice] [cross-product] [six times] shoot the projectile-launcher.

On two occasions, I fire the gun six times.

</pre><lx "pi'u"><cx "pi'u, use in connecting tenses"><cx "Cartesian product, with tenses"><cx "cross product, with tenses">It would be confusing, though grammatical, to run the “reroi” and the “xaroi” directly together. However, the non-logical connective “pi'u” expresses a Cartesian product (also known as a cross product) of two sets. In this case, there is a set of two firings each of which is represented by a set of six shots, for twelve shots in all (hence the name “product”: the product of 2 and 6 is 12). Its use specifies very precisely what oc­curs.

<p>

<cx "interval properties, strings of"><cx "event contours, strings of">In fact, you can specify strings of interval properties and event contours within a sin­gle tense without the use of a logical or non-logical connective cmavo. This allows tenses of the type:

<p>

<pre><a name=e21d2>21.2) la djordj. ca'o co'a ciska

George [continuitive] [initiative] writes.

George continues to start to write.

<a name=e21d3>21.3) mi reroi ca'o xaroi darxi le damri

I [twice] [continuitive] [six times] hit the drum.

On two occasions, I continue to beat the drum six times.

### </pre><a name=s22><h3>Conversion of sumti tcita: JAI</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> jai JAI tense conversion

fai FA indefinite place

</pre><lx "SE"><cx "conversion, definition">Conversion is the regular Lojban process of moving around the places of a place structure. The cmavo of selma'o SE serve this purpose, exchanging the first place with one of the others:

<p>

<pre><a name=e22d1>22.1) mi cu klama le zarci

I go-to the market.

<a name=e22d2>22.2) le zarci cu se klama mi

The market is-gone-to by-me.

</pre><cx "conversion, accessing tense of bridi with jai"><cx "tense conversion, accessing tense of bridi with jai"><lx "jai"><cx "jai with tense, as equivalent of SE in grammar">It is also possible to bring a place that is specified by a sumti tcita (for the pur­poses of this chapter, a tense sumti tcita) to the front, by using “jai” plus the tense as the gram­matical equivalent of SE:

<p>

<ex "rat eats cheese in park"><pre><a name=e22d3>22.3) le ratcu cu citka le cirla vi le panka

The rat eats the cheese [short distance] the park.

The rat eats the cheese in the park.

<a name=e22d4>22.4) le panka cu jai vi citka le cirla fai le ratcu

The park is-the-place-of eating the cheese by-the rat.

The park is where the rat eats the cheese.

</pre><cx "tense conversion, accessing original first place with fai"><lx "fai"><lx "FA">In <a href=#e22d4>Example 22.4</a>, the construction JAI+tense converts the location sumti into the first place. The previous first place has nowhere to go, since the location sumti is not a num­bered place; however, it can be inserted back into the bridi with “fai”, the indefinite member of selma'o FA.

<p>

(The other members of FA are used to mark the first, second, etc. places of a bridi explicitly:

<p>

<pre><a name=e22d5>22.5) fa mi cu klama fe le zarci

</pre>means the same as

<p>

<pre><a name=e22d6>22.6) fe le zarci cu klama fa mi

</pre>as well as the simple

<p>

<pre><a name=e22d7>22.7) mi cu klama le zarci

</pre>in which the place structure is determined by position.)

<p>

<cx "tense conversion, use in sumti descriptions"><lx "LE">Like SE conversion, JAI+tense conversion is especially use­ful in descriptions with LE selma'o:

<p>

<ex "place of eating"><pre><a name=e22d8>22.8) mi viska le jai vi citka be le cirla

I saw the place-of eating the cheese.

</pre><p>Here the eater of the cheese is elided, so no “fai” appears.

<p>

<cx "tense conversion, of temporal tenses">Of course, temporal tenses are also usable with JAI:

<p>

<ex "time of death"><pre><a name=e22d9>22.9) mi djuno fi le jai ca morsi be fai la djan.

I know about the [present] is-dead of-the-one-called “John”

I know the time of John's death.

I know when John died.

### </pre><a name=s23><h3>Tenses versus modals</h3>

<p>

<cx "tenses, compared with modals in syntax"><cx "modals, compared with tenses in syntax"><cx "tenses, contrasted with modals in semantics"><cx "modals, contrasted with tenses in semantics">Grammatically, every use of tenses seen so far is exactly paralleled by some use of modals as explained in <a href=chap9.html>Chapter 9</a>. Modals and tenses alike can be followed by sumti, can appear before the sel­bri, can be used in pure and mixed connections, can participate in JAI conversions. The parallelism is perfect. However, there is a deep dif­ference in the semantics of tense constructs and modal constructs, grounded in histori­cal differences between the two forms. Originally, modals and tenses were utterly dif­ferent things in ear­lier versions of Loglan; only in Lojban have they become grammati­cally interchange­able. And even now, differences in semantics continue to be main­tained.

<p>

<cx "modals, importance of 1st sumti place for sumti tcita use">The core distinction is that whereas the modal bridi

<p>

<pre><a name=e23d1>23.1) mi nelci do mu'i le nu do nelci mi

I like you with-motivation the event-of you like me.

I like you because you like me.

</pre>places the “le nu” sumti in the x1 place of the gismu “mukti” (which underlies the mo­dal “mu'i”), namely the motivating event, the tensed bridi

<p>

<cx "tenses, importance of 2nd sumti place for sumti tcita use"><pre><a name=e23d2>23.2) mi nelci do ba le nu do nelci mi

I like you after the event-of you like me.

I like you after you like me.

</pre>places the “le nu” sumti in the x2 place of the gismu “balvi” (which underlies the tense “ba”), namely the point of reference for the future tense. Paraphrases of <a href=#e23d1>Example 23.1 </a>and <a href=#e23d2>Example 23.2</a>, employing the brivla “mukti” and “balvi” explicitly, would be:

<p>

<pre><a name=e23d3>23.3) le nu do nelci mi cu mukti le nu mi nelci do

The event-of you like me motivates the event-of I like you

Your liking me is the motive for my liking you.

</pre>and

<p>

<pre><a name=e23d4>23.4) le nu mi nelci do cu balvi le nu do nelci mi

The event-of I like you is after the event of you like me.

My liking you follows (in time) your liking me.

</pre>(Note that the paraphrase is not perfect due to the difference in what is claimed; <a href=#e23d3>Exam­ple 23.3 </a>and <a href=#e23d4>Example 23.4 </a>claim only the causal and temporal relationships between the events, not the existence of the events themselves.)

<p>

<cx "afterthought sentence connection, modal contrasted with tense">As a result, the afterthought sentence-connective forms of <a href=#e23d1>Example 23.1 </a>and <a href=#e23d2>Exam­ple 23.2 </a>are, respectively:

<p>

<pre><a name=e23d5>23.5) mi nelci do .imu'ibo do nelci mi

I like you. [That is] Because you like me.

<a name=e23d6>23.6) do nelci mi .ibabo mi nelci do

You like me. Afterward, I like you.

</pre><p>In <a href=#e23d5>Example 23.5</a>, the order of the two bridi “mi nelci do” and “do nelci mi” is the same as in <a href=#e23d1>Example 23.1</a>. In <a href=#e23d6>Example 23.6</a>, how­ever, the order is reversed: the ori­gin point “do nelci mi” physically appears before the future-time event “mi nelci do”. In both cases, the bridi characterizing the event in the x2 place appears before the bridi charac­terizing the event in the x1 place of “mukti” or “balvi”.

<p>

<cx "forethought connections, modal compared with tense in semantics"><cx "forethought tense connection, contrasted with afterthought in likeness to modal connection"><cx "afterthought tense connection, contrasted with forethought in likeness to modal connection">In forethought connections, however, the asymmetry be­tween modals and tenses is not found. The forethought equivalents of <a href=#e23d5>Example 23.5 </a>and <a href=#e23d6>Example 23.6 </a>are

<p>

<pre><a name=e23d7>23.7) mu'igi do nelci mi gi mi nelci do

Because you like me, I like you.

</pre>and

<p>

<pre><a name=e23d8>23.8) bagi do nelci mi gi mi nelci do

After you like me, I like you.

</pre>respectively.

<p>

<cx "modal sentence connection, table of equivalent schemata">The following modal sentence schemata (where X and Y rep­resent sentences) all have the same meaning:

<p>

<dl compact><dt><dd>X .i BAI bo Y

BAI gi Y gi X

X BAI le nu Y

</dl><cx "tense sentence connection, table of equivalent schemata">whereas the following tensed sentence schemata also have the same meaning:

<p>

<dl compact><dt><dd>X .i TENSE bo Y

TENSE gi X gi Y

Y TENSE le nu X

</dl>neglecting the question of what is claimed. In the modal sentence schemata, the modal tag is always followed by Y, the sentence rep­resenting the event in the x1 place of the gismu that underlies the BAI. In the tensed sentences, no such simple rule exists.

<p>

### <a name=s24><h3>Tense questions: “cu'e”</h3>

<p>

The following cmavo is discussed in this section:

<p>

<pre> cu'e CUhE tense question

</pre><lx "ma"><cx "tense questions, methods of asking"><cx "tense questions with ma"><cx "ma, for tense questions">There are two main ways to ask questions about tense. The main English tense ques­tion words are “When?” and “Where?”. These may be paraphrased respectively as “At what time?” and “At what place?” In these forms, their Lojban equivalents simply in­volve a tense plus “ma”, the Lojban sumti question:

<p>

<ex "when"><pre><a name=e24d1>24.1) do klama le zdani ca ma

You go-to the house [present] [what sumti?].

You go to the house at what time?

When do you go to the house?

</pre><ex "where"><pre><a name=e24d2>24.2) le verba vi ma pu cadzu le bisli

The child [short space] [what sumti?] [past] walks-on the ice.

The child at/near what place walked on the ice?

Where did the child walk on the ice?

</pre><cx "tense-or-modal questions, with cu'e"><cx "modal-or-tense question, with cu'e">There is also a non-specific tense and modal question, “cu'e”, belonging to selma'o CUhE. This can be used wherever a tense or modal construct can be used.

<p>

<ex "when/where/how"><pre><a name=e24d3>24.3) le nanmu cu'e batci le gerku

The man [what tense?] bites the dog.

When/Where/How does the man bite the dog?

</pre><cx "answers, to tense-or-modal questions">Possible answers to <a href=#e24d3>Example 24.3 </a>might be:

<p>

<pre><a name=e24d4>24.4) va

[medium space].

Some ways from here.

<a name=e24d5>24.5) puzu

[past] [long time].

A long time ago.

<a name=e24d6>24.6) vi le lunra

[short space] The moon.

On the moon.

<a name=e24d7>24.7) pu'o

[inchoative]

He hasn't yet done so.

</pre>or even the modal reply (from selma'o BAI; see <a href=chap9.html>Chapter 9</a>):

<p>

<pre><a name=e24d8>24.8) seka’a le briju

With-destination the office..

</pre><cx "cu'e, combining with other tense cmavo"><cx "tense-or-modal questions, pre-specifying some information"><cx "modal-or-tense questions, pre-specifying some information">The only way to combine “cu'e” with other tense cmavo is through logical connec­tion, which makes a question that pre-specifies some information:

<p>

<ex "sowed grain"><ex "when else"><pre><a name=e24d9>24.9) do puzi je cu'e sombo le gurni

You [past] [short] and [when?] sow the grain?

You sowed the grain a little while ago; when else do you sow it?

</pre><p>Additionally, the logical connective itself can be replaced by a question word:

<p>

<cx "tense questions, by using logical connective question"><pre><a name=e24d10>24.10) la .artr. pu je'i ba nolraitru

Arthur [past] [which?] [future] is-a-king

Was Arthur a king or will he be?

</pre><p>Answers to <a href=#e24d10>Example 24.10 </a>would be logical connectives such as “je”, meaning “both”, “naje” meaning “the latter”, or “jenai” meaning “the former”.

<p>

### Explicit magnitudes</h3>

<p><cx "explicit magnitude"><cx "tense magnitude"><cx "magnitude, tense"><a name=s25><h3>

It is a limitation of the VA and ZI system of specifying mag­nitudes that they can only prescribe vague magnitudes: small, me­dium, or large. In order to express both an origin point and an exact distance, the Lojban construction called a “termset” is em­ployed. (Termsets are explained further in <a href=chap14.html>Chapter 14 </a>and <a href=chap16.html>Chapter 16</a>.) It is grammati­cal for a termset to be placed after a tense or modal tag rather than a sumti, which al­lows both the origin of the imaginary journey and its distance to be specified. Here is an example:

<p>

<pre><a name=e25d1>25.1) la frank. sanli zu'a nu'i la djordj.

lu'a lo mitre be li mu [nu'u]

Frank stands [left] [start termset] George

[quantity] a thing-measuring-in-meters the-number 5 [end termset].

Frank is standing five meters to the left of George.

</pre><p>Here the termset extends from the “nu'i” to the implicit “nu'u” at the end of the sen­tence, and includes the terms “la djordj.”, which is the unmarked origin point, and the tagged sumti “lo mitre be li mu”, which the cmavo “la'u” (of selma'o BAI, and meaning “with quantity”; see <a href=chap9.html>Chapter 9</a>) marks as a quantity. Both terms are governed by the tag “zu'a”.

<p>

It is not necessary to have both an origin point and an explicit magnitude: a termset may have only a single term in it. A less precise version of <a href=#e25d1>Example 25.1 </a>is:

<p>

<pre><a name=e25d2>25.2) la frank. sanli zu'a nu'i lu'a

lo mitre be li mu

Frank stands [left] [termset] [quantity]

a thing-measuring-in-meters the-number 5.

Frank stands five meters to the left.

### </pre><a name=s26><h3>Finally (an exercise for the much-tried reader)</h3>

<p>

<pre><a name=e26d1>26.1) a'o do pu seju ba roroi ca'o fe'e su'oroi jimpe

fi le lojbo temci selsku ciste

### </pre><a name=s27><h3>Summary of tense selma'o</h3>

<p>

<cx "tense selma'o, summary of"><dl compact><dt>PU <dd>temporal direction

pu = past, ca = present, ba = future

ZI temporal distance

zi = short, za = medium, zu = long

ZEhA temporal interval

ze'i = short, ze'a = medium, ze'u = long, ze'e = infinite

ROI objective quantified tense flag

noroi = never, paroi = once, <dots>…</dots>, roroi = always, etc.

pare’u = the first time, rere’u = the second time, etc.

TAhE subjective quantified tense

di'i = regularly, na'o = typically, ru'i = continuously, ta'e = habitually

ZAhO event contours

see <a href=#s10>Section 10 </a>

<p><dt>FAhA <dd>spatial direction

see <a href=#s27>Section 28

</a>VA spatial distance

vi = short, va = medium, vu = long

VEhA spatial interval

ve'i = short, ve'a = medium, ve'u = long, ve'e = infinite

VIhA spatial dimensionality

vi'i = line, vi'a = plane, vi'u = space, vi'e = space-time

FEhE spatial interval modifier flag

fe'enoroi = nowhere, fe'eroroi = everywhere, fe'eba'o = beyond, etc.

MOhI spatial movement flag

mo'i = motion; see <a href=#s27>Section 27 </a>

<p><dt>KI <dd>set or reset sticky tense

tense+“ki” = set, “ki” alone = reset

CUhE tense question, reference point

cu'e = asks for a tense or aspect, nau = use speaker's reference point

JAI tense conversion

jaica = the time of, jaivi = the place of, etc.

### </dl><a name=s28><h3>List of spatial directions and direction-like relations</h3>

<p>

<cx "spatial directions, list of">The following list of FAhA cmavo gives rough English glosses for the cmavo, first when used without “mo'i” to express a direction, and then when used with “mo'i” to ex­press movement in the direction. When possible, the gismu from which the cmavo is de­rived is also listed.

<p>

<pre>cmavo gismu without mo'i with mo'i

ca'u crane in front (of) forward

ti'a trixe behind backward

zu'a zunle on the left (of) leftward

ri'u pritu on the right (of) rightward

ga'u gapru above upward(ly)

ni'a cnita below downward(ly)

ne'i nenri within into

ru'u sruri surrounding orbiting

pa'o pagre transfixing passing through

ne'a next to moving while next to

te'e bordering moving along the border (of)

re'o adjacent (to) along

fa'a farna towards arriving at

to'o away from departing from

zo'i inward (from) approaching

ze'o outward (from) receding from

zo'a tangential (to) passing (by)

bu'u coincident (with) moving to coincide with

be'a berti north (of) northward(ly)

ne'u snanu south (of) southward(ly)

du'a stuna east (of) eastward(ly)

vu'a west (of) westward(ly)

</pre><cx "fa'a, special note on direction orientation"><cx "to'o, special note on direction orientation"><cx "zo'i, special note on direction orientation"><cx "ze'o, special note on direction orientation">Special note on “fa'a”, “to'o”, “zo'i”, and “ze'o”:

<p>

“zo'i” and “ze'o” refer to direction towards or away from the speaker's loca­tion, or whatever the origin is.

<p>

“fa'a” and “to'o” refer to direction towards or away from some other point.

<p>

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## <h2>Chapter 11

## <br>

## Events, Qualities, Quantities, And Other Vague Words: On Lojban Abstraction</h2>

###### <h6>$Revision: 4.1 $<br> mkhtml: 1.1</h6></p></center>

<p>

### The syntax of abstraction</h3>

<p><cx "abstraction, syntax"><cx "NU, syntax"><a name=s1><h3>

<cx "clause, subordinate using abstraction"><cx "gerund, using abstraction">The purpose of the feature of Lojban known as “abstraction” is to provide a means for taking whole bridi and packaging them up, as it were, into simple selbri. Syntactically, abstractions are very sim­ple and uniform; semantically, they are rich and complex, with few features in common between one variety of abstraction and another. We will begin by discussing syntax without regard to semantics; as a result, the notion of abstraction may seem unmotivated at first. Bear with this difficulty until <a href=#s2>Section 2</a>.

<p>

<lx "NU"><lx "kei"><lx "KEI">An abstraction selbri is formed by taking a full bridi and pre­ceding it by any cmavo of selma'o NU. There are twelve such cmavo; they are known as “abstractors”. The bridi is closed by the elidable terminator “kei”, of selma'o KEI. Thus, to change the bridi

<p>

<pre><a name=e1d1>1.1) mi klama le zarci

I go-to the store.

</pre>into an abstraction using “nu”, one of the members of selma'o NU, we change it into

<p>

<cx "observatives, and abstractions"><pre><a name=e1d2>1.2) nu mi klama le zarci [kei]

an-event-of my going-to the store

</pre><cx "KEI, eliding">The bridi may be a simple selbri, or it may have associated sumti, as here. It is impor­tant to beware of eliding “kei” improperly, as many of the common uses of abstraction selbri involve following them with words that would appear to be part of the abstraction if “kei” had been elided.

<p>

(Technically, “kei” is never necessary, because the elidable terminator “vau” that closes every bridi can substitute for it; however, “kei” is specific to abstractions, and us­ing it is almost always clearer.)

<p>

<cx "abstraction, grammatical uses"><cx "tanru, and abstractions">The grammatical uses of an abstraction selbri are exactly the same as those of a sim­ple brivla. In particular, abstraction selbri may be used as observatives, as in <a href=#e1d2>Ex­ample 1.2</a>, or used in tanru:

<p>

<ex "want to be a soldier"><pre><a name=e1d3>1.3) la djan. cu nu sonci kei djica

John is-an-(event-of being-a-soldier) type-of desirer.

John wants to be a soldier.

</pre><cx "descriptions, and abstractions">Abstraction selbri may also be used in descriptions, preceded by “le” (or any other member of selma'o LE):

<p>

<pre><a name=e1d4>1.4) la djan. cu djica le nu sonci [kei]

John desires the event-of being-a-soldier.

</pre><p>We will most often use descriptions containing abstraction either at the end of a bridi, or just before the main selbri with its “cu”; in either of these circumstances, “kei” can nor­mally be elided.

<p>

<cx "abstractions, place structure">The place structure of an abstraction selbri depends on the particular abstrac­tor, and will be explained individually in the following sections.

<p>

Note: In glosses of bridi within abstractions, the grammatical form used in the Eng­lish changes. Thus, in the gloss of <a href=#e1d2>Example 1.2 </a>we see “my going-to the store” rather than “I go-to the store”; like­wise, in the glosses of <a href=#e1d3>Example 1.3 </a>and <a href=#e1d4>Example 1.4 </a>we see “being-a-soldier” rather than “is-a-soldier”. This procedure reflects the desire for more understandable glosses, and does not indicate any change in the Lojban form. A bridi is a bridi, and undergoes no change when it is used as part of an abstraction selbri.

<p>

### Event abstraction</h3>

<p><cx "event abstractions"><cx "abstractions, event"><a name=s2><h3>

The following cmavo is discussed in this section:

<p>

<pre> nu NU event abstractor

</pre><cx "common abstractor"><lx "nu"><lx "NU"><cx "nu, definition"><cx "le nu, definition">The examples in <a href=#s1>Section 1 </a>made use of “nu” as the abstrac­tor, and it is cer­tainly the most common abstractor in Lojban text. Its purpose is to capture the event or state of the bridi considered as a whole. Do not confuse the “le” description built on a “nu” abstrac­tion with ordinary descriptions based on “le” alone. The following sumti are quite dis­tinct:

<p>

<pre><a name=e2d1>2.1) le klama

the comer, that which comes

<a name=e2d2>2.2) le se klama

the destination

<a name=e2d3>2.3) le te klama

the origin

<a name=e2d4>2.4) le ve klama

the route

<a name=e2d5>2.5) le xe klama

the means of transportation

<a name=e2d6>2.6) le nu klama

the event of someone coming to somewhere from somewhere by some route

using some means

</pre><a href=#e2d{1}>Examples 2.1 </a>through <a href=#e2d5>2.5 </a>are descriptions that isolate the five indi­vidual sumti places of the selbri “klama”. <a href=#e2d6>Example 2.6 </a>describes something associated with the bridi as a whole: the event of it.

<p>

<cx "events, duration">In Lojban, the term “event” is divorced from its ordinary Eng­lish sense of something that happens over a short period of time. The description:

<p>

<pre><a name=e2d7>2.7) le nu mi vasxu

the event-of my breathing

</pre>is an event which lasts for the whole of my life (under normal circum­stances). On the other hand,

<p>

<pre><a name=e2d8>2.8) le nu la djan. cinba la djein.

the event-of John kissing Jane

</pre><cx "normal circumstances">is relatively brief by comparison (again, under normal circumstances).

<p>

<cx "abstraction, sumti ellipsis in">We can see from <a href=#e2d{6}>Examples 2.6 </a>through <a href=#e2d8>2.8 </a>that ellipsis of sumti is valid in the bridi of abstraction selbri, just as in the main bridi of a sentence. Any sumti may be ellipsized if the listener will be able to figure out from context what the proper value of it is, or else to rec­ognize that the proper value is unimportant. It is extremely common for “nu” ab­stractions in descriptions to have the x1 place ellipsized:

<p>

<pre><a name=e2d9>2.9) mi nelci le nu limna

I like the event-of swimming.

I like swimming.

</pre>is elliptical, and most probably means:

<p>

<pre><a name=e2d10>2.10) mi nelci le nu mi limna

I like the event-of I swim.

</pre><p>In the proper context, of course, <a href=#e2d9>Example 2.9 </a>could refer to the event of somebody else swimming. Its English equivalent, “I like swimming”, can't be interpreted as “I like Frank's swimming”; this is a fundamental distinction between English and Lojban. In Lojban, an omitted sumti can mean whatever the context indicates that it should mean.

<p>

<cx "abstraction, implicit in sumti">Note that the lack of an explicit NU cmavo in a sumti can sometimes hide an implicit abstraction. In the context of <a href=#e2d10>Example 2.10</a>, the appearance of “le se nelci” (“that which is liked”) is in effect an abstraction:

<p>

<pre><a name=e2d11>2.11) le se nelci cu cafne

The liked-thing is-frequent.

The thing which I like happens often.

</pre>which in this context means

<p>

<dl compact><dt> <dd>My swimming happens often.

</dl><p>Event descriptions with “le nu” are commonly used to fill the “under condi­tions <dots>…</dots>” places, among others, of gismu and lujvo place structures:

<p>

<ex "under conditions"><pre><a name=e2d12>2.12) la lojban. cu frili mi le nu mi tadni [kei]

Lojban is-easy for-me under-conditions-the event-of I study

Lojban is easy for me when I study.

</pre>(The “when” of the English would also be appropriate for a construc­tion involving a Loj­ban tense, but the Lojban sentence says more than that the studying is concurrent with the ease.)

<p>

<cx "events, place structure"><cx "nu, place structure">The place structure of a “nu” abstraction selbri is simply:

<p>

<dl compact><dt><dd>nu: x1 is an event of (the bridi)

### Types of event abstractions</h3>

<p></dl><cx "event abstractions, types"><a name=s3><h3>

The following cmavo are discussed in this section:

<p>

<lx "mu'e"><lx "pu'u"><lx "zu'o"><lx "za'i"><lx "NU"><pre> mu'e NU point-event abstractor

pu'u NU process abstractor

zu'o NU activity abstractor

za'i NU state abstractor

</pre><p>Event abstractions with “nu” suffice to express all kinds of events, whether long, short, unique, repetitive, or whatever. Lojban also has more finely discriminating machin­ery for talking about events, however. There are four other abstractors of sel­ma'o NU for talking about four specific types of events, or four ways of looking at the same event.

<p>

<cx "point-event abstractor"><cx "triumph"><cx "abstraction, point-event"><cx "abstraction, achievement"><cx "point-event abstraction, definition"><cx "achievement abstraction, definition"><lx "mu'e">An event considered as a point in time is called a “point-event”, or sometimes an “achievement”. (This latter word should be divorced, in this context, from all con­nota­tions of success or triumph.) A point-event can be extended in duration, but it is still a point-event if it is thought of as unitary, having no internal structure. The ab­stractor “mu'e” means “point-event-of”:

<p>

<cx "killing Jim"><ex "killing Jim"><pre><a name=e3d1>3.1) le mu'e la djan. catra la djim. cu zekri

The point-event-of (John kills Jim) is-a-crime

John's killing Jim (considered as a point in time) is a crime.

</pre><cx "process abstractor"><cx "process abstraction, definition"><cx "abstraction, process"><lx "pu'u">An event considered as extended in time, and structured with a beginning, a middle containing one or more stages, and an end, is called a “process”. The abstractor “pu'u” means “process-of”:

<p>

<cx "Roman Empire"><ex "Roman Empire"><pre><a name=e3d2>3.2) ca'o le pu'u le latmo balje'a cu porpi kei

so'i je'atru cu selcatra

[continuitive] The process-of-(the Latin great-state breaking-up)

many state-rulers were-killed.

During the fall of the Roman Empire, many Emperors were killed.

</pre><cx "activity abstractor"><cx "activity abstraction, definition"><cx "abstraction, activity"><lx "zu'o">An event considered as extended in time and cyclic or repeti­tive is called an “activity”. The abstractor “zu'o” means “activity-of”:

<p>

<pre><a name=e3d3>3.3) mi tatpi ri'a le zu'o mi plipe

I am-tired because-of the activity-of (I jump)

I am tired because I jump.

</pre><cx "state abstractor"><cx "state abstraction, definition"><cx "abstraction, state"><lx "za'i">An event considered as something that is either happening or not happening, with sharp boundaries, is called a “state”. The ab­stractor “za'i” means “state-of”:

<p>

<ex "being alive"><pre><a name=e3d4>3.4) le za'i mi jmive cu ckape do

The state-of (I am-alive) is-dangerous-to you

My being alive is dangerous to you.

</pre><cx "event types, described">The abstractors in <a href=#e3d{1}>Examples 3.1 </a>through <a href=#e3d4>3.4 </a>could all have been replaced by “nu”, with some loss of precision. Note that Lojban allows every sort of event to be viewed in any of these four ways:

<p>

* <cx "state event, described"><dl compact><dt><dd>the “state of running” begins when the runner starts and ends when the runner stops;
* </dl><cx "activity event, described"><dl compact><dt><dd>the “activity of running” consists of the cycle “lift leg, step forward, drop leg, lift other leg <dots>…</dots>” (each such cycle is a process, but the activity con­sists in the repetition of the cycle);
* </dl><cx "steady speed"><cx "slowdown"><cx "process event, described"><dl compact><dt><dd>the “process of running” puts emphasis on the initial sprint, the steady speed, and the final slowdown;
* </dl><cx "Pheidippides"><cx "marathon"><cx "indivisible"><cx "Athens"><cx "achievement event, described"><dl compact><dt><dd>the “achievement of running” is most alien to English, but sees the event of running as a single indivisible thing, like “Pheidippides' run from Mara­thon to Athens” (the original marathon).

</dl><p>Further information on types of events can be found in <a href=#s12>Sec­tion 12</a>.

<p>

The four event type abstractors have the following place structures:

<p>

<cx "achievement, place structure"><cx "point-event, place structure"><cx "mu'e, place structure"><dl compact><dt><dd>“mu'e”: x1 is a point event of (the bridi)

<cx "process, place structure"><cx "pu'u, place structure">“pu'u”: x1 is a process of (the bridi) with stages x2

<cx "state, place structure"><cx "za'i, place structure">“za'i”: x1 is a continuous state of (the bridi) being true

<cx "activity, place structure"><cx "zu'o, place structure">“zu'o”: x1 is an activity of (the bridi) consisting of repeated actions x2

### Property abstractions</h3>

</dl><cx "property abstractions"><cx "abstractions, property"><a name=s4><h3><p>

The following cmavo are discussed in this section:

<pre> ka NU property abstractor

ce'u KOhA abstraction focus

</pre><p>The things described by “le nu” descriptions (or, to put it an­other way, the things of which “nu” selbri may correctly be predicated) are only moderately “abstract”. They are still closely tied to happen­ings in space and time. Properties, how­ever, are much more ethereal. What is “the property of being blue”, or “the property of being a go-er”? They are what logicians call “intensions”. If John has a heart, then “the property of having a heart” is an abstract object which, when applied to John, is true. In fact,

<p>

<ex "has a heart"><pre><a name=e4d1>4.1) la djan. cu se risna zo'e

John has-as-heart something-unspecified.

John has a heart.

</pre>has the same truth conditions as

<p>

<pre><a name=e4d2>4.2) la djan. cu ckaji le ka se risna [zo'e] [kei]

John has-the-property the property-of having-as-heart something.

John has the property of having a heart.

</pre><cx "having, of properties">(The English word “have” frequently appears in any discussion of Loj­ban properties: things are said to “have” properties, but this is not the same sense of “have” as in “I have money”, which is possession.)

<p>

Property descriptions, like event descriptions, are often wanted to fill places in brivla place structures:

<p>

<pre><a name=e4d3>4.3) do cnino mi le ka xunre [kei]

You are-new to-me in-the-quality-of-the property-of being-red.

You are new to me in redness.

</pre><cx "-ness"><cx "-ity">(The English suffix “-ness” often signals a property abstraction, as does the suffix “‑ity”.)

<p>

<cx "property description">We can also move the property description to the x1 place of <a href=#e4d3>Example 4.3</a>, produc­ing:

<p>

<pre><a name=e4d4>4.4) le ka do xunre [kei] cu cnino mi

The property-of your being-red is-new to me.

Your redness is new to me.

</pre><cx "sunburn"><cx "beach">It would be suitable to use <a href=#e4d{3}>Examples 4.3 </a>and <a href=#e4d4>4.4 </a>to someone who has returned from the beach with a sunburn.

<p>

<cx "property abstraction, sumti ellipsis in"><cx "property abstraction, specifying determining place by sumti ellipsis">There are several different properties that can be extracted from a bridi, de­pending on which place of the bridi is “understood” as being specified externally. Thus:

<p>

<ex "property of loving"><pre><a name=e4d5>4.5) ka mi prami [zo'e] [kei]

a-property-of me loving something-unspecified

</pre>is quite different from

<p>

<pre><a name=e4d6>4.6) ka [zo'e] prami mi [kei]

a-property-of something-unspecified loving me

</pre><p>In particular, sentences like <a href=#e4d7>Example 4.7 </a>and <a href=#e4d8>Example 4.8 </a>are quite different in meaning:

<p>

<ex "love more"><pre><a name=e4d7>4.7) la djan. cu zmadu la djordj. le ka mi prami

John exceeds George in-the property-of (I love X)

I love John more than I love George.

<a name=e4d8>4.8) la djan. cu zmadu la djordj. le ka prami mi

John exceeds George in the property of (X loves me).

John loves me more than George loves me.

</pre><lx "ce'u"><lx "KOhA"><p>

<cx "property abstraction, specifying determining place with ce'u">The “X” used in the glosses of <a href=#e4d{7}>Examples 4.7 </a>through <a href=#e4d8>4.8 </a>as a place-holder cannot be rep­resented only by ellipsis in Lojban, because el­lipsis means that there must be a spe­cific value that can fill the ellip­sis, as mentioned in <a href=#s2>Section 2</a>. Instead, the cmavo “ce'u” of selma'o KOhA is employed when an explicit sumti is wanted. (The form “X” will be used in literal translations.)

<p>

Therefore, an explicit equivalent of <a href=#e4d7>Example 4.7</a>, with no el­lipsis, is:

<p>

<pre><a name=e4d9>4.9) la djan. cu zmadu la djordj. le ka mi prami ce'u

John exceeds George in-the property-of (I love X).

</pre>and of <a href=#e4d8>Example 4.8 </a>is:

<p>

<pre><a name=e4d10>4.10) la djan. cu zmadu la djordj. le ka ce'u prami mi

John exceeds George in-the property-of (X loves me).

</pre><p>This convention allows disambiguation of cases like:

<p>

<ex "giving the horse"><pre><a name=e4d11>4.11) le ka [zo'e] dunda le xirma [zo'e] [kei]

the property-of giving the horse

</pre>into

<p>

<pre><a name=e4d12>4.12) le ka ce'u dunda le xirma [zo'e] [kei]

the property-of (X is-a-giver of-the horse to someone-unspecified)

the property of being a giver of the horse

</pre>which is the most natural interpretation of <a href=#e4d11>Example 4.11</a>, versus

<p>

<pre><a name=e4d13>4.13) le ka [zo'e] dunda le xirma ce'u [kei]

the property-of (someone-unspecified is-a-giver of-the horse to X)

the property of being one to whom the horse is given

</pre>which is also a possible interpretation.

<p>

<cx "relationship abstraction"><cx "property abstractions for relationships">It is also possible to have more than one “ce'u” in a “ka” ab­straction, which trans­forms it from a property abstraction into a rela­tionship abstraction. Relationship abstrac­tions “package up” a complex relationship for future use; such an abstraction can be translated back into a selbri by placing it in the x2 place of the selbri “bridi”, whose place structure is:

“bridi”: x1 is a predicate relationship with relation x2 (abstraction)

among arguments (sequence/set) x3

<p>

<cx "properties, place structure">The place structure of “ka” abstraction selbri is simply:

<p>

<dl compact><dt>ka: <dd>x1 is a property of (the bridi)

### Amount abstractions</h3>

<p></dl><cx "amount abstraction"><cx "abstraction, amount"><a name=s5><h3>

The following cmavo is discussed in this section:

<p>

<pre> ni NU amount abstraction

</pre><p>Amount abstractions are far more limited than event or prop­erty abstractions. They really make sense only if the selbri of the ab­stracted bridi is subject to measure­ment of some sort. Thus we can speak of:

<p>

<ex "blueness"><pre><a name=e5d1>5.1) le ni le pixra cu blanu [kei]

the amount-of (the picture being-blue)

the amount of blueness in the picture

</pre><cx "colorimeter">because “blueness” could be measured with a colorimeter or a similar device. However,

<p>

<pre><a name=e5d2>5.2) le ni la djein. cu mamta [kei]

the amount-of (Jane being-a-mother)

the amount of Jane's mother-ness (?)

the amount of mother-ness in Jane (?)

</pre><cx "measurement scale">makes very little sense in either Lojban or English. We simply do not have any sort of measurement scale for being a mother.

<p>

<cx "amount abstraction and mathematics">Semantically, a sumti with “le ni” is a number; however, it cannot be treated gram­matically as a quantifier in Lojban unless pre­fixed by the mathematical cmavo “mo'e”:

<p>

<pre><a name=e5d3>5.3) li pa vu'u mo'e le ni le pixra cu blanu [kei]

The-number 1 minus the-operand the amount-of (the picture being-blue)

1 - *B*, where *B* = blueness of the picture

</pre><p>Mathematical Lojban is beyond the scope of this chapter, and is ex­plained more fully in <a href=chap18.html>Chapter 18</a>.

<p>

<cx "amount abstraction, specifying determining place with ce'u"><lx "ce'u"><cx "abstraction, amount contrasted with property"><cx "property abstraction, contrasted with amount abstraction">There are contexts where either property or amount abstrac­tions make sense, and in such constructions, amount abstractions can make use of “ce'u” just like property ab­stractors. Thus,

<p>

<ex "blueness varying"><pre><a name=e5d4>5.4) le pixra cu cenba le ka ce'u blanu [kei]

The picture varies in-the property-of (X is blue)

The picture varies in being blue.

The picture varies in blueness.

</pre>is not the same as

<p>

<pre><a name=e5d5>5.5) le pixra cu cenba le ni ce'u blanu [kei]

The picture varies in-the amount-of (X is blue)

The picture varies in how blue it is.

The picture varies in blueness.

</pre><a href=#e5d4>Example 5.4 </a>conveys that the blueness comes and goes, whereas <a href=#e5d5>Example 5.5 </a>conveys that its quantity changes over time.

<p>

<cx "amount abstraction, scale"><cx "amount abstraction, place structure">Whenever we talk of measurement of an amount, there is some sort of scale, and so the place structure of “ni” abstraction sel­bri is:

<p>

<dl compact><dt>ni: <dd>x1 is the amount of (the bridi) on scale x2

</dl><lx "ni"><lx "kei"><lx "be">Note: the best way to express the x2 places of abstract sumti is to use something like “le ni <dots>…</dots>kei be”. See <a href=#e9d5>Example 9.5 </a>for the use of this construction.

<p>

### Truth-value abstraction: “jei”</h3>

<p><cx "value abstraction"><cx "truth-value abstraction"><cx "abstraction, truth-value"><a name=s6><h3>

<lx "jei"><lx "NU"><cx "abstraction, truth-value contrasted with amount">The “blueness of the picture” discussed in <a href=#s5>Section 5 </a>refers to the measurable amount of blue pigment (or other source of blue­ness), not to the degree of truth of the claim that blueness is present. That abstraction is expressed in Lojban using “jei”, which is closely related semantically to “ni”. In the simplest cases, “le jei” produces not a number but a truth value:

<p>

<ex "2 + 2"><pre><a name=e6d1>6.1) le jei li re su'i re du li vo [kei]

the truth-value-of the-number 2 + 2 = the-number 4

the truth of 2 + 2 being 4

</pre>is equivalent to “truth”, and

<p>

<pre><a name=e6d2>6.2) le jei li re su'i re du li mu [kei]

the truth-value-of the-number 2 + 2 = the-number 5

the truth of 2 + 2 being 5

</pre>is equivalent to “falsehood”.

<p>

However, not everything in life (or even in Lojban) is simply true or false. There are shades of gray even in truth value, and “jei” is Lojban's mechanism for indi­cating the shade of grey intended:

<p>

<ex "whether criminal"><pre><a name=e6d3>6.3) mi ba jdice le jei la djordj. cu zekri gasnu [kei]

I [future] decide the truth-value of (George being-a-(crime doer)).

I will decide whether George is a criminal.

</pre><cx "legal system"><cx "truth-value abstraction, place structure"><cx "jei, place structure"><a href=#e6d3>Example 6.3 </a>does not imply that George is, or is not, definitely a criminal. Depending on the legal system I am using, I may make some intermediate decision. As a result, “jei” requires an x2 place analogous to that of “ni”:

<p>

<dl compact><dt>jei: <dd>x1 is the truth value of (the bridi) under epistemology x2

</dl><cx "abstraction, truth-value and fuzzy logic"><cx "fuzzy logic and truth-value abstraction">Abstractions using “jei” are the mechanism for fuzzy logic in Lojban; the “jei” ab­straction refers to a number between 0 and 1 in­clusive (as distinct from “ni” abstrac­tions, which are often on open-ended scales). The detailed conventions for using “jei” in fuzzy-logic contexts have not yet been established.

<p>

### Predication/sentence abstraction</h3>

<p><cx "predication abstraction"><cx "sentence abstraction"><cx "abstraction, predication/sentence"><a name=s7><h3>

The following cmavo is discussed in this section:

<p>

<pre> du'u NU predication abstraction

</pre><cx "propositional attitudes"><cx "abstraction, with knowing, believing, etc."><cx "abstraction, mental activity">There are some selbri which demand an entire predication as a sumti; they make claims about some predication considered as a whole. Logicians call these the “propositional attitudes”, and they in­clude (in English) things like knowing, believing, learning, seeing, hearing, and the like. Consider the English sentence:

<p>

<ex "know"><ex "Frank is a fool"><pre><a name=e7d1>7.1) I know that Frank is a fool.

</pre><p>How's that in Lojban? Let us try:

<p>

<pre><a name=e7d2>7.2) mi djuno le nu la frank. cu bebna [kei]

I know the event of Frank being a fool.

</pre><cx "mental activity">Not quite right. Events are actually or potentially physical, and can't be contained inside one's mind, except for events of thinking, feeling, and the like; <a href=#e7d2>Example 7.2 </a>comes close to claiming that Frank's being-a-fool is purely a mental activity on the part of the speaker. (In fact, <a href=#e7d2>Example 7.2 </a>is an instance of improperly marked “sumti raising”, a concept dis­cussed further in <a href=#s10>Section 10</a>).

<p>

Try again:

<p>

<pre><a name=e7d3>7.3) mi djuno le jei la frank. cu bebna [kei]

I know the truth-value of Frank being a fool.

</pre><p>Closer. <a href=#e7d3>Example 7.3 </a>says that I know whether or not Frank is a fool, but doesn't say that he is one, as <a href=#e7d1>Example 7.1 </a>does. To catch that nuance, we must say:

<p>

<lx "du'u"><lx "NU"><pre><a name=e7d4>7.4) mi djuno le du'u la frank. cu bebna [kei]

I know the predication that Frank is a fool.

</pre><p>Now we have it. Note that the implied assertion “Frank is a fool” is not a property of “le du'u” abstraction, but of “djuno”; we can only know what is in fact true. (As a re­sult, “djuno” like “jei” has a place for epistemology, which specifies how we know.) <a href=#e7d5>Example 7.5 </a>has no such implied assertion:

<p>

<cx "curious"><ex "curious"><ex "Frank is a fool"><pre><a name=e7d5>7.5) mi kucli le du'u la frank. cu bebna [kei]

I am curious about whether Frank is a fool.

</pre>and here “du'u” could probably be replaced by “jei” without much change in meaning:

<p>

<pre><a name=e7d6>7.6) mi kucli le jei la frank. cu bebna [kei]

I am curious about how true it is that Frank is a fool.

</pre><cx "truth-value abstraction, place structure">As a matter of convenience rather than logical necessity, “du'u” has been given an x2 place, which is a sentence (piece of lan­guage) expressing the bridi:

<p>

<dl compact><dt>du’u: <dd>x1 is the predication (the bridi) expressed in sentence x2

</dl><cx "linguistic behavior"><cx "se du'u"><cx "abstraction, speaking, writing, etc.">and “le se du'u <dots>…</dots>” is very useful in filling places of selbri which refer to speaking, writ­ing, or other linguistic behavior regarding bridi:

<p>

<cx "abstraction of sentences, contrasted with quotation"><cx "quotation, contrasted with sentence abstraction"><pre><a name=e7d7>7.7) la djan. cusku le se du'u la djordj. klama le zarci [kei]

John expresses the sentence-expressing-that George goes-to the store

John says that George goes to the store.

</pre><a href=#e7d7>Example 7.7 </a>differs from

<p>

<pre><a name=e7d8>7.8) la djan cusku lu la djordj. klama le zarci li'u

John expresses, quote, George goes to the store, unquote.

John says “George goes to the store”.

</pre>because <a href=#e7d8>Example 7.8 </a>claims that John actually said the quoted words, whereas <a href=#e7d7>Example 7.7 </a>claims only that he said some words or other which were to the same purpose.

<p>

<lx "lu'e">“le se du'u” is much the same as “lu'e le du'u”, a symbol for the predication, but “se du'u” can be used as a selbri, whereas “lu'e” is ungrammatical in a selbri. (See <a href=chap5.html>Chapter 5 </a>for a discussion of “lu'e”.)

<p>

### Indirect questions</h3>

<p><cx "indirect questions"><cx "questions, indirect"><a name=s8><h3>

The following cmavo is discussed in this section:

<p>

<pre> kau UI indirect question marker

</pre><lx "du'u">There is an alternative type of sentence involving “du'u” and a selbri express­ing a propositional attitude. In addition to sentences like

<p>

<pre><a name=e8d1>8.1) I know that John went to the store.

</pre>we can also say things like

<p>

<ex "know who"><pre><a name=e8d2>8.2) I know who went to the store.

</pre><cx "abstraction, with wonder, doubt, etc.">This form is called an “indirect question” in English because the em­bedded English sen­tence is a question: “Who went to the store?” A person who says <a href=#e8d2>Example 8.2 </a>is claiming to know the answer to this question. Indirect questions can occur with many other English verbs as well: I can wonder, or doubt, or see, or hear, as well as know who went to the store.

<p>

<lx "kau"><lx "UI">To express indirect questions in Lojban, we use a “le du'u” abstraction, but rather than using a question word like “who” (“ma” in Lojban), we use any word that will fit grammatically and mark it with the suffix particle “kau”. This cmavo belongs to selma'o UI, so gram­matically it can appear anywhere. The simplest Lojban translation of <a href=#e8d2>Example 8.2 </a>is therefore:

<p>

<pre><a name=e8d3>8.3) mi djuno le du'u makau pu klama le zarci

I know the predication-of X [indirect question] [past] going to the store.

<cx "kau, “ma kau” contrasted with “la djan. kau”"><cx "Indirect questions, “ma kau” contrasted with “la djan. kau”"><cx "know who, contrasted with know that">In <a href=#e8d3>Example 8.3</a>, we have chosen to use “ma” as the word marked by “kau”. In fact, any other sumti would have done as well: “zo'e” or “da” or even “la djan.”. Using “la djan.” would suggest that it was John who I knew had gone to the store, however:

<p>

<pre><a name=e8d4>8.4) mi djuno le du'u la djan. kau pu klama

le zarci

I know the predication-of/fact-that John [indirect question] [past] going

to the store.

I know who went to the store, namely John.

I know that it was John who went to the store.

</pre><p>Using one of the indefinite pro-sumti such as “ma”, “zo'e”, or “da” does not suggest any particular value.

<p>

Why does Lojban require the “kau” marker, rather than using “ma” as English and Chinese and many other languages do? Be­cause “ma” always signals a direct ques­tion, and so

<p>

<pre><a name=e8d5>8.5) mi djuno le du'u ma pu klama le zarci

I know the predication-of [what sumti?] [past] goes-to the store

</pre>means

<p>

<pre><a name=e8d6>8.6) Who is it that I know goes to the store?

</pre><cx "indirect question involving sumti"><cx "indirect questions without “kau”">It is actually not necessary to use “le du'u” and “kau” at all if the indi­rect question in­volves a sumti; there is generally a paraphrase of the type:

<p>

<pre><a name=e8d7>8.7) mi djuno fi le pu klama be le zarci

I know about the [past] goer to-the store.

I know something about the one who went to the store (namely, his

identity).

</pre>because the x3 place of “djuno” is the subject of knowledge, as op­posed to the fact that is known. But when the questioned point is not a sumti, but (say) a logical connection, then there is no good alterna­tive to “kau”:

<p>

<pre><a name=e8d8>8.8) mi ba zgana le du'u la djan.

jikau la djordj. cu zvati le panka

I [future] observe the predication-of/fact-that John

[connective indirect question] George is-at the park.

I will see whether John or George (or both) is at the park.

</pre><p>In addition, <a href=#e8d7>Example 8.7 </a>is only a loose paraphrase of <a href=#e8d3>Example 8.3</a>, because it is left to the listener's insight to realize that what is known about the goer-to-the-store is his iden­tity rather than some other of his attributes.

<p>

### Minor abstraction types</h3>

<p><cx "abstraction types"><a name=s9><h3>

The following cmavo are discussed in this section:

<p>

<pre> li'i NU experience abstractor

si'o NU concept abstractor

su'u NU general abstractor

</pre><cx "experience abstractor"><cx "experience abstraction"><cx "abstraction, experience"><lx "li'i">There are three more abstractors in Lojban, all of them little used so far. The ab­stractor “li'i” expresses experience:

<p>

<pre><a name=e9d1>9.1) mi morji le li'i mi verba

I remember the experience-of (my being-a-child)

</pre><cx "concept abstractor"><cx "idea abstraction"><cx "concept abstraction"><cx "abstraction, idea"><cx "abstraction, concept"><lx "si'o">The abstractor “si'o” expresses a mental image, a concept, an idea:

<p>

<pre><a name=e9d2>9.2) mi nelci le si'o la lojban. cu mulno

I enjoy the concept-of Lojban being-complete.

</pre><cx "vague abstractor"><cx "vague abstraction"><cx "abstraction, vague"><lx "su'u">Finally, the abstractor “su'u” is a vague abstractor, whose meaning must be grasped from context:

<p>

<pre><a name=e9d3>9.3) ko zgana le su'u le ci smacu cu bajra

You [imperative] observe the abstract-nature-of the three mice running

See how the three mice run!

</pre><cx "experience abstraction, place structure">All three of these abstractors have an x2 place. An experi­ence requires an ex­peri­encer, so the place structure of “li'i” is:

<p>

<dl compact><dt>li’i: <dd>x1 is the experience of (the bridi) as experienced by x2

</dl><cx "concept abstraction, place structure"><cx "idea abstraction, place structure">Similarly, an idea requires a mind to hold it, so the place structure of “si'o” is:

<p>

<dl compact><dt>si’o: <dd>x1 is the idea/concept of (the bridi) in the mind of x2

</dl><cx "vague abstraction, place structure">Finally, there needs to be some way of specifying just what sort of abstraction “su'u” is representing, so its place structure is:

<p>

<dl compact><dt>su’u: <dd>x1 is an abstract nature of (the bridi) of type x2

</dl><cx "template"><cx "abstraction, creating new types">The x2 place of “su'u” allows it to serve as a substitute for any of the other abstractors, or as a template for creating new ones. For exam­ple,

<p>

<pre><a name=e9d4>9.4) le nu mi klama

the event-of my going

</pre>can be paraphrased as

<p>

<pre><a name=e9d5>9.5) le su'u mi klama kei be lo fasnu

the abstract-nature-of (my going) of-type an event

</pre>and there is a book whose title might be rendered in Lojban as:

<p>

<cx "Jesus"><cx "intersect"><ex "Jesus"><ex "bicycle race"><pre><a name=e9d6>9.6) le su'u la .iecuas. kuctra selcatra kei

be lo sao'rdzifa'a

ke nalmatma'e sutyterjvi

The abstract-nature-of (Jesus is-an-intersect-shape type-of-killed-one)

of-type a slope-low-direction

type-of non-motor-vehicle speed-competition

The Crucifixion of Jesus Considered As A Downhill Bicycle Race

</pre><p>Note the importance of using “kei” after “su'u” when the x2 of “su'u” (or any other ab­stractor) is being specified; otherwise, the “be lo” ends up inside the abstraction bridi.

<p>

### Lojban sumti raising</h3>

<p><cx "sumti raising"><cx "abstraction, simplification to sumti"><a name=s10><h3>

The following cmavo are discussed in this section:

<p>

<pre> tu'a LAhE an abstraction involving

jai JAI abstraction conversion

</pre><cx "abstract description">It is sometimes inconvenient, in a situation where an abstract description is logically required, to express the abstraction. In English we can say:

<p>

<pre><a name=e10d1>10.1) I try to open the door.

</pre>which in Lojban is:

<p>

<pre><a name=e10d2>10.2) mi troci le nu [mi] gasnu le nu le vorme cu karbi'o

I try the event-of (I am-agent-in the event-of (the door open-becomes)).

</pre>which has an abstract description within an abstract description, quite a complex struc­ture. In English (but not in all other languages), we may also say:

<p>

<cx "abstraction, simplification to sumti with tu'a"><lx "tu'a"><lx "LAhE"><ex "try the door"><pre><a name=e10d3>10.3) I try the door.

</pre>where it is understood that what I try is actually not the door itself, but the act of open­ing it. The same simplification can be done in Lojban, but it must be marked explicitly using a cmavo. The relevant cmavo is “tu'a”, which belongs to selma'o LAhE. The Loj­ban equivalent of <a href=#e10d3>Ex­ample 10.3 </a>is:

<p>

<pre><a name=e10d4>10.4) mi troci tu'a le vorme

I try some-action-to-do-with the door.

</pre><cx "intermediate abstraction">The term “sumti-raising”, as in the title of this section, signifies that a sumti which logi­cally belongs within an abstraction (or even within an abstraction which is itself inside an intermediate abstraction) is “raised” to the main bridi level. This transforma­tion from <a href=#e10d2>Example 10.2 </a>to <a href=#e10d4>Example 10.4 </a>loses information: nothing except convention tells us what the abstraction was.

<p>

Using “tu'a” is a kind of laziness: it makes speaking easier at the possible ex­pense of clarity for the listener. The speaker must be prepared for the listener to respond something like:

<p>

<lx "lu'u"><lx "LUhU"><pre><a name=e10d5>10.5) tu'a le vorme lu'u ki'a

something-to-do-with the door [terminator] [confusion!]

</pre>which indicates that “tu'a le vorme” cannot be understood. (The ter­minator for “tu'a” is “lu'u”, and is used in <a href=#e10d5>Example 10.5 </a>to make clear just what is being questioned: the sumti-raising, rather than the word “vorme” as such.) An example of a confusing raised sumti might be:

<p>

<pre><a name=e10d6>10.6) tu'a la djan. cu cafne

Something-to-do-with John frequently-occurs

</pre><p>This must mean that something which John does, or which happens to John, occurs fre­quently: but without more context there is no way to figure out what. Note that without the “tu'a”, <a href=#e10d6>Example 10.6 </a>would mean that John considered as an event frequently oc­curs — in other words, that John has some sort of on-and-off existence! Normally we do not think of people as events in English, but the x1 place of “cafne” is an event, and if some­thing that does not seem to be an event is put there, the Lojbanic listener will attempt to construe it as one. (Of course, this analysis assumes that “djan.” is the name of a person, and not the name of some event.)

<p>

<lx "jai"><lx "JAI"><cx "abstraction, making concrete"><cx "abstraction, simplification to sumti with jai">Logically, a counterpart of some sort is needed to “tu'a” which transposes an abstract sumti into a concrete one. This is achieved at the selbri level by the cmavo “jai” (of sel­ma'o JAI). This cmavo has more than one function, discussed in <a href=chap9.html>Chapter 9 </a>and <a href=chap11.html>Chapter 11</a>; for the purposes of this chapter, it operates as a conversion of selbri, similarly to the cmavo of selma'o SE. This conversion changes

<p>

<ex "cause death"><pre><a name=e10d7>10.7) tu'a mi rinka le nu do morsi

Something-to-do-with me causes the event-of you are-dead

My action causes your death.

</pre>into

<p>

<pre><a name=e10d8>10.8) mi jai rinka le nu do morsi

I am-associated-with causing the event-of your death.

I cause your death.

</pre><p>In English, the subject of “cause” can either be the actual cause (an event), or else the agent of the cause (a person, typically); not so in Lojban, where the x1 of “rinka” is al­ways an event. <a href=#e10d7>Example 10.7 </a>and <a href=#e10d8>Example 10.8 </a>look equally convenient (or incon­ven­ient), but in mak­ing descriptions, <a href=#e10d8>Example 10.8 </a>can be altered to:

<p>

<pre><a name=e10d9>10.9) le jai rinka be le nu do morsi

that-which-is associated-with causing (the event-of your death)

the one who caused your death

</pre>because “jai” modifies the selbri and can be incorporated into the de­scription — not so for “tu'a”.

<p>

The weakness of “jai” used in descriptions in this way is that it does not spec­ify which argument of the implicit abstraction is being raised into the x1 place of the de­scription selbri. One can be more specific by using the modal form of “jai” explained in <a href=chap9.html>Chapter 9</a>:

<p>

<pre><a name=e10d10>10.10) le jai gau rinka be le nu do morsi

that-which-is agent-in causing (the event-of your death)

### Event-type abstractors and event contour tenses</h3>

<p></pre><cx "abstraction contours, compared with contour tenses"><cx "tense contours, compared with event abstraction contours"><cx "NU compared with ZAhO"><cx "ZAhO compared with NU"><a name=s11><h3>

This section is a logical continuation of <a href=#s3>Section 3</a>.

<p>

<lx "NU"><lx "ZAhO">There exists a relationship between the four types of events explained in <a href=#s3>Sec­tion 3 </a>and the event contour tense cmavo of selma'o ZAhO. The specific cmavo of NU and of ZAhO are mutually interde­fining; the ZAhO contours were chosen to fit the needs of the NU event types and vice versa. Event contours are explained in full in <a href=chap10.html>Chapter 10</a>, and only summarized here.

<p>

The purpose of ZAhO cmavo is to represent the natural por­tions of an event, such as the beginning, the middle, and the end. They fall into several groups:

<p>

* <cx "process abstraction, related tense contours"><dl compact><dt><dd>The cmavo “pu'o”, “ca'o”, and “ba'o” represent spans of time: before an event begins, while it is going on, and after it is over, respectively.
* <p><dt><dd>The cmavo “co'a”, “de'a”, “di'a”, and “co'u” represent points of time: the start of an event, the temporary stop­ping of an event, the resumption of an event after a stop, and the end of an event, respectively. Not all events can have breaks in them, in which case “de'a” and “di'a” do not apply.
* <p><dt><dd>The cmavo “mo'u” and “za'o” correspond to “co'u” and “ba'o” respectively, in the case of those events which have a natural ending point that may not be the same as the actual ending point: “mo'u” refers to the natural end­ing point, and “za'o” to the time between the natural ending point and the actual ending point (the “excessive” or “superfective” part of the event).
* <p><dt><dd>The cmavo “co'i” represents an entire event considered as a point-event or achievement.

</dl><lx "pu'u">All these cmavo are applicable to events seen as processes and abstracted with “pu'u”. Only processes have enough internal structure to make all these points and spans of time meaningful.

<p>

<cx "state abstraction, related tense contours"><lx "za'i">For events seen as states and abstracted with “za'i”, the meaningful event con­tours are the spans “pu'o”, “ca'o”, and “ba'o”; the starting and ending points “co'a” and “co'u”, and the achievement contour “co'i”. States do not have natural endings distinct from their actual endings. (It is an open question whether states can be stopped and re­sumed.)

<p>

<cx "activity abstraction, related tense contours"><lx "zu'o">For events seen as activities and abstracted with “zu'o”, the meaningful event con­tours are the spans “pu'o”, “ca'o”, and “ba'o”, and the achievement contour “co'i”. Be­cause activities are inherently cyclic and repetitive, the beginning and ending points are not well-defined: you do not know whether an activity has truly begun until it be­gins to repeat.

<p>

<cx "point-event abstraction, related tense contours"><cx "achievement abstraction, related tense contours">For events seen as point-events and abstracted with “mu'e”, the meaningful event contours are the spans “pu'o” and “ba'o” but not “ca'o” (a point-event has no du­ration), and the achievement contour “co'i”.

<p>

Note that the parts of events are themselves events, and may be treated as such. The points in time may be seen as “mu'e” point-events; the spans of time may constitute proc­esses or activities. Therefore, Lojban allows us to refer to processes within proc­esses, activities within states, and many other complicated abstract things.

<p>

### Abstractor connection</h3>

<p><cx "abstractions, connection"><cx "connectives, for abstractions"><a name=s12><h3>

An abstractor may be replaced by two or more abstractors joined by logical or non-logical connectives. Connectives are ex­plained in detail in <a href=chap14.html>Chapter 14</a>. The con­nection can be expanded to one between two bridi which differ only in abstraction marker. <a href=#e13d1>Exam­ple 13.1 </a>and <a href=#e13d2>Example 13.2 </a>are equivalent in meaning:

<p>

<pre><a name=e13d1>13.1) le ka la frank. ciska cu xlali

.ije le ni la frank. ciska cu xlali

The quality-of Frank's writing is bad,

and the quantity of Frank's writing is bad.

<a name=e13d2>13.2) le ka je ni la frank. ciska cu xlali

The quality and quantity of Frank's writing is bad.

</pre><p>This feature of Lojban has hardly ever been used, and nobody knows what uses it may eventually have.

<p>

### Table of abstractors</h3>

<p><cx "abstraction, table"><a name=s13><h3>

The following table gives each abstractor, an English gloss for it, a Lojban gismu which is connected with it (more or less re­motely: the associations between ab­stractors and gismu are meant more as memory hooks than for any kind of inference), the rafsi as­sociated with it, and (on the following line) its place structure.

<p>

<pre>nu event of fasnu nun

x1 is an event of (the bridi)

ka property of ckaji kam

x1 is a property of (the bridi)

ni amount of klani nil

x1 is an amount of (the bridi) measured on scale x2

jei truth-value of jetnu jez

x1 is a truth-value of (the bridi) under epistemology x2

li'i experience of lifri liz

x1 is an experience of (the bridi) to experiencer x2

si'o idea of sidbo siz

x1 is an idea/concept of (the bridi) in the mind of x2

du'u predication of —– dum

x1 is the bridi (the bridi) expressed by sentence x2

su'u abstraction of sucta sus

x1 is an abstract nature of (the bridi)

za'i state of zasti zam

x1 is a state of (the bridi)

zu'o activity of zukte zum

x1 is an activity of (the bridi)

pu'u process of pruce pup

x1 is a process of (the bridi)

mu'e point-event of mulno mub

x1 is a point-event/achievement of (the bridi)

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## <h2>Chapter 12

## <br>

## Dog House And White House: Determining lujvo Place Struc­tures</h2>

###### <h6>$Revision: 4.0 $<br> mkhtml: 1.1</h6></p></center>

### Why have lujvo?</h3>

<p><cx "lujvo, place structure of"><a name=s1><h3>

<cx "world's languages"><cx "word lists"><cx "semantic primitives"><cx "minimal list"><cx "gismu, rationale for"><cx "lujvo, grammar of"><cx "compound words">The Lojban vocabulary is founded on its list of 1350-plus gismu, made up by com­bining word lists from various sources. These gismu are not intended to be either a com­plete vocabulary for the language nor a minimal list of semantic primitives. In­stead, the gismu list serves as a basis for the creation of compound words, or lujvo. The intention is that (except in certain semantically broad but shallow fields such as cul­tures, nations, foods, plants, and animals) suitable lujvo can be devised to cover the ten million or so concepts expressi­ble in all the world's languages taken together. Gram­matically, lujvo behave just like gismu: they have place structures and function as sel­bri.

<p>

<cx "lujvo, compared with tanru">There is a close relationship between lujvo and tanru. In fact, lujvo are con­densed forms of tanru:

<p>

<pre><a name=e1d1>1.1) ti fagri festi

That is-fire waste.

</pre>contains a tanru which can be reduced to the lujvo in:

<p>

<pre><a name=e1d2>1.2) ti fagyfesti

That is-fire-waste.

That is-ashes.

</pre><p>Although the lujvo “fagyfesti” is derived from the tanru “fagri festi”, it is not equivalent in meaning to it. In particular, “fagyfesti” has a distinct place structure of its own, not the same as that of “festi”. (In contrast, the tanru does have the same place structure as “festi”.) The lujvo needs to take account of the places of “fagri” as well. When a tanru is made into a lujvo, there is no equivalent of “be <dots>…</dots>bei <dots>…</dots>be'o” (described in <a href=chap5.html>Chapter 5</a>) to incorporate sumti into the middle of the lujvo.

<p>

<cx "creative understanding"><cx "lujvo, rationale for">So why have lujvo? Primarily to reduce semantic ambiguity. On hearing a tanru, there is a burden on the listener to figure out what the tanru might mean. Adding further terms to the tanru reduces ambiguity in one sense, by providing more informa­tion; but it in­creases ambiguity in another sense, because there are more and more tanru joints, each with an ambiguous significance. Since lujvo, like other brivla, have a fixed place struc­ture and a single meaning, encapsulating a commonly-used tanru into a lujvo relieves the listener of the burden of creative understanding. In addition, lujvo are typi­cally shorter than the corresponding tanru.

<p>

<cx "alternative guidelines"><cx "absolute laws"><cx "lujvo, guidelines for place structure"><cx "lujvo place structure, guidelines">There are no absolute laws fixing the place structure of a newly created lujvo. The maker must consider the place structures of all the components of the tanru and then de­cide which are still rele­vant and which can be removed. What is said in this chapter repre­sents guidelines, presented as one possible standard, not necessarily com­plete, and not the only possible standard. There may well be lujvo that are built without regard for these guidelines, or in accordance with entirely different guidelines, should such alternative guidelines someday be developed. The reason for presenting any guidelines at all is so that Lojbanists have a starting point for deciding on a likely place structure — one that others seeing the same word can also arrive at by similar consid­eration.

<p>

<cx "lujvo, cmavo incorporation">If the tanru includes connective cmavo such as “bo”, “ke”, “ke'e”, or “je”, or conver­sion or abstraction cmavo such as “se” or “nu”, there are ways of incorporating them into the lujvo as well. Sometimes this makes the lujvo excessively long; if so, the cmavo may be dropped. This leads to the possibility that more than one tanru could produce the same lujvo. Typically, however, only one of the possible tanru is useful enough to justify mak­ing a lujvo for it.

<p>

The exact workings of the lujvo-making algorithm, which takes a tanru built from gismu (and possibly cmavo) and produces a lujvo from it, are described in <a href=chap4.html>Chapter 4</a>.

<p>

### The meaning of tanru: a necessary detour</h3>

<p><cx "necessary detour"><a name=s2><h3>

<cx "lujvo meaning"><cx "veljvo, definition"><cx "seltau, definition"><cx "tertau, definition"><cx "modifier, of a tanru"><cx "modified, of a tanru">The meaning of a lujvo is controlled by — but is not the same as — the meaning of the tanru from which the lujvo was constructed. The tanru corresponding to a lujvo is called its “veljvo” in Lojban, and since there is no concise English equivalent, that term will be used in this chapter. Furthermore, the left (modifier) part of a tanru will be called the “seltau”, and the right (modified) part the “tertau”, following the us­age of <a href=chap5.html>Chapter 5</a>. For brevity, we will speak of the seltau or tertau of a lujvo, meaning of course the seltau or tertau of the veljvo of that lujvo. (If this terminology is confus­ing, substituting “modifier” for “seltau” and “modified” for “tertau” may help.)

<p>

<cx "tanru, place structure of">The place structure of a tanru is always the same as the place structure of its tertau. As a result, the meaning of the tanru is a modified version of the meaning of the tertau; the tanru will typically, but not always, refer to a subset of the things referred to by the ter­tau.

<p>

<cx "wine-dark sea"><cx "tanru, purpose">The purpose of a tanru is to join concepts together without necessarily focusing on the exact meaning of the seltau. For exam­ple, in the <cite>Iliad</cite>, the poet talks about “the wine-dark sea”, in which “wine” is a seltau relative to “dark”, and the pair of words is a seltau relative to “sea”. We're talking about the sea, not about wine or color. The other words are there to paint a scene in the listener's mind, in which the real action will oc­cur, and to evoke relations to other sagas of the time similarly describing the sea. Logi­cal inferences about wine or color will be rejected as irrelevant.

<p>

<ex "goer-house">As a simple example, consider the rather non-obvious tanru “klama zdani”, or “goer-house”. The gismu “zdani” has two places:

<p>

<pre><a name=e2d1>2.1) x1 is a nest/house/lair/den for inhabitant x2

</pre>(but in this chapter we will use simply “house”, for brevity), and the gismu “klama” has five:

<p>

<pre><a name=e2d2>2.2) x1 goes to destination x2 from origin point x3 via route x4 using means x5

</pre><p>The tanru “klama zdani” will also have two places, namely those of “zdani”. Since a “klama zdani” is a type of “zdani”, we can assume that all goer-houses — whatever they may be — are also houses.

<p>

<cx "fleas"><ex "dog house"><cx "tanru, possible meanings of">But is knowing the places of the tertau everything that is needed to understand the meaning of a tanru? No. To see why, let us switch to a less unlikely tanru: “gerku zdani”, literally “dog house”. A tanru expresses a very loose relation: a “gerku zdani” is a house that has something to do with some dog or dogs. What the precise rela­tion might be is left unstated. Thus, the meaning of “lo gerku zdani” can include all of the following: houses occupied by dogs, houses shaped by dogs, dogs which are also houses (e.g. houses for fleas), houses named after dogs, and so on. All that is essential is that the place structure of “zdani” continues to apply.

<p>

For something (call it z1) to qualify as a “gerku zdani” in Loj­ban, it's got to be a house, first of all. For it to be a house, it's got to house someone (call that z2). Fur­ther­more, there's got to be a dog somewhere (called g1). For g1 to count as a dog in Lojban, it's got to belong to some breed as well (called g2). And finally, for z1 to be in the first place of “gerku zdani”, as opposed to just “zdani”, there's got to be some rela­tionship (called r) between some place of “zdani” and some place of “gerku”. It doesn't matter which places, because if there's a relationship between some place of “zdani” and any place of “gerku”, then that relationship can be compounded with the relation­ship between the places of “gerku” — namely, “gerku” itself — to reach any of the other “gerku” places. Thus, if the relationship turns out to be between z2 and g2, we can still state r in terms of z1 and g1: “the relationship involves the dog g1, whose breed has to do with the occupant of the house z1”.

<p>

<ex "Bill Clinton">Doubtless to the relief of the reader, here's an illustration. We want to find out whether the White House (the one in which the U. S. President lives, that is) counts as a “gerku zdani”. We go through the five variables. The White House is the z1. It houses Bill Clinton as z2, as of this writing, so it counts as a “zdani”. Let's take a dog — say, Spot (g1). Spot has to have a breed; let's say it's a Saint Bernard (g2). Now, the White House counts as a “gerku zdani” if there is any relationship (r) at all between the White House and Spot. (We'll choose the g1 and z1 places to relate by r; we could have cho­sen any other pair of places, and simply gotten a different relationship.)

<p>

<cx "Chelsea Clinton">The sky is the limit for r; it can be as complicated as “The other day, g1 (Spot) chased Socks, who is owned by Chelsea Clin­ton, who is the daughter of Bill Clinton, who lives in z1 (the White House)” or even worse. If no such r can be found, well, you take an­other dog, and keep going until no more dogs can be found. Only then can we say that the White House cannot fit into the first place of “gerku zdani”.

<p>

As we have seen, no less than five elements are involved in the definition of “gerku zdani”: the house, the house dweller, the dog, the dog breed (everywhere a dog goes in Lojban, a dog breed fol­lows), and the relationship between the house and the dog. Since tanru are explicitly ambiguous in Lojban, the relationship r cannot be ex­pressed within a tanru (if it could, it wouldn't be a tanru any more!) All the other places, however, can be expressed — thus:

<p>

<pre><a name=e2d3>2.3) la blabi zdani cu gerku be fa la spot. bei la sankt. berNARD. be'o

zdani la bil. klinton.

The White House is-a-dog (namely Spot of-breed Saint Bernard)

type-of-house-for Bill Clinton.

</pre><cx "derogatory terms">Not the most elegant sentence ever written in either Lojban or Eng­lish. Yet if there is any relation at all between Spot and the White House, <a href=#e2d4>Example 2.4 </a>is arguably true. If we concentrate on just one type of relation in interpreting the tanru “gerku zdani”, then the meaning of “gerku zdani” changes. So if we understand “gerku zdani” as having the same meaning as the English word “doghouse”, the White House would no longer be a “gerku zdani” with respect to Spot, because as far as we know Spot does not actually live in the White House, and the White House is not a doghouse (derogatory terms for incumbents notwithstanding).

<p>

### <a name=s3><h3>The meaning of lujvo</h3>

<p>

This is a fairly long way to go to try and work out how to say “doghouse”! The reader can take heart; we're nearly there. Recall that one of the components involved in fixing the meaning of a tanru — the one left deliberately vague — is the precise rela­tion between the tertau and the seltau. Indeed, fixing this relation is tantamount to giv­ing an interpretation to the ambiguous tanru.

<p>

<cx "disambiguated instance"><cx "lujvo, interpreting"><cx "lujvo, and seltau/tertau relationship">A lujvo is defined by a single disambiguated instance of a tanru. That is to say, when we try to design the place structure of a lujvo, we don't need to try to discover the relation between the tertau and the seltau. We already know what kind of relation we're looking for; it's given by the specific need we wish to express, and it deter­mines the place struc­ture of the lujvo itself.

<p>

Therefore, it is generally not appropriate to simply devise luj­vo and decide on place structures for them without considering one or more specific usages for the coin­age. If one does not consider spe­cifics, one will be likely to make erroneous generaliza­tions on the re­lationship r.

<p>

<cx "lujvo, design consideration for relationship">The insight driving the rest of this chapter is this: while the relation expressed by a tanru can be very distant (e.g. Spot chasing Socks, above), the relationship singled out for disambiguation in a lujvo should be quite close. This is because lujvo-making, paralleling natural language compounding, picks out the most salient relationship r between a tertau place and a seltau place to be expressed in a sin­gle word. The relation­ship “dog chases cat owned by daughter of per­son living in house” is too distant, and too incidental, to be likely to need expression as a single short word; the relationship “dog lives in house” is not. From all the various interpretations of “gerku zdani”, the person creating “gerzda” should pick the most useful value of r. The most useful one is usually going to be the most obvious one, and the most obvious one is usually the clos­est one.

<p>

In fact, the relationship will almost always be so close that the predicate ex­pressing r will be either the seltau or the tertau predicate itself. This should come as no surprise, given that a word like “zdani” in Lojban is a predicate. Predicates express re­lations; so when you're looking for a relation to tie together “le zdani” and “le gerku”, the most ob­vious relation to pick is the very relation named by the tertau, “zdani”: the relation be­tween a home and its dweller. As a result, the object which fills the first place of “gerku” (the dog) also fills the sec­ond place of “zdani” (the house-dweller).

<p>

<cx "lujvo place structure, dropping redundant places">The seltau-tertau relationship in the veljvo is expressed by the seltau or tertau predi­cate itself. Therefore, at least one of the seltau places is going to be equivalent to a tertau place. This place is thus redundant, and can be dropped from the place structure of the lujvo. As a corollary, the precise relationship between the veljvo com­ponents can be im­plicitly determined by finding one or more places to overlap in this way.

<p>

So what is the place structure of “gerzda”? We're left with three places, since the dweller, the “se zdani”, turned out to be identi­cal to the dog, the “gerku”. We can proceed as follows:

<p>

<cx "lujvo place structure, notation conventions">(The notation introduced casually in <a href=#s2>Section 2 </a>will be useful in the rest of this chap­ter. Rather than using the regular x1, x2, etc. to represent places, we'll use the first letter of the relevant gismu in place of the “x”, or more than one letter where necessary to re­solve ambiguities. Thus, z1 is the first place of “zdani”, and g2 is the sec­ond place of “gerku”.)

<p>

<cx "new notation"><cx "lujvo place structure, explicated walk-through">The place structure of “zdani” is given as <a href=#e2d1>Example 2.1</a>, but is repeated here using the new notation:

<p>

<ex "doghouse"><pre><a name=e3d1>3.1) z1 is a nest/house/lair/den of z2

</pre><p>The place structure of “gerku” is:

<p>

<pre><a name=e3d2>3.2) g1 is a dog of breed g2

</pre><p>But z2 is the same as g1; therefore, the tentative place structure for “gerzda” now be­comes:

<p>

<pre><a name=e3d3>3.3) z1 is a house for dweller z2 of breed g2

</pre>which can also be written

<p>

<pre><a name=e3d4>3.4) z1 is a house for dog g1 of breed g2

</pre>or more comprehensively

<p>

<pre><a name=e3d5>3.5) z1 is a house for dweller/dog z2=g1 of breed g2

</pre><p>Despite the apparently conclusive nature of <a href=#e3d5>Example 3.5</a>, our task is not yet done: we still need to decide whether any of the re­maining places should also be elimi­nated, and what order the lujvo places should appear in. These concerns will be ad­dressed in the re­mainder of the chapter; but we are now equipped with the terminol­ogy needed for those discussions.

<p>

### <a name=s4><h3>Selecting places</h3>

<p>

<cx "lujvo place structure, basis of">The set of places of an ordinary lujvo are selected from the places of its com­ponent gismu. More precisely, the places of such a lujvo are derived from the set of places of the component gismu by eliminating unnecessary places, until just enough places remain to give an appropriate meaning to the lujvo. In general, including a place makes the concept expressed by a lujvo more general; excluding a place makes the con­cept more specific, because omitting the place requires assuming a standard value or range of values for it.

<p>

<cx "lujvo place structure, rationale for standardization">It would be possible to design the place structure of a lujvo from scratch, treating it as if it were a gismu, and working out what arguments contribute to the no­tion to be ex­pressed by the lujvo. There are two reasons arguing against doing so and in favor of the procedure detailed in this chapter.

<p>

The first is that it might be very difficult for a hearer or reader, who has no precon­ceived idea of what concept the lujvo is intended to convey, to work out what the place structure actually is. Instead, he or she would have to make use of a lujvo diction­ary every time a lujvo is encountered in order to work out what a “se jbopli” or a “te klagau” is. But this would mean that, rather than having to learn just the 1300-odd gismu place structures, a Lojbanist would also have to learn myriads of lujvo place structures with little or no apparent pattern or regularity to them. The purpose of the guidelines docu­mented in this chapter is to apply regularity and to make it conventional wherever possi­ble.

<p>

The second reason is related to the first: if the veljvo of the lujvo has not been prop­erly selected, and the places for the lujvo are formulated from scratch, then there is a risk that some of the places formulated may not correspond to any of the places of the gismu used in the veljvo of the lujvo. If that is the case — that is to say, if the lujvo places are not a subset of the veljvo gismu places — then it will be very difficult for the hearer or reader to understand what a par­ticular place means, and what it is doing in that particular lujvo. This is a topic that will be further discussed in <a href=#s14>Section 14</a>.

<p>

However, second-guessing the place structure of the lujvo is useful in guiding the process of subsequently eliminating places from the veljvo. If the Lojbanist has an idea of what the final place structure should look like, he or she should be able to pick an appro­priate vel­jvo to begin with, in order to express the idea, and then to decide which places are relevant or not relevant to expressing that idea.

<p>

### <a name=s5><h3>Symmetrical and asymmetrical lujvo</h3>

<p>

<cx "lujvo, symmetrical"><cx "veljvo, symmetrical"><ex "great soldier"><cx "lujvo place structure, when first places redundant">A common pattern, perhaps the most common pattern, of luj­vo-making creates what is called a “symmetrical lujvo”. A symmetrical lujvo is one based on a tanru in­terpreta­tion such that the first place of the seltau is equivalent to the first place of the tertau: each compo­nent of the tanru characterizes the same object. As an illustration of this, consider the lujvo “balsoi”: it is intended to mean “both great and a soldier” — that is, “great sol­dier”, which is the interpretation we would tend to give its veljvo, “banli sonci”. The un­derlying gismu place structures are:

<p>

<pre><a name=e5d1>5.1) “banli”: b1 is great in property b2 by standard b3

“sonci”: s1 is a soldier of army s2

</pre><p>In this case the s1 place of “sonci” is redundant, since it is equivalent to the b1 place of “banli”. Therefore the place structure of “balsoi” need not include places for both s1 and b1, as they refer to the same thing. So the place structure of “balsoi” is at most

<p>

<pre><a name=e5d2>5.2) b1=s1 is a great soldier of army s2 in property b2 by standard b3

</pre><cx "symmetrical veljvo"><ex "listen attentively"><cx "lujvo place structure, when first places redundant plus others">Some symmetrical veljvo have further equivalent places in addition to the re­spective first places. Consider the lujvo “tinju'i”, “to listen” (“to hear attentively, to hear and pay attention”). The place structures of the gismu “tirna” and “jundi” are:

<p>

<cx "background noise"><pre><a name=e5d3>5.3) “tirna”: t1 hears sound t2 against background noise t3

“jundi”: j1 pays attention to j2

</pre>and the place structure of the lujvo is:

<p>

<pre><a name=e5d4>5.4) j1=t1 listens to j2=t2 against background noise t3

</pre><p>Why so? Because not only is the j1 place (the one who pays atten­tion) equivalent to the t1 place (the hearer), but the j2 place (the thing paid attention to) is equivalent to the t2 place (the thing heard).

<p>

<cx "lujvo, asymmetrical"><cx "lujvo place structure, when first place redundant with non-first">A substantial minority of lujvo have the property that the first place of the sel­tau (“gerku” in this case) is equivalent to a place other than the first place of the tertau; such lujvo are said to be “asymmetrical”. (There is a deliberate parallel here with the terms “asymmetrical tanru” and “symmetrical tanru” used in <a href=chap5.html>Chapter 5</a>.)

<p>

<cx "lujvo place structure, effect of “SE”">In principle any asymmetrical lujvo could be expressed as a symmetrical lujvo. Con­sider “gerzda”, discussed in <a href=#s3>Section 3</a>, where we learned that the g1 place was equivalent to the z2 place. In order to get the places aligned, we could convert “zdani” to “se zdani” (or “selzda” when expressed as a lujvo). The place structure of “selzda” is

<p>

<pre><a name=e5d5>5.5) s1 is housed by nest s2

</pre>and so the three-part lujvo “gerselzda” would have the place structure

<p>

<pre><a name=e5d6>5.6) s1=g1 is a dog housed in nest s2 of dog breed g2

</pre><p>However, although “gerselzda” is a valid lujvo, it doesn't translate “doghouse”; its first place is the dog, not the doghouse. Furthermore, it is more complicated than necessary; “gerzda” is simpler than “gerselzda”.

<p>

From the reader's or listener's point of view, it may not al­ways be obvious whether a newly met lujvo is symmetrical or asym­metrical, and if the latter, what kind of asymmet­rical lujvo. If the place structure of the lujvo isn't given in a dictionary or elsewhere, then plausibility must be applied, just as in interpreting tanru.

<p>

<ex "car goer">The lujvo “karcykla”, for example, is based on “karce klama”, or “car goer”. The place structure of “karce” is:

<p>

<pre><a name=e5d7>5.7) karce: ka1 is a car carrying ka2 propelled by ka3

</pre><p>An asymmetrical interpretation of “karcykla” that is strictly analogous to the place structure of “gerzda”, equating the kl2 (destination) and ka1 (car) places, would lead to the place structure

<p>

<pre><a name=e5d8>5.8) kl1 goes to car kl2=ka1 which carries ka2 propelled by ka3 from origin kl3

via route kl4 by means of kl5

</pre><p>But in general we go about in cars, rather than going to cars, so a far more likely place structure treats the ka1 place as equivalent to the kl5 place, leading to

<p>

<pre><a name=e5d9>5.9) kl1 goes to destination kl2 from origin kl3 via route kl4

by means of car kl5=ka1 carrying ka2 propelled by ka3.

</pre>instead.

<p>

### <a name=s6><h3>Dependent places</h3>

<p>

<cx "lujvo place structure, dependent places">In order to understand which places, if any, should be com­pletely removed from a lujvo place structure, we need to understand the concept of dependent places. One place of a brivla is said to be dependent on another if its value can be predicted from the values of one or more of the other places. For example, the g2 place of “gerku” is dependent on the g1 place. Why? Because when we know what fits in the g1 place (Spot, let us say, a well-known dog), then we know what fits in the g2 place (“St. Bernard”, let us say). In other words, when the value of the g1 place has been specified, the value of the g2 place is determined by it. Conversely, since each dog has only one breed, but each breed con­tains many dogs, the g1 place is not dependent on the g2 place; if we know only that some dog is a St. Bernard, we cannot tell by that fact alone which dog is meant.

<p>

For “zdani”, on the other hand, there is no dependency be­tween the places. When we know the identity of a house-dweller, we have not determined the house, be­cause a dweller may dwell in more than one house. By the same token, when we know the iden­tity of a house, we do not know the identity of its dweller, for a house may contain more than one dweller.

<p>

<cx "lujvo place structure, dropping dependent seltau places">The rule for eliminating places from a lujvo is that dependent places provided by the seltau are eliminated. Therefore, in “gerzda” the dependent g2 place is removed from the tentative place structure given in <a href=#e3d5>Example 3.5</a>, leaving the place structure:

<p>

<pre><a name=e6d1>6.1) z1 is the house dwelt in by dog z2=g1

</pre><p>Informally put, the reason this has happened — and it happens a lot with seltau places — is that the third place was describing not the doghouse, but the dog who lives in it. The sentence

<p>

<ex "Mon Repos"><pre><a name=e6d2>6.2) la mon. rePOS. gerzda la spat.

Mon Repos is a doghouse of Spot.

</pre>really means

<p>

<pre><a name=e6d3>6.3) la mon. rePOS. zdani la spat. noi gerku

Mon Repos is a house of Spot, who is a dog.

</pre>since that is the interpretation we have given “gerzda”. But that in turn means

<p>

<pre><a name=e6d4>6.4) la mon. rePOS. zdani la spat noi ke'a gerku zo'e

Mon Repos is a house of Spot, who is a dog of unspecified breed.

</pre><p>Specifically,

<p>

<pre><a name=e6d5>6.5) la mon. rePOS. zdani la spat. noi ke'a gerku la sankt. berNARD.

Mon Repos is a house of Spot, who is a dog of breed St. Bernard.

</pre>and in that case, it makes little sense to say

<p>

<pre><a name=e6d6>6.6) la mon. rePOS. gerzda la spat.noi ke'a gerku la sankt. berNARD. ku'o

la sankt. berNARD.

Mon Repos is a doghouse of Spot, who is a dog of breed St. Bernard,

of breed St. Bernard.

</pre><cx "supplementary information">employing the over-ample place structure of <a href=#e3d5>Example 3.5</a>. The dog breed is redundantly given both in the main selbri and in the relative clause, and (intuitively speaking) is re­peated in the wrong place, since the dog breed is supplementary information about the dog, and not about the doghouse.

<p>

<ex "beetle">As a further example, take “cakcinki”, the lujvo for “beetle”, based on the tanru “calku cinki”, or “shell-insect”. The gismu place structures are:

<p>

<cx "arthropod"><pre><a name=e6d7>6.7) “calku”: ca1 is a shell/husk around ca2 made of ca3

“cinki”: ci1 is an insect/arthropod of species ci2

</pre><cx "cross-dependency"><cx "lujvo place structure, cross-dependent places"><cx "lujvo place structure, dropping cross-dependent places">This example illustrates a cross-dependency between a place of one gismu and a place of the other. The ca3 place is dependent on ci1, because all insects (which fit into ci1) have shells made of chitin (which fits into ca3). Furthermore, ca1 is dependent on ci1 as well, because each insect has only a single shell. And since ca2 (the thing with the shell) is equivalent to ci1 (the insect), the place structure is

<p>

<pre><a name=e6d8>6.8) ci1=ca2 is a beetle of species ci2

</pre>with not a single place of “calku” surviving independently!

<p>

<cx "Coleoptera"><cx "beetles">(Note that there is nothing in this explanation that tells us just why “cakcinki” means “beetle” (member of Coleoptera), since all in­sects in their adult forms have chi­tin shells of some sort. The answer, which is in no way predictable, is that the shell is a prominent, highly noticeable feature of beetles in particular.)

<p>

<cx "lujvo place structure, dropping dependent tertau places">What about the dependency of ci2 on ci1? After all, no beetle belongs to more than one species, so it would seem that the ci2 place of “cakcinki” could be eliminated on the same reasoning that allowed us to eliminate the g2 place of “gerzda” above. However, it is a rule that dependent places are not eliminated from a lujvo when they are derived from the tertau of its veljvo. This rule is imposed to keep the place struc­tures of lujvo from drifting too far from the tertau place structure; if a place is necessary in the tertau, it's treated as neces­sary in the lujvo as well.

<p>

<cx "wrong concept"><cx "shoehorn"><cx "lujvo place structure, selecting tertau">In general, the desire to remove places coming from the ter­tau is a sign that the vel­jvo selected is simply wrong. Different place structures imply different concepts, and the lujvo maker may be trying to shoehorn the wrong concept into the place structure of his or her choosing. This is obvious when someone tries to shoe-horn a “klama” tertau into a “litru” or “cliva” concept, for example: these gismu differ in their number of ar­guments, and suppressing places of “klama” in a lujvo doesn't make any sense if the resulting modified place structure is that of “litru” or “cliva”.

<p>

Sometimes the dependency is between a single place of the tertau and the whole event described by the seltau. Such cases are discussed further in <a href=#s13>Section 13</a>.

<p>

<cx "recital rooms"><cx "playgrounds"><cx "elementary schools"><cx "auditoriums"><ex "school building"><cx "lujvo place structure, dropping dependent places, caveat">Unfortunately, not all dependent places in the seltau can be safely removed: some of them are necessary to interpreting the luj­vo's meaning in context. It doesn't matter much to a doghouse what breed of dog inhabits it, but it can make quite a lot of difference to the construction of a school building what kind of school is in it! Music schools need audito­riums and recital rooms, elementary schools need playgrounds, and so on: therefore, the place structure of “kuldi'u” (from “ckule dinju”, and meaning “school building”) needs to be

<p>

<pre><a name=e6d9>6.9) d1 is a building housing school c1 teaching subject c3 to audience c4

</pre>even though c3 and c4 are plainly dependent on c1. The other places of “ckule”, the loca­tion (c2) and operators (c5), don't seem to be nec­essary to the concept “school building”, and are dependent on c1 to boot, so they are omitted. Again, the need for case-by-case consid­eration of place structures is demonstrated.

<p>

### <a name=s7><h3>Ordering lujvo places</h3>

<p>

<cx "lujvo place order">So far, we have concentrated on selecting the places to go into the place structure of a lujvo. However, this is only half the story. In using selbri in Lojban, it is important to remember the right order of the sumti. With lujvo, the need to attend to the order of sumti be­comes critical: the set of places selected should be ordered in such a way that a reader unfamiliar with the lujvo should be able to tell which place is which.

<p>

<cx "lujvo place order, rationale for standardization"><ex "prayer">If we aim to make understandable lujvo, then, we should make the order of places in the place structure follow some conven­tions. If this does not occur, very real ambiguities can turn up. Take for example the lujvo “jdaselsku”, meaning “prayer”. In the sentence

<p>

<pre><a name=e7d1>7.1) di'e jdaselsku la dong.

This-utterance is-a-prayer somehow-related-to-Dong.

</pre>we must be able to know if Dong is the person making the prayer, giving the meaning

<p>

<pre><a name=e7d2>7.2) This is a prayer by Dong.

</pre>or is the entity being prayed to, resulting in

<p>

<pre><a name=e7d3>7.3) This is a prayer to Dong.

</pre><p>We could resolve such problems on a case-by-case basis for each lujvo (<a href=#s14>Section 14 </a>discusses when this is actually necessary), but case-by-case resolution for run-of-the-mill lujvo makes the task of learning lujvo place structures unmanageable. People need consis­tent patterns to make sense of what they learn. Such patterns can be found across gismu place structures (see <a href=#s16>Section 16</a>), and are even more necessary in lujvo place structures. Case-by-case consideration is still necessary; lujvo creation is a subtle art, after all. But it is help­ful to take advantage of any available regularities.

<p>

<cx "elimination process"><cx "lujvo place order, symmetrical lujvo"><ex "great soldier">We use two different ordering rules: one for symmetrical lujvo and one for asymmet­rical ones. A symmetrical lujvo like “balsoi” (from <a href=#s5>Section 5</a>) has the places of its tertau followed by whatever places of the seltau survive the elimination process. For “balsoi”, the surviving places of “banli” are b2 and b3, leading to the place structure:

<p>

<pre><a name=e7d4>7.4) b1=s1 is a great soldier of army s2 in property b2 by standard b3

</pre>just what appears in <a href=#e5d1>Example 5.1</a>. In fact, all place structures shown until now have been in the correct order by the conventions of this section, though the fact has been left tacit until now.

<p>

The motivation for this rule is the parallelism between the luj­vo bridi-schema

<p>

<pre><a name=e7d5>7.5) b1 bansoi s2 b2 b3

b1 is-a-great-soldier of-army-s2 in-property-b2 by-standard-b3

</pre>and the more or less equivalent bridi-schema

<p>

<pre><a name=e7d6>7.6) b1 sonci s2 gi'e banli b2 b3

b1 is-a-soldier of-army-s2 and is-great in-property-b2 by-standard-b3

</pre>where “gi'e” is the Lojban word for “and” when placed between two partial bridi, as ex­plained in <a href=chap14.html>Chapter 14</a>.

<p>

<cx "animal doctor"><cx "lujvo place order, asymmetrical lujvo"><ex "veterinarian">Asymmetrical lujvo like “gerzda”, on the other hand, employ a different rule. The seltau places are inserted not at the end of the place structure, but rather immedi­ately after the tertau place which is equivalent to the first place of the seltau. Consider “dalmikce”, meaning “veterinarian”: its veljvo is “danlu mikce”, or “animal doctor”. The place struc­tures for those gismu are:

<p>

<cx "ailment"><pre><a name=e7d7>7.7) “danlu”: d1 is an animal of species d2

“mikce”: m1 is a doctor to patient m2 for ailment m3 using treatment m4

</pre>and the lujvo place structure is:

<p>

<pre><a name=e7d8>7.8) m1 is a doctor for animal m2=d1 of species d2 for ailment m3

using treatment m4

</pre><cx "animal patient">Since the shared place is m2=d1, the animal patient, the remaining seltau place d2 is in­serted immediately after the shared place; then the remaining tertau places form the last two places of the lujvo.

<p>

### <a name=s8><h3>lujvo with more than two parts</h3>

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<cx "lujvo place order, based on 3-or-more part veljvo"><ex "tomorrow">The theory we have outlined so far is an account of lujvo with two parts. But often lujvo are made containing more than two parts. An example is “bavlamdei”, “tomorrow”: it is composed of the rafsi for “future”, “adjacent”, and “day”. How does the account we have given apply to lujvo like this?

<p>

The best way to approach such lujvo is to continue to classify them as based on bi­nary tanru, the only difference being that the seltau or the tertau or both is itself a lujvo. So it is easiest to make sense of “bavlamdei” as having two components: “bavla'i”, “next”, and “djedi”. If we know or invent the lujvo place structure for the compo­nents, we can compose the new lujvo place structure in the usual way.

<p>

In this case, “bavla'i” is given the place structure

<p>

<pre><a name=e8d1>8.1) b1=l1 is next after b2=l2

</pre>making it a symmetrical lujvo. We combine this with “djedi”, which has the place struc­ture:

<p>

<pre><a name=e8d2>8.2) duration d1 is d2 days long (default 1) by standard d3

</pre><cx "anomalous ordering of lujvo places">While symmetrical lujvo normally put any trailing tertau places before any seltau places, the day standard is a much less important concept than the day the tomorrow follows, in the definition of “bavlamdei”. This is an example of how the guidelines pre­sented for selecting and ordering lujvo places are just that, not laws that must be rigidly ad­hered to. In this case, we choose to rank places in order of relative importance. The resulting place structure is:

<p>

<pre><a name=e8d3>8.3) d1=b1=l1 is a day following b2=l2, d2 days later (default 1) by standard d3

</pre><cx "medieval weapon"><ex "long-sword">Here is another example of a multi-part lujvo: “cladakyxa'i”, meaning “long-sword”, a specific type of medieval weapon. The gismu place structures are:

<p>

<pre><a name=e8d4>8.4) “clani”: c1 is long in direction c2 by standard c3

“dakfu”: d1 is a knife for cutting d2 with blade made of d3

“xarci”: xa1 is a weapon for use against xa2 by wielder xa3

</pre><cx "sword blade">Since “cladakyxa'i” is a symmetrical lujvo based on “cladakfu xarci”, and “cladakfu” is itself a symmetrical lujvo, we can do the necessary analyses all at once. Plainly c1 (the long thing), d1 (the knife), and xa1 (the weapon) are all the same. Likewise, the d2 place (the thing cut) is the same as the xa2 place (the target of the weapon), given that swords are used to cut victims. Finally, the c2 place (direction of length) is always along the sword blade in a longsword, by definition, and so is dependent on c1=d1=xa1. Adding on the places of the re­maining gismu in right-to-left order we get:

<p>

<pre><a name=e8d5>8.5) xa1=d1=c1 is a long-sword for use against xa2=d2 by wielder xa3,

with a blade made of d3, length measured by standard c3.

</pre><p>If the last place sounds unimportant to you, notice that what counts legally as a “sword”, rather than just a “knife”, depends on the length of the blade (the legal limit varies in dif­ferent jurisdictions). This fifth place of “cladakyxa'i” may not often be ex­plicitly filled, but it is still useful on occasion. Because it is so seldom important, it is best that it be last.

<p>

### <a name=s9><h3>Eliding SE rafsi from seltau</h3>

<p>

<cx "lujvo, dropping SE rafsi">It is common to form lujvo that omit the rafsi based on cmavo of selma'o SE, as well as other cmavo rafsi. Doing so makes lujvo construction for common or useful construc­tions shorter. Since it puts more strain on the listener who has not heard the lujvo before, the shortness of the word should not necessarily outweigh ease in under­standing, espe­cially if the lujvo refers to a rare or unusual concept.

<p>

<cx "proposed law">Consider as an example the lujvo “ti'ifla”, from the veljvo “stidi flalu”, and meaning “bill, proposed law”. The gismu place structures are:

<p>

<pre><a name=e9d1>9.1) “stidi”: agent st1 suggests idea/action st2 to audience st3

“flalu”: f1 is a law specifying f2 for community f3 under conditions f4

by lawgiver f5

</pre><cx "lined up">This lujvo does not fit any of our existing molds: it is the second sel­tau place, st2, that is equivalent to one of the tertau places, namely f1. However, if we understand “ti'ifla” as an abbreviation for the lujvo “selti'ifla”, then we get the first places of seltau and tertau lined up. The place structure of “selti'i” is: <dl compact><dt> <dd>

<a name=e9d2>9.2) “selti'i”: idea/action se1 is suggested by agent se2 to audience se3

</dl><p>Here we can see that se1 (what is suggested) is equivalent to f1 (the law), and we get a normal symmetrical lujvo. The final place structure is:

<p>

<pre><a name=e9d3>9.3) f1=se1 is a bill specifying f2 for community f3 under conditions f4

by suggester se2 to audience/lawgivers f5=se3

</pre>or, relabeling the places,

<p>

<pre><a name=e9d4>9.4) f1=st2 is a bill specifying f2 for community f3 under conditions f4

by suggester st1 to audience/lawgivers f5=st3

</pre>where the last place (st3) is probably some sort of legislature.

<p>

<cx "lujvo, abbreviated">Abbreviated lujvo like “ti'ifla” are more intuitive (for the lujvo-maker) than their more explicit counterparts like “selti'ifla” (as well as shorter). They don't require the coiner to sit down and work out the precise relation between the seltau and the ter­tau: he or she can just rattle off a rafsi pair. But should the lujvo get to the stage where a place structure needs to be worked out, then the precise relation does need to be speci­fied. And in that case, such abbreviated lujvo form a trap in lujvo place ordering, since they obscure the most straightforward relation between the seltau and tertau. To give our lujvo-making guidelines as wide an application as possible, and to encourage ana­lyzing the seltau-tertau relation in lujvo, lujvo like “ti'ifla” are given the place structure they would have with the appro­priate SE added to the seltau.

<p>

<cx "implausible"><cx "abbreviated lujvo and plausibility"><cx "plausibility, in abbreviated lujvo">Note that, with these lujvo, an interpretation requiring SE in­sertion is safe only if the alternatives are either implausible or unlikely to be needed as a lujvo. This may not al­ways be the case, and Loj­banists should be aware of the risk of ambiguity.

<p>

### <a name=s10><h3>Eliding SE rafsi from tertau</h3>

<p>

<cx "lujvo place structure, effect of “SE”-dropping in tertau">Eliding SE rafsi from tertau gets us into much more trouble. To understand why, re­call that lujvo, following their veljvo, describe some type of whatever their ter­tau de­scribe. Thus, “posydji” describes a type of “djica”, “gerzda” describes a type of “zdani”, and so on. What is certain is that “gerzda” does not describe a “se zdani” — it is not a word that could be used to describe an inhabitant such as a dog.

<p>

<ex "blue-eyed">Now consider how we would translate the word “blue-eyed”. Let's tentatively trans­late this word as “blakanla” (from “blanu kanla”, meaning “blue eye”). But imme­diately we are in trouble: we cannot say

<p>

<pre><a name=e10d1>10.1) la djak. cu blakanla

Jack is-a-blue-eye

</pre>because Jack is not an eye, “kanla”, but someone with an eye, “se kanla”. At best we can say

<p>

<pre><a name=e10d2>10.2) la djak. cu se blakanla

Jack is-the-bearer-of-blue-eyes

</pre><p>But look now at the place structure of “blakanla”: it is a symmetrical lujvo, so the place structure is:

<p>

<pre><a name=e10d3>10.3) bl1=k1 is a blue eye of bl2=k2

</pre><p>We end up being most interested in talking about the second place, not the first (we talk much more of people than of their eyes), so “se” would almost always be required.

<p>

What is happening here is that we are translating the tertau wrongly, under the influ­ence of English. The English suffix “-eyed” does not mean “eye”, but someone with an eye, which is “selkanla”.

<p>

Because we've got the wrong tertau (eliding a “se” that really should be there), any attempt to accommodate the resulting lujvo into our guidelines for place structure is fit­ting a square peg in a round hole. Since they can be so misleading, lujvo with SE rafsi elided from the tertau should be avoided in favor of their more explicit counter­parts: in this case, “blaselkanla”.

<p>

### <a name=s11><h3>Eliding KE and KEhE rafsi from lujvo</h3>

<p>

<cx "lujvo place structure, dropping “KE”"><cx "lujvo place structure, dropping “KEhE”">People constructing lujvo usually want them to be as short as possible. To that end, they will discard any cmavo they regard as ni­ceties. The first such cmavo to get thrown out are usually “ke” and “ke'e”, the cmavo used to structure and group tanru. We can usu­ally get away with this, because the interpretation of the tertau with “ke” and “ke'e” missing is less plausible than that with the cmavo inserted, or because the distinction isn't really important.

<p>

<cx "beefsteak"><ex "beefsteak">For example, in “bakrecpa'o”, meaning “beefsteak”, the veljvo is

<p>

<pre><a name=e11d1>11.1) [ke] bakni rectu [ke'e] panlo

( bovine meat ) slice

</pre>because of the usual Lojban left-grouping rule. But there doesn't seem to be much dif­ference between that veljvo and

<p>

<pre><a name=e11d2>11.2) bakni ke rectu panlo [ke'e]

bovine ( meat slice )

</pre><ex "sneak in">On the other hand, the lujvo “zernerkla”, meaning “to sneak in”, almost cer­tainly was formed from the veljvo

<p>

<pre><a name=e11d3>11.3) zekri ke nenri klama [ke'e]

crime ( inside go )

to go within, criminally

</pre>because the alternative,

<p>

<pre><a name=e11d4>11.4) [ke] zekri nenri [ke'e] klama

(crime inside) go

</pre>doesn't make much sense. (To go to the inside of a crime? To go into a place where it is criminal to be inside — an interpretation almost identical with <a href=#e11d3>Example 11.3 </a>anyway?)

<p>

<cx "shellfish"><ex "shellfish">There are cases, however, where omitting a KE or KEhE rafsi can produce an­other lujvo, equally useful. For example, “xaskemcakcurnu” means “oceanic shellfish”, and has the veljvo

<p>

<pre><a name=e11d5>11.5) xamsi ke calku curnu

ocean type-of (shell worm)

</pre><cx "invertebrate">(“worm” in Lojban refers to any invertebrate), but “xascakcurnu” has the veljvo

<p>

<pre><a name=e11d6>11.6) [ke] xamsi calku [ke'e] curnu

(ocean shell) type-of worm

</pre><cx "parasitic worms"><cx "clamshells">and might refer to the parasitic worms that infest clamshells.

<p>

<cx "misinterpretation"><cx "lujvo creation, interaction of KE with SE"><cx "lujvo creation, interaction of KE with NAhE">Such misinterpretation is more likely than not in a lujvo start­ing with “sel-” (from “se”), “nal-” (from “na'e”) or “tol-” (from “to'e”): the scope of the rafsi will like­liest be presumed to be as narrow as possi­ble, since all of these cmavo normally bind only to the following brivla or “ke <dots>…</dots>ke'e” group. For that reason, if we want to modify an entire lujvo by putting “se”, “na'e” or “to'e” before it, it's better to leave the result as two words, or else to insert “ke”, than to just stick the SE or NAhE rafsi on.

<p>

It is all right to replace the phrase “se klama” with “selkla”, and the places of “selkla” are exactly those of “se klama”. But con­sider the related lujvo “dzukla”, meaning “to walk to somewhere”. It is a symmmetrical lujvo, derived from the veljvo “cadzu klama” as fol­lows:

<p>

<pre><a name=e11d7> “cadzu”: c1 walks on surface c2 using limbs c3

“klama”: k1 goes to k2 from k3 via route k4 using k5

“dzukla”: c1=k1 walks to k2 from k3 via route k4 using limbs k5=c3

on surface c2

</pre><p>We can swap the k1 and k2 places using “se dzukla”, but we cannot directly make “se dzukla” into “seldzukla”, which would represent the veljvo “selcadzu klama” and plau­sibly mean something like “to go to a walking surface”. Instead, we would need “selkemdzukla”, with an explicit rafsi for “ke”. Similarly, “nalbrablo” (from “na'e barda bloti”) means “non-big boat”, whereas “na'e brablo” means “other than a big boat”.

<p>

<cx "lujvo creation, use of multiple SE in">If the lujvo we want to modify with SE has a seltau already starting with a SE rafsi, we can take a shortcut. For instance, “gekmau” means “happier than”, while “selgekmau” means “making people happier than, more enjoyable than, more of a 'se gleki' than”. If something is less enjoyable than something else, we can say it is “se selgekmau”.

<p>

But we can also say it is “selselgekmau”. Two “se” cmavo in a row cancel each other (“se se gleki” means the same as just “gleki”), so there would be no good reason to have “selsel” in a lujvo with that meaning. Instead, we can feel free to inter­pret “selsel-” as “selkemsel-”. The rafsi combinations “terter-”, “velvel-” and “xelxel-” work in the same way.

<p>

Other SE combinations like “selter-”, although they might conceivably mean “se te”, more than likely should be interpreted in the same way, namely as “se ke te”, since there is no need to re-or­der places in the way that “se te” provides. (See <a href=chap9.html>Chapter 9</a>.)

<p>

### <a name=s12><h3>Abstract lujvo</h3>

<p>

<cx "lujvo, abstract"><cx "abstract lujvo"><cx "lujvo place structure, “nu” lujvo">The cmavo of NU can participate in the construction of lujvo of a particularly simple and well-patterned kind. Consider that old standard example, “klama”:

<p>

<pre><a name=e12d1>12.1) k1 comes/goes to k2 from k3 via route k4 by means k5.

</pre><p>The selbri “nu klama [kei]” has only one place, the event-of-going, but the full five places exist implicitly between “nu” and “kei”, since a full bridi with all sumti may be placed there. In a lujvo, there is no room for such inside places, and consequently the lujvo “nunkla” (“nun-” is the rafsi for “nu”), needs to have six places:

<p>

<pre><a name=e12d2>12.2) nu1 is the event of k1's coming/going to k2 from k3 via route k4

by means k5.

</pre><p>Here the first place of “nunklama” is the first and only place of “nu”, and the other five places have been pushed down by one to occupy the second through the sixth places. Full information on “nu”, as well as the other abstractors mentioned in this section, is given in <a href=chap11.html>Chapter 11</a>.

<p>

<cx "lujvo place structure, “ni” lujvo"><cx "lujvo place structure, multi-place abstraction lujvo">For those abstractors which have a second place as well, the standard conven­tion is to place this place after, rather than before, the places of the brivla being ab­stracted. The place structure of “nilkla”, the lujvo derived from “ni klama”, is the im­posing:

<p>

<pre><a name=e12d3>12.3) ni1 is the amount of k1's coming/going to k2 from k3 via route k4

by means k5, measured on scale ni2.

</pre><p>It is not uncommon for abstractors to participate in the mak­ing of more com­plex luj­vo as well. For example, “nunsoidji”, from the veljvo

<p>

<pre><a name=e12d4>12.4) nu sonci kei djica

event-of being-a-soldier desirer

</pre>has the place structure

<p>

<pre><a name=e12d5>12.5) d1 desires the event of (s1 being a soldier of army s2) for purpose d3

</pre><cx "lujvo place order, multi-part with “NU”">where the d2 place has disappeared altogether, being replaced by the places of the sel­tau. As shown in <a href=#e12d5>Example 12.5</a>, the ordering follows this idea of replacement: the seltau places are inserted at the point where the omitted abstraction place exists in the tertau.

<p>

<cx "asymmetric lujvo">The lujvo “nunsoidji” is quite different from the ordinary asymmetric lujvo “soidji”, a “soldier desirer”, whose place structure is just

<p>

<pre><a name=e12d6>12.6) d1 desires (a soldier of army s2) for purpose d3

</pre><p>A “nunsoidji” might be someone who is about to enlist, whereas a “soidji” might be a camp-follower.

<p>

<cx "abstract lujvo, contrasted with abstract bridi">One use of abstract lujvo is to eliminate the need for explicit “kei” in tanru: “nunkalri gasnu” means much the same as “nu kalri kei gasnu”, but is shorter. In addi­tion, many English words ending in “-hood” are represented with “nun-” lujvo, and other words ending in “-ness” or “-dom” are often representable with “kam-” lujvo (“kam-” is the rafsi for “ka”); “kambla” is “blueness”.

<p>

<cx "lujvo, scope abstraction in underlying veljvo">Even though the cmavo of NU are long-scope in nature, gov­erning the whole fol­lowing bridi, the NU rafsi should generally be used as short-scope modifiers, like the SE and NAhE rafsi discussed in <a href=#s9>Section 9</a>.

<p>

<cx "lujvo, with “jai”">There is also a rafsi for the cmavo “jai”, namely “jax”, which allows sentences like

<p>

<ex "cause death"><pre><a name=e12d7>12.7) mi jai rinka le nu do morsi

I am-associated-with causing the event-of your death.

I cause your death.

</pre>explained in <a href=chap11.html>Chapter 11</a>, to be rendered with lujvo:

<p>

<pre><a name=e12d8>12.8) mi jaxri'a le nu do morsi

I am-part-of-the-cause-of the event-of your dying.

</pre><cx "lujvo place structure, with “jai” lujvo"><lx "fai"><lx "jai">In making a lujvo that contains “jax-” for a selbri that contains “jai”, the rule is to leave the “fai” place as a “fai” place of the lujvo; it does not participate in the regular luj­vo place structure. (The use of “fai” is also explained in <a href=chap11.html>Chapter 11</a>.)

<p>

### <a name=s13><h3>Implicit-abstraction lujvo</h3>

<p>

<cx "lujvo, dropping NU rafsi">Eliding NU rafsi involves the same restrictions as eliding SE rafsi, plus addi­tional ones. In general, NU rafsi should not be elided from the tertau, since that changes the kind of thing the lujvo is talk­ing about from an abstraction to a concrete sumti. However, they may be elided from the seltau if no reasonable ambiguity would result.

<p>

<cx "lujvo, NU-dropping contrasted with SE-dropping"><cx "lujvo, implicit-abstraction">A major difference, however, between SE elision and NU eli­sion is that the former is a rather sparse process, providing a few convenient shortenings. Eliding “nu”, however, is extremely important in producing a class of lujvo called “implicit-abstrac­tion lujvo”.

<p>

<ex "feed">Let us make a detailed analysis of the lujvo “nunctikezgau”, meaning “to feed”. (If you think this lujvo is excessively longwinded, be patient.) The veljvo of “nunctikezgau” is “nu citka kei gasnu”. The relevant place structures are:

<p>

<pre><a name=e13d1>13.1) “nu”: n1 is an event

“citka”: c1 eats c2

“gasnu”: g1 does action/is the agent of event g2

</pre><p>In accordance with the procedure for analyzing three-part luj­vo given in <a href=#s8>Sec­tion 8</a>, we will first create an intermediate lujvo, “nuncti”, whose veljvo is “nu citka [kei]”. By the rules given in <a href=#s12>Section 12</a>, “nuncti” has the place structure

<p>

<pre><a name=e13d2>13.2) n1 is the event of c1 eating c2

</pre><cx "lujvo place structure, dropping first place of NU">Now we can transform the veljvo of “nunctikezgau” into “nuncti gasnu”. The g2 place (what is brought about by the actor g1) obviously denotes the same thing as n1 (the event of eating). So we can eliminate g2 as redundant, leaving us with a tentative place structure of

<p>

<pre><a name=e13d3>13.3) g1 is the actor in the event n1=g2 of c1 eating c2

</pre><p>But it is also possible to omit the n1 place itself! The n1 place describes the event brought about; an event in Lojban is described as a bridi, by a selbri and its sumti; the selbri is already known (it's the seltau), and the sumti are also already known (they're in the lujvo place structure). So n1 would not give us any information we didn't already know. In fact, the n1=g2 place is dependent on c1 and c2 jointly — it does not depend on either c1 or c2 by itself. Being de­pendent and derived from the seltau, it is omissible.

So the final place structure of “nunctikezgau” is:

<p>

<pre><a name=e13d4>13.4) g1 is the actor in the event of c1 eating c2

</pre><cx "lujvo, asymmetric abstraction"><cx "abstraction lujvo, asymmetric">There is one further step that can be taken. As we have al­ready seen with “balsoi” in <a href=#s5>Section 5</a>, the interpretation of lujvo is constrained by the semantics of gismu and of their sumti places. Now, any asymmetrical lujvo with “gasnu” as its tertau will involve an event abstraction either implicitly or explicitly, since that is how the g2 place of “gasnu” is defined.

<p>

<cx "lujvo, dropping NU in implicit abstractions">Therefore, if we assume that “nu” is the type of abstraction one would expect to be a “se gasnu”, then the rafsi “nun” and “kez” in “nunctikezgau” are only telling us what we would already have guessed — that the seltau of a “gasnu” lujvo is an event. If we drop these rafsi out, and use instead the shorter lujvo “ctigau”, rejecting its symmet­rical inter­pretation (“someone who both does and eats”; “an eating doer”), we can still deduce that the seltau refers to an event.

<p>

(You can't “do an eater”/“gasnu lo citka”, with the meaning of “do” as “bring about an event”; so the seltau must refer to an event, “nu citka”. The English slang meanings of “do someone”, namely “socialize with someone” and “have sex with someone”, are not rele­vant to “gasnu”.)

<p>

So we can simply use “ctigau” with the same place structure as “nunctikezgau”:

<p>

<pre><a name=e13d5>13.5) agent g1 causes c1 to eat c2

g1 feeds c2 to c1.

</pre><cx "implicit-abstraction lujvo, definition">This particular kind of asymmetrical lujvo, in which the seltau serves as the selbri of an abstraction which is a place of the tertau, is called an implicit-abstraction lujvo, be­cause one deduces the pres­ence of an abstraction which is unexpressed (implicit).

<p>

<ex "replace">To give another example: the gismu “basti”, whose place structure is

<p>

<pre><a name=e13d6>13.6) b1 replaces b2 in circumstances b3

</pre>can form the lujvo “basygau”, with the place structure:

<p>

<pre><a name=e13d7>13.7) g1 (agent) replaces b1 with b2 in circumstances b3

</pre>where both “basti” and “basygau” are translated “replace” in English, but represent dif­ferent relations: “basti” may be used with no mention of any agent doing the replacing.

<p>

In addition, “gasnu”-based lujvo can be built from what we would consider nouns or adjectives in English. In Lojban, everything is a predicate, so adjectives, nouns and verbs are all treated in the same way. This is consistent with the use of similar causative affixes in other languages. For example, the gismu “litki”, meaning “liquid”, with the place structure

<p>

<ex "liquefy"><pre><a name=e13d8>13.8) l1 is a quantity of liquid of composition l2 under conditions l3

</pre>can give “likygau”, meaning “to liquefy”:

<p>

<pre><a name=e13d9>13.9) g1 (agent) causes l1 to be a quantity of liquid of composition l2

under conditions l3.

</pre><p>While “likygau” correctly represents “causes to be a liquid”, a different lujvo based on “galfi” (meaning “modify”) may be more ap­propriate for “causes to become a liquid”. On the other hand, “fetsygau” is potentially confusing, because it could mean “agent in the event of something becoming female” (the implicit-abstraction interpretation) or sim­ply “female agent” (the parallel interpretation), so using implicit-abstraction lujvo is al­ways accompa­nied with some risk of being mis­understood.

<p>

<ex "sun liquefies">Many other Lojban gismu have places for event abstractions, and therefore are good candidates for the tertau of an implicit-ab­straction lujvo. For example, lujvo based on “rinka”, with its place structure

<p>

<pre><a name=e13d10>13.10) event r1 causes event r2 to occur

</pre>are closely related to those based on “gasnu”. However, “rinka” is less generally useful than “gasnu”, because its r1 place is another event rather than a person: “lo rinka” is a cause, not a causer. Thus the place structure of “likyri'a”, a lujvo analogous to “likygau”, is

<p>

<pre><a name=e13d11>13.11) event r1 causes l1 to be a quantity of liquid of composition l2

under conditions l3

</pre>and would be useful in translating sentences like “The heat of the sun liquefied the block of ice.”

<p>

<cx "expressive power">Implicit-abstraction lujvo are a powerful means in the lan­guage of rendering quite verbose bridi into succinct and manageable concepts, and increasing the expres­sive power of the language.

<p>

### <a name=s14><h3>Anomalous lujvo</h3>

<p>

<cx "unusual position"><cx "lujvo, anomalous">Some lujvo that have been coined and actually employed in Lojban writing do not follow the guidelines expressed above, either because the places that are equivalent in the seltau and the tertau are in an unusual position, or because the seltau and tertau are re­lated in a complex way, or both. An example of the first kind is “jdaselsku”, meaning “prayer”, which was mentioned in <a href=#s7>Section 7</a>. The gismu places are:

<p>

<cx "lujvo place order, redundant non-first places"><ex "prayer"><pre><a name=e14d1>14.1) “lijda”: l1 is a religion with believers l2 and beliefs l3

“cusku”: c1 expresses text c2 to audience c3 in medium c4

</pre>and “selsku”, the tertau of “jdaselsku”, has the place structure

<p>

<pre><a name=e14d2>14.2) s1 is a text expressed by s2 to audience s3 in medium s4

Now it is easy to see that the l2 and s2 places are equivalent: the believer in the re­ligion (l2) is the one who expresses the prayer (s2). This is not one of the cases for which a place ordering rule has been given in <a href=#s7>Section 7 </a>or <a href=#s13>Section 13</a>; therefore, for lack of a better rule, we put the tertau places first and the remaining seltau places after them, lead­ing to the place structure:

<a name=e14d3>14.3) s1 is a prayer expressed by s2=l2 to audience s3 in medium s4

pertaining to religion l1

</pre><p>The l3 place (the beliefs of the religion) is dependent on the l1 place (the religion) and so is omitted.

<p>

We could make this lujvo less messy by replacing it with “se seljdasku”, where “seljdasku” is a normal symmetrical lujvo with place structure:

<p>

<pre><a name=e14d4>14.4) c1=l2 religiously expresses prayer c2 to audience c3 in medium s4

pertaining to religion l1

</pre>which, according to the rule expressed in <a href=#s9>Section 9</a>, can be further expressed as “selseljdasku”. However, there is no need for the ugly “selsel-” prefix just to get the rules right: “jdaselsku” is a reasonable, if anomalous, lujvo.

<p>

However, there is a further problem with “jdaselsku”, not re­solvable by using “seljdasku”. No veljvo involving just the two gismu “lijda” and “cusku” can fully ex­press the relationship implicit in prayer. A prayer is not just anything said by the adher­ents of a religion; nor is it even anything said by them acting as adherents of that religion. Rather, it is what they say under the authority of that religion, or using the religion as a medium, or following the rules associated with the religion, or something of the kind. So the veljvo is somewhat elliptical.

<p>

As a result, both “seljdasku” and “jdaselsku” belong to the second class of anoma­lous lujvo: the veljvo doesn't really supply all that the lujvo requires.

<p>

<cx "sheepdog"><ex "sheepdog"><cx "sheep breed"><cx "lujvo place order, non-overlapping place structures"><cx "lujvo place order, complex relation">Another example of this kind of anomalous lujvo, drawn from the tanru lists in <a href=chap5.html>Chapter 5</a>, is “lange'u”, meaning “sheepdog”. Clearly a sheepdog is not a dog which is a sheep (the symmetrical interpre­tation is wrong), nor a dog of the sheep breed (the asym­metrical in­terpretation is wrong). Indeed, there is simply no overlap in the places of “lanme” and “gerku” at all. Rather, the lujvo refers to a dog which controls sheep flocks, a “terlanme jitro gerku”, the lujvo from which is “terlantroge'u” with place structure:

<p>

<pre><a name=e14d5>14.5) g1=j1 is a dog that controls sheep flock l3=j2 made up of sheep l1

in activity j3 of dog breed g2

</pre>based on the gismu place structures

<p>

<pre><a name=e14d6>14.6) “lanme”: l1 is a sheep of breed l2 belonging to flock l3

“gerku”: g1 is a dog of breed g2

“jitro”: j1 controls j2 in activity j3

</pre><p>Note that this lujvo is symmetrical between “lantro” (sheep-controller) and “gerku”, but “lantro” is itself a asymmetrical lujvo. The l2 place, the breed of sheep, is removed as dependent on l1. How­ever, the lujvo “lange'u” is both shorter than “terlantroge'u” and suffi­ciently clear to warrant its use: its place structure, however, should be the same as that of the longer lujvo, for which “lange'u” can be under­stood as an abbreviation.

<p>

<ex "beckon"><cx "lujvo place order, elliptical lujvo">Another example is “xanmi'e”, “to command by hand, to beckon”. The com­ponent place structures are:

<p>

<pre><a name=e14d7>14.7) “xance”: xa1 is the hand of xa2

“minde”: m1 gives commands to m2 to cause m3 to happen

</pre><p>The relation between the seltau and tertau is close enough for there to be an overlap: xa2 (the person with the hand) is the same as m1 (the one who commands). But inter­preting “xanmi'e” as a symmetrical lujvo with an elided “sel-” in the seltau, as if from “se xance mindu”, misses the point: the real relation expressed by the lujvo is not just “one who commands and has a hand”, but “to command using the hand”. The concept of “using” suggests the gismu “pilno”, with place structure

<p>

<pre><a name=e14d8>14.8) p1 uses tool p2 for purpose p3

</pre><p>Some possible three-part veljvo are (depending on how strictly you want to constrain the veljvo)

<p>

<pre><a name=e14d9>14.9) [ke] xance pilno [ke'e] minde

(hand user) type-of commander

<a name=e14d10>14.10) [ke] minde xance [ke'e] pilno

(commander hand) type-of user

</pre>or even

<p>

<pre><a name=e14d11>14.11) minde ke xance pilno [ke'e]

commander type-of (hand user)

</pre>which lead to the three different lujvo “xanplimi'e”, “mi'erxanpli”, and “minkemxanpli” respectively.

<p>

<cx "latent component">Does this make “xanmi'e” wrong? By no means. But it does mean that there is a la­tent component to the meaning of “xanmi'e”, the gismu “pilno”, which is not ex­plicit in the veljvo. And it also means that, for a place structure derivation that actually makes sense, rather than being ad-hoc, the Lojbanist should probably go through a deri­va­tion for “xancypliminde” or one of the other possibilities that is analo­gous to the analysis of “terlantroge'u” above, even if he or she de­cides to stick with a shorter, more convenient form like “xanmi'e”. In addition, of course, the possibilities of elliptical luj­vo increase their potential ambiguity enormously — an unavoidable fact which should be borne in mind.

<p>

### <a name=s15><h3>Comparatives and superlatives</h3>

<p>

<cx "lujvo, comparatives"><cx "lujvo, superlatives">English has the concepts of “comparative adjectives” and “superlative adjec­tives” which can be formed from other adjectives, either by adding the suffixes “-er” and “-est” or by using the words “more” and “most”, respectively. The Lojbanic equivalents, which can be made from any brivla, are lujvo with the tertau “zmadu”, “mleca”, “zenba”, “jdika”, and “traji”. In order to make these lujvo regular and easy to make, certain special guidelines are imposed.

<p>

We will begin with lujvo based on “zmadu” and “mleca”, whose place struc­tures are:

<p>

<pre><a name=e15d1>15.1) “zmadu”: z1 is more than z2 in property z3 in quantity z4

“mleca”: m1 is less than m2 in property m3 in quantity m4

</pre><p>For example, the concept “young” is expressed by the gismu “citno”, with place struc­ture

<p>

<pre><a name=e15d2>15.2) “citno”: c1 is young

</pre><cx "lujvo place order, comparatives"><ex "younger">The comparative concept “younger” can be expressed by the lujvo “citmau” (based on the veljvo “citno zmadu”, meaning “young more-than”).

<p>

<pre><a name=e15d3>15.3) mi citmau do lo nanca be li xa

I am-younger-than you by-years the-number six.

I am six years younger than you.

</pre><p>The place structure for “citmau” is

<p>

<pre><a name=e15d4>15.4) z1=c1 is younger than z2=c1 by amount z4

</pre><p>Similarly, in Lojban you can say:

<p>

<pre><a name=e15d5>15.5) do citme'a mi lo nanca be li xa

You are-less-young-than me by-years the-number six.

You are six years less young than me.

</pre><p>In English, “more” comparatives are easier to make and use than “less” comparatives, but in Lojban the two forms are equally easy.

<p>

Because of their much simpler place structure, lujvo ending in “mau” and “me'a” are in fact used much more frequently than “zmadu” and “mleca” themselves as selbri. It is highly unlikely for such lujvo to be construed as anything other than im­plicit-abstraction lujvo. But there is another type of ambiguity relevant to these lujvo, and which has to do with what is being compared.

<p>

<cx "comparative lujvo, potential ambiguity in">For example, does “nelcymau” mean “X likes Y more than X likes Z”, or “X likes Y more than Z likes Y”? Does “klamau” mean: “X goes to Y more than to Z”, “X goes to Y more than Z does”, “X goes to Y from Z more than from W”, or what?

<p>

<cx "comparative lujvo, standardized meanings"><cx "lujvo place structure, comparative lujvo">We answer this concern by putting regularity above any con­siderations of con­cept usefulness: by convention, the two things be­ing compared always fit into the first place of the seltau. In that way, each of the different possible interpretations can be ex­pressed by SE-converting the seltau, and making the required place the new first place. As a result, we get the following comparative lujvo place structures:

<p>

<pre><a name=e15d6>15.6) “nelcymau”: z1, more than z2, likes n2 by amount z4

“selnelcymau”: z1, more than z2, is liked by n1 in amount z4

“klamau”: z1, more than z2, goes to k2 from k3 via k4 by means of k5

“selklamau”: z1, more than z2, is gone to by k1 from k3 via k4

by means of k5

“terklamau”: z1, more than z2, is an origin point from destination k2

for k1's going via k4 by means of k5

</pre>(See <a href=chap11.html>Chapter 11 </a>for the way in which this problem is resolved when lujvo aren't used.)

<p>

The ordering rule places the things being compared first, and the other seltau places following. Unfortunately the z4 place, which expresses by how much one entity exceeds the other, is displaced into a lujvo place whose number is different for each lujvo. For exam­ple, while “nelcymau” has z4 as its fourth place, “klamau” has it as its sixth place. In any sentence where a difficulty arises, this amount-place can be redun­dantly tagged with “vemau” (for “zmadu”) or “veme'a” (for “mleca”) to help make the speaker's inten­tion clear.

<p>

<cx "nonagenarian"><cx "octogenarian"><cx "comparative lujvo, and seltau presupposition">It is important to realize that such comparative lujvo do not presuppose their seltau. Just as in English, saying someone is younger than someone else doesn't imply that they're young in the first place: an octogenarian, after all, is still younger than a nonage­narian. Rather, the 80-year-old has a greater “ni citno” than the 90-year-old. Similarly, a 5-year-old is older than a 1-year-old, but is not considered “old” by most standards.

<p>

<cx "former state"><cx "comparative lujvo, against former state">There are some comparative concepts which are in which the “se zmadu” is difficult to specify. Typically, these involve comparisons implicitly made with a former state of affairs, where stating a z2 place explicitly would be problematic.

<p>

In such cases, it is best not to use “zmadu” and leave the comparison hanging, but to use instead the gismu “zenba”, meaning “increase” (and “jdika”, meaning “decrease”, in place of “mleca”). The gismu “zenba” was included in the language pre­cisely in order to capture those notions of increase which “zmadu” can't quite cope with; in addition, we don't have to waste a place in lujvo or tanru on something that we'd never fill in with a value anyway. So we can translate “I'm stronger now” not as

<p>

<pre><a name=e15d7>15.7) mi ca tsamau

I now am-stronger.

</pre>which implies that I'm currently stronger than somebody else (the elided occu­pant of the second or z2 place), but as

<p>

<pre><a name=e15d8>15.8) mi ca tsaze'a

I increase in strength.

</pre><p>Finally, lujvo with a tertau of “traji” are used to build superla­tives. The place struc­ture of “traji” is

<p>

<pre><a name=e15d9>15.9) t1 is superlative in property t2, being the t3 extremum (largest by default)

of set t4

</pre><p>Consider the gismu “xamgu”, whose place structure is:

<p>

<pre><a name=e15d10>15.10) xa1 is good for xa2 by standard xa3

</pre><ex "better">The comparative form is “xagmau”, corresponding to English “better”, with a place structure (by the rules given above) of

<p>

<pre><a name=e15d11>15.11) z1 is better than z2 for xa2 by standard xa3 in amount z4

</pre><cx "lujvo place structure, superlatives"><cx "lujvo place order, superlatives">We would expect the place structure of “xagrai”, the superlative form, to somehow mir­ror that, given that comparatives and superlatives are comparable concepts, resulting in:

<p>

<pre><a name=e15d12>15.12) xa1=t1 is the best of the set t4 for xa2 by standard xa3.

</pre><p>The t2 place in “traji”, normally filled by a property abstraction, is re­placed by the sel­tau places, and the t3 place specifying the extremum of “traji” (whether the most or the least, that is) is presumed by default to be “the most”.

<p>

<cx "lujvo place order, superlatives as exceptions">But the set against which the t1 place of “traji” is compared is not the t2 place (which would make the place structure of “traji” fully parallel to that of “zmadu”), but rather the t4 place. Nevertheless, by a special exception to the rules of place ordering, the t4 place of “traji”-based lujvo becomes the second place of the lujvo. Some exam­ples:

<p>

<pre><a name=e15d12>15.13) la djudis. cu citrai lo'i lobypli

Judy is the youngest of all Lojbanists.

<pre><a name=e15d13>15.14) la ainctain. cu balrai lo'i skegunka

Einstein was the greatest of all scientists.

### </pre><a name=s16><h3>Notes on gismu place structures</h3>

<p>

<cx "gismu place structures"><cx "place structure, gismu">Unlike the place structures of lujvo, the place structures of gismu were as­signed in a far less systematic way through a detailed case-by-case analysis and re­peated reviews with associated changes. (The gismu list is now baselined, so no further changes are con­templated.) Nevertheless, certain regularities were imposed both in the choice of places and in the ordering of places which may be helpful to the learner and the lujvo-maker, and which are therefore discussed here.

<p>

<cx "gismu place structures, rationale">The choice of gismu places results from the varying outcome of four different pres­sures: brevity, convenience, metaphysical ne­cessity, and regularity. (These are also to some extent the underlying factors in the lujvo place structures generated by the methods of this chapter.) The implications of each are roughly as follows:

<p>

* <dl compact><dt><dd>Brevity tends to remove places: the fewer places a gismu has, the easier it is to learn, and the less specific it is. As mentioned in <a href=#s4>Section 4</a>, a brivla with fewer place structures is less specific, and generality is a virtue in gismu, because they must thoroughly blanket all of se­mantic space.
* <p><dt><dd>Convenience tends to increase the number of places: if a concept can be expressed as a place of some existing gismu, there is no need to make an­other gismu, a lujvo or a fu'ivla for it.
* <p><dt><dd>Metaphysical necessity can either increase or decrease places: it is a pres­sure tending to provide the “right number” of places. If something is part of the essential nature of a concept, then a place must be made for it; on the other hand, if instances of the concept need not have some property, then this pressure will tend to re­move the place.
* <p><dt><dd>Regularity is a pressure which can also either increase or decrease places. If a gismu has a given place, then gismu which are semantically related to it are likely to have the place also.

</dl><p>Here are some examples of gismu place structures, with a discussion of the pressures operating on them:

<p>

<pre><a name=e16d1>16.1) “xekri”: xe1 is black

</pre><cx "color standards">Brevity was the most important goal here, reinforced by one inter­pretation of meta­physi­cal necessity. There is no mention of color standards here, as many people have pointed out; like all color gismu, “xekri” is explicitly subjective. Objective color stan­dards can be brought in by an appropriate BAI tag such as “ci'u” (“in system”; see <a href=chap9.html>Chapter 9</a>) or by making a lujvo.

<p>

<pre><a name=e16d2>16.2) “jbena”: j1 is born to j2 at time j3 and location j4

</pre><p>The gismu “jbena” contains places for time and location, which few other gismu have: normally, the time and place at which something is done is supplied by a tense tag (see <a href=chap10.html>Chapter 10</a>). However, providing these places makes “le te jbena” a simple term for “birthday” and “le ve jbena” for “birthplace”, so these places were provided despite their lack of metaphysical necessity.

<p>

<pre><a name=e16d3>16.3) “rinka”: event r1 is the cause of event r2

</pre><cx "melting">The place structure of “rinka” does not have a place for the agent, the one who causes, as a result of the pressure toward metaphysical ne­cessity. A cause-effect relationship does not have to include an agent: an event (such as snow melting in the mountains) may cause another event (such as the flooding of the Nile) without any human inter­vention or even knowledge.

<p>

<cx "lujvo, as suppliers of agent place">Indeed, there is a general tendency to omit agent places from most gismu ex­cept for a few such as “gasnu” and “zukte” which are then used as tertau in order to restore the agent place when needed: see <a href=#s13>Section 13</a>.

<p>

<pre><a name=e16d4>16.4) “cinfo”: c1 is a lion of species/breed c2

</pre><cx "general terms"><cx "diversified species">The c2 place of “cinfo” is provided as a result of the pressure toward regularity. All ani­mal and plant gismu have such an x2 place; al­though there is in fact only one species of lion, and breeds of lion, though they exist, aren't all that important in talking about lions. The species/breed place must exist for such diversified species as dogs, and for general terms like “cinki” (insect), and are provided for all other animals and plants as a matter of regularity.

<p>

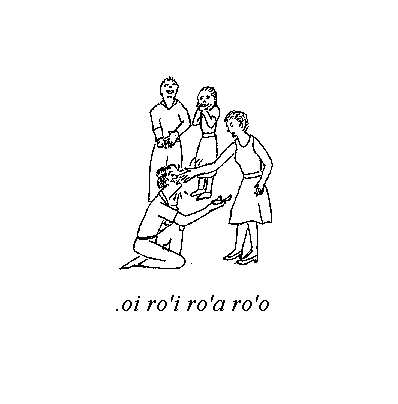
<cx "gismu place order, rationale">Less can be said about gismu place structure ordering, but some regularities are ap­parent. The places tend to appear in de­creasing order of psychological saliency or impor­tance. There is an implication within the place structure of “klama”, for example, that “lo klama” (the one going) will be talked about more often, and is thus more im­portant, than “lo se klama” (the destination), which is in turn more important than “lo xe klama” (the means of transport).

<p>

Some specific tendencies (not really rules) can also be ob­served. For example, when there is an agent place, it tends to be the first place. Similarly, when a destination and an origin point are men­tioned, the destination is always placed just before the ori­gin point. Places such as “under conditions” and “by standard”, which often go unfilled, are moved to near the end of the place structure.

<p>

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## <h2>Chapter 13

## <br>

## Oooh! Arrgh! Ugh! Yecch! Attitudinal and Emotional Indica­tors</h2>

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### <a name=s1><h3>What are attitudinal indicators?</h3>

<cx "attitude"><cx "punctuation"><cx "tone of voice"><cx "feeling"><cx "emotion">This chapter explains the various words that Lojban provides for expressing attitude and related notions. In natural languages, at­titudes are usually expressed by the tone of voice when speaking, and (very imperfectly) by punctuation when writing. For example, the bare words

<p>

<pre><a name=e1d1>1.1) John is coming.

</pre>can be made, through tone of voice, to express the speaker's feeling of happiness, pity, hope, surprise, or disbelief. These fine points of tone cannot be expressed in writing. At­titudes are also expressed with various sounds which show up in print as oddly spelled words, such as the “Oooh!”, “Arrgh!”, “Ugh!”, and “Yecch!” in the title. These are part of the English language; people born to other languages use a different set; yet you won't find any of these words in a dictionary.

<p>

<cx "attitudinal indicators">In Lojban, everything that can be spoken can also be written. Therefore, these tones of voice must be represented by explicit words known as “attitudinal indicators”, or just “attitudinals”. This rule seems awkward and clunky to English-speakers at first, but is an essential part of the Lojbanic way of doing things.

<p>

<cx "attitidinals, prevailing attitude"><cx "attitidinals, placement for prevailing attitude">The simplest way to use attitudinal indicators is to place them at the beginning of a text. In that case, they express the speaker's prevailing attitude. Here are some ex­amples, correlated with the atti­tudes mentioned following <a href=#e1d1>Example 1.1</a>:

<p>

<ex "John is coming"><lx ".ui"><pre><a name=e1d2>1.2) .ui la djan klama

[Whee!] John is coming!

</pre><lx ".uu"><pre><a name=e1d3>1.3) .uu la djan klama

[Alas!] John is coming.

</pre><lx ".a'o"><pre><a name=e1d4>1.4) .a'o la djan klama

[Hopefully] John is coming.

</pre><lx ".ue"><pre><a name=e1d5>1.5) .ue la djan klama

[Wow!] John is coming!

</pre><lx ".ianai"><pre><a name=e1d6>1.6) .ianai la djan klama

[Nonsense!] John is coming.

</pre><cx "attitudinals, word-form for primary"><lx "UI">The primary Lojban attitudinals are all the cmavo of the form VV or V'V: one of the few cases where cmavo have been classified solely by their form. There are 39 of these cmavo: all 25 possible vowel pairs of the form V'V, the four standard diphthongs (“.ai”, “.au”, “.ei”, and “.oi”), and the ten more diphthongs that are permitted only in these atti­tudinal indicators and in names and borrowings (“.ia”, “.ie”, “.ii”, “.io”, “.iu”, “.ua”, “.ue”, “.ui”, “.uo”, and “.uu”). Note that each of these cmavo has a period before it, marking the pause that is man­datory before every word beginning with a vowel. At­titudi­nals, like most of the other kinds of indicators described in this chapter, belong to selma'o UI.

<p>

<cx "attitudinals, compound">Attitudinals can also be compound cmavo, of the types ex­plained in Sections 4-8; <a href=#e1d6>Example 1.6 </a>illustrates one such possibility, the compound attitudinal “.ianai”. In attitu­dinals, “-nai” indicates polar negation: the opposite of the simple attitudinal with­out the “-nai”. Thus, as you might suppose, “.ia” expresses belief, since “.ianai” ex­presses disbe­lief.

<p>

<cx "indicators"><cx "indicators, types of">In addition to the attitudinals, there are other classes of indi­cators: intensity markers, emotion categories, attitudinal modifiers, observationals, and discursives. All of them are grammatically equivalent, which is why they are treated together in this chapter.

<p>

<cx "indicators, placement of">Every indicator behaves in more or less the same way with respect to the grammar of the rest of the language. In general, one or more indicators can be inserted at the begin­ning of an utterance or after any word. Indicators at the beginning apply to the whole ut­ter­ance; otherwise, they apply to the word that they follow. More details can be found in <a href=#s9>Section 9</a>.

<p>

<cx "indicator tables, format convention">Throughout this chapter, tables of indicators will be written in four columns. The first column is the cmavo itself. The second col­umn is a corresponding English word, not necessarily a literal transla­tion. The fourth column represents the opposite of the second col­umn, and shows the approximate meaning of the attitudinal when suf­fixed with “-nai”. The third column, which is sometimes omitted, indicates a neutral point between the sec­ond and fourth columns, and shows the approximate meaning of the attitudinal when it is suffixed with “-cu'i”. The cmavo “cu'i” belongs to selma'o CAI, and is explained more fully in <a href=#s4>Section 4</a>.

<p>

<cx "feelings, expression of contrasted with talking about"><cx "claims, contrasted with expression of feelings">One flaw that the English glosses are particularly subject to is that in English it is often difficult to distinguish between expressing your feelings and talking about them, particularly with the limited re­source of the written word. So the gloss for “.ui” should not really be “happiness” but some sound or tone that expresses happiness. How­ever, there aren't nearly enough of those that have unambiguous or obvious meanings in Eng­lish to go around for all the many, many dif­ferent emotions Lojban speakers can readily express.

<p>

<cx "indicators, derived from gismu"><cx "indicators derived from gismu, notation convention">Many indicators of CV'V form are loosely derived from spe­cific gismu. The gismu should be thought of as a memory hook, not an equivalent of the cmavo. Such gismu are shown in this chapter between square brackets, thus: [gismu].

<p>

### <a name=s2><h3>Pure emotion indicators</h3>

<p>

<cx "attitudinals and claims"><cx "attitudinals and truth value">Attitudinals make no claim: they are expressions of attitude, not of facts or al­leged facts. As a result, attitudinals themselves have no truth value, nor do they directly affect the truth value of a bridi that they modify. However, since emotional attitudes are carried in your mind, they reflect reactions to that version of the world that the mind is thinking about; this is seldom identical with the real world. At times, we are thinking about our idealized version of the real world; at other times we are thinking about a potential world that might or might not ever exist.

<p>

<cx "attitudinals, pure emotion"><cx "attitudinals, u- series"><cx "attitudinals, o- series"><cx "attitudinals, i- series">Therefore, there are two groups of attitudinals in Lojban. The “pure emotion indica­tors” express the way the speaker is feeling, without direct reference to what else is said. These indicators com­prise the attitudinals which begin with “u” or “o” and many of those beginning with “i”.

<p>

<cx "attitudinals for emotional reaction">The cmavo beginning with “u” are simple emotions, which represent the speaker's reaction to the world as it is, or as it is per­ceived to be.

<p>

<pre> .ua discovery confusion

.u'a gain loss

.ue surprise no surprise expectation

.u'e wonder commonplace

.ui happiness unhappiness

.u'i amusement weariness

.uo completion incompleteness

.u'o courage timidity cowardice

.uu pity cruelty

.u'u repentance lack of regret innocence

</pre><p>Here are some typical uses of the “u” attitudinals:

<p>

<ex "Eureka!"> <pre><a name=e2d1>2.1) .ua mi facki fi le mi mapku

[Eureka!] I found my hat! [emphasizes the discovery of the hat]

<a name=e2d2>2.2) .u'a mi facki fi le mi mapku

[Gain!] I found my hat! [emphasizes the obtaining of the hat]

</pre><ex "Yay!"><ex "Hooray!"><pre><a name=e2d3>2.3) .ui mi facki fi le mi mapku

[Yay!] I found my hat! [emphasizes the feeling of happiness]

<a name=e2d4>2.4) .uo mi facki fi le mi mapku

[At last!] I found my hat! [emphasizes that the finding is complete]

</pre><ex "sympathy"><pre><a name=e2d5>2.5) .uu do cortu

[Pity!] You feel-pain. [expresses speaker's sympathy]

<a name=e2d6>2.6) .u'u do cortu

[Repentance!] You feel-pain. [expresses that speaker feels guilty]

</pre><cx "attitudinal phrase">In <a href=#e2d4>Example 2.4</a>, note that the attitudinal “.uo” is translated by an English non-attitu­dinal phrase: “At last!” It is common for the Eng­lish equivalents of Lojban attitu­dinals to be short phrases of this sort, with more or less normal grammar, but actually expressions of emo­tion.

<p>

<lx "uu"><lx "u'u"><cx "uu, contrasted with u'u"><cx "u'u, contrasted with uu">In particular, both “.uu” and “.u'u” can be translated into Eng­lish as “I'm sorry”; the difference between these two attitudes fre­quently causes confusion among English-speak­ers who use this phrase, leading to responses like “Why are you sorry? It's not your fault!”

<p>

<cx "attitudinals and irony">It is important to realize that “.uu”, and indeed all attitudinals, are meant to be used sincerely, not ironically. In English, the excla­mation “Pity!” is just as likely to be ironi­cally intended, but this usage does not extend to Lojban. Lying with attitudinals is (normally) as in­appropriate to Lojban discourse as any other kind of lying: perhaps worse, because misunderstood emotions can cause even greater problems than misun­der­stood statements.

<p>

<lx "nai"><lx "cu'i"><cx "attitudinals, effect of nai"><cx "attitudinals, effect of cu'i">The following examples display the effects of “nai” and “cu'i” when suffixed to an attitudinal:

<p>

<pre><a name=e2d7>2.7) .ue la djan. klama

[Surprise!] John comes.

<a name=e2d8>2.8) .uecu'i la djan. klama

[Ho hum.] John comes.

<a name=e2d9>2.9) .uenai la djan. klama

[Expected!] John comes.

</pre><p>In <a href=#e2d9>Example 2.9</a>, John's coming has been anticipated by the speaker. In <a href=#e2d7>Example 2.7 </a>and <a href=#e2d8>Example 2.8</a>, no such anticipation has been made, but in <a href=#e2d7>Example 2.7 </a>the lack-of-an­tici­pation goes no further — in <a href=#e2d8>Example 2.8</a>, it amounts to actual surprise.

<p>

<cx "attitudinals, complex emotion words"><cx "attitudinals, ambivalent emotion words"><cx "attitudinals, difficult emotion words">It is not possible to firmly distinguish the pure emotion words beginning with “o” or “i” from those beginning with “u”, but in general they represent more complex, more ambivalent, or more difficult emotions.

<p>

<pre> .o'a pride modesty shame

.o'e closeness detachment distance

.oi complaint/pain doing OK pleasure

.o'i caution boldness rashness

.o'o patience mere tolerance anger

.o'u relaxation composure stress

</pre><p>Here are some examples:

<p>

<ex ".oi"><pre><a name=e2d10>2.10) .oi la djan. klama

[Complaint!] John is coming.

</pre><p>Here the speaker is distressed or discomfited over John's coming. The word “.oi” is de­rived from the Yiddish word “oy” of similar mean­ing. It is the only cmavo with a Yid­dish origin.

<p>

<ex ".o'onai"><pre><a name=e2d11>2.11) .o'onai la djan. klama

[Anger!] John is coming!

</pre><p>Here the speaker feels anger over John's coming.

<p>

<ex ".o'i"><pre><a name=e2d12>2.12) .o'i la djan. klama

[Beware!] John is coming.

</pre><p>Here there is a sense of danger in John's arrival.

<p>

<ex ".o'ecu'i"><pre><a name=e2d13>2.13) .o'ecu'i la djan. klama

[Detachment!] John is coming.

</pre><ex ".o'u"><pre><a name=e2d14>2.14) .o'u la djan. klama

[Phew!] John is coming.

</pre><p>In <a href=#e2d13>Example 2.13 </a>and <a href=#e2d14>Example 2.14</a>, John's arrival is no problem: in the former exam­ple, the speaker feels emotional distance from the situation; in the latter example, John's coming is actually a relief of some kind.

<p>

The pure emotion indicators beginning with “i” are those which could not be fitted into the “u” or “o” groups because there was a lack of room, so they are a mixed lot. “.ia”, “.i'a”, “.ie”, and “.i'e” do not appear here, as they belong in <a href=#s3>Section 3 </a>instead.

<p>

<pre> .ii fear nervousness security

.i'i togetherness privacy

.io respect disrespect

.i'o appreciation envy

.iu love no love lost hatred

.i'u familiarity mystery

</pre><p>Here are some examples:

<lx ".ii"><ex "Eek!"><pre><a name=e2d15>2.15) .ii smacu

[Fear!] [Observative:] a-mouse

Eek! A mouse!

</pre><lx ".iu"><pre><a name=e2d16>2.16) la djan. .iu klama

John [love!] is coming.

</pre><lx ".ionai"><pre><a name=e2d17>2.17) la djan. .ionai klama

John [disrespect!] is coming.

</pre><a href=#e2d15>Example 2.15 </a>shows an attitude-colored observative; the attitudinal modifies the situa­tion described by the observative, namely the mouse that is causing the emotion. Loj­ban-speaking toddlers, if there ever are any, will probably use sentences like <a href=#e2d15>Example 2.15 </a>a lot.

<p>

<cx "attitudinals, comparison of meaning based on position"><a href=#e2d16>Example 2.16 </a>and <a href=#e2d17>Example 2.17 </a>use attitudinals that follow “la djan.” rather than being at the beginning of the sentence. This form means that the attitude is at­tached to John rather than the event of his coming; the speaker loves or disrespects John specifi­cally. Compare:

<p>

<pre><a name=e2d18>2.18) la djan. klama .iu

John is-coming [love!]

</pre>where it is specifically the coming of John that inspires the feeling.

<p>

<a href=#e2d17>Example 2.17 </a>is a compact way of swearing at John: you could translate it as “That good-for-nothing John is coming.”

<p>

### <a name=s3><h3>Propositional attitude indicators</h3>

<p>

<cx "attitudinals, propositional indicators"><cx "propositional, of attitudinals"><cx "internal world"><cx "hypothetical world">As mentioned at the beginning of <a href=#s2>Section 2</a>, attitudinals may be divided into two groups, the pure emotion indicators explained in that section, and a contrasting group which may be called the “propositional attitude indicators”. These indicators es­tablish an inter­nal, hypothetical world which the speaker is reacting to, distinct from the world as it really is. Thus we may be expressing our attitude to­wards “what the world would be like if <dots>…</dots>”, or more directly stating our attitude towards making the potential world a reality.

<p>

<cx "attitudinals, emotional contrasted with propositional"><cx "attitudinals, propositional contrasted with emotional"><cx "attitudinals, propositional effect on claim">In general, the bridi paraphrases of pure emotions look (in English) something like “I'm going to the market, and I'm happy about it”. The emotion is present with the subject of the primary claim, but is logically independent of it. Propositional attitudes, though, look more like “I intend to go to the market”, where the main claim is logically subordi­nate to the intention: I am not claiming that I am actually going to the market, but merely that I intend to.

<p>

<cx "attitudinals, a- series"><cx "attitudinals, e- series"><cx "attitudinals, i- series">There is no sharp distinction between attitudinals beginning with “a” and those be­ginning with “e”; however, the original intent (not entirely realized due to the need to cram too many attitudes into too little space) was to make the members of the “a”-series the purer, more attitudinal realizers of a potential world, while the members of the “e”-series were more ambivalent or complex about the speaker's intention with regard to the predication. The relationship between the “a”-series and the “e”-series is similar to that between the “u”-series and the “o”-series, respectively. A few propositional attitude indi­cators overflowed into the “i”-series as well.

<p>

<cx "attitudinals, emotional/propositional caveat"><cx "attitudinals, propositional/emotional caveat"><cx "attitudinals, logical language and">In fact, the entire distinction between pure emotions and propositional attitudes is it­self a bit shaky: “.u'u” can be seen as a propositional attitude indicator meaning “I regret that <dots>…</dots>”, and “a'e” (discussed below) can be seen as a pure emotion meaning “I'm awake/aware”. The division of the attitudinals into pure-emotion and propositional-at­titude classes in this chapter is mostly by way of ex­planation; it is not intended to per­mit firm rulings on specific points. Attitudinals are the part of Lojban most distant from the “logical lan­guage” aspect.

<p>

Here is the list of propositional attitude indicators grouped by initial letter, starting with those beginning with “a”:

<p>

<pre> .a'a attentive inattentive avoiding

.a'e alertness exhaustion

.ai intent indecision refusal

.a'i effort no real effort repose

.a'o hope despair

.au desire indifference reluctance

.a'u interest no interest repulsion

</pre><p>Some examples (of a parental kind):

<p>

<lx ".a'a"><pre><a name=e3d1>3.1) .a'a do zgana le veltivni

[attentive] you observe the television-receiver.

I'm noticing that you are watching the TV.

</pre><lx ".a'enai"><pre><a name=e3d2>3.2) .a'enai do ranji bacru

[exhaustion] you continuously utter.

I'm worn out by your continuous talking.

</pre><lx ".ai"><pre><a name=e3d3>3.3) .ai mi benji do le ckana

[intent] I transfer you to-the bed.

I'm putting you to bed.

</pre><lx ".a'i"><pre><a name=e3d4>3.4) .a'i mi ba gasnu le nu do cikna binxo

[effort] I [future] am-the-actor-in the event-of you awake-ly become.

It'll be hard for me to wake you up.

</pre><lx ".a'o"><pre><a name=e3d5>3.5) .a'o mi kanryze'a ca le bavlamdei

[hope] I am-health-increased at-time the future-adjacent-day.

I hope I feel better tomorrow!

</pre><lx ".au"><pre><a name=e3d6>3.6) .au mi sipna

[desire] I sleep.

I want to sleep.

</pre><lx ".a'ucu'i"><pre><a name=e3d7>3.7) a'ucu'i do pante

[no interest] you complain

I have no interest in your complaints.

</pre>(In a real-life situation, Examples 3.1-3.7 would also be decorated by various pure emo­tion indicators, certainly including “.oicai”, but probably also “.iucai”.)

<p>

<cx "attitudinals, contrasted with bridi"><cx "attitudinals, rationale for">Splitting off the attitude into an indicator allows the regular bridi grammar to do what it does best: express the relationships be­tween concepts that are intended, de­sired, hoped for, or whatever. Rephrasing these examples to express the attitude as the main selbri would make for unacceptably heavyweight grammar.

<p>

Here are the propositional attitude indicators beginning with “e”, which stand roughly in the relation to those beginning with “a” as the pure-emotion indicators be­gin­ning with “o” do to those beginning with “u” — they are more complex or difficult:

<p>

<pre> .e'a permission prohibition

.e'e competence incompetence

.ei obligation freedom

.e'i constraint independence resistance to constraint

.e'o request negative request

.e'u suggestion no suggestion warning

</pre><ex "after sleep">More examples (after a good night's sleep):

<p>

<lx ".e'a"><pre><a name=e3d8>3.8) .e'a do sazri le karce

[permission] You drive the car.

Sure, you can drive the car.

</pre><lx ".e'e"><pre><a name=e3d9>3.9) e'e mi lifri tu'a do

[competence] I experience something-related-to you

I feel up to dealing with you.

</pre><lx ".ei"><pre><a name=e3d10>3.10) .ei mi tisna le karce ctilyvau

[obligation] I fill the car-type-of petroleum-container.

I should fill the car's gas tank.

</pre><lx ".e'o"><pre><a name=e3d11>3.11) .e'o ko ko kurji

[request] You-imperative of-you-imperative take-care.

Please take care of yourself!

</pre><lx ".e'u"><pre><a name=e3d12>3.12) .e'u do klama le panka

[suggestion] You go to-the park.

I suggest going to the park.

</pre><p>Finally, the propositional attitude indicators beginning with “i”, which are the over­flow from the other sets:

<p>

<pre> .ia belief skepticism disbelief

.i'a acceptance blame

.ie agreement disagreement

.i'e approval non-approval disapproval

</pre><p>Still more examples (much, much later):

<p>

<lx ".ianai"><pre><a name=e3d13>3.13) .ianai do pu pensi le nu tcica mi

[disbelief] You [past] think the event-of deceiving me.

I can't believe you thought you could fool me.

</pre><lx ".i'anai"><pre><a name=e3d14>3.14) do .i'anai na xruti do le zdani

You [blame] did-not return you to-the house

I blame you for not coming home.

</pre><lx ".ie"><pre><a name=e3d15>3.15) .ie mi na cusku lu'e le tcika

be le nu xruti

[agreement] I did-not express a-symbol-for the time-of-day

of the event-of (you return)

It's true I didn't tell you when to come back.

</pre><lx ".i'enai"><lx ".i'e"><pre><a name=e3d16>3.16) .i'enai do .i'e zukte

[disapproval] you [approval] act

I don't approve of what you did, but I approve of you.

</pre><a href=#e3d16>Example 3.16 </a>illustrates the use of a propositional attitude indicator, “i'e”, in both the usual sense (at the beginning of the bridi) and as a pure emotion (attached to “do”). The event expressed by the main bridi is disapproved of by the speaker, but the referent of the sumti in the x1 place (namely the listener) is approved of.

<p>

<cx "attitudinal, signaling as non-propositional">To indicate that an attitudinal discussed in this section is not meant to indicate a propositional attitude, the simplest expedient is to split the attitudinal off into a sepa­rate sentence. Thus, a version of <a href=#e3d8>Example 3.8 </a>which actually claimed that the listener was or would be driving the car might be:

<p>

<pre><a name=e3d17>3.17) do sazri le karce .i e'a

You drive the car. [Permission].

You're driving (or will drive) the car, and that's fine.

### </pre><a name=s4><h3>Attitudes as scales</h3>

<p>

<cx "attitudinals, scale of"><cx "attitudinals, positive"><cx "attitudinals, negative"><cx "attitudinals, neutral">In Lojban, all emotions and attitudes are scales. These scales run from some extreme value (which we'll call “positive”) to an oppo­site extreme (which we'll call “negative”). In the tables above, we have seen three points on the scale: “positive”, neutral, and “negative”. The terms “positive” and “negative” are put into quotation marks because they are loaded words when applied to emotions, and the attitudinal system reflects this load­ing, which is a known cul­tural bias. Only two of the “positive” words, namely “.ii” (fear) and “.oi” (pain/complaint), represent emotions commonly thought of as less “virtuous” in most cases than their negative counterparts. But these two were felt to be instinctive, dis­tinct, and very powerful emotions that needed to be expressible in a mono­syllable when necessary, while their counterparts are less commonly expressed.

<p>

<cx "attitudinal scales, rationale for assignment">(Why the overt bias? Because there are a lot of attitudinals and they will be difficult to learn as an entire set. By aligning our scales arbitrarily, we give the mono­syllable “nai” a useful meaning and make it easier for a novice to recognize at least the positive or negative alignment of an indicator, if not the specific word. Other choices considered were “random” orientation, which would have un­known biases and be diffi­cult to learn, and orientation based on our guesses as to which scale orientations made the most fre­quent us­ages shorter, which would be biased in favor of American percep­tions of “usefulness”. If bias must exist in our indicator set, it might as well be a known bias that eases learning, and in addition might as well favor a harmonious and positive world-view.)

<p>

<cx "emotional scale"><cx "attitudinal scale, seven-position"><lx "cai"><lx "sai"><lx "ru'e"><lx "cu'i"><lx "nairu'e"><lx "naisai"><lx "naicai"><lx "CAI">In fact, though, each emotional scale has seven positions de­fined, three “positive” ones (shown below on the left), three “negative” ones (shown below on the right), and a neutral one indicating that no particular attitude on this scale is felt. The following chart indicates the seven positions of the scale and the associated cmavo. All of these cmavo, except “nai”, are in selma'o CAI.

<p>

<pre>cai sai ru'e cu'i nairu'e naisai naicai

[carmi] [tsali] [ruble] [cumki]

</pre><cx "scalar attitude"><cx "attitude, scalar">A scalar attitude is expressed by using the attitudinal word, and then following it by the desired scalar intensity. The bias creeps in because the “negative” emotions take the extra syllable “nai” to in­dicate their negative position on the axis, and thus re­quire a bit more effort to express.

<p>

<cx "attitudinal scale, usage">Much of this system is optional. You can express an attitude without a scale indica­tor, if you don't want to stop and think about how strongly you feel. Indeed, for most at­titudinals, we've found that either no scalar value is used, or “cai” is used to in­dicate es­pecially high intensity. Less often, “ru'e” is used for a recognizably weak in­tensity, and “cu'i” is used in response to the attitudinal question “pei” (see <a href=#s10>Section 10</a>) to indicate that the emotion is not felt.

<p>

<cx "attitudinal, example of scale effect">The following shows the variations resulting from intensity variation:

<p>

<lx ".ei"><pre><a name=e4d1>4.1) .ei

I ought to

(a non-specific obligation)

</pre><lx ".eicai"><pre><a name=e4d2>4.2) .eicai

I shall/must

(an intense obligation or requirement, possibly a formal one)

</pre><lx ".eisai"><ex "formal requirement"><pre><a name=e4d3>4.3) .eisai

I should

(a strong obligation or necessity, possibly an implied but not formal

requirement)

</pre><lx ".eiru'e"><pre><a name=e4d4>4.4) .eiru'e

I might

(a weak obligation — in English often mixed with permission and desire)

</pre><lx ".eicu'i"><pre><a name=e4d5>4.5) .eicu'i

No matter

(no particular obligation)

</pre><lx ".einai"><pre><a name=e4d6>4.6) .einai

I need not

(a non-obligation)

</pre><cx "attitudinal scale, stand-alone usage">You can also utter a scale indicator without a specific emo­tion. This is often used in the language: in order to emphasize a point about which you feel strongly, you mark what you are saying with the scale indicator “cai”. You could also indicate that you don't care using “cu'i” by itself.

<p>

### <a name=s5><h3>The space of emotions</h3>

<p>

<cx "attitudinal scale, as axis in emotion-space">Each of the attitude scales constitutes an axis in a multi-di­mensional space. In effect, given our total so far of 39 scales, we have a 39-dimensional space. At any given time, our emotions and attitudes are represented by a point in this 39-dimensional space, with the intensity indicators serving as coordinates along each dimen­sion. A complete attitudi­nal inventory, should one decide to express it, would consist of reading off each of the scale values for each of the emotions, with the vector sum serving as a distinct single point, which is our attitude.

<p>

<cx "compound emotions"><cx "emotions, compound"><cx "emotion, insights"><cx "emotion, when expressed">Now no one is going to ever utter a string of 100-odd attitudi­nals to express their emotions. If asked, we normally do not recog­nize more than one or two emotions at a time — usually the ones that are strongest or which most recently changed in some sig­nificant way. But the scale system provides some useful insights into a possi­ble the­ory of emotion (which might be testable using Lojban), and incidentally explains how Lojban­ists express compound emotions when they do recognize them.

<p>

<cx "attitudinal scale, neutral compared with positive + negative">The existence of 39 scales highlights the complexity of emo­tion. We also aren't bound to the 39. There are modifiers described in <a href=#s6>Section 6 </a>that multiply the set of scales by an order of magnitude. You can also have mixed feelings on a scale, which might be ex­pressed by “cu'i”, but could also be expressed by using both the “positive” and “negative” scale emotions at once. One expression of “fortitude” might be “.ii.iinai” — fear coupled with security.

<p>

<cx "attitudinals, order of"><cx "attitudinals, contrasted with rationalizations of emotion">Uttering one or more attitudinals to express an emotion re­flects several things. We will tend to utter emotions in their immediate order of importance to us. We feel several emotions at once, and our expression reflects these emotions simultaneously, although their order of importance to us is also revealing — of our attitude towards our attitude, so to speak. There is little analysis necessary; for those emotions you feel, you express them; the “vector sum” naturally ex­presses the result. This is vital to their na­ture as attitudinals — if you had to stop and think about them, or to worry about gram­mar, they wouldn't be emotions but rationalizations.

<p>

<cx "attitudinals, contrasted with bridi">People have proposed that attitudinals be expressed as bridi just like everything else; but emotions aren't logical or analytical — saying “I'm awed” is not the same as saying “Wow!!!”. The Lojban system is intended to give the effects of an analytical system without the thought involved. Thus, you can simply feel in Lojban.

<p>

<cx "attitudinals, design benefit">A nice feature of this design is that you can be simple or complex, and the system works the same way. The most immediate benefit is in learning. You only need to learn a couple of the scale words and a couple of attitude words, and you're ready to express your emotions Lojbanically. As you learn more, you can express your emotions more thor­oughly and more precisely, but even a limited vo­cabulary offers a broad range of expres­sion.

<p>

### <a name=s6><h3>Emotional categories</h3>

<p>

<cx "emotional categories"><cx "attitudinal categories"><cx "attitudinal categories, rationale">The Lojban attitudinal system was designed by starting with a long list of English emotion words, far too many to fit into the 39 available VV-form cmavo. To keep the number of cmavo limited, the emotion words in the list were grouped together by com­mon features: each group was then assigned a separate cmavo. This was like making tanru in reverse, and the result is a collection of indicators that can be com­bined, like tanru, to express very complex emotions. Some examples in a moment.

<p>

The most significant “common feature” we identified was that the emotional words on the list could easily be broken down into six major groups, each of which was assigned its own cmavo:

<p>

<lx "ro'a"><lx "ro'e"><lx "ro'i"><lx "ro'o"><lx "ro'u"><lx "re'e"><pre> ro'a social asocial antisocial

ro'e mental mindless

ro'i emotional denying emotion

ro'o physical denying physical

ro'u sexual sexual abstinence

re'e spiritual secular sacrilegious

</pre><p>Using these, we were able to assign “o'u” to mark a scale of what we might call “generalized comfort”. When you are comfortable, relaxed, satisfied, you express comfort with “o'u”, possibly followed by a scale indicator to indicate how comfortable you are. The six cmavo given above allow you to turn this scale into six separate ones, should you wish.

<p>

<ex "sexual discomfort"><ex "spiritual discomfort"><ex "embarrassment"><ex "stress"><ex "physical distress"><ex "mental discomfort"><cx "attitudinal categories, example of effect">For example, embarrassment is a social discomfort, ex­pressible as “.o'unairo'a”. Some emotions that we label “stress” in English are expressed in Lojban with “.o'unairo'i”. Physical distress can be expressed with “.o'unairo'o”, which makes a nice groan if you say it with feeling. Mental discomfort might be what you feel when you don't know the answer to the test question, but feel that you should. Most adults can recall some instance where we felt sexual discomfort, “o'unairo'u”. Spiritual discomfort, “o'unaire'e”, might be felt by a church-goer who has wandered into the wrong kind of religious building.

<p>

Most of the time when expressing an emotion, you won't categorize it with these words. Emotional expressions should be quickly expressible without having to think about them. However, we sometimes have mixed emotions within this set, as for example emo­tional discomfort coupled with physical comfort or vice versa.

<p>

<lx ".eiro'u">Coupling these six words with our 39 attitude scales, each of which has a posi­tive and negative side, already gives you far more emotional expression words than we have emotional labels in Eng­lish. Thus, you'll never see a Lojban-English emotional dictionary that covers all the Lojban possibilities. Some may be useless, but others con­vey emotions that probably never had a word for them before, though many have felt them (“.eiro'u”, for example — look it up).

<p>

<cx "attitudinals, categories with scale markers"><cx "attitudinals, categories with nai"><cx "attitudinals, stand-alone categories"><ex "ro'anai">You can use scale markers and “nai” on these six category words, and you can also use category words without specifying the emotion. Thus, “I'm trying to concen­trate” could be expressed simply as “ro'e”, and if you are feeling anti-social in some non-spe­cific way, “ro'anai” will express it.

<p>

<cx "attitudinal categories, mnemonic for">There is a mnemonic device for the six emotion categories, based on moving your arms about. In the following table, your hands begin above your head and move down your body in sequence.

<p>

<pre> ro'a hands above head social

ro'e hands on head intellectual

ro'i hands on heart emotional

ro'o hands on belly physical

ro'u hands on groin sexual

re'e hands moving around spiritual

</pre><p>The implicit metaphors “heart” for emotional and “belly” for physical are not really Loj­banic, but they work fine for English-speakers.

<p>

### <a name=s7><h3>Attitudinal modifiers</h3>

<p>

The following cmavo are discussed in this section:

<p>

<ex "self-orientation"><pre>ga'i [galtu] hauteur equal rank meekness

rank lack of rank

le'o aggressive passive defensive

vu'e [vrude] virtue (zabna) sin (mabla)

se'i [sevzi] self-orientation other-orientation

ri'e [zifre] release restraint control

fu'i [frili] with help without help with opposition

easily with difficulty

be'u lack presence satiation

need satisfaction

se'a [sevzi] self-sufficiency dependency

</pre><cx "attitudinal modifiers">It turned out that, once we had devised the six emotion categories, we also recognized some other commonalities among emotions. These tended to fit nicely on scales of their own, but generally tend not to be thought of as separate emotions. Some of these are self-explanatory, some need to be placed in context. Some of these tend to go well with only a few of the attitudinals, others go with nearly all of them. To really understand these modi­fiers, try to use them in combination with one or two of the attitudinals found in <a href=#s2>Sections 2 </a>and <a href=#s3>3</a>, and see what emotional pictures you can build:

<p>

<ex "inferior"><ex "deference"><ex "condescension"><lx "ga'i"><lx "ga'inai">The cmavo “ga'i” expresses the scale used to indicate con­descension or polite defer­ence; it is not respect in general, which is “.io”. Whatever it is attached to is marked as being below (for “ga'i”) or above (for “ga'inai”) the speaker's rank or social position. Note that it is always the referent, not the speaker or listener, who is so marked: in order to mark the listener, the listener must appear in the sentence, as with “doi ga'inai”, which can be appended to a statement addressed to a social superior.

<p>

<pre><a name=e7d1>7.1) ko ga'inai nenri klama le mi zdani

You-imperative [low-rank!] enter-type-of come-to my house.

I would be honored if you would enter my residence.

</pre><cx "imperatives, attitude">Note that imperatives in Lojban need not be imperious! Correspond­ing examples with “ga'icu'i” and “ga'inai”:

<p>

<pre><a name=e7d2>7.2) ko ga'icu'i nenri klama le mi zdani

You-imperative [equal-rank!] enter-type-of come-to my house.

Come on in to my place.

<a name=e7d3>7.3) ko ga'i nenri klama le mi zdani

You-imperative [high-rank!] enter-type-of come-to my house.

You! Get inside!

</pre><p>Since “ga'i” expresses the relative rank of the speaker and the refer­ent, it does not make much sense to attach it to “mi”, unless the speaker is using “mi” to refer to a group (as in English “we”), or a past or future version of himself with a different rank.

<p>

It is also possible to attach “ga'i” to a whole bridi, in which case it expresses the speaker's superiority to the event the bridi re­fers to:

<p>

<pre><a name=e7d4>7.4) ga'i le xarju pu citka

[High-rank!] The pig [past] eats.

The pig ate (which is an event beneath my notice).

</pre><lx "ga'icai">When used without being attached to any bridi, “ga'i” ex­presses the speaker's superi­ority to things in general, which may rep­resent an absolute social rank: “ga'icai” is an appropriate opening word for an emperor's address from the throne.

<p>

<lx "le'o">The cmavo “le'o” represents the scale of aggressiveness. We seldom overtly recog­nize that we are feeling aggressive or defensive, but perhaps in counseling ses­sions, a psychologist might encourage someone to express these feelings on this scale. And foot­ball teams could be urged on by their coach using “ro'ole'o”. “le'o” is also use­ful in threats as an alternative to “o'onai”, which expresses anger.

<p>

<ex "righteous indignation"><lx "vu'e"><ex "virtue"><ex "sinful">The cmavo “vu'e” represents ethical virtue or its absence. An excess of almost any emotion is usually somewhat “sinful” in the eyes of most ethical systems. On the other hand, we often feel virtuous about our feelings — what we call righteous indigna­tion might be “o'onaivu'e”. Note that this is distinct from lack of guilt: “.u'unai”.

<p>

<lx "se'i">The cmavo “se'i” expresses the difference between selfishness and generosity, for example (in combination with “.au”):

<p>

<pre><a name=e7d5>7.5) ause'i

[desire] [self]

I want it!

<a name=e7d6>7.6) ause'inai

[desire] [other]

I want you to have it!

</pre><p>In both cases, the English “it” is vague, reflecting the absence of a bridi. <a href=#e7d5>Example 7.5 </a>and <a href=#e7d6>Example 7.6 </a>are pure expressions of attitude. Analogously, “.uuse'i” is self-pity, whereas “.uuse'inai” is pity for someone else.

<p>

<lx "ri'e">The modifier “ri'e” indicates emotional release versus emo­tional control. “I will not let him know how angry I am”, you say to yourself before entering the room. The Lojban is much shorter:

<p>

<pre><a name=e7d7>7.7) .o'onai ri'enai

[anger] [control]

</pre><p>On the other hand, “ri'e” can be used by itself to signal an emotional outburst.

<p>

<lx "fu'i">The cmavo “fu'i” may express a reason for feeling the way we do, as opposed to a feeling in itself; but it is a reason that is more emotionally determined than most. For ex­ample, it could show the difference between the mental discomfort mentioned in <a href=#s6>Section 6 </a>when it is felt on an easy test, as opposed to on a hard test. When someone gives you a back massage, you could use “.o'ufu'i” to show appreciation for the assis­tance in your comfort.

<p>

<lx "be'u">The cmavo “be'u” expresses, roughly speaking, whether the emotion it modi­fies is in response to something you don't have enough of, something you have enough of, or something you have too much of. It is more or less the attitudinal equivalent of the sub­jec­tive quantifier cmavo “mo'a”, “rau”, and “du'e” (these belong to sel­ma'o PA, and are discussed in <a href=chap18.html>Chapter 18</a>). For example,

<p>

<pre><a name=e7d8>7.8) .uiro'obe'unai

[Yay!] [physical] [Enough!]

</pre><ex "large meal">might be something you say after a large meal which you enjoyed.

<p>

Like all modifiers, “be'u” can be used alone:

<p>

<pre><a name=e7d9>7.9) le cukta be'u cu zvati ma

The book [Needed!] is at-location [what sumti?]

Where's the book? — I need it!

</pre><lx "se'a">Lastly, the modifier “se'a” shows whether the feeling is asso­ciated with self-suffi­ciency or with dependence on others.

<p>

<pre><a name=e7d10>7.10) .e'ese'a

[I can!] [self-sufficient!]

I can do it all by myself!

</pre>is something a Lojban-speaking child might say. On the other hand,

<p>

<pre><a name=e7d11>7.11) .e'ese'anai

[I can!] [dependent]

I can do it if you help me.

</pre>from the same child would indicate a (hopefully temporary) loss of self- confidence. It is also possible to negate the “.e'e” in <a href=#e7d10>Example 7.10 </a>and <a href=#e7d11>Example 7.11</a>, leading to:

<p>

<pre><a name=e7d12>7.12) .e'enaise'a

[I can't!] [self-sufficient]

I can't do it if you insist on “helping” me!

</pre>and

<p>

<pre><a name=e7d13>7.13) .e'enaise'anai

[I can't!] [dependent]

I can't do it by myself!

</pre><cx "attitudinals, complexity">Some of the emotional expressions may seem too compli­cated to use. They might be for most circumstances. It is likely that most combinations will never get used. But if one person uses one of these expressions, another person can understand (as un­ambigu­ously as the expresser intends) what emotion is being expressed. Most probably as the system becomes well-known and internalized by Lojban-speakers, particular at­titudinal combi­nations will come to be standard expressions (if not cliches) of emotion.

<p>

### <a name=s8><h3>Compound indicators</h3>

<p>

<cx "indicators, grammar for compounding"><cx "indicators, meaning when compounded">The grammar of indicators is quite simple; almost all facets are optional. You can combine indicators in any order, and they are still grammatical. The presumed de­notation is additive; thus the whole is the sum of the parts regardless of the order ex­pressed, al­though the first expressed is presumed most important to the speaker. Every possible string of UI cmavo has some meaning.

<p>

<cx "unspecified emotion"><cx "attitudinal indicators, conventions of interpretation"><lx "ge'e"><cx "attitudinal indicator, unspecified">Within a string of indicators, there will be conventions of in­terpretation which amount to a kind of second-order grammar. Each of the modifier words is presumed to modify an indicator to the left, if there is one. (There is an “unspecified emotion” word, “ge'e”, re­served to ensure that if you want to express a modifier without a root emotion, it doesn't attach to and modify a previous but distinct emo­tional expression.)

<p>

<cx "unstated emotion"><cx "unspecified level of emotion">For example, “.ieru'e” expresses a weak positive value on the scale of agree­ment: the speaker agrees (presumably with the listener or with something else just stated), but with the least possible degree of intensity. But “.ie ge'eru'e” expresses agreement (at an un­specified level), followed by some other unstated emotion which is felt at a weak level. A rough English equivalent of “.ie ge'eru'e” might be “I agree, but <dots>…</dots>” where the “but” is left hanging. (Again, attitudes aren't always expressed in English by English attitudinals.)

<p>

<cx "attitudinal indicators, placement of scale in">A scale variable similarly modifies the previous emotion word. You put the scale word for a root emotion word before a modifier, since the latter can have its own scale word. This merely maximizes the amount of information expressible. For exam­ple, “.oinaicu'i ro'u­cai” expresses a feeling midway between pain (“.oi”) and pleasure (“.oinai”) which is intensely sexual (“ro'u”) in nature.

<p>

<cx "attitudinal indicators, placement of “nai” in"><cx "attitudinals, placement in sentences with “nai”">The cmavo “nai” is the most tightly bound modifier in the lan­guage: it always ne­gates exactly one word — the preceding one. Of all the words used in indicator con­structs, “nai” is the only one with any meaning outside the indicator system. If you try to put an indica­tor between a non-indicator cmavo and its “nai” negator, the “nai” will end up negating the last word of the indicator. The result, though un­ambiguous, is not what you want. For example,

<p>

<pre><a name=e8d1>8.1) mi .e .ui nai do

I and [Yay!] [Not!] you

</pre>means “I and (unfortunately) you”, whereas

<p>

<pre><a name=e8d2>8.2) mi .e nai .ui do

I and [Not!] [Yay!] you

</pre>means “I but (fortunately) not you”. Attitudinal “nai” expresses a “scalar negation”, a concept explained in <a href=chap15.html>Chapter 15</a>; since every at­titudinal word implies exactly one scale, the effect of “nai” on each should be obvious.

<p>

<cx "attitudinals, internal grammar, complete"><cx "attitudinals, grammar of internal compounding">Thus, the complete internal grammar of UI is as follows, with each listed part option­ally present or absent without affecting gram­maticality, though it obviously would affect meaning.

<p>

<dl compact><dt><dd>attitudinal “nai” intensity-word “nai” modifier “nai” intensity-word “nai”

(possibly repeated)

</dl>“ge'e”, the non-specific emotion word, functions as an attitu­dinal. If multiple atti­tudes are being expressed at once, then in the 2nd or greater position, either “ge'e” or a VV word must be used to prevent any modifiers from modifying the previous atti­tudinal.

<p>

### <a name=s9><h3>The uses of indicators</h3>

<p>

<cx "attitudinals, grammar of placement in bridi"><cx "attitudinals, external grammar"><lx "si"><lx "sa"><lx "su">The behavior of indicators in the “outside grammar” is nearly as simple as their in­ternal structure. Indicator groupings are identified immediately after the metal­inguistic erasers “si”, “sa”, and “su” and some, though not all, kinds of quotations. The details of such interac­tions are discussed in <a href=chap19.html>Chapter 19</a>.

<p>

<lx "zo">A group of indicators may appear anywhere that a single in­dicator may, except in those few situations (as in “zo” quotation, ex­plained in <a href=chap19.html>Chapter 19</a>) where compound cmavo may not be used.

<p>

<cx "attitudinals, at beginning of text">At the beginning of a text, indicators modify everything fol­lowing them in­definitely: such a usage is taken as a raw emotional expression, and we normally don't turn off our emotions when we start and stop sentences. In every other place in an utter­ance, the indi­cator (or group) attaches to the word immediately to its left, and indicates that the attitude is being expressed concerning the object or concept to which the word refers.

<p>

<cx "attitudinals, affecting whole grammatical structures">If the word that an indicator (or group) attaches to is itself a cmavo which gov­erns a grammatical structure, then the indicator construct pertains to the referent of the entire structure. There is also a mechanism, discussed in <a href=chap19.html>Chapter 19</a>, for explicitly marking the range of words to which an indicator applies.

<p>

<cx "attitudinals, referent uncertainty">More details about the uses of indicators, and the way they interact with other spe­cialized cmavo, are given in <a href=chap19.html>Chapter 19</a>. It is worth mentioning that real-world in­terpre­tation is not necessarily con­sistent with the formal scope rules. People generally express emo­tions when they feel them, with only a minimum of grammatical con­straint on that expression; complexities of emotional expression are seldom logically analyz­able. Lojban attempts to provide a systematic reference that could possibly be ingrained to an instinc­tive level. However, it should always be assumed that the referent of an indica­tor has some uncertainty.

<p>

<cx "multiple indicators">For example, in cases of multiple indicators expressed to­gether, the combined form has some ambiguity of interpretation. It is possible to interpret the second indica­tor as expressing an attitude about the first, or to interpret both as expressing attitudes about the common referent. For example, in

<p>

<pre><a name=e9d1>9.1) mi pu tavla do .o'onai .oi

I [past] talk-to you [Grrr!] [Oy!]

</pre>can be interpreted as expressing complaint about the anger, in which case it means “Damn, I snapped at you”; or as expressing both anger and complaint about the listener, in which case it means “I told you, you pest!”

<p>

Similarly, an indicator after the final brivla of a tanru may be taken to express an at­titude about the particular brivla placed there — as the rules have it — or about the entire bridi which hinges on that brivla. Remembering that indicators are supposedly direct ex­pres­sions of emotion, this ambiguity is acceptable.

<p>

<cx "attitudinals, benefit in written expression">Even if the scope rules given for indicators turn out to be im­practical or unin­tuitive for use in conversation, they are still useful in written expression. There, where you can go back and put in markers or move words around, the scope rules can be used in lieu of elabo­rate nuances of body language and intonation to convey the writer's in­tent.

<p>

### <a name=s10><h3>Attitude questions; empathy; attitude contours</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> pei attitude question

dai empathy

bu'o start emotion continue emotion end emotion

</pre><p>You can ask someone how they are feeling with a normal bridi sentence, but you will get a normal bridi answer in response, one which may be true or false. Since the response to a question about emotions is no more logical than the emotion itself, this isn't appropri­ate.

<p>

<lx "pei"><cx "attitudinal questions">The word “pei” is therefore reserved for attitude questions. Asked by itself, it cap­tures all of the denotation of English “How are you?” coupled with “How do you feel?” (which has a slightly different range of usage).

<p>

<cx "attitudinal answers, plausibility">When asked in the context of discourse, “pei” acts like other Lojban question words — it requests the respondent to “fill in the blank”, in this case with an appropri­ate attitu­dinal describing the re­spondent's feeling about the referent expression. As with other ques­tions, plausibility is polite; if you answer with an irrelevant UI cmavo, such as a dis­cursive, you are probably making fun of the questioner. (A “ge'e”, however, is always in order — you are not required to an­swer emotionally. This is not the same as “.i'inai”, which is privacy as the reverse of conviviality.)

<p>

<cx "attitudinal questions, asking intensity">Most often, however, the asker will use “pei” as a place holder for an intensity marker. (As a result, “pei” is placed in selma'o CAI, although selma'o UI would have been almost as appropriate. Grammatically, there is no difference between UI and CAI.) Such us­age corresponds to a whole range of idiomatic usages in natural lan­guages:

<p>

<pre><a name=e10d1>10.1) .iepei

[agreement] [question]

Do you agree?

<a name=e10d2>10.2) .iare'epei

[belief] [spiritual] [question]

Are you a Believer?

<a name=e10d3>10.3) .aipei

[intention] [question]

Are you going to do it?

</pre><a href=#e10d3>Example 10.3 </a>might appear at the end of a command, to which the response

<p>

<pre><a name=e10d4>10.4) .aicai

[intention] [maximal]

</pre>corresponds to “Aye! Aye!” (hence the choice of cmavo).

<p>

<pre><a name=e10d5>10.5) .e'apei

[permission] [question]

Please, Mommy! Can I??

</pre><cx "attitudinal questions, asking about specific attitude">Additionally, when “pei” is used at the beginning of an indi­cator construct, it asks specifically if that construct reflects the atti­tude of the respondent, as in (asked of some­one who has been ill or in pain):

<p>

<pre><a name=e10d6>10.6) pei.o'u

[question] [comfort]

Are you comfortable?

<a name=e10d7>10.7) pei.o'ucu'i

[question] [comfort] [neutral]

Are you no longer in pain?

<a name=e10d8>10.8) pei.o'usai

[question] [comfort] [strong]

Are you again healthy?

</pre><ex "empathy"><ex "sympathy"><cx "attitudinals, attributing emotion to others"><cx "attitudes, empathy contrasted with sympathy"><lx "dai"><lx ".uuse'inai">Empathy, which is not really an emotion, is expressed by the indicator “dai”. (Don't confuse empathy with sympathy, which is “.uuse'inai”.) Sometimes, as when telling a story, you want to attribute emotion to someone else. You can of course make a bridi claim that so-and-so felt such-and-such an emotion, but you can also make use of the at­titudinal system by adding the indicator “dai”, which attributes the preceding attitudinal to someone else — exactly whom, must be determined from context. You can also use “dai” conversationally when you empathize, or feel someone else's emo­tion as if it were your own:

<p>

<pre><a name=e10d9>10.9) .oiro'odai

[Pain!] [physical] [empathy]

Ouch, that must have hurt!

</pre><p>It is even possible to “empathize” with a non-living object:

<p>

<ex "ship sank"><pre><a name=e10d10>10.10) le bloti .iidai .uu pu klama le xasloi

The ship [fear!] [empathy] [pity!] [past] goes-to the ocean-floor

Fearfully the ship, poor thing, sank.

</pre>suggesting that the ship felt fear at its impending destruction, and simultaneously re­port­ing the speaker's pity for it.

<p>

<cx "attitudinals, exceptions"><cx "attitudinals, non-speaker attitudes">Both “pei” and “dai” represent exceptions to the normal rule that attitudinals reflect the speaker's attitude.

<p>

<cx "attitudes, expressing changes in"><cx "attitudinals, contours"><cx "attitudes, continuing"><cx "attitudes, beginning"><cx "attitudes, ceasing"><lx "bu'o"><lx "bu'onai">Finally, we often want to report how our attitudes are chang­ing. If our attitude has not changed, we can just repeat the attitudinal. (Therefore, “.ui .ui .ui” is not the same as “.uicai”, but simply means that we are continuing to be happy.) If we want to report that we are beginning to feel, continuing to feel, or ceasing to feel an emotion, we can use the attitudinal contour cmavo “bu'o”.

<p>

When attached to an attitudinal, “bu'o” means that you are starting to have that atti­tude, “bu'ocu'i” that you are continuing to have it, and “bu'onai” that you are ceasing to have it. Some examples:

<p>

<pre><a name=e10d11>10.11) o'onai bu'o

[Anger!] [start emotion]

I'm getting angry!

<a name=e10d12>10.12) .iu bu'onai .uinai

[Love!] [end emotion] [unhappiness!]

I don't love you any more; I'm sad.

</pre><p>Note the difference in effect between <a href=#e10d12>Example 10.12 </a>and:

<p>

<pre><a name=e10d13>10.13) mi ca ba'o prami do ja'e le nu mi badri

I [present] [cessitive] love you with-result the event-of (I am-sad).

I no longer love you; therefore, I am sad.

</pre>which is a straightforward bridi claim. <a href=#e10d13>Example 10.13 </a>states that you have (or have had) certain emotions; <a href=#e10d12>Example 10.12 </a>expresses those emotions directly.

<p>

### <a name=s11><h3>Evidentials</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre>ja'o [jalge] I conclude

ca'e I define

ba'a [balvi] I expect I experience I remember

su'a [sucta] I generalize I particularize

ti'e [tirna] I hear (hearsay)

ka'u [kulnu] I know by cultural means

se'o [senva] I know by internal experience

za'a [zgana] I observe

pe'i [pensi] I opine

ru'a [sruma] I postulate

ju'a [jufra] I state

</pre><cx "Elgin, Suzette Haden and evidentials"><cx "American Indian languages and evidentials"><cx "Lá&aacute;adan evidentials"><cx "evidentials, definition"><cx "evidentials, inspiration for">Now we proceed from the attitudinal indicators and their rela­tives to the other, se­mantically unrelated, categories of indicators. The indicators known as “evidentials” show how the speaker came to say the utterance; i.e. the source of the information or the idea. Loj­ban's list of evidentials was derived from lists describing several American In­dian languages. Evidentials are also essential to the con­structed language Lá&aacute;adan, de­signed by the linguist and novelist Su­zette Haden Elgin. Lá&aacute;adan's set of indicators was drawn on exten­sively in developing the Lojban indicator system.

<p>

<cx "evidentials in English">It is important to realize, however, that evidentials are not some odd system used by some strange people who live at the other end of nowhere: although their Eng­lish equivalents aren't single words, English-speakers have vivid notions of what con­stitutes evi­dence, and of the different kinds of evidence.

<p>

<cx "evidentials, grammar"><cx "evidentials, scales">Like the attitudinal indicators, the evidentials belong to sel­ma'o UI, and may be treated identically for grammatical purposes. Most of them are not usually consid­ered scalar in nature, but a few have associated scales.

<p>

<cx "indisputable bridi"><cx "evidential, indisputable bridi"><cx "evidential, rhetorical flavor">A bridi with an evidential in it becomes “indisputable”, in the sense that the speaker is saying “how it is with him or her”, which is beyond argument. Claims about one's own mental states may be true or false, but are hardly subject to other people's examination. If you say that you think, or perceive, or postulate such-and-such a predi­ca­tion, who can contradict you? Discourse that uses evidentials has therefore a different rhetorical flavor than discourse that does not; arguments tend to become what can be called dialogues or alternat­ing monologues, depending on your prejudices.

<p>

<cx "evidentials, placement in bridi">Evidentials are most often placed at the beginning of sen­tences, and are often at­tached to the “.i” that separates sentences in connected discourse. It is in the nature of an evidential to affect the entire bridi in which it is placed: like the propositional atti­tude indica­tors, they strongly affect the claim made by the main bridi.

<p>

<lx "ja'o"><ex "thus"><ex "deduction">A bridi marked by “ja'o” is a conclusion by the speaker based on other (stated or un­stated) information or ideas. Rough English equivalents of “ja'o” are “thus” and “therefore”.

<p>

<ex "husband and wife"><lx "ca'e"><ex "pronouncement">A bridi marked by “ca'e” is true because the speaker says so. In addition to defini­tions of words, “ca'e” is also appropriate in what are called performatives, where the very act of speaking the words makes them true. An English example is “I now pro­nounce you hus­band and wife”, where the very act of uttering the words makes the lis­teners into hus­band and wife. A Lojban translation might be:

<p>

<pre><a name=e11d1>11.1) ca'e le re do cu simxu speni

[I define!] The two of-you are-mutual spouses.

</pre><lx "ba'a"><lx "ba'acu'i"><lx "ba'anai"><cx "evidentials, ba'a scale"><ex "anticipated"><ex "remembered"><ex "experienced">The three scale positions of “ba'a”, when attached to a bridi, indicate that it is based on the speaker's view of the real world. Thus “ba'a” means that the statement rep­resents a future event as antici­pated by the speaker; “ba'acu'i”, a present event as expe­rienced by the speaker; “ba'anai”, a past event as remembered by the speaker. It is acci­dental that this scale runs from future to past instead of past to future.

<p>

<pre><a name=e11d2>11.2) ba'acu'i le tuple be mi cu se cortu

[I experience!] The leg of me is-the-locus-of-pain.

My leg hurts.

</pre><ex "induction"><lx "su'a"><cx "evidentials, su'a contrasted with ja'o"><cx "evidentials, ja'o contrasted with su'a">A bridi marked by “su'a” is a generalization by the speaker based on other (stated or unstated) information or ideas. The differ­ence between “su'a” and “ja'o” is that “ja'o” suggests some sort of reasoning or deduction (not necessarily rigorous), whereas “su'a” suggests some sort of induction or pattern recognition from existing ex­amples (not neces­sarily rigorous).

<p>

<ex "abduction"><lx "su'anai">The opposite point of the scale, “su'anai”, indicates abduc­tion, or drawing spe­cific conclusions from general premises or pat­terns.

<p>

<cx "discursive, su'a as">This cmavo can also function as a discursive (see <a href=#s12>Section 12</a>), in which case “su'a” means “abstractly” or “in general”, and “su'anai” means “concretely” or “in par­ticular”.

<p>

<lx "ti'e"><ex "hearsay">A bridi marked by “ti'e” is relayed information from some source other than the speaker. There is no necessary implication that the information was relayed via the speaker's ears; what we read in a newspaper is an equally good example of “ti'e”, unless we have per­sonal knowledge of the content.

<p>

<pre><a name=e11d3>11.3) ti'e la .uengas cu zergau

[I hear!] Wenga is-a-criminal-doer.

I hear that Wenga is a crook.

</pre><ex "myth"><lx "ka'u"><ex "cultural knowledge">A bridi marked by “ka'u” is one held to be true in the speaker's cultural con­text, as a matter of myth or custom, for exam­ple. Such statements should be agreed on by a com­munity of people — you cannot just make up your own cultural context — although “objectivity” in the sense of actual correspondence with the facts is certainly not required.

<p>

<ex "revelation"><ex "dream"><lx "se'o"><lx "ka'u"><cx "evidentials, se'o contrasted with ka'u"><cx "evidentials, ka'u contrasted with se'o">On the other hand, “se'o” marks a bridi whose truth is as­serted by the speaker as a re­sult of an internal experience not directly available to others, such as a dream, vision, or personal revelation. In some cultures, the line between “ka'u” and “se'o” is fuzzy or even nonexistent.

<p>

<lx "za'a"><ex "observation"><cx "observative, contrasted with observation evidential"><cx "observation evidential, contrasted with observative ">A bridi marked by “za'a” is based on perception or direct ob­servation by the speaker. This use of “observe” is not connected with the Lojban “observative”, or bridi with the first sumti omitted. The lat­ter has no explicit aspect, and could be a direct ob­servation, a con­clusion, an opinion, or other aspectual point of view.

<p>

<pre><a name=e11d4>11.4) za'a do tatpi

[I observe!] You are-tired.

I see you are tired.

</pre><lx "pe'i"><ex "opinion"><lx "pe'ipei">A bridi marked by “pe'i” is the opinion of the speaker. The form “pe'ipei” is com­mon, meaning “Is this your opinion?”. (Strictly, this should be “peipe'i”, in accor­dance with the distinction explained in Examples 10.6-10.8, but since “pe'i” is not really a scale, there is no real difference between the two orders.)

<p>

<ex "Carthage destroyed"><pre><a name=e11d5>11.5) pe'i la kartagos. .ei se daspo

[I opine!] Carthage [obligation] is-destroyed.

In my opinion, Carthage should be destroyed.

</pre><lx "ru'a"><cx "ru'a, compared with e'u"><cx "e'u, compared with ru'a"><lx "e'u"><ex "assumption">A bridi marked by “ru'a” is an assumption made by the speaker. This is similar to one possible use of “.e'u”.

<p>

<ex "Livingston"><pre><a name=e11d6>11.6) ru'a doi livinston.

Dr. Livingstone, I presume?

(A rhetorical question: Stanley knew who he was.)

</pre><lx "ju'a"><ex "basis"><lx "ju'apei">Finally, the evidential “ju'a” is used to avoid stating a specific basis for a statement. It can also be used when the basis for the speaker's statement is not covered by any other evidential. For the most part, using “ju'a” is equivalent to using no eviden­tial at all, but in question form it can be useful: “ju'apei” means “What is the basis for your statement?” and serves as an evidential, as distinct from emo­tional, question.

<p>

### <a name=s12><h3>Discursives</h3>

<p>

<cx "discursive, definition"><cx "utterance, expressing relation to discourse"><cx "discourse, expressing utterance relation to">The term “discursive” is used for those members of selma'o UI that provide structure to the discourse, and which show how a given word or utterance relates to the whole dis­course. To express these concepts in regular bridi would involve extra layers of nesting: rather than asserting that “I also came”, we would have to say “I came; fur­thermore, the event of my coming is an additional instance of the relationship expressed by the previous sentence”, which is in­tolerably clumsy. Typical English equivalents of discursives are words or phrases like “however”, “summarizing”, “in conclusion”, and “for example”.

<p>

<cx "discursives, contrasted with attitudinals"><cx "attitudinals, contrasted with discursives"><cx "discursives, as metalinguistic claims">Discursives are not attitudinals: they express no particular emotion. Rather, they are abbreviations for metalinguistic claims that reference the sentence or text they are found in.

<p>

<cx "discursives, placement in sentence">Discursives are most often used at the beginning of sen­tences, often attached to the “.i” that separates sentences in running discourse, but can (like all other indicators) be attached to single words when it seems necessary or useful.

<p>

<cx "discursives for consecutive discourse">The discursives discussed in this section are given in groups, roughly organ­ized by function. First, the “consecutive discourse” group:

<p>

<lx "ku'i"><lx "ji'a"><lx "si'a"><lx "mi'u"><lx "po'o"><pre>ku'i [karbi] however/but/in contrast

ji'a [jmina] additionally

si'a [simsa] similarly

mi'u [mintu] ditto

po'o the only relevant case

</pre><cx "discursives for consecutive discourse, contrasted"><cx "mi'u, contrasted with go'i"><cx "go'i, contrasted with mi'u"><lx "go'i"><ex "ditto"><ex "but"><ex "too">These five discursives are mutually exclusive, and therefore they are not usu­ally con­sidered as scales. The first four are used in consecutive discourse. The first, “ku'i”, makes an exception to the previous argument. The second, “ji'a”, adds weight to the previous argument. The third, “si'a”, adds quantity to the previous argument, enu­merating an addi­tional example. The fourth, “mi'u”, adds a parallel case to the previous argument, and can also be used in tables or the like to show that something is being repeated from the previ­ous col­umn. It is distinct from “go'i” (of selma'o GOhA, dis­cussed in <a href=chap7.html>Chapter 7</a>), which is a non-discursive version of “ditto” that explicitly repeats the claim of the previous bridi.

<p>

<ex "only">Lastly, “po'o” is used when there is no other comparable case, and thus corre­sponds to some of the uses of “only”, a word dif­ficult to express in pure bridi form:

<p>

<ex "hit cousin"><ex "hit nose"><pre><a name=e12d1>12.1) mi po'o darxi le mi tamne fo le nazbi

I [only] hit my cousin at-locus the nose.

Only I (nobody else) hit my cousin on his nose.

<a name=e12d2>12.2) mi darxi po'o le mi tamne fo le nazbi

I hit [only] my cousin at-locus the nose.

I only hit my cousin on his nose (I did nothing else to him).

<a name=e12d3>12.3) mi darxi le mi tamne po'o fo le nazbi

I hit my cousin [only] at-locus the nose.

I hit only my cousin on his nose (no one else).

<a name=e12d4>12.4) mi darxi le mi tamne fo le nazbi po'o

I hit my cousin at-locus the nose [only].

I hit my cousin only on his nose (nowhere else).

</pre><cx "po'o, placement in sentence">Note that “only” can go before or after what it modifies in English, but “po'o”, as an indi­cator, always comes afterward.

<p>

Next, the “commentary on words” group:

<p>

<lx "va'i"><lx "ta'u"><pre>va'i [valsi] in other words in the same words

ta'u [tanru] expanding a tanru making a tanru

</pre><cx "discursives, word-level"><cx "discursives, expressing how things are said">The discursives “va'i” and “ta'u” operate at the level of words, rather than dis­course proper, or if you like, they deal with how things are said. An alternative English expres­sion for “va'i” is “rephrasing”; for “va'inai”, “repeating”. Also compare “va'i” with “ke'u”, discussed below.

<p>

<cx "tanru, expanding"><cx "tanru, explicating"><cx "tanru, explicitly defining"><lx "ta'unai">The cmavo “ta'u” is a discursive unique to Lojban; it ex­presses the particularly Lo­j­banic device of tanru. Since tanru are se­mantically ambiguous, they are subject to mis­understanding. This ambiguity can be removed by expanding the tanru into some seman­tically unambiguous structure, often involving relative clauses or the introduction of ad­ditional brivla. The discursive “ta'u” marks the tran­sition from the use of a brief but pos­sibly confusing tanru to its fuller, clearer expansion; the discursive “ta'unai” marks a tran­sition in the reverse direction.

<p>

Next, the “commentary on discourse” group:

<p>

<lx "li'a"><lx "ba'u"><lx "zo'o"><lx "sa'e"><lx "to'u"><lx "do'a"><lx "sa'u"><lx "pa'e"><lx "ge'u"><pre> li'a [klina] clearly obscurely

obviously

ba'u [banli] exaggeration accuracy understatement

zo'o humorously dully seriously

sa'e [satci] precisely speaking loosely speaking

to'u [tordu] in brief in detail

do'a [dunda] generously parsimoniously

sa'u [sampu] simply elaborating

pa'e [pajni] justice prejudice

je'u [jetnu] truly falsely

</pre><lx "zo'o"><cx "discursives, discourse commentary"><cx "discourse, commentary on"><cx "discourse, tone of voice markers"><cx "discourse, gesture markers">This group is used by the speaker to characterize the nature of the discourse, so as to prevent misunderstanding. It is well-known that listeners often fail to recognize a humor­ous statement and take it seriously, or miss an exaggeration, or try to read more into a state­ment than the speaker intends to put there. In speech, the tone of voice often provides the necessary cue, but the reader of ironic or understated or imprecise dis­course is often simply clueless. As with the attitudinals, the use of these cmavo may seem fussy to new Loj­banists, but it is important to remember that “zo'o”, for example, is the equivalent of smiling while you speak, not the equivalent of a flat declaration like “What I'm about to say is supposed to be funny.”

<p>

<lx "sa'enai">A few additional English equivalents: for “sa'enai”, “roughly speaking” or “approximately speaking”; for “sa'unai”, “furthermore”; for “to'u”, “in short” or “skipping details”; for “do'a”, “broadly construed”; for “do'anai” (as you might expect), “narrowly construed”.

<p>

<lx "pa'e"><lx "pa'enai">The cmavo “pa'e” is used to claim (truly or falsely) that one is being fair or just to all parties mentioned, whereas “pa'enai” admits (or proclaims) a bias in favor of one party.

<p>

<ex "sarcasm"><ex "irony"><cx "sarcasm, expressing"><cx "irony, expressing"><lx "zo'o"><lx ".ianai">The scale of “je'u” and “je'unai” is a little different from the others in the group. By default, we assume that people speak the truth — or at least, that if they are lying, they will do their best to con­ceal it from us. So under what circumstances would “je'unai” be used, or “je'u” be useful? For one thing, “je'u” can be used to mark a tau­tol­ogy: a sen­tence that is a truth of logic, like “All cats are cats.” Its counterpart “je'unai” then serves to mark a logical contradiction. In addition, “je'unai” can be used to express one kind of sarcasm or irony, where the speaker pretends to believe what he/she says, but actually wishes the listener to infer a contrary opinion. Other forms of irony can be marked with “zo'o” (humor) or “.ianai” (disbelief).

<p>

<lx "su'a">When used as a discursive, “su'a” (see <a href=#s11>Section 11</a>) belongs to this group.

<p>

Next, the “knowledge” group:

<p>

<cx "knowledge discursives"><cx "discursives, knowledge"><lx "ju'o"><lx "la'a"><pre>ju'o [djuno] certainly uncertain certainly not

la'a [lakne] probably improbably

</pre><cx "speaker's state of knowledge"><cx "propositional attitudes, compared with knowledge discursives"><cx "knowledge discursives, compared with propositional attitudes">These two discursives describe the speaker's state of knowl­edge about the claim of the associated bridi. They are similar to the propositional attitudes of <a href=#s3>Section 3</a>, as they create a hypothetical world. We may be quite certain that something is true, and label our bridi with “ju'o”; but it may be false all the same.

<p>

Next, the “discourse management” group:

<p>

<lx "ta'o"><lx "ra'u"><lx "mu'a"><lx "zu'u"><lx "ke'u"><lx "da'i"><pre>ta'o [tanjo] by the way returning to point

ra'u [ralju] chiefly equally incidentally

mu'a [mupli] for example omitting end examples

examples

zu'u on the one hand on the other hand

ke'u [krefu] repeating continuing

da'i supposing in fact

</pre><cx "discursives, discourse management"><cx "discursives for managing discourse flow"><cx "flow of discourse, managing with discursives">This final group is used to perform what may be called “managing the dis­course”: providing reference points to help the lis­tener understand the flow from one sentence to the next.

<p>

<lx "ta'onao">Other English equivalents of “ta'onai” are “anyway”, “anyhow”, “in any case”, “in any event”, “as I was saying”, and “continuing”.

<p>

<cx "importance of point, scale with ra'u"><cx "ra'u, scale of importance">The scale of “ra'u” has to do with the importance of the point being, or about to be, expressed: “ra'u” is the most important point, “ra'ucu'i” is a point of equal im­portance, and “ra'unai” is a lesser point. Other English equivalents of “ra'u” are “above all” and “primarily”.

<p>

<cx "va'i, contrasted with ke'u"><cx "ke'u, contrasted with va'i"><lx "va'i"><lx "va'inai"><lx "ke'unai">The cmavo “ke'u” is very similar to “va'i”, although “ke'unai” and “va'inai” are quite different. Both “ke'u” and “va'i” indicate that the same idea is going to be ex­pressed using different words, but the two cmavo differ in emphasis. Using “ke'u” em­phasizes that the content is the same; using “va'i” emphasizes that the words are differ­ent. Therefore, “ke'unai” shows that the content is new (and therefore the words are also); “va'inai” shows that the words are the same (and therefore so is the content). One English equiva­lent of “ke'unai” is “furthermore”.

<p>

<cx "real world point of view"><cx "hypothetical world point of view"><cx "if, expressing hypothetical world"><cx "if, expressing real world">The discursive “da'i” marks the discourse as possibly taking a non-real-world view­point (“Supposing that”, “By hypothesis”), whereas “da'inai” insists on the real-world point of view (“In fact”, “In truth”, “According to the facts”). A common use of “da'i” is to distinguish between:

<p>

<ex "sister pregnant"><ex "pregnant sister"><cx "real world, contrasted with hypothetical world, example"><cx "hypothetical world, contrasted with real world, example"><pre><a name=e12d5>12.5) ganai da'i do viska le mi citno mensi gi ju'o do djuno

le du'u ri pazvau

If you [hypothetical] see my young sister, then [certain] you know that

she is-pregnant.

If you were to see my younger sister, you would certainly know she

is pregnant.

</pre>and:

<p>

<pre><a name=e12d6>12.6) ganai da'inai do viska le mi citno mensi gi ju'o do djuno

le du'u ri pazvau

If you [factual] see my young sister, then [certainty] you know that

she is-pregnant.

If you saw my younger sister, you would certainly know she is pregnant.

</pre><p>It is also perfectly correct to omit the discursive altogether, and leave the con­text to indicate which significance is meant. (Chinese always leaves this distinction to the con­text: the Chinese sentence

<p>

<pre><a name=e12d7>12.7) ru2<sup>2</sup>guo3 ni3 kan4<sup>4</sup>dao4 wo3 mei4<sup>4</sup>mei, ni3 yi2<sup>2</sup>ding4 zhi1<sup>1</sup>dao4 ta1 huai2<sup>2</sup>yun4 le

if you see-arrive my younger-sister, you certainly know she pregnant

</pre>is the equivalent of either <a href=#e12d5>Example 12.5 </a>or <a href=#e12d6>Example 12.6</a>.)

<p>

### <a name=s13><h3>Miscellaneous indicators</h3>

<p>

Some indicators do not fall neatly into the categories of atti­tudinal, evidential, or dis­cursive. This section discusses the following miscellaneous indicators:

<p>

<pre> ki'a metalinguistic confusion

na'i metalinguistic negator

jo'a metalinguistic affirmer

li'o omitted text (quoted material)

sa'a material inserted by editor/narrator

xu true-false question

pau question premarker rhetorical question

pe'a figurative language literal language

bi'u new information old information

ge'e non-specific indicator

</pre><lx "ki'a"><ex "huh?"> <cx "confusion, metalinguistic"><cx "confusion about what was said">The cmavo “ki'a” is one of the most common of the miscella­neous indicators. It ex­presses metalinguistic confusion; i.e. confusion about what has been said, as op­posed to confusion not tied to the discourse (which is “.uanai”). The confusion may be about the mean­ing of a word or of a grammatical construct, or about the referent of a sumti. One of the uses of English “which” corresponds to “ki'a”:

<p>

<pre><a name=e13d1>13.1) mi nelci le ctuca

.i le ki'a ctuca

I like the teacher

Which teacher?

</pre><p>Here, the second speaker does not understand the referent of the sumti “le ctuca”, and so echoes back the sumti with the confusion marker.

<p>

<lx "na'i"><lx "jo'a"><cx "error marking, metalinguistic"><cx "invalid speech, marking as error with na'i">The metalinguistic negation cmavo “na'i” and its opposite “jo'a” are explained in full in <a href=chap15.html>Chapter 15</a>. In general, “na'i” indicates that there is something wrong with a piece of discourse: either an error, or a false underlying assumption, or something else of the sort. The discourse is invalid or inappropriate due to the marked word or con­struct.

<p>

<cx "valid speech, marking as error with jo'a">Similarly, “jo'a” marks something which looks wrong but is in fact correct. These two cmavo constitute a scale, but are kept apart for two reasons: “na'inai” means the same as “jo'a”, but would be too confusing as an affirmation; “jo'anai” means the same as “na'i”, but is too long to serve as a convenient metalinguistic negator.

<p>

<cx "fragmentary text"><lx "li'o"><cx "partial quotation">The next two cmavo are used to assist in quoting texts writ­ten or spoken by others. It is often the case that we wish to quote only part of a text, or to supply addi­tional material either by way of commentary or to make a fragmentary text grammati­cal. The cmavo “li'o” serves the former function. It indicates that words were omitted from the quotation. What remains of the quotation must be grammati­cal, however, as “li'o” does not serve any grammatical function. It cannot, for example, take the place of a missing selbri in a bridi, or supply the missing tail of a description sumti: “le li'o” in isolation is not gram­matical.

<p>

<lx "sa'a"><cx "editorial insertion, with "sa'a"><lx "sei"><lx "to'i"><cx "sa'a, interaction with li'o"><cx "sa'a, interaction with sei"><cx "sa'a, interaction with to'i">The cmavo “sa'a” indicates in a quotation that the marked word or construct was not actually expressed, but is inserted for edi­torial, narrative, or grammatical pur­poses. Strictly, even a “li'o” should appear in the form “li'osa'a”, since the “li'o” was not part of the original quotation. In practice, this and other forms which are already associ­ated with metalinguistic expressions, such as “sei” (of selma'o SEI) or “to'i” (of selma'o TO) need not be marked except where confusion might result.

<p>

<cx "editorial insertion, of text already containing sa'a"><cx "sa'a, editorial insertion of text already containing sa'a">In the rare case that the quoted material already contains one or more instances of “sa'a”, they can be changed to “sa'asa'a”.

<p>

<lx "xu"><cx "yes/no questions"><cx "truth questions"><cx "questions, with "xu">The cmavo “xu” marks truth questions, which are discussed in detail in <a href=chap15.html>Chap­ter 15</a>. In general, “xu” may be translated “Is it true that <dots>…</dots>?” and questions whether the attached bridi is true. When “xu” is attached to a specific word or construct, it directs the focus of the question to that word or construct.

<p>

<lx "pau"><cx "questions, marking in advance">Lojban question words, unlike those of English, frequently do not stand at the begin­ning of the question. Placing the cmavo “pau” at the beginning of a bridi helps the listener realize that the bridi is a question, like the symbol at the beginning of written Spanish ques­tions that looks like an upside-down question mark. The listener is then warned to watch for the actual question word.

<p>

<cx "pau, placement in sentence"><cx "rhetorical question"><cx "question, rhetorical"><lx "paunai">Although “pau” is grammatical in any location (like all indica­tors), it is not really useful except at or near the beginning of a bridi. Its scalar opposite, “paunai”, signals that a bridi is not really a ques­tion despite its form. This is what we call in Eng­lish a rhetorical ques­tion: an example appears in the English text near the beginning of <a href=#s11>Section 11</a>.

<p>

<lx "pe'a"><cx "figurative speech"><ex "blue, as sad">The cmavo “pe'a” is the indicator of figurative speech, indi­cating that the pre­vious word should be taken figuratively rather than literally:

<p>

<pre><a name=e13d2>13.2) mi viska le blanu pe'a zdani

I see the blue [figurative] house.

I see the “blue” house.

</pre><p>Here the house is not blue in the sense of color, but in some other sense, whose mean­ing is entirely culturally dependent. The use of “pe'a” unambiguously marks a cultural refer­ence: “blanu” in <a href=#e13d2>Example 13.2 </a>could mean “sad” (as in English) or something completely differ­ent.

<p>

<lx "pe'anai"><cx "literally">The negated form, “pe'anai”, indicates that what has been said is to be inter­preted lit­erally, in the usual way for Lojban; natural-language intuition is to be ignored.

<p>

<cx "lujvo, place structure of figurative lujvo"><cx "figurative lujvo"><cx "figurative lujvo, place structure"><cx "culturally dependent lujvo"><ex "heartburn">Alone among the cmavo of selma'o UI, “pe'a” has a rafsi, namely “pev”. This rafsi is used in forming figurative (culturally de­pendent) lujvo, whose place structure need have nothing to do with the place structure of the components. Thus “risnyjelca” (heart burn) might have a place structure like:

<p>

<dl compact><dt><dd>x1 is the heart of x2, burning in atmosphere x3 at temperature x4

</dl>whereas “pevrisnyjelca”, explicitly marked as figurative, might have the place struc­ture:

<p>

<dl compact><dt><dd>x1 is indigestion/heartburn suffered by x2

</dl>which obviously has nothing to do with the places of either “risna” or “jelca”.

<p>

<lx "bi'u"><lx "bi'unai"><ex "the"><ex "a"><ex "an"><cx "the, contrasted with a/an"><cx "a/an, contrasted with the">The uses of “bi'u” and “bi'unai” correspond to one of the uses of the English articles “the” and “a/an”. An English-speaker telling a story may begin with “I saw a man who <dots>…</dots>”. Later in the story, the same man will be referred to with the phrase “the man”. Lojban does not use its articles in the same way: both “a man” and “the man” would be translated “le nanmu”, since the speaker has in mind a spe­cific man. How­ever, the first use might be marked “le bi'u nanmu”, to indicate that this is a new man, not mentioned before. Later uses could correspondingly be tagged “le bi'unai nanmu”.

<p>

Most of the time, the distinction between “bi'u” and “bi'unai” need not be made, as the listener can infer the right referent. How­ever, if a different man were re­ferred to still later in the story, “le bi'u nanmu” would clearly show that this man was different from the pre­vious one.

<p>

<lx "ge'e"><cx "attitude, avoidance of expression">Finally, the indicator “ge'e” has been discussed in <a href=#s8>Sections 8 </a>and <a href=#s10>10</a>. It is used to ex­press an attitude which is not covered by the existing set, or to avoid expressing any atti­tude.

<p>

Another use for “ge'e” is to explicitly avoid expressing one's feeling on a given scale; in this use, it functions like a member of selma'o CAI: “.iige'e” means roughly “I'm not telling whether I'm afraid or not.”

<p>

<lx "kau"><cx "indirect question"><pre> kau indirect question

</pre><p>This cmavo is explained in detail in <a href=chap11.html>Chapter 11</a>. It marks the word it is at­tached to as the focus of an indirect question:

<p>

<pre><a name=e13d3>13.3) mi djuno le du'u dakau klama le zarci

I know the statement-that somebody [indirect ?] goes to-the store.

I know who goes to the store.

### </pre><a name=s14><h3>Vocative scales</h3>

<p>

<cx "vocatives, definition"><cx "vocatives, contrasted with “la”"><cx "“la”, contrasted with vocatives"><lx "COI"><cx "direct address">““Vocatives” are words used to address someone directly; they precede and mark a name used in direct address, just as “la” (and the other members of selma'o LA) mark a name used to refer to some­one. The vocatives actually are indicators — in fact, dis­cur­sives — but the need to tie them to names and other descriptions of listeners requires them to be separated from selma'o UI. But like the cmavo of UI, the members of sel­ma'o COI can be “negated” with “nai” to get the opposite part of the scale.

<p>

<cx "redundancy, effect on vocative design"><cx "vocatives, rationale for redundancy">Because of the need for redundancy in noisy environments, the Lojban design does not compress the vocatives into a minimum number of scales. Doing so would make a non-redundant “nai” too often vital to interpretation of a protocol signal, as ex­plained later in this section.

<p>

<lx "DOhU"><lx "do'u"><cx "vocatives, grammar overview">The grammar of vocatives is explained in <a href=chap6.html>Chapter 6</a>; but in brief, a vocative may be followed by a name (without “la”), a descrip­tion (without “le” or its relatives), a complete sumti, or nothing at all (if the addressee is obvious from the context). There is an elidable ter­minator, “do'u” (of selma'o DOhU) which is almost never required un­less no name (or other indication of the addressee) follows the voca­tive.

<p>

<cx "you, defining"><cx "vocatives, and definition of “you”">Using any vocative except “mi'e” (explained below) implicitly defines the meaning of the pro-sumti “do”, as the whole point of vocatives is to specify the listener, or at any rate the desired listener — even if the desired listener isn't listening! We will use the terms “speaker” and “listener” for clarity, although in written Lojban the ap­pro­priate terms would be “writer” and “reader”.

<p>

<cx "vocatives, notation convention symbol “X”">In the following list of vocatives, the translations include the symbol X. This repre­sents the name (or identifying description, or whatever) of the listener.

<p>

<lx "doi"><lx "DOI"><cx "pause before name, effect of doi"><cx "doi, effect on pause before name">The cmavo “doi” is the general-purpose vocative. Unlike the cmavo of selma'o COI, explained below, “doi” can precede a name directly without an intervening pause. It is not considered a scale, and “doinai” is not grammatical. In general, “doi” needs no translation in English (we just use names by themselves without any preceding word, although in poetic styles we sometimes say “Oh X”, which is equivalent to “doi”). One may attach an attitudinal to “doi” to express various English vocatives. For example, “doi .io” means “Sir/Madam!”, whereas “doi .ionai” means “You there!”.

<p>

<cx "pause before name, effect of vocatives of COI"><cx "COI, effect on pause before name">All members of selma'o COI require a pause when used im­mediately before a name, in order to prevent the name from absorb­ing the COI word. This is unlike selma'o DOI and LA, which do not require pauses because the syllables of these cmavo are not permit­ted to be embedded in a Lojban name. When calling out to someone, this is fairly natural, anyway. “Hey! John!” is thus a better translation of “ju'i .djan.” than “Hey John!”. No pause is needed if the vocative reference is something other than a name, as in the title of the Lojban journal, “ju'i lobypli”.

<p>

(Alternatively, “doi” can be inserted between the COI cmavo and the name, making a pause unnecessary: “coi doi djan.”)

<p>

<lx "coi"><pre>coi greetings

</pre>“Hello, X”; “Greetings, X”; indicates a greeting to the listener.

<p>

<lx "co'o"><pre>co'o partings

</pre>“Good-bye, X”; indicates parting from immediate company by either the speaker or the listener. “coico'o” means “greeting in passing”.

<p>

<lx "ju'i"><pre>ju'i [jundi] attention at ease ignore me/us

</pre>“Attention/Lo/Hark/Behold/Hey!/Listen, X”; indicates an important communication that the listener should listen to.

<p>

<lx "nu'e"><pre>nu'e [nupre] promise release promise non-promise

</pre>“I promise, X”; indicates a promise to the listener. In some contexts, “nu'e” may be pre­fixed to an oath or other formal declaration.

<p>

<lx "ta'e"><pre>ta'a [tavla] interruption

</pre>“I interrupt, X”, “I desire the floor, X”; a vocative expression to (possibly) interrupt and claim the floor to make a statement or ex­pression. This can be used for both rude and po­lite interruptions, al­though rude interruptions will probably tend not to use a vocative at all. An appropriate response to an interruption might be “re'i” (or “re'inai” to ignore the interruption).

<p>

<lx "pe'u"><pre>pe'u [cpedu] request

</pre><cx "pe'u, contrasted with e'o"><cx "e'o, contrasted with pe'u">““Please, X”; indicates a request to the listener. It is a formal, non-atti­tudinal, equivalent of “.e'o” with a specific recipient being addressed. On the other hand, “.e'o” may be used when there is no specific lis­tener, but merely a “sense of petition floating in the air”, as it were.

<p>

<lx "ki'e"><pre>ki'e [ckire] appreciation disappreciation

gratitude ingratitude

</pre><ex "thank you"><cx "politeness, thank you and you're welcome"><cx "politeness, you're welcome"><lx "je'e"><lx "fi'i">““Thank you, X”; indicates appreciation or gratitude toward the listener. The usual re­sponse is “je'e”, but “fi'i” is appropriate on rare occasions: see the explanation of “fi'i”.

<p>

<pre>fi'i [friti] welcome, unwelcome,

offering inhospitality

</pre><lx "fi'i"><cx "you're welcome, fi'i contrasted with je'e"><cx "you're welcome, je'e contrasted with fi'i"><ex "hospitality">““At your service, X”; “Make yourself at home, X”; offers hospitality (possibly in re­sponse to thanks, but not necessarily) to the listener. Note that “fi'i” is *not* the equiva­lent of American English “You're wel­come” as a mechanical response to “Thank you”; that is “je'e”, as noted below.

<p>

<pre>be'e [benji] request to send

</pre><lx "be'e"><cx "telephone conversation, hello">““Request to send to X”; indicates that the speaker wishes to express something, and wishes to ensure that the listener is listening. In a telephone conversation, can be used to request the desired conver­sant(s). A more colloquial equivalent is “Hello? Can I speak to X?”.

<p>

<pre>re'i [bredi] ready to receive not ready

</pre><lx "re'i">““Ready to receive, X”; indicates that the speaker is attentive and awaiting communica­tion from the listener. It can be used instead of “mi'e” to respond when called to the telephone. The negative form can be used to prevent the listener from continuing to talk when the speaker is unable to pay attention: it can be translated “Hold on!” or “Just a minute”.

<p>

<pre>mu'o [mulno] completion of utterance more to follow

</pre><lx "mu'o">““Over, X”; indicates that the speaker has completed the current utter­ance and is ready to hear a response from the listener. The negative form signals that the pause or non-lin­guistic sound which follows does not represent the end of the current utterance: more colloquially, “I'm not done talking!”

<p>

<pre>je'e [jimpe] successful receipt unsuccessful receipt

</pre><lx "je'e"><ex "roger"><cx "politeness, you're welcome">““Roger, X!”, “I understand”; acknowledges the successful receipt of a communication from the listener. The negative form indicates failure to receive correctly, and is usually followed by “ke'o”. The colloquial English equivalents of “je'e” and “je'enai” are the grunt typically writ­ten “uh-huh” and “What?/Excuse me?”: “je'e” is also used to mean “You're welcome” when that is a response to “Thank you”.

<p>

<pre>vi'o will comply will not comply

</pre><lx "vi'o"><cx "je'e, contrasted with vi'o"><cx "vi'o, contrasted with je'e">““Wilco, X”, “I understand and will comply”. Similar to “je'e” but signals an intention (similar to “.ai”) to comply with the other speaker's re­quest. This cmavo is the main way of saying “OK” in Lojban, in the usual sense of “Agreed!”, although “.ie” carries some of the same meaning. The negative form indicates that the message was received but that you will not comply: a very colloquial version is “No way!”.

<p>

<pre>ke'o [krefu] please repeat no repeat needed

</pre><lx "ke'o"><cx "ke'o, compared to ki'a"><cx "ki'a, compared to ke’o">““What did you say, X?”; a request for repetition or clarification due to unsuccessful re­ceipt or understanding. This is the vocative equivalent of “ki'a”, and is related to “je'enai”. The negative form may be ren­dered “Okay, already; I get the point!”

<p>

<pre>fe'o [fanmo] end of communication not done

</pre><lx "fe'o">““Over and out, X”; indicates completion of statement(s) and communi­cation directed at the identified person(s). Used to terminate a letter if a signature is not required because the sender has already been identified (as in memos). The negative form means “Wait, hold it, we're not done!” and differs from “mu'onai” in that it means more ex­changes are to follow, rather than that the current exchange is in­complete.

<p>

<cx "fe'o, contrasted with fa'o"><cx "fa'o, contrasted with fe'o">Do not confuse “fe'o” with “fa'o” (selma'o FAhO) which is a mechanical, ex­tra-grammatical signal that a text is complete. One may say “fe'o” to one participant of a multi-way conversation and then go on speaking to the others.

<p>

<lx "mi'e"><pre>mi'e [cmavo: mi] self-identification non-identification

</pre><cx "introduce oneself"><cx "mi'e, contrasted with other members of COI"><cx "me, explicitly specifying">““And I am X”; a generalized self-vocative. Although grammatically just like the other members of selma'o COI, “mi'e” is quite different se­mantically. In particular, rather than specifying the listener, the person whose name (or description) follows “mi'e” is taken to be the speaker. Therefore, using “mi'e” specifies the meaning of the pro-sumti “mi”. It can be used to introduce oneself, to close letters, or to identify one­self on the telephone.

<p>

<cx "closings, letter"><lx "fe’omi'e"><lx "re'imi'e"><cx "COI, ordering multiple with mi'e"><cx "mi'e, effect of ordering multiple COI">This cmavo is often combined with other members of COI: “fe'omi'e” would be an appropriate closing at the end of a letter; “re'imi'e” would be a self-vocative used in de­layed responses, as when called to the phone, or possibly in a roll-call. As long as the “mi'e” comes last, the following name is that of the speaker; if another COI cmavo is last, the following name is that of the listener. It is not possible to name both speaker and lis­tener in a single vocative ex­pression, but this fact is of no importance, because wherever one vocative expression is grammatical, any number of consecutive ones may appear.

<p>

<lx "mi'enai">The negative form denies an identity which someone else has attributed to you; “mi'enai .djan.” means that you are saying you are not John.

<p>

<cx "protocol, parliamentary using COI"><cx "protocol, computer communications using COI"><cx "protocol, using vocatives"><lx "ta'apei">Many of the vocatives been listed with translations which are drawn from radio use: “roger”, “wilco”, “over and out”. This form of translation does not mean that Loj­ban is a language of CB enthusi­asts, but rather that in most natural languages these forms are so well handled by the context that only in specific domains (like speak­ing on the radio) do they need special words. In Lojban, dependence on the context can be dangerous, as speaker and listener may not share the right context, and so the vocatives provide a for­mal protocol for use when it is appropriate. Other appropriate contexts include computer communications and parliamentary procedure: in the latter context, the protocol question “ta'apei” would mean “Will the speaker yield?”

<p>

### <a name=s15><h3>A sample dialogue</h3>

<p>

The following dialogue in Lojban illustrates the uses of attitu­dinals and proto­col vocatives in conversation. The phrases enclosed in “sei <dots>…</dots>se'u” indicate the speaker of each sentence.

<p>

<pre><a name=e15d1>15.1) la rik. .e la .alis. nerkla le kafybarja

Rick and Alice in-go to-the coffee-bar.

Rick and Alice go into the coffee bar.

<a name=e15d2>15.2) .i sei la rik. cusku se'u ta'a ro zvati be ti

mi baza speni ti .iu

[Comment] Rick says, [end-comment] [Interrupt] all at this-place,

I [future] [medium] am-spouse-to this-one [love].

Rick said, “Sorry to break in, everybody. Pretty soon I'm getting married

to my love here.”

<a name=e15d3>15.3) .i sei la djordj. cusku se'u

a'o ko gleki doi ma

[Comment] George says, [end-comment]

[Hope] [You-imperative] are-happy, O [who?].

George said, “I hope you'll be happy, um, <dots>…</dots>?”

<a name=e15d4>15.4) .i sei la pam. cusku se'u pe'u .alis.

xu mi ba terfriti le nunspenybi'o

[Comment] Pam says, [Please] Alice, [end-comment]

[Is it true?] I [future] receive-offer-of the event-of-spouse-becoming?

Pam said, “Please, Alice, am I going to be invited to the wedding?”

<a name=e15d5>15.5) .i sei la mark. cusku se'u

coi baza speni

a'o le re do lifri le ka xamgu

[Comment] Mark says, [end-comment]

[Greetings] [future] [medium] spouse(s),

[Hope] the two of-you experience the-property-of being-happy

Mark said, “Hello, spouses-to-be. I hope both of you will be very happy.”

<a name=e15d6>15.6) .i sei la rik. cusku se'u mi'e .rik. doi terpreti

[Comment] Rick says, [end-comment] [I am] Rick, O questioners.

Rick said, “My name is Rick, for those of you who want to know.”

<a name=e15d7>15.7) .i sei la .alis. cusku se'u

nu'e .pam. .o'ero'i do ba zvati

[Comment] Alice says, [end-comment]

[Promise-to] Pam, [closeness] [emotional] you [future] are-at.

Alice said, “I promise you'll be there, Pam honey.”

<a name=e15d8>15.8) .i sei la fred. cusku se'u .uinaicairo'i

mi ji'a prami la .alis. fe'o .rik.

[Comment] Fred says, [end-comment] [Happy] [not] [emphatic] [emotional]

I [additionally] love Alice. [Over and out to] Rick.

“I love Alice too,” said Fred miserably. “Have a nice life, Rick.”

<a name=e15d9>15.9) .i la fred. cliva

Fred leaves.

And he left.

<a name=e15d10>15.10) .i sei la rik. cusku se'u

fi'i ro zvati

ko pinxe pa ckafi fi'o pleji mi

[Comment] Rick says, [end-comment]

[Welcome-to] all at-place,

[You-imperative] drink one coffee with-payer me.

Rick said, raising his voice, “A cup of coffee for the house,

on me.”

<a name=e15d11>15.11) .i sei la pam. cusku se'u be'e selfu

[Comment] Pam says, [end-comment] [Request to speak to] server.

Pam said, “Waiter!”

<a name=e15d12>15.12) .i sei le selfu cu cusku se'u re'i [end-comment]

[Comment] The server says, [Ready to receive].

The waiter replied, “May I help you?”

<a name=e15d13>15.13) .i sei la pam. cusku se'u

e'o ko selfu le traji xamgu ckafi

le baza speni fi'o selpleji mi

[Comment] Pam says, [end-comment]

[Petition] [You-imperative] serve the (superlatively good) coffee

to-the [future] [medium] spouse with-payment me.

Pam said, “One Jamaica Blue for the lovebirds here, on my tab.”

<a name=e15d14>15.14) .i sei le selfu cu cusku se'u vi'o

[Comment] The server says, [end-comment] [Will comply].

“Gotcha”, said the waiter.

<a name=e15d15>15.15) .i sei la rik. cusku se'u ki'e .pam.

[Comment] Rick says, [end-comment] [Thanks O] Pam.

“Thanks, Pam”, said Rick.

<a name=e15d16>15.16) .i sei la pam. cusku se'u je'e

[Comment] Pam says, [end-comment] [Acknowledge].

“Sure”, said Pam.

<a name=e15d17>15.17) .i sei la djan. cusku se'u

.y. mi .y. mutce spopa .y.

le nu le speni si .y. ba speni .y. .y.

su .yyyyyy. mu'o

[Comment] John says, [end-comment]

[Uh] I [uh] very [nonexistent gismu] [uh]

the event-of the spouse [erase] [uh] [future] spouse [uh] [uh]

[erase all] [uh] [over]

John said, “I, er, a lotta, uh, marriage, upcoming marriage, <dots>…</dots>. Oh, forget it.

Er, later.”

<a name=e15d18>15.18) .i sei la djordj. cusku se'u ke'o .djan. zo'o

[Comment] George says, [end-comment] [Repeat O] John [humor].

“How's that again, John?” said George.

<a name=e15d19>15.19) .i sei la pam. cusku se'u

ju'i .djordj. .e'unai le kabri bazi farlu

[Comment] Pam says, [end-comment]

[Attention] George, [Warning] the cup [future] [short] falls

“George, watch out!” said Pam. “The cup's falling!”

<a name=e15d20>15.20) .i le kabri cu je'a farlu

The cup indeed falls.

The cup fell.

<a name=e15d21>15.21) .i sei la djan. cusku se'u

e'o doi djordj. zo'o rapygau

[Comment] John says, [end-comment]

[Petition] O George [humor] repeat-cause.

John said, “Try that again, George!”

<a name=e15d22>15.22) .i sei la djordj. cusku se'u

co'o ro zvati pe secau la djan. ga'i

[Comment] George says, [end-comment]

[Partings] all at-place without John [superiority]

“Goodbye to all of you,” said George sneeringly, “except John.”

<a name=e15d23>15.23) .i la djordj. cliva

George leaves.

George left.

### </pre><a name=s16><h3>Tentative conclusion</h3>

<p>

<cx "Kzinti, communication with"><cx "aliens, communication with"><cx "indicators, ramifications">The exact ramifications of the indicator system in actual us­age are unknown. There has never been anything like it in natural language before. The system provides great po­tential for emotional expression and transcription, from which significant Sapir-Whorf ef­fects can be anticipated. When communicating across cultural boundaries, where different indicators are often used for the same emotion, accidental offense can be avoided. If we ever ran into an alien race, a culturally neutral language of emotion could be vital. (A classic example, taken from the science fiction of Larry Niven, is to imagine speaking Lojban to the carnivorous warriors called Kzinti, noting that a human smile bares the teeth, and could be seen as an intent to attack.) And for communicating emotions to com­puters, when we cannot identify all of the signals involved in sublimi­nal hu­man commu­nication (things like body language are also cultural), a system like this is needed.

<p>

<cx "indicators, rationale for selection">We have tried to err on the side of overkill. There are distinc­tions possible in this system that no one may care to make in any culture. But it was deemed more neu­tral to overspecify and let usage decide, than to choose a limited set and constrain emo­tional expres­sion. For circumstances in which even the current indicator set is not enough, it is possible using the cmavo “sei”, explained in <a href=chap19.html>Chapter 19</a>, to create metalin­guistic com­ments that act like indicators.

<p>

<cx "indicators, evolutionary development of">We envision an evolutionary development. At this point, the system is little more than a mental toy. Many of you who read this will try playing around with various com­binations of indicators, trying to figure out what emotions they express and when the ex­pressions might be useful. You may even find an expression for which there cur­rently is no good English word and start using it. Why not, if it helps you express your feelings?

<p>

There will be a couple dozen of these used pretty much uni­versally – mostly just simple attitudinals with, at most, intensity mark­ers. These are the ones that will quickly be expressed at the subcon­scious level. But every Lojbanist who plays with the list will bring in a couple of new words. Poets will paint emotional pictures, and people who identify with those pictures will use the words so created for their own experi­ences.

<p>

Just as a library of tanru is built up, so will a library of atti­tudes be built. Un­like the tanru, though, the emotional expressions are built on some fairly nebulous root emotions — words that cannot be defined with the precision of the gismu. The emotion words of Loj­ban will very quickly take on a life of their own, and the outline given here will evolve into a true system of emotions.

<p>

<cx "emotions, recording using indicators"><cx "emotions, research using indicators">There are several theories as to the nature of emotion, and they change from year to year as we learn more about ourselves. Whether or not Lojban's additive/scalar emotional model is an accu­rate model for human emotions, it does support the linguis­tic needs for expressing those emotions. Researchers may learn more about the nature of human emo­tions by exploring the use of the system by Lojban speakers. They also may be able to use the Lojban system as a means for more clearly recording emotions.

<p>

<cx "emotions, cultural bias of expression">The full list of scales and attitudes will probably not be used until someone speaks the language from birth. Until then, people will use the attitudes that are impor­tant to them. In this way, we counter cultural bias — if a culture is prone to recognizing and/or expressing certain emotions more than others, its members will use only those out of the enormous set available. If a culture hides certain emotions, its members sim­ply won't ex­press them.

<p>

<cx "Sapir-Whorf effects, and emotional indicators">Perhaps native Lojban speakers will be more expressively clear about their emotions than others. Perhaps they will feel some emotions more strongly than others in ways that can be correlated with the word choices; any difference from the norms of other cul­tures could be significant. Psychologists have devised elaborate tests for meas­uring attitudes and personality; this may be the easiest area in which to detect any sys­tematic cultural effect of the type sought to confirm Sapir-Whorf, simply because we already have tools in exis­tence to test it. Because Lojban is unique among languages in having such extensive and expressive indicators, it is likely that a Sapir-Whorf effect will occur and will be rec­ognized.

<p>

It is unlikely that we will know the true potential of a system like this one until and unless we have children raised entirely in a multi-cultural Lojban-speaking envi­ronment. We learn too many cul­tural habits in the realm of emotional communication “at our mother's knee”. Such children will have a Lojban system that has stronger re­inforcement than any typical culture system. The second generation of such children, then, could be said to be the start of a true Lojbanic culture.

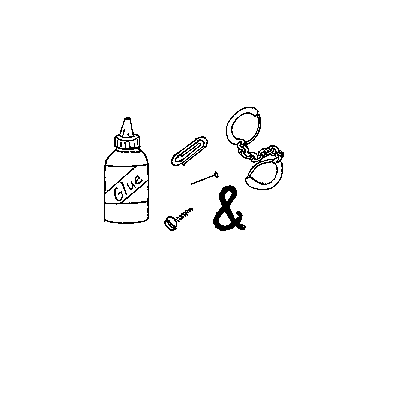
<p>

<cx "emotional indicators, noticeable effects of">We shouldn't need to wait that long to detect significant ef­fects. Emotion is so basic to our lives that even a small change or improvement in emotional communica­tion would have immediately noticeable effects. Perhaps it will be the case that the most important contribution of our “logical language” will be in the non-logical realm of emotion!

<p>

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## <h2>Chapter 14

## <br>

## If Wishes Were Horses: The Lojban Connective System</h2>

###### <h6>$Revision: 4.1 $<br> mkhtml: 1.1</h6></p></center>

<p>

### <a name=s1><h3>Logical connection and truth tables</h3>

<p>

<cx "logical language, truth functions"><cx "truth functions">Lojban is a logical language: the name of the language itself means “logical lan­guage”. The fundamentals of ordinary logic (there are variant logics, which aren't ad­dressed in this book) include the notions of a “sentence” (sometimes called a “statement” or “proposition”), which asserts a truth or falsehood, and a small set of “truth functions”, which combine two sentences to create a new sentence. The truth functions have the spe­cial characteristic that the truth value (that is, the truth or false­hood) of the results de­pends only on the truth value of the component sentences. For example,

<p>

<ex "man or woman"><pre><a name=e1d1>1.1) John is a man or James is a woman.

</pre>is true if “John is a man” is true, or if “James is a woman” is true. If we know whether John is a man, and we know whether James is a woman, we know whether “John is a man or James is a woman” is true, provided we know the meaning of “or”. Here “John is a man” and “James is a woman” are the component sentences.

<p>

<cx "negating a sentence, and truth value">We will use the phrase “negating a sentence” to mean changing its truth value. An English sentence may always be negated by prefixing “It is false that <dots>…</dots>”, or more idio­matically by inserting “not” at the right point, generally before the verb. “James is not a woman” is the negation of “James is a woman”, and vice versa. Recent slang can also negate a sentence by following it with the exclamation “Not!”

<p>

<cx "logical connectives">Words like “or” are called “logical connectives”, and Lojban has many of them, as befits a logical language. This chapter is mostly concerned with explaining the forms and uses of the Lojban logical connectives. There are a number of other logical connectives in English such as “and”, “and/or”, “if”, “only if”, “whether or not”, and others; however, not every use of these English words corresponds to a logical connec­tive. This point will be made clear in particular cases as needed. The other English meanings are supported by different Lojban connective constructs.

<p>

The Lojban connectives form a system (as the title of this chapter suggests), regular and predictable, whereas natural-language connectives are rather less systematic and therefore less predictable.

<p>

<cx "truth functions, 16 possible"><cx "truth table, explanation">There exist 16 possible different truth functions. A truth table is a graphical device for specifying a truth function, making it clear what the value of the truth func­tion is for every possible value of the component sentences. Here is a truth table for “or”:

<p>

<pre> first second result

True True True

True False True

False True True

False False False

</pre><p>This table means that if the first sentence stated is true, and the second sentence stated is true, then the result of the truth function is also true. The same is true for every other pos­sible combination of truth values except the one where both the first and the second sen­tences are false, in which case the truth value of the result is also false.

<p>

Suppose that “John is a man” is true (and “John is not a man” is false), and that “James is a woman” is false (and “James is not a woman” is true). Then the truth table tells us that

<p>

<dl compact><dt> <dd>“John is a man, or James is not a woman” (true, true) is true;

“John is a man, or James is a woman” (true, false) is true;

“John is not a man, or James is not a woman” (false, true) is true;

“John is not a man, or James is a woman” (false, false) is false.

</dl><cx "or”, “and/or” contrasted with “either … or … but not both">Note that the kind of “or” used in this example can also be expressed (in formal Eng­lish) with “and/or”. There is a different truth table for the kind of “or” that means “either <dots>…</dots> or <dots>…</dots> but not both”.

<p>

<cx "truth tables, abbreviated format"><cx "truth tables, notation convention">To save space, we will write truth tables in a shorter format henceforth. Let the let­ters T and F stand for True and False. The rows will always be given in the order shown above: TT, TF, FT, FF for the two sentences. Then it is only necessary to give the four letters from the result column, which can be written TTTF, as can be seen by reading down the third column of the table above. So TTTF is the abbreviated truth table for the “or” truth function. Here are the 16 possible truth functions, with an Eng­lish version of what it means to assert that each function is, in fact, true (“first” refers to the first sen­tence, and “second” to the second sentence):

<p>

<cx "truth tables, list of 16 in abbreviated form"><pre> TTTT (always true)

TTTF first is true and/or second is true.

TTFT first is true if second is true.

TTFF first is true whether or not second is true.

TFTT first is true only if second is true.

TFTF whether or not first is true, second is true.

TFFT first is true if and only if second is true.

TFFF first is true and second is true

FTTT first and second are not both true.

FTTF first or second is true, but not both.

FTFT whether or not first is true, second is false.

FTFF first is true, but second is false.

FFTT first is false whether or not second is true.

FFTF first is false, but second is true.

FFFT neither first nor second is true.

FFFF (always false)

</pre><p>Skeptics may work out the detailed truth tables for themselves.

<p>

### <a name=s2><h3>The four basic vowels</h3>

<p>

<cx "truth functions, fundamental 4 in Lojban"><cx "truth functions, relation to logical connectives"><cx "logical connectives, relation to truth functions">Lojban regards four of these 16 truth functions as fundamental, and assigns them the four letters vowels <font face="Brush Script MT, Script">A</font>, <font face="Brush Script MT, Script">E</font>, <font face="Brush Script MT, Script">O</font>, and <font face="Brush Script MT, Script">U</font>. These letters do not represent actual cmavo or selma'o, but rather a component vowel from which actual logical-connective cmavo are built up, as explained in the next section. Here are the four vowels, their truth tables, and rough Eng­lish equivalents:

<p>

<cx "truth tables, for 4 fundamental Lojban truth functions"><cx "fancy A, notation convention"><cx "fancy E, notation convention"><cx "fancy O, notation convention"><cx "fancy U, notation convention"><pre> <font face="Brush Script MT, Script">A</font> TTTF or, and/or

<font face="Brush Script MT, Script">E</font> TFFF and

<font face="Brush Script MT, Script">O</font> TFFT if and only if

<font face="Brush Script MT, Script">U</font> TTFF whether or not

</pre><p>More precisely:

<p>

<dl compact><dt><dd><font face="Brush Script MT, Script"> A </font>is true if either or both sentences are true;

<font face="Brush Script MT, Script">E </font>is true if both sentences are true, but not otherwise;

<font face="Brush Script MT, Script">O </font>is true if the sentences are both true or both false;

<font face="Brush Script MT, Script">U </font>is true if the first sentence is true, regardless of the truth value of the

second sentence.

</dl><cx "truth functions, creating all 16 with Lojban's basic set">With the four vowels, the ability to negate either sentence, and the ability to ex­change the sentences, as if their order had been reversed, we can create all of the 16 pos­sible truth functions except TTTT and FFFF, which are fairly useless anyway. The fol­lowing table illustrates how to create each of the 14 remaining truth functions:

<p>

<pre> TTTF <font face="Brush Script MT, Script">A</font>

TTFT <font face="Brush Script MT, Script">A </font>with second sentence negated

TTFF <font face="Brush Script MT, Script">U</font>

TFTT <font face="Brush Script MT, Script">A </font>with first sentence negated

TFTF <font face="Brush Script MT, Script">U </font>with sentences exchanged

TFFT <font face="Brush Script MT, Script">O</font>

TFFF <font face="Brush Script MT, Script">E</font>

FTTT <font face="Brush Script MT, Script">A </font>with both sentences negated

FTTF <font face="Brush Script MT, Script">O </font>with either first or second negated (not both)

FTFT <font face="Brush Script MT, Script">U </font>with sentences exchanged and then second negated

FTFF <font face="Brush Script MT, Script">E </font>with second sentence negated

FFTT <font face="Brush Script MT, Script">U </font>with first sentence negated

FFTF <font face="Brush Script MT, Script">E </font>with first sentence negated

FFFT <font face="Brush Script MT, Script">E </font>with both sentences negated

</pre><cx "commutative truth functions"><cx "truth functions, commutative">Note that exchanging the sentences is only necessary with <font face="Brush Script MT, Script">U</font>. The three other basic truth functions are commutative; that is, they mean the same thing regardless of the order of the component sentences. There are other ways of getting some of these truth tables; these just happen to be the methods usually employed.

<p>

### <a name=s3><h3>The six types of logical connectives</h3>

<p>

<cx "logical connectives, rationale for multiple sets in grammar">In order to remain unambiguous, Lojban cannot have only a single logical connective for each truth function. There are many places in the grammar of the lan­guage where logical connection is permitted, and each must have its appropriate set of connectives. If the connective suitable for sumti were used to connect selbri, ambiguity would result.

Consider the English sentence:

<p>

<ex "window"><pre><a name=e3d1>3.1) Mary went to the window and <dots>…</dots>

</pre>where the last word could be followed by “the door”, a noun phrase, or by “saw the horses”, a sentence with subject omitted, or by “John went to the door”, a full sentence, or by one of a variety of other English grammatical constructions. Lojban cannot toler­ate such grammatical looseness.

<p>

<lx "A"><lx "GA"><lx "GIhA"><lx "JA"><cx "logical connective selma'o, enumerated">Instead, there are a total of five different selma'o used for logical connection: A, GA, GIhA, GUhA, and JA. Each of these includes four cmavo, one based on each of the four vowels, which is always the last vowel in the cmavo. In selma'o A, the vowel is the entire cmavo.

<p>

<cx "logical connective cmavo, format for each selma'o">Thus, in selma'o A, the cmavo for the function <font face="Brush Script MT, Script">A </font>is “a”. (Do not confuse A, which is a selma'o, with <font face="Brush Script MT, Script">A</font>, which is a truth function, or “a”, which is a cmavo.) Like­wise, the cmavo for <font face="Brush Script MT, Script">E </font>in selma'o GIhA is “gi'e”, and the cmavo for <font face="Brush Script MT, Script">U </font>in selma'o GA is “gu”. This systematic regularity makes the cmavo easier to learn.

<p>

<cx "compound logical connectives, components">Obviously, four cmavo are not enough to express the 14 truth functions ex­plained in <a href=#s1>Section 1</a>. Therefore, compound cmavo must be used. These compound cmavo follow a systematic pattern: each has one cmavo from the five logical connec­tion selma'o at its heart, and may also contain one or more of the auxiliary cmavo “se”, “na”, or “nai”. Which auxiliaries are used with which logical connection cmavo, and with what grammar and meaning, will be explained in the following sections. The uses of each of these aux­iliary cmavo relates to its other uses in other parts of Lojban gram­mar.

<p>

<cx "compound logical connectives, naming convention"><cx "-ek, in name for logical connectives"><cx "ek, definition"><cx "jek, definition"><lx "A"><lx "JA">For convenience, each of the types of compound cmavo used for logical con­nection is designated by a Lojban name. The name is derived by changing the final “-A” of the selma'o name to “-ek”; the reasons for using “-ek” are buried deep in the his­tory of the Loglan Project. Thus, compound cmavo based on selma'o A are known as eks, and those based on selma'o JA are known as jeks. (When writing in English, it is conventional to use “eks” as the plural of “ek”.) When the term “logical connective” is used in this chap­ter, it refers to one or more of these kinds of compound cmavo.

<p>

<cx "ijek, definition"><lx "JA"><lx "I">Why does the title of this section refer to “six types” when there are only five sel­ma'o? A jek may be preceded by “.i”, the usual Lojban cmavo for connecting two sen­tences. The compound produced by “.i” followed by a jek is known as an ijek. It is useful to think of ijeks as a sixth kind of logical connective, parallel to eks, jeks, geks, giheks, and guheks.

<p>

<cx "gik, as name for compound cmavo"><cx "joik, as name for compound cmavo"><cx "joigik, as name for compound cmavo"><cx "ijoik, as name for compound cmavo"><lx "GI"><lx "JOI"><lx "I">There also exist giks, joiks, ijoiks, and joigiks, which are not logical connec­tives, but are other kinds of compound cmavo which will be introduced later.

<p>

### <a name=s4><h3>Logical connection of bridi</h3>

<p>

<lx "JA"><lx "I"><cx "ijek logical connective, connecting bridi"><cx "bridi, logical connective for">Now we are ready to express <a href=#e1d1>Example 1.1 </a>in Lojban! The kind of logical con­nective which is placed between two Lojban bridi to connect them logically is an ijek:

<p>

<pre><a name=e4d1>4.1) la djan. nanmu .ija la djeimyz. ninmu

John is-a-man or James is-a-woman.

</pre><p>Here we have two separate Lojban bridi, “la djan. nanmu” and “la djeimyz. ninmu”. These bridi are connected by “.ija”, the ijek for the truth function <font face="Brush Script MT, Script">A</font>. The “.i” portion of the ijek tells us that we are dealing with separate sentences here. Similarly, we can now say:

<p>

<pre><a name=e4d2>4.2) la djan. nanmu .ije la djeimyz. ninmu

John is-a-man and James is-a-woman.

<a name=e4d3>4.3) la djan. nanmu .ijo la djeimyz. ninmu

John is-a-man if-and-only-if James is-a-woman.

<a name=e4d4>4.4) la djan. nanmu .iju la djeimyz. ninmu

John is-a-man whether-or-not James is-a-woman.

</pre><cx "bridi, logical connection with negation">To obtain the other truth tables listed in <a href=#s2>Section 2</a>, we need to know how to negate the two bridi which represent the component sentences. We could negate them directly by inserting “na” before the selbri, but Lojban also allows us to place the nega­tion within the connective itself.

<p>

<lx "JA"><lx "I">To negate the first or left-hand bridi, prefix “na” to the JA cmavo but after the “.i”. To negate the second or right-hand bridi, suffix “-nai” to the JA cmavo. In either case, the negating word is placed on the side of the connective that is closest to the bridi being ne­gated.

<p>

So to express the truth table FTTF, which requires <font face="Brush Script MT, Script">O </font>with either of the two bridi ne­gated (not both), we can say either:

<p>

<pre><a name=e4d5>4.5) la djan. nanmu .inajo la djeimyz. ninmu

John is-not-a-man if-and-only-if James is-a-woman.

<a name=e4d6>4.6) la djan. nanmu .ijonai la djeimyz. ninmu

John is a man if-and-only-if James is-not-a-woman

</pre><p>The meaning of both <a href=#e4d5>Example 4.5 </a>and <a href=#e4d6>Example 4.6 </a>is the same as that of:

<p>

<pre><a name=e4d7>4.7) John is a man or James is a woman, but not both.

</pre><p>Here is another example:

<p>

<pre><a name=e4d8>4.8) la djan. nanmu .ijanai la djeimyz. ninmu

John is-a-man or James is-not-a-woman.

John is a man if James is a woman.

</pre><cx "if, meaning in logical connections"><cx "if, English usage contrasted with Lojban logical connective">How's that again? Are those two English sentences in <a href=#e4d8>Example 4.8 </a>really equivalent? In English, no. The Lojban TTFT truth function can be glossed “A if B”, but the “if” does not quite have its English sense. <a href=#e4d8>Example 4.8 </a>is true so long as John is a man, even if James is not a woman; likewise, it is true just because James is not a woman, regardless of John's gender. This kind of “if-then” is technically known as a “material condi­tional”.

<p>

Since James is not a woman (by our assertions in <a href=#s1>Section 1</a>), the English sen­tence “John is a man if James is a woman” seems to be neither true nor false, since it assumes something which is not true. It turns out to be most convenient to treat this “if” as TTFT, which on investigation means that <a href=#e4d8>Example 4.8 </a>is true. <a href=#e4d9>Example 4.9</a>, how­ever, is equally true:

<p>

<pre><a name=e4d9>4.9) la djan. ninmu .ijanai la djeimyz. ninmu

John is a woman if James is a woman.

</pre><cx "principle of consistency, of logical-if statements"><cx "false statement, implications of">This can be thought of as a principle of consistency, and may be paraphrased as fol­lows: “If a false statement is true, any statement follows from it.” All uses of English “if” must be considered very carefully when translating into Lojban to see if they really fit this Loj­ban mold.

<p>

<cx "if … then, compared with only if"><cx "only if, compared with if … then"><a href=#e4d10>Example 4.10</a>, which uses the TFTT truth function, is subject to the same rules: the stated gloss of TFTT as “only if” works naturally only when the right-hand bridi is true; if it is false, the left-hand bridi may be either true or false. The last gloss of <a href=#e4d10>Example 4.10 </a>illustrates the use of “if <dots>…</dots> then” as a more natural substitute for “only if”.

<p>

<pre><a name=e4d10>4.10) la djan. nanmu .inaja la djeimyz. ninmu

John is-not-a-man or James is-a-woman.

John is a man only if James is a woman.

If John is a man, then James is a woman.

</pre><lx "se"><cx "se, in logical connective to exchange sentences">The following example illustrates the use of “se” to, in effect, exchange the two sen­tences. The normal use of “se” is to (in effect) transpose places of a bridi, as ex­plained in <a href=chap5.html>Chapter 5</a>.

<p>

<pre><a name=e4d11>4.11) la djan. nanmu .iseju la djeimyz. ninmu

Whether or not John is a man, James is a woman.

</pre><lx "na"><lx "nai"><lx "se"><cx "se, order in logical connectives with na"><cx "na, order in logical connectives with se">If both “na” and “se” are present, which is legal but never necessary, “na” would come before “se”.

<p>

<cx "ijeks, syntax of"><lx "I"><lx "JA">The full syntax of ijeks, therefore, is:

<p>

<dl compact><dt><dd>.i [na] [se] JA [nai]

</dl>where the cmavo in brackets are optional.

<p>

### <a name=s5><h3>Forethought bridi connection</h3>

<p>

<cx "afterthought, contrasted with forethought for connectives"><cx "forethought, contrasted with afterthought for connectives">Many concepts in Lojban are expressible in two different ways, generally re­ferred to as “afterthought” and “forethought”. <a href=#s4>Section 4 </a>discussed what is called “afterthought bridi logical connection”. The word “afterthought” is used because the connective cmavo and the second bridi were added, as it were, afterwards and without changing the form of the first bridi. This form might be used by someone who makes a statement and then wishes to add or qualify that statement after it has been completed. Thus,

<p>

<pre><a name=e5d1>5.1) la djan. nanmu

</pre>is a complete bridi, and adding an afterthought connection to make

<p>

<pre><a name=e5d2>5.2) la djan. nanmu .ija la djeimyz. ninmu

John is a man or James is a woman (or both)

</pre>provides additional information without requiring any change in the form of what has come before; changes may not be possible or practical, especially in speaking. (The meaning, however, may be changed by the use of a negating connective.) Afterthought connectives make it possible to construct all the important truth-functional relationships in a variety of ways.

<p>

<cx "gek, definition"><cx "ijek bridi connectives, contrasted with geks"><cx "gek bridi connectives, contrasted with ijeks"><cx "forethought bridi connectives, contrasted with afterthought bridi connectives"><cx "afterthought bridi connectives, contrasted with forethought bridi connectives"><lx "GA"><lx "JA"><lx "I">In forethought style the speaker decides in advance, before expressing the first bridi, that a logical connection will be expressed. Forethought and afterthought connec­tives are expressed with separate selma'o. The forethought logical connectives corre­sponding to afterthought ijeks are geks:

<p>

<pre><a name=e5d3>5.3) ga la djan. nanmu gi la djeimyz. ninmu

Either John is a man or James is a woman (or both).

</pre><lx "GA"><lx "GI">“ga” is the cmavo which represents the <font face="Brush Script MT, Script">A </font>truth function in selma'o GA. The word “gi” does not belong to GA at all, but constitutes its own selma'o: it serves only to separate the two bridi without having any content of its own. The English translation of “ga <dots>…</dots>gi” is “either <dots>…</dots> or”, but in the English form the truth function is specified both by the word “either” and by the word “or”: not so in Lojban.

<p>

<cx "forethought bridi connection, as grammatically one sentence"><cx "i, regarding forethought bridi connection"><lx "I">Even though two bridi are being connected, geks and giks do not have any “.i” in them. The forethought construct binds up the two bridi into a single sentence as far as the grammar is concerned.

<p>

Some more examples of forethought bridi connection are:

<p>

<pre><a name=e5d4>5.4) ge la djan. nanmu gi la djeimyz. ninmu

(It is true that) both John is a man and James is a woman.

</pre><lx "gu"><lx "GU"><pre><a name=e5d5>5.5) gu la djan. nanmu gi la djeimyz. ninmu

It is true that John is a man, whether or not James is a woman.

</pre><p>It is worth emphasizing that <a href=#e5d5>Example 5.5 </a>does not assert that James is (or is not) a woman. The “gu” which indicates that “la djeimyz. ninmu” may be true or false is un­fortunately rather remote from the bridi thus affected.

<p>

Perhaps the most important of the truth functions commonly expressed in fore­thought is TFTT, which can be paraphrased as “if <dots>… </dots>then <dots>…</dots>”:

<p>

<lx "ganai"><lx "GA"><pre><a name=e5d6>5.6) ganai la djan. nanmu gi la djeimyz. ninmu

Either John is not a man, or James is a woman.

If John is a man, then James is a woman.

</pre><cx "nai, placement in forethought bridi connection contrasted with afterthought"><cx "nai, placement in afterthought bridi connection contrasted with forethought">Note the placement of the “nai” in <a href=#e5d6>Example 5.6</a>. When added to afterthought selma'o such as JA, a following “nai” negates the second bridi, to which it is adjacent. Since GA cmavo precede the first bridi, a following “nai” negates the first bridi instead.

<p>

<cx "logical connectives, negated first sentence as a potential problem for understanding">Why does English insist on forethought in the translation of <a href=#e5d6>Example 5.6</a>? Pos­sibly because it would be confusing to seemingly assert a sentence and then make it conditional (which, as the Lojban form shows, involves a negation). Truth functions which involve negating the first sentence may be confusing, even to the Lojbanic un­derstanding, when expressed using afterthought.

<p>

<cx "if … then, logical connectives contrasted with other translations">It must be reiterated here that not every use of English “if <dots>…</dots> then” is properly trans­lated by “.inaja” or “ganai <dots>…</dots>gi”; anything with implications of time needs a somewhat different Lojban translation, which will be discussed in <a href=#s18>Section 18</a>. Causal sentences like “If you feed the pig, then it will grow” are not logical connectives of any type, but rather need a translation using “rinka” as the selbri joining two event abstrac­tions, thus:

<p>

<pre><a name=e5d7>5.7) le nu do cidja dunda fi le xarju cu rinka le nu ri ba banro

The event-of (you food-give to the pig) causes the event-of (it will grow).

</pre><p>Causality is discussed in far more detail in <a href=chap9.html>Chapter 9</a>.

<p>

<a href=#e5d8>Example 5.8 </a>and <a href=#e5d9>Example 5.9 </a>illustrates a truth function, FTTF, which needs to ne­gate either the first or the second bridi. We already understand how to negate the first bridi:

<p>

<pre><a name=e5d8>5.8) gonai la djan. nanmu gi la djeimyz. ninmu

John is-not-a-man if-and-only-if James is-a-woman,

Either John is a man or James is a woman but not both.

</pre><lx "ginai"><lx "GI">How can the second bridi be negated? By adding “-nai” to the “gi”.

<p>

<pre><a name=e5d9>5.9) go la djan. nanmu ginai la djeimyz. ninmu

John is-a-man if-and-only-if James is-not-a-woman.

Either John is a man or James is a woman but not both.

</pre><cx "gik, definition"><lx "GI">A compound cmavo based on “gi” is called a gik; the only giks are “gi” itself and “ginai”.

<p>

Further examples:

<p>

<pre><a name=e5d10>5.10) ge la djan. nanmu ginai la djeimyz. ninmu

John is-a-man and James is-not-a-woman.

</pre><lx "ganai"><lx "GA"><pre><a name=e5d11>5.11) ganai la djan. nanmu ginai la djeimyz. ninmu

John is-not-a-man or James is-not-a-woman.

</pre><lx "se"><lx "nai"><lx "GA"><cx "geks, syntax of">The syntax of geks is:

<p>

<dl compact><dt><dd>[se] GA [nai]

</dl><lx "gi"><lx "GI"><lx "nai"><cx "giks, syntax of">and of giks (which are not themselves connectives, but part of the machinery of fore­thought connection) is:

<p>

<dl compact><dt><dd>gi [nai]

### </dl><a name=s6><h3>sumti connection</h3>

<p>

<cx "sumti logical connection"><cx "sumti logical connection, rationale for"><cx "sumti logical connection, compared with bridi logical connections"><cx "bridi logical connection, compared with sumti logical connections">Geks and ijeks are sufficient to state every possible logical connection between two bridi. However, it is often the case that two bridi to be logically connected have one or more portions in common:

<p>

<pre><a name=e6d1>6.1) la djan. klama le zarci .ije la .alis. klama le zarci

John goes to the market, and Alice goes to the market.

</pre><p>Here only a single sumti differs between the two bridi. Lojban does not require that both bridi be expressed in full. Instead, a single bridi can be given which contains both of the different sumti and uses a logical connective from a different selma'o to combine the two sumti:

<p>

<lx ".e"><lx "A"><pre><a name=e6d2>6.2) la djan .e la .alis. klama le zarci

John and Alice go-to the market.

</pre><cx "logical connection, transformation between forms"><a href=#e6d2>Example 6.2 </a>means exactly the same thing as <a href=#e6d1>Example 6.1</a>: one may be rigorously trans­formed into the other without any change of logical meaning. This rule is true in general for every different kind of logical connection in Lojban; all of them, with one exception (see <a href=#s12>Section 12</a>), can always be transformed into a logical connection be­tween sentences that expresses the same truth function.

<p>

<cx "sumti connection, afterthought"><cx "eks, in sumti forethought logical connection"><lx "A">The afterthought logical connectives between sumti are eks, which contain a connec­tive cmavo of selma'o A. If ijeks were used in <a href=#e6d2>Example 6.2</a>, the meaning would be changed:

<p>

<pre><a name=e6d3>6.3) la djan. .ije la .alis. klama le zarci

John [is/does something]. And Alices goes-to the market.

</pre>leaving the reader uncertain why John is mentioned at all.

<p>

Any ek may be used between sumti, even if there is no direct English equiva­lent:

<p>

<pre><a name=e6d4>6.4) la djan. .o la .alis. klama le zarci

John if-and-only-if Alice goes-to the market.

John goes to the market if, and only if, Alice does.

</pre><p>The second line of <a href=#e6d3>Example 6.3 </a>is highly stilted English, but the first line (of which it is a literal translation) is excellent Lojban.

<p>

<cx "sumti connection, forethought"><cx "geks, in forethought sumti connection"><lx "GA">What about forethought sumti connection? As is the case for bridi connection, geks are appropriate. They are not the only selma'o of forethought logical-connectives, but are the most commonly used ones.

<p>

<pre><a name=e6d5>6.5) ga la djan. gi la .alis. klama le zarci

Either John or Alice (or both) goes-to the market.

</pre><cx "na writing convention, in eks"><cx "se writing convention, in eks"><lx "A">Of course, eks include all the same patterns of compound cmavo that ijeks do. When “na” or “se” is part of an ek, a special writing convention is invoked, as in the following example:

<p>

<lx "na.a"><lx "A"><pre><a name=e6d6>6.6) la djan. na.a la .alis. klama le zarci

John only if Alice goes-to the market.

John goes to the market only if Alice does.

</pre><p>Note the period in “na.a”. The cmavo of A begin with vowels, and therefore must al­ways be preceded by a pause. It is conventional to write all connective compounds as single words (with no spaces), but this pause must still be marked in writing as in speech; oth­erwise, the “na” and “a” would tend to run together.

<p>

### <a name=s7><h3>More than two propositions</h3>

<p>

<cx "logical connectives, more than 2 sentences">So far we have seen logical connectives used to connect exactly two sentences. How about connecting three or more? Is this possible in Lojban? The answer is yes, subject to some warnings and some restrictions.

<p>

<cx "logical connectives, associative">Of the four primitive truth functions <font face="Brush Script MT, Script">A</font>, <font face="Brush Script MT, Script">E</font>, <font face="Brush Script MT, Script">O</font>, and <font face="Brush Script MT, Script">U</font>, all but <font face="Brush Script MT, Script">O </font>have the same truth val­ues no matter how their component sentences are associated in pairs. There­fore,

<p>

<pre><a name=e7d1>7.1) mi dotco .ije mi ricfu .ije mi nanmu

I am-German. And I am-rich. And I am-a-man.

</pre>means that all three component sentences are true. Likewise,

<p>

<pre><a name=e7d2>7.2) mi dotco .ija mi ricfu .ija mi nanmu

I am-German. Or I am-rich. Or I am-a-man.

</pre>means that one or more of the component sentences is true.

<p>

<cx "logical connectives, non-associative"><cx "logical connectives, equivalence relation on 3 sentences"><font face="Brush Script MT, Script">O</font>, however, is different. Working out the truth table for

<p>

<pre><a name=e7d3>7.3) mi dotco .ijo mi ricfu .ijo mi nanmu

I am-German. If-and-only-if I am-rich. If-and-only-if I am-a-man.

</pre>shows that <a href=#e7d3>Example 7.3 </a>does not mean that either I am all three of these things or none of them; instead, an accurate translation would be:

<p>

<dl compact><dt><dd>Of the three properties — German-ness, wealth, and manhood — I possess either

ex­ctly one or else all three.

</dl><cx "logical connection of more than 2 sentences, things to avoid"><cx "logical connection, negation in connecting more than 2 sentences">Because of the counterintuitiveness of this outcome, it is safest to avoid <font face="Brush Script MT, Script">O </font>with more than two sentences. Likewise, the connectives which involve negation also have unex­pected truth values when used with more than two sentences.

<p>

<cx "logical connection of more than 2 sentences, all or none">In fact, no combination of logical connectives can produce the “all or none” inter­pretation intended (but not achieved) by <a href=#e7d3>Example 7.3 </a>without repeating one of the bridi. See <a href=#e8d11>Example 8.11</a>.

<p>

There is an additional difficulty with the use of more than two sentences. What is the meaning of:

<p>

<cx "logical connection of more than 2 sentences, mixed “and” and “or”"><pre><a name=e7d4>7.4) mi nelci la djan. .ije mi nelci la martas. .ija mi nelci la meris.

I like John. And I like Martha. Or I like Mary.

</pre><p>Does this mean:

<p>

<pre><a name=e7d5>7.5) I like John, and I like either Martha or Mary or both.

</pre><p>Or is the correct translation:

<p>

<pre><a name=e7d6>7.6) Either I like John and I like Martha, or I like Mary, or both.

</pre><cx "logical connectives, pairing from left"><cx "logical connection of more than 2 sentences, forethought"><a href=#e7d6>Example 7.6 </a>is the correct translation of <a href=#e7d4>Example 7.4</a>. The reason is that Lojban logical connectives pair off from the left, like many constructs in the language. This rule, called the left-grouping rule, is easy to forget, especially when intuition pulls the other way. Forethought connectives are not subject to this problem:

<p>

<pre><a name=e7d7>7.7) ga ge mi nelci la djan. gi mi nelci la martas. gi mi nelci la meris.

Either (Both I like John and I like Martha) or I like Mary.

</pre>is equivalent in meaning to <a href=#e7d4>Example 7.4</a>, whereas

<p>

<pre><a name=e7d8>7.8) ge mi nelci la djan. gi ga mi nelci la martas. gi mi nelci la meris.

Both I like John and (Either I like Martha or I like Mary).

</pre>is not equivalent to <a href=#e7d4>Example 7.4</a>, but is instead a valid translation into Lojban, using forethought, of <a href=#e7d5>Example 7.5</a>.

<p>

### <a name=s8><h3>Grouping of afterthought connectives</h3>

<p>

<lx "bo"><lx "BO"><cx "logical connectives, grouping with bo"><cx "logical connection with bo, precedence"><cx "bo, in logical connectives">There are several ways in Lojban to render <a href=#e7d5>Example 7.5 </a>using afterthought only. The simplest method is to make use of the cmavo “bo” (of selma'o BO). This cmavo has sev­eral functions in Lojban, but is always associated with high precedence and short scope. In particular, if “bo” is placed after an ijek, the result is a grammati­cally distinct kind of ijek which overrides the regular left-grouping rule. Connections marked with “bo” are interpreted before connections not so marked. <a href=#e8d1>Example 8.1 </a>is equivalent in meaning to <a href=#e7d8>Example 7.8</a>:

<p>

<pre><a name=e8d1>8.1) mi nelci la djan. .ije mi nelci la martas. .ijabo mi nelci la meris.

I like John, and I like Martha or I like Mary.

</pre><p>The English translation feebly indicates with a comma what the Lojban marks far more clearly: the “I like Martha” and “I like Mary” sentences are joined by “.ija” first, before the result is joined to “I like John” by “.ije”. <dl compact><dt><dd>Eks can have “bo” attached in exactly the same way, so that <a href=#e8d2>Example 8.2 </a>is equivalent in meaning to Example 8.l:

<p><dt><a name=e8d2>8.2) <dd>mi nelci la djan. .e la martas. .abo la meris.

</dl><cx "forethought connectives and bo"><cx "bo and forethought connectives">Forethought connectives, however, never can be suffixed with “bo”, for every use of forethought connectives clearly indicates the intended pattern of grouping.

<p>

What happens if “bo” is used on both connectives, giving them the same high prece­dence, as in <a href=#e8d3>Example 8.3</a>?

<p>

<pre><a name=e8d3>8.3) mi nelci la djan. .ebo la martas. .abo la meris.

</pre><cx "bo, right-grouping"><cx "logical connectives, right-grouping with bo"><lx "BO">Does this wind up meaning the same as <a href=#e7d4>Example 7.4 </a>and <a href=#e7d6>Example 7.6</a>? Not at all. A sec­ond rule relating to “bo” is that where several “bo”-marked connectives are used in suc­cession, the normal Lojban left-grouping rule is replaced by a right-grouping rule. As a result, <a href=#e8d3>Example 8.3 </a>in fact means the same as <a href=#e8d{1}>Examples 8.1 </a>and <a href=#e8d2>8.2</a>. This rule may be occasionally exploited for special effects, but is tricky to keep straight; in writing in­tended to be easy to understand, multiple consecutive connectives marked with “bo” should be avoided.

<p>

<cx "complex logical connection, grouping strategies contrasted"><cx "logical connection, grouping strategies for complex cases contrasted"><lx "tu'e"><lx "tu'u"><lx "ke"><lx "ke'e"><lx "TUhE"><lx "TUhU"><lx "KE"><lx "KEhE"><cx "complex logical connectives, grouping with parentheses">The use of “bo”, therefore, gets tricky in complex connections of more than three sentences. Look back at the English translations of <a href=#e7d{7}>Examples 7.7 </a>and <a href=#e7d8>7.8</a>: pa­rentheses were used to clarify the grouping. These parentheses have their Lojban equivalents, two sets of them actually. “tu'e” and “tu'u” are used with ijeks, and “ke” and “ke'e” with eks and other connectives to be discussed later. (“ke” and “ke'e” are also used in other roles in the language, but always as grouping markers). Consider the English sentence:

<p>

<pre><a name=e8d4>8.4) I kiss you and you kiss me, if I love you and you love me.

</pre><cx "complex logical connectives, grouping with bo"><lx "BO"><lx "bo">where the semantics tells us that the instances of “and” are meant to have higher prece­dence than that of “if”. If we wish to express <a href=#e8d4>Example 8.4 </a>in afterthought, we can say:

<p>

<pre><a name=e8d5>8.5) mi cinba do .ije[bo] do cinba mi .ijanai mi prami do .ijebo do prami mi

I kiss you and you kiss me, if I love you and you love me.

</pre>marking two of the ijeks with “bo” for high precedence. (The first “bo” is not strictly nec­essary, because of the left-grouping rule, and is shown here in brackets.)

<p>

<cx "complex logical connectives, grouping with parentheses">But it may be clearer to use explicit parenthesis words and say:

<p>

<pre><a name=e8d6>8.6) tu'e mi cinba do .ije do cinba mi tu'u

.ijanai tu'e mi prami do .ije do prami mi [tu'u]

( I kiss you and you kiss me )

if ( I love you and you love me).

</pre>where the “tu'e <dots>…</dots>tu'u” pairs set off the structure. The cmavo “tu'u” is an elidable ter­mi­nator, and its second occurrence in <a href=#e8d6>Example 8.6 </a>is bracketed, because all terminators may be elided at the end of a text.

<p>

In addition, parentheses are a general solution: multiple parentheses may be nested inside one another, and additional afterthought material may be added without upsetting the existing structure. Neither of these two advantages apply to “bo” group­ing. In general, afterthought constructions trade generality for simplicity.

<p>

Because of the left-grouping rule, the first set of “tu'e <dots>…</dots>tu'u” parentheses may actu­ally be left off altogether, producing:

<p>

<pre><a name=e8d7>8.7) mi cinba do .ije do cinba mi

.ijanai tu'e mi prami do .ije do prami mi [tu'u]

I kiss you and you kiss me

if ( I love you and you love me ).

</pre><p>What about parenthesized sumti connection? Consider

<p>

<pre><a name=e8d8>8.8) I walk to either the market and the house, or the school and the office.

</pre><cx "logical connection of sumti, grouping with parentheses"><cx "logical connection of sumti, restriction on ke"><cx "sumti, beginning with "ke"><lx "ke"><lx "KE">Two pairs of parentheses, analogous to <a href=#e8d6>Example 8.6</a>, would seem to be the right ap­proach. However, it is a rule of Lojban grammar that a sumti may not begin with “ke”, so the first set of parentheses must be omitted, producing <a href=#e8d10>Example 8.10</a>, which is instead parallel to <a href=#e8d7>Example 8.7</a>:

<p>

<pre><a name=e8d9>8.9) mi dzukla le zarci .e le zdani .a ke le ckule .e le briju [ke'e]

I walk-to the market and the house or ( the school and the office ).

</pre><cx "ke in sumti grouping, where allowed"><lx "ke"><lx "KE">If sumti were allowed to begin with “ke”, unavoidable ambiguities would result, so “ke” grouping of sumti is allowed only just after a logical connective. This rule does not apply to “tu'e” grouping of bridi, as <a href=#e8d6>Example 8.6 </a>shows.

<p>

<ex "German rich man">Now we have enough facilities to handle the problem of <a href=#e7d3>Example 7.3</a>: “I am German, rich, and a man — or else none of these.” The following paraphrase has the correct meaning:

<p>

<pre><a name=e8d10>8.10) [tu'e] mi dotco .ijo mi ricfu [tu'u]

.ije tu'e mi dotco .ijo mi nanmu [tu'u]

( I am-German if-and-only-if I am-rich )

and ( I am-German if-and-only-if I am-a-man ).

</pre><p>The truth table, when worked out, produces T if and only if all three component sen­tences are true or all three are false.

<p>

### <a name=s9><h3>Compound bridi</h3>

<p>

<cx "logical connection of selbri">So far we have seen how to handle two sentences that need have no similarity at all (bridi connection) and sentences that are identical except for a difference in one sumti (sumti connection). It would seem natural to ask how to logically connect sen­tences that are identical except for having different selbri.

<p>

<cx "compound bridi, definition">Surprise! Lojban provides no logical connective that is designed to handle sel­bri and nothing else. Instead, selbri connection is provided as part of a more general-purpose mechanism called “compound bridi”. Compound bridi result from logically connecting sentences that differ in their selbri and possibly some of their sumti.

<p>

<cx "compound bridi, one sumti in common">The simplest cases result when the x1 sumti is the only common point:

<p>

<pre><a name=e9d1>9.1) mi klama le zarci .ije mi nelci la djan.

I go to the market, and I like John.

</pre>is equivalent in meaning to the compound bridi:

<p>

<pre><a name=e9d2>9.2) mi klama le zarci gi'e nelci la djan.

I go-to the market and like John.

</pre><cx "gihek, definition"><lx "gi'e"><cx "bridi-tail, definition"><cx "compound bridi, logical connection of"><lx "GIhA">As <a href=#e9d2>Example 9.2 </a>indicates, giheks are used in afterthought to create compound bridi; “gi'e” is the gihek corresponding to “and”. The actual phrases “klama le zarci” and “nelci la djan.” that the gihek connects are known as “bridi-tails”, because they represent (in this use) the “tail end” of a bridi, including the selbri and any following sumti, but excluding any sumti that precede the selbri:

<p>

<pre><a name=e9d3>9.3) mi ricfu gi'e klama le zarci

I am-rich and go-to the market.

</pre><p>In <a href=#e9d3>Example 9.3</a>, the first bridi-tail is “ricfu”, a simple selbri, and the second bridi-tail is “klama le zarci”, a selbri with one following sumti.

<p>

<cx "compound bridi, more than one sumti in common">Suppose that more than a single sumti is identical between the two sentences:

<p>

<pre><a name=e9d4>9.4) mi dunda le cukta do .ije mi lebna lo rupnu do

I give the book to-you, and I take some currency-units from-you.

</pre><cx "compound bridi with more than one sumti in common, with common sumti first">In <a href=#e9d4>Example 9.4</a>, the first and last sumti of each bridi are identical; the selbri and the sec­ond sumti are different. By moving the final sumti to the beginning, a form analo­gous to <a href=#e9d2>Example 9.2 </a>can be achieved:

<p>

<pre><a name=e9d5>9.5) fi do fa mi dunda le cukta gi'e lebna lo rupnu

To/from you I give the book and take some currency-units.

</pre><cx "logical connectives, bridi-tail connection"><cx "tail-terms, definition">where the “fi” does not have an exact English translation because it merely places “do” in the third place of both “lebna” and “dunda”. However, a form that preserves natural sumti order also exists in Lojban. Giheks connect two bridi-tails, but also allow sumti to be added following the bridi-tail. These sumti are known as tail-terms, and apply to both bridi. The straightforward gihek version of <a href=#e9d4>Example 9.4 </a>therefore is:

<p>

<lx "vau"><lx "VAU"><cx "compound bridi with more than one sumti in common, with vau"><pre><a name=e9d6>9.6) mi dunda le cukta gi'e lebna lo rupnu vau do

I (give the book) and (take some currency-units) to/from you.

</pre><cx "bridi-tails, eliding vau in">The “vau” (of selma'o VAU) serves to separate the bridi-tail from the tail-terms. Every bridi-tail is terminated by an elidable “vau”, but only in connection with compound bridi is it ever necessary to express this “vau”. Thus:

<p>

<pre><a name=e9d7>9.7) mi klama le zarci [vau]

I go-to the market.

</pre>has a single elided “vau”, and <a href=#e9d2>Example 9.2 </a>is equivalent to:

<p>

<pre><a name=e9d8>9.8) mi klama le zarci [vau] gi'e nelci la djan. [vau] [vau]

</pre>where the double “vau” at the end of <a href=#e9d8>Example 9.8 </a>terminates both the right-hand bridi-tail and the unexpressed tail-terms.

<p>

<cx "logical connectives, observative sentence connection">A final use of giheks is to combine bridi-tails used as complete sentences, the Lojban observative:

<p>

<pre><a name=e9d9>9.9) klama le zarci gi'e dzukla le briju

A goer to-the market and a walker to-the office.

</pre><cx "logical connection of observatives, relation of first places">Since x1 is omitted in both of the bridi underlying <a href=#e9d9>Example 9.9</a>, this compound bridi does not necessarily imply that the goer and the walker are the same. Only the presence of an explicit x1 (other than “zo'e”, which is equivalent to omission) can force the goer and the walker to be identical.

<p>

<cx "relation of first places in logical connection of observatives, rationale">A strong argument for this convention is provided by analysis of the following ex­ample:

<p>

<pre><a name=e9d10>9.10) klama la nu,IORK. la finyks. gi'e klama la nu,IORK. la rom.

A goer to-New York from-Phoenix and a goer to-New York from-Rome.

</pre><p>If the rule were that the x1 places of the two underlying bridi were identified, then (since there is nothing special about x1), the unspecified x4 (route) and x5 (means) places would also have to be the same, leading to the absurd result that the route from Phoenix to New York is the same as the route from Rome to New York. Inserting “da”, meaning roughly “something”, into the x1 place cures the problem:

<p>

<pre><a name=e9d11>9.11) da klama la nu,IORK. la finyks.

gi'e klama la nu,IORK. la rom.

Something is-a-goer to-New York from-Phoenix

and is-a-goer to-New York from-Rome.

</pre><cx "giheks, syntax of"><lx "na"><lx "se"><lx "nai"><lx "GIhA">The syntax of giheks is:

<p>

<dl compact><dt><dd>[na] [se] GIhA [nai]

</dl>which is exactly parallel to the syntax of eks.

<p>

### <a name=s10><h3>Multiple compound bridi</h3>

<p>

<cx "compound bridi, multiple with bo">Giheks can be combined with “bo” in the same way as eks:

<p>

<pre><a name=e10d1>10.1) mi nelci la djan. gi'e nelci la martas. gi'abo nelci la meris.

I like John and ( like Martha or like Mary ).

</pre><cx "compound bridi, multiple with ke…ke'e">is equivalent in meaning to <a href=#e8d1>Example 8.1 </a>and <a href=#e8d2>Example 8.2</a>. Likewise, “ke<dots>…</dots>ke'e” grouping can be used after giheks:

<p>

<pre><a name=e10d2>10.2) mi dzukla le zarci gi'e dzukla le zdani

gi'a ke dzukla le ckule gi'e dzukla le briju [ke'e]

I walk-to the market and walk-to the house,

or walk-to the school and walk-to the office.

</pre><cx "multiple compound bridi, restriction on ke"><cx "logical connection of bridi-tails, restriction on ke"><lx "ke"><lx "KEhE">is the gihek version of <a href=#e8d9>Example 8.9</a>. The same rule about using “ke <dots>…</dots>ke'e” bracketing only just after a connective applies to bridi-tails as to sumti, so the first two bridi-tails in <a href=#e10d2>Example 10.2 </a>cannot be explicitly grouped; implicit left-grouping suffices to associ­ate them.

<p>

<cx "compound bridi, separate tail-terms for bridi-tails">Each of the pairs of bridi-tails joined by multiple giheks can have its own set of tail-terms:

<p>

<pre><a name=e10d3>10.3) mi dejni lo rupnu la djan. .inaja mi dunda le cukta la djan.

.ijabo mi lebna le cukta la djan.

[If] I owe some currency-units to John, then I give the book to John

or I take the book from John.

</pre>is equivalent in meaning to:

<p>

<ex "owe money"><pre><a name=e10d4>10.4) mi dejni lo rupnu nagi'a dunda gi'abo lebna vau le cukta vau la djan.

[If] I owe some currency-units then (give or take) a book to/from John.

</pre><p>The literal English translation in <a href=#e10d4>Example 10.4 </a>is almost unintelligible, but the Loj­ban is perfectly grammatical. “mi” fills the x1 place of all three selbri; “lo rupnu” is the x2 of “dejni”, whereas “le cukta” is a tail-term shared between “dunda” and “lebna”; “la djan.” is a tail-term shared by “dejni” and by “dunda gi'abo lebna”. In this case, greater clarity is probably achieved by moving “la djan.” to the beginning of the sentence, as in <a href=#e9d5>Example 10.5</a>:

<p>

<pre><a name=e10d5>10.5) fi la djan. fa mi dejni lo rupnu nagi'a dunda gi'abo lebna vau le cukta

To/from John, [if] I owe some currency-units then [I] give or take the book.

</pre><cx "logical connection of bridi-tails, forethought">Finally, what about forethought logical connection of bridi-tails? There is no direct mechanism for the purpose. Instead, Lojban grammar allows a pair of fore­thought-con­nected sentences to function as a single bridi-tail, and of course the sen­tences need not have terms before their selbri. For example:

<p>

<pre><a name=e10d6>10.6) mi ge klama le zarci gi nelci la djan.

I both go to the market and like John.

</pre>is equivalent in meaning to <a href=#e9d2>Example 9.2</a>.

<p>

Of course, either of the connected sentences may contain giheks:

<p>

<pre><a name=e10d7>10.7) mi ge klama le zarci gi'e dzukla le zdani gi nelci la djan.

I both ( go to the market and walk to the house ) and like John.

</pre><cx "negating a forethought-connected sentence pair"><cx "negating a forethought-connected bridi-tail pair">The entire gek-connected sentence pair may be negated as a whole by prefix­ing “na”:

<p>

<pre><a name=e10d8>10.8) mi na ge klama le zarci gi dzukla le zdani

[False!] I both go to the market and walk to the house.

</pre><cx "compound bridi, separate tail-terms for forethought-connected bridi-tails">Since a pair of sentences joined by geks is the equivalent of a bridi-tail, it may be followed by tail terms. The forethought equivalent of <a href=#e9d6>Example 9.6 </a>is:

<p>

<pre><a name=e10d9>10.9) mi ge dunda le cukta gi lebna lo rupnu vau do

I both ( give the book ) and ( take some currency-units ) to/from you.

</pre><cx "forethought connection, observatives">Here is a pair of gek-connected observatives, a forethought equivalent of <a href=#e9d9>Ex­ample 9.9</a>:

<p>

<pre><a name=e10d10>10.10) ge klama le zarci gi dzukla le briju

Both a goer to-the market and a walker to-the office.

</pre><p>Finally, here is an example of gek-connected sentences with both shared and un­shared terms before their selbri:

<p>

<ex "office or ice-dance"><pre><a name=e10d11>10.11) mi gonai le zarci cu klama gi le bisli cu dansu

I either-but-not-both to-the office go or on-the ice dance.

I either go to the office or dance on the ice (but not both).

### </pre><a name=s11><h3>Termset logical connection</h3>

<cx "termset logical connection, contrasted with bridi connection"><cx "termset logical connection, contrasted with sumti connection"><cx "termset logical connection, contrasted with bridi-tail connection"><cx "termset logical connection, when used">So far we have seen sentences that differ in all components, and require bridi con­nection; sentences that differ in one sumti only, and permit sumti connection; and sen­tences that differ in the selbri and possibly one or more sumti, and permit bridi-tail con­nection. Termset logical connectives are employed for sentences that differ in more than one sumti but not in the selbri, such as:

<p>

<pre><a name=e11d1>11.1) I go to the market from the office and to the house from the school.

</pre><lx "ce'e"><lx "CEhE"><lx "pe'e"><lx "PEhE"><cx "term, definition"><cx "termset, formation"><cx "logical connection, termsets">The Lojban version of <a href=#e11d1>Example 11.1 </a>requires two termsets joined by a logical con­nective. A “term” is either a sumti or a sumti preceded by a tense or modal tag such as “pu” or “bai”. Afterthought termsets are formed by linking terms together by insert­ing the cmavo “ce'e” (of selma'o CEhE) between each of them. Furthermore, the logical connec­tive (which is a jek) must be prefixed by the cmavo “pe'e” (of selma'o PEhE). (We could refer to the combination of “pe'e” and a jek as a “pehejek”, I suppose.)

<p>

<cx "to the market from the office"><pre><a name=e11d2>11.2) mi klama le zarci ce'e le briju pe'e je

le zdani ce'e le ckule

I go to-the market [plus] from-the office [joint] and

to-the house [plus] from-the school.

</pre><p>The literal translation uses “[plus]” to indicate the termset connective, and “[joint]” to indicate the position of the logical connective joint. As usual, there is an equivalent bridi-connection form:

<p>

<pre><a name=e11d3>11.3) mi klama le zarci le briju .ije mi klama le zdani le ckule

I go to-the market from-the office, and I go to-the house from-the school.

</pre>which illustrates that the two bridi differ in the x2 and x3 places only.

<p>

<cx "termset logical connection, unequal length">What happens if the two joined sets of terms are of unequal length? Expanding to bridi connection will always make clear which term goes in which place of which bridi. It can happen that a sumti may fall in the x2 place of one bridi and the x3 place of another:

<p>

<pre><a name=e11d4>11.4) mi pe'e ja do ce'e le zarci cu klama le briju

I [joint] or you to-the market [plus] go to/from-the office.

</pre>can be clearly understood by expansion to:

<p>

<pre><a name=e11d5>11.5) mi klama le briju .ija do le zarci cu klama le briju

I go to-the office, or you to-the market go from-the office.

</pre><cx "unequal termset connection, compared with compound bridi connection with unequal separate bridi-tails">So “le briju” is your origin but my destination, and thus falls in the x2 and x3 places of “klama” simultaneously! This is legal because even though there is only one selbri, “klama”, there are two distinct bridi expressed here. In addition, “mi” in <a href=#e11d4>Example 11.4 </a>is serving as a termset containing only one term. An analogous paradox applies to com­pound bridi with tail-terms and unequal numbers of sumti within the connected bridi-tails:

<p>

<pre><a name=e11d6>11.6) mi klama le zarci gi'e dzukla vau le briju

I ( go to-the market and walk ) to/from-the office.

</pre>means that I go to the market from the office, and I walk to the office; “le briju” is the x3 place of “klama” and the x2 place of “dzukla”.

<p>

<lx "nu'i"><lx "nu'u"><lx "NUhI"><lx "NUhU"><cx "logical connection of forethought termsets"><cx "forethought termsets, logical connection of">Forethought termsets also exist, and use “nu'i” of selma'o NUhI to signal the begin­ning and “nu'u” of selma'o NUhU (an elidable terminator) to signal the end. Nothing is inserted between the individual terms: they simply sit side-by-side. To make a logical connection in a forethought termset, use a gek, with the gek just after the “nu'i”, and an extra “nu'u” just before the gik:

<p>

<pre><a name=e11d7>11.7) mi klama nu'i ge le zarci le briju

nu'u gi le zdani le ckule [nu'u]

I go [start termset] both to-the market from-the office

[joint] and to-the house from-the school [end termset].

</pre><p>Note that even though two termsets are being connected, only one “nu'i” is used.

<p>

The grammatical uses of termsets that do not contain logical connectives are ex­plained in <a href=chap12.html>Chapter 12 </a>and <a href=chap16.html>Chapter 16</a>.

<p>

### <a name=s12><h3>Logical connection within tanru</h3>

<p>

<cx "logical connectives in tanru">As noted at the beginning of <a href=#s9>Section 9</a>, there is no logical connective in Lojban that joins selbri and nothing but selbri. However, it is possible to have logical connec­tives within a selbri, forming a kind of tanru that involves a logical connection. Con­sider the simple tanru “blanu zdani”, blue house. Now anything that is a blue ball, in the most or­dinary understanding of the phrase at least, is both blue and a ball. And indeed, instead of “blanu bolci”, Lojbanists can say “blanu je bolci”, using a jek connective within the tanru. (We saw jeks used in <a href=#s11>Section 11 </a>also, but there they were always pre­fixed by “pe'e”; in this section they are used alone.) Here is a pair of examples:

<p>

<ex "blue house"><pre><a name=e12d1>12.1) ti blanu zdani

This is-a-blue type-of house.

<a name=e12d2>12.2) ti blanu je zdani

This is-blue and a-house.

</pre><cx "logical connection in tanru, contrasted with unconnected version"><cx "unconnected tanru, contrasted with logically connected version">But of course <a href=#e12d1>Example 12.1 </a>and <a href=#e12d2>Example 12.2 </a>are not necessarily equivalent in meaning! It is the most elementary point about Lojban tanru that <a href=#e12d1>Example 12.1 </a>might just as well mean

<p>

<pre><a name=e12d3>12.3) This is a house for blue inhabitants.

</pre>and <a href=#e12d2>Example 12.2 </a>certainly is not equivalent in meaning to <a href=#e12d3>Example 12.3</a>.

<p>

<cx "logical connection in tanru, expandability of">A full explanation of logical connection within tanru belongs rather to a dis­cussion of selbri structure than to logical connectives in general. Why? Because al­though <a href=#e12d2>Example 12.2 </a>happens to mean the same as

<p>

<pre><a name=e12d4>12.4) ti blanu gi'e zdani

</pre>and therefore as

<p>

<pre><a name=e12d5>12.5) ti blanu .ije ti zdani

</pre>the rule of expansion into separate bridi simply does not always work for tanru connec­tion. Supposing Alice to be a person who lives in blue houses, then

<p>

<pre><a name=e12d6>12.6) la .alis. cu blanu je zdani prenu

Alice is-a ( blue and house ) type-of-person.

</pre>would be true, because tanru grouping with a jek has higher precedence than unmarked tanru grouping, but:

<p>

<pre><a name=e12d7>12.7) la .alis. cu blanu prenu .ije la .alis. cu zdani prenu

Alice is-a blue person, and Alice is-a house person.

</pre>is probably false, because the blueness is associated with the house, not with Alice, even leaving aside the question of what it means to say “Alice is a blue person”. (Perhaps she belongs to the Blue team, or is wearing blue clothes.) The semantic ambi­guity of tanru make such logical manipulations impossible.

<p>

<lx "bo"><lx "BO"><cx "logical connection in tanru, grouping with bo">It suffices to note here, then, a few purely grammatical points about tanru logi­cal connection. “bo” may be appended to jeks as to eks, with the same rules:

<p>

<pre><a name=e12d8>12.8) la teris. cu ricfu je nakni jabo fetsi

Terry is rich and ( male or female ).

</pre><cx "logical connection in tanru, grouping with ke"><lx "ke"><lx "KE">The components of tanru may be grouped with “ke” both before and after a logical connective:

<p>

<pre><a name=e12d9>12.9) la .teris. cu [ke] ricfu ja pindi [ke'e] je ke nakni ja fetsi [ke'e]

Terry is (rich or poor) and (male or female).

</pre>where the first “ke <dots>…</dots>ke'e” pair may be omitted altogether by the rule of left-grouping, but is optionally permitted. In any case, the last instance of “ke'e” may be elided.

<p>

<lx "na"><lx "se"><lx "nai"><lx "JA"><cx "jeks, syntax of">The syntax of jeks is:

<p>

<dl compact><dt><dd>[na] [se] JA [nai]

</dl>parallel to eks and giheks.

<p>

<cx "forethought tanru connection"><cx "guhek, definition"><lx "GUhA">Forethought tanru connection does not use geks, but uses guheks instead. Gu­heks have exactly the same form as geks:

<p>

<lx "se"><lx "nai"><lx "GUhA"><cx "guheks, syntax of"><dl compact><dt><dd>[se] GUhA [nai]

</dl><cx "guheks for tanru connection, rationale"><cx "logical connection, of bridi-tail as opposed to tanru"><cx "logical connection, of tanru as opposed to bridi-tail">Using guheks in tanru connection (rather than geks) resolves what would otherwise be an unacceptable ambiguity between bridi-tail and tanru connection:

<p>

<pre><a name=e12d10>12.10) la .alis. gu'e ricfu gi fetsi

Alice is both rich and female.

</pre><cx "tanru grouping, guheks compared with jeks"><cx "tanru connection grouping, guheks unmarked tanru"><lx "GUhA"><lx "JA">Note that giks are used with guheks in exactly the same way they are used with geks. Like jeks, guheks bind more closely than unmarked tanru grouping does:

<p>

<pre><a name=e12d11>12.11) la .alis. gu'e blanu gi zdani prenu

Alice is-a-(both blue and a-house) type-of-person.

</pre>is the forethought version of <a href=#e12d6>Example 12.6</a>.

<p>

<cx "logical connection of tanru, caveat"><cx "tanru, reducing logically connected sumti to, caveat"><cx "tanru logical connection, contrasted with sumti logical connection"><cx "sumti logical connection, contrasted with tanru logical connection">A word of caution about the use of logically connected tanru within descrip­tions. English-based intuition can lead the speaker astray. In correctly reducing

<p>

<pre><a name=e12d12>12.12) mi viska pa nanmu .ije mi viska pa ninmu

I see a man, and I see a woman.

</pre>to

<p>

<pre><a name=e12d13>12.13) mi viska pa nanmu .e pa ninmu

I see a man and a woman.

</pre>there is a great temptation to reduce further to:

<p>

<ex "man-woman"><pre><a name=e12d14>12.14) mi viska pa nanmu je ninmu

I see a man and woman.

</pre><p>But <a href=#e12d14>Example 12.14 </a>means that you see one thing which is both a man and a woman si­multaneously! A “nanmu je ninmu” is a manwoman, a presumably non-existent crea­ture who is both a “nanmu” and a “ninmu”.

<p>

### <a name=s13><h3>Truth questions and connective questions</h3>

<p>

So far we have addressed only sentences which are statements. Lojban, like all hu­man languages, needs also to deal with sentences which are questions. There are many ways of asking questions in Lojban, but some of these (like questions about quantity, tense, and emotion) are discussed in other chapters.

<p>

<cx "truth questions, simple">The simplest kind of question is of the type “Is it true that <dots>…</dots>” where some statement follows. This type is called a “truth question”, and can be represented in English by <a href=#e13d1>Ex­ample 13.1</a>:

<p>

<pre><a name=e13d1>13.1) Is it true that Fido is a dog?

Is Fido a dog?

</pre><lx "xu"><lx "UI">Note the two formulations. English truth questions can always be formed by prefixing “Is is true that” to the beginning of a statement; there is also usually a more idiomatic way involving putting the verb before its subject. “Is Alice a dog?” is the truth question corre­sponding to “Alice is a dog”. In Lojban, the equivalent mechanism is to prefix the cmavo “xu” (of selma'o UI) to the statement:

<p>

<pre><a name=e13d2>13.2) xu la faidon. gerku

is-it-true-that Fido is-a-dog?

</pre><a href=#e13d1>Example 13.1 </a>and <a href=#e13d2>Example 13.2 </a>are equivalent in meaning.

<p>

<cx "truth questions, as yes-or-no questions"><cx "truth questions, answering “yes”"><cx "truth questions, answering “no”">A truth question can be answered “yes” or “no”, depending on the truth or fal­sity, re­spectively, of the underlying statement. The standard way of saying “yes” in Lojban is “go'i” and of saying “no” is “nago'i”. (The reasons for this rule are explained in <a href=chap7.html>Chapter 7</a>.) In answer to <a href=#e13d2>Example 13.2</a>, the possible answers are:

<p>

<pre><a name=e13d3>13.3) go'i

Fido is a dog.

</pre>and

<p>

<pre><a name=e13d4>13.4) nago'i

Fido is not a dog.

</pre><cx "truth questions, contrasted with connection questions">Some English questions seemingly have the same form as the truth questions so far discussed. Consider

<p>

<ex "dog or cat"><pre><a name=e13d5>13.5) Is Fido a dog or a cat?

</pre><p>Superficially, <a href=#e13d5>Example 13.5 </a>seems like a truth question with the underlying statement:

<p>

<pre><a name=e13d6>13.6) Fido is a dog or a cat.

</pre><p>By translating <a href=#e13d6>Example 13.6 </a>into Lojban and prefixing “xu” to signal a truth question, we get:

<p>

<pre><a name=e13d7>13.7) xu la faidon. gerku gi'onai mlatu

is-it-true-that Fido is-a-dog or is-a-cat (but not both)?

</pre><p>Given that Fido really is either a dog or a cat, the appropriate answer would be “go'i”; if Fido were a fish, the appropriate answer would be “nago'i”.

<p>

But that is not what an English-speaker who utters <a href=#e13d5>Example 13.5 </a>is asking! The true significance of <a href=#e13d5>Example 13.5 </a>is that the speaker desires to know the truth value of either of the two underlying bridi (it is presupposed that only one is true).

<p>

<cx "questions, connection">Lojban has an elegant mechanism for rendering this kind of question which is very unlike that used in English. Instead of asking about the truth value of the con­nected bridi, Lojban users ask about the truth function which connects them. This is done by using a special question cmavo: there is one of these for each of the logical connective selma'o, as shown by the following table:

<p>

<lx "ge'i"><lx "gi'i"><lx "gu'i"><lx "je'i"><lx "ji"><lx "GA"><lx "GIhA"><lx "GUhA"><lx "JA"><lx "A"><pre> ge'i GA forethought connective question

gi'i GIhA bridi-tail connective question

gu'i GUhA tanru forethought connective question

je'i JA tanru connective question

ji A sumti connective question

</pre><cx "connective question cmavo, departure from regularity of">(This list unfortunately departs from the pretty regularity of the other cmavo for logical connection. The two-syllable selma'o, GIhA and GUhA, make use of the cmavo ending in “-i” which is not used for a truth function, but “gi” and “.i” were not available, and differ­ent cmavo had to be chosen. This table must simply be memorized, like most other non-connective cmavo assignments.)

<p>

<cx "connective questions, answering">One correct translation of <a href=#e13d5>Example 13.5 </a>employs a question gihek:

<p>

<pre><a name=e13d8>13.8) la .alis gerku gi'i mlatu

Alice is-a-dog [truth function?] is-a-cat?

</pre><p>Here are some plausible answers:

<p>

<pre><a name=e13d9>13.9) nagi'e

Alice is not a dog and is a cat.

<a name=e13d10>13.10) gi'enai

Alice is a dog and is not a cat.

<a name=e13d11>13.11) nagi'enai

Alice is not a dog and is not a cat.

<a name=e13d12>13.12) nagi'o

gi'onai

Alice is a dog or is a cat but not both (I'm not saying which).

</pre><a href=#e13d12>Example 13.12 </a>is correct but uncooperative.

<p>

<cx "connective, as complete grammatical utterance"><cx "afterthought connective, as complete grammatical utterance">As usual, Lojban questions are answered by filling in the blank left by the question. Here the blank is a logical connective, and therefore it is grammatical in Loj­ban to utter a bare logical connective without anything for it to connect.

<p>

The answer “gi'e”, meaning that Alice is a dog and is a cat, is impossible in the real world, but for:

<p>

<ex "coffee or tea"><pre><a name=e13d13>13.13) do djica tu'a loi ckafi

ji loi tcati

You desire something-about a-mass-of coffee

[truth function?] a-mass-of tea?

Do you want coffee or tea?

</pre>the answer “.e”, meaning that I want both, is perfectly plausible, if not necessarily po­lite.

<p>

<cx "connective, as ungrammatical utterance"><cx "forethought connective, as ungrammatical utterance"><cx "forethought connection, contrasted with afterthought for grammatical utterances"><cx "afterthought connection, contrasted with forethought for grammatical utterances">The forethought questions “ge'i” and “gu'i” are used like the others, but ambi­guity forbids the use of isolated forethought connectives as answers — they sound like the start of forethought-connected bridi. So although <a href=#e13d14>Example 13.14 </a>is the forethought version of <a href=#e13d13>Example 13.13</a>:

<p>

<pre><a name=e13d14>13.14) do djica tu'a

ge'i loi ckafi gi loi tcati

You desire something-about

[truth function?] a-mass-of coffee [or] a-mass-of tea?

</pre>the answer must be in afterthought form.

<p>

<cx "connective questions, compared with other languages">There are natural languages, notably Chinese, which employ the Lojbanic form of connective question. The Chinese sentence

<p>

<pre><a name=e13d15>13.15) ni<sup>3</sup> zou<sup>3</sup> hai<sup>2</sup>shi pao<sup>3</sup>

you walk [or?] run?

</pre>means “Do you walk or run?”, and is exactly parallel to the Lojban:

<p>

<pre><a name=e13d16>13.16) do cadzu gi'i bajra

you walk [or?] run?

</pre><cx "connective question answers, contrasted with other languages">However, Chinese does not use logical connectives in the reply to such a question, so the resemblance, though striking, is superficial.

<p>

<cx "bridi connection, use of truth questions in"><cx "bridi connection, use of imperatives in"><cx "truth, in imperative sentences"><cx "imperatives, and truth"><ex "Abraham Lincoln"><ex "if coffee, bring tea">Truth questions may be used in bridi connection. This form of sentence is per­fectly legitimate, and can be interpreted by using the convention that a truth question is true if the answer is “yes” and false if the answer is “no”. Analogously, an imperative sentence (involving the special pro-sumti “ko”, which means “you” but marks the sen­tence as a command) is true if the command is obeyed, and false otherwise. A request of Abraham Lincoln's may be translated thus:

<p>

<pre><a name=e13d17>13.17) ganai ti ckafi gi ko bevri loi tcati mi

.ije ganai ti tcati gi ko bevri loi ckafi mi

If this is-coffee then [you!] bring a-mass-of tea to-me,

and if this is-tea then [you!] bring a-mass-of coffee to-me.

If this is coffee, bring me tea; but if this is tea, bring me coffee.

</pre><cx "but, compared with and"><cx "and, compared with but"><lx "ku'i"><lx "UI">In logical terms, however, “but” is the same as “and”; the difference is that the sentence after a “but” is felt to be in tension or opposition to the sentence before it. Lojban repre­sents this distinction by adding the discursive cmavo “ku'i” (of selma'o UI), which is ex­plained in <a href=chap13.html>Chapter 13</a>, to the logical “.ije”.)

<p>

### <a name=s14><h3>Non-logical connectives</h3>

<p>

<cx "and, as non-logical connective">Way back in <a href=#s1>Section 1</a>, the point was made that not every use of English “and”, “if <dots>…</dots>then”, and so on represents a Lojban logical connective. In particular, con­sider the “and” of:

<p>

<ex "carried piano"><pre><a name=e14d1>14.1) John and Alice carried the piano.

</pre><cx "mass, joining elements into a">Given the nature of pianos, this probably means that John carried one end and Alice the other. So it is not true that:

<p>

<pre><a name=e14d2>14.2) John carried the piano, and Alice carried the piano.

</pre><lx "joi"><lx "JOI">which would mean that each of them carried the piano by himself/herself. Lojban deals with this particular linguistic phenomenon as a “mass”. John and Alice are joined to­gether into a mass, John-and-Alice, and it is this mass which carried the piano, not ei­ther of them separately. The cmavo “joi” (of selma'o JOI) is used to join two or more compo­nents into a mass:

<p>

<pre><a name=e14d3>14.3) la djan. joi la .alis. cu bevri le pipno

John massed-with Alice carry the piano.

</pre><cx "supervising, as a contribution to mass action"><cx "mass contrasted with components, in properties of"><cx "components contrasted with mass, in properties of"><a href=#e14d3>Example 14.3 </a>covers the case mentioned, where John and Alice divide the la­bor; it also could mean that John did all the hauling and Alice did the supervising. This possibil­ity arises because the properties of a mass are the properties of its components, which can lead to apparent contradictions: if John is small and Alice is large, then John-and-Alice is both small and large. Masses are also discussed in <a href=chap6.html>Chapter 6</a>.

<p>

<lx "JOI"><lx "A"><lx "JA"><cx "non-logical connection, and elidability of terminators"><cx "joi grammar, contrasted with eks"><cx "joi grammar, contrasted with jeks"><cx "non-logical connection of sumti, distinguishing from connection in tanru"><cx "non-logical connection in tanru, distinguishing from connection of sumti">Grammatically, “joi” can appear between two sumti (like an ek) or between two tanru components (like a jek). This flexibility must be paid for in the form of occa­sional terminators that cannot be elided:

<p>

<lx "ku"><lx "le"><cx "terminators, eliding ku in non-logical connections"><lx "KU"><lx "LE"><pre><a name=e14d4>14.4) le nanmu ku joi le ninmu [ku] cu klama le zarci

The man massed-with the woman go-to the market.

</pre><p>The cmavo “ku” is the elidable terminator for “le”, which can almost always be elided, but not in this case. If the first “ku” were elided here, Lojban's parsing rules would see “le nanmu joi” and assume that another tanru component is to follow; since the sec­ond “le” cannot be part of a tanru, a parsing error results. No such problem can occur with logical connectives, because an ek signals a following sumti and a jek a fol­lowing tanru component unambiguously.

<p>

<cx "joik, definition"><lx "JOI">Single or compound cmavo involving members of selma'o JOI are called joiks, by analogy with the names for logical connectives. It is not grammatical to use joiks to con­nect bridi-tails.

<p>

<cx "tanru connection, connotation of non-logical"><ex "mixed with"><ex "blue and red">In tanru, “joi” has the connotation “mixed with”, as in the following example:

<p>

<pre><a name=e14d5>14.5) ti blanu joi xunre bolci

This is-a-(blue mixed-with red) ball.

This is a blue and red ball.

</pre><p>Here the ball is neither wholly blue nor wholly red, but partly blue and partly red. Its blue/redness is a mass property. (Just how blue something has to be to count as “wholly blue” is an unsettled question, though. A “blanu zdani” may be so even though not every part of it is blue.)

<p>

There are several other cmavo in selma'o JOI which can be used in the same gram­matical constructions. Not all of them are well-defined as yet in all contexts. All have clear definitions as sumti connectives; those definitions are shown in the following table:

<p>

<lx "JOI"><lx "joi"><lx "ce"><lx "ce'o"><lx "sece'o"><lx "jo'u"><lx "fa'u"><lx "sefa'u"><lx "jo'e"><lx "ku'a"><lx "pi'u"><lx "sepi'u"><lx "se"><pre> A joi B the mass with components A and B

A ce B the set with elements A and B

A ce'o B the sequence with elements A and B in order

A sece'o B the sequence with elements B and A in order

A jo'u B A and B considered jointly

A fa'u B A and B respectively

A sefa'u B B and A respectively

A jo'e B the union of sets A and B

A ku'a B the intersection of sets A and B

A pi'u B the cross product of sets A and B

A sepi'u B the cross product of sets B and A

</pre><cx "se, as grammatical in JOI compounds"><cx "joiks, use of “se” in"><lx "JOI">The cmavo “se” is grammatical before any JOI cmavo, but only useful with those that have inherent order. Here are some examples of joiks:

<p>

<ex "choose from"><pre><a name=e14d6>14.6) mi cuxna la .alis. la frank. ce la .alis. ce la djeimyz.

I choose Alice from Frank and-member Alice and-member James.

I choose Alice from among Frank, Alice, and James.

</pre><cx "set, as specified by members"><cx "set, contrasted with mass in distribution of properties"><cx "mass, contrasted with set in distribution of properties">The x3 place of “cuxna” is a set from which the choice is being made. A set is an ab­stract object which is determined by specifying its members. Unlike those of a mass, the prop­erties of a set are unrelated to its members' properties: the set of all rats is large (since many rats exist), but the rats themselves are small. This chapter does not attempt to ex­plain set theory (the mathematical study of sets) in detail: explaining propositional logic is quite enough for one chapter!

<p>

<lx "ce"><cx "set, by listing members with ce">In <a href=#e14d6>Example 14.6 </a>we specify that set by listing the members with “ce” joining them.

<p>

<ex "list"><pre><a name=e14d7>14.7) ti liste mi ce'o do ce'o la djan.

This is-a-list-of me and-sequence you and-sequence John.

This is a list of you, me, and John.

</pre><cx "list, contrasted with sequence"><cx "sequence, contrasted with list"><cx "list, as a physical object"><cx "sequence, as an abstract list"><cx "ordered sequence, by listing members"><cx "ordered sequence, contrasted with set"><cx "ordered sequence, contrasted with mass"><cx "mass, contrasted with ordered sequence"><cx "set, contrasted with ordered sequence">The x2 place of “liste” is a sequence of the things which are mentioned in the list. (It is worth pointing out that “lo liste” means a physical object such as a grocery list: a purely abstract list is “lo porsi”, a sequence.) Here the three sumti connected by “ce'o” are in a definite order, not just lumped together in a set or a mass.

<p>

<cx "non-logical connection, of individuals into mass"><cx "non-logical connection, of individuals into set"><cx "individuals into mass, by non-logical connection"><cx "individuals into set, by non-logical connection"><lx "jo'u"><cx "jo'u, contrasted with joi"><cx "jo'u, contrasted with ce"><cx "jo'u, contrasted with ce'o"><cx "jo'u, result of connection with">So “joi”, “ce”, and “ce'o” are parallel, in that the sumti connected are taken to be in­dividuals, and the result is something else: a mass, a set, or a sequence respec­tively. The cmavo “jo'u” serves as a fourth element in this pattern: the sumti connected are individu­als, and the result is still individuals — but inseparably so. The normal Loj­ban way of saying that James and George are brothers is:

<p>

<ex "brothers"><pre><a name=e14d8>14.8) la djeimyz. bruna la djordj.

James is-the-brother-of George.

</pre>possibly adding a discursive element meaning “and vice versa”. However, “James and George are brothers” cannot be correctly translated as:

<p>

<pre><a name=e14d9>14.9) la djeimyz. .e la djordj. bruna

James and George is-a-brother.

</pre>since that expands to two bridi and means that James is a brother and so is George, but not necessarily of each other. If the “.e” is changed to “jo'u”, however, the meaning of <a href=#e14d8>Example 14.8 </a>is preserved:

<p>

<pre><a name=e14d10>14.10) la djeimyz. jo'u la djordj. cu remei bruna

James in-common-with George are-a-twosome type-of-brothers.

</pre><p>The tanru “remei bruna” is not strictly necessary in this sentence, but is used to make clear that we are not saying that James and George are both brothers of some third per­son not specified. Alternatively, we could turn the tanru around: the x1 place of “remei” is a mass with two components, leading to:

<p>

<lx "joi"><pre><a name=e14d11>14.11) la djeimyz. joi la djordj. cu bruna remei

James massed-with George are-a-brother type-of-twosome.

</pre>where “joi” is used to create the necessary mass.

<p>

<lx "fa'u"><cx "connection, non-distributed"><cx "respectively, specifying with fa'u"><ex "respectively">Likewise, “fa'u” can be used to put two individuals together where order mat­ters. Typically, there will be another “fa'u” somewhere else in the same bridi:

<p>

<pre><a name=e14d12>14.12) la djeimyz. fa'u la djordj. prami la meris. fa'u la martas.

James jointly-in-order-with George loves Mary jointly-in-order-with Martha.

James and George love Mary and Martha, respectively.

</pre><cx "fa'u, contrasted with .e"><cx ".e, contrasted with fa'u">Here the information carried by the English adverb “respectively”, namely that James loves Mary and George loves Martha, is divided between the two occurrences of “fa'u”. If both uses of “fa'u” were to be changed to “.e”, we would get:

<p>

<pre><a name=e14d13>14.13) la djeimyz. .e la djordj. prami la meris. .e la martas.

James and George love Mary and Martha.

</pre>which can be transformed to four bridi:

<p>

<pre><a name=e14d14>14.14) la djeimyz. prami la meris. .ije la djordj. prami la meris.

.ije la djeimyz. prami la martas. .ije la djordj. prami la martas.

James loves Mary, and George loves Mary,

and James loves Martha, and George loves Martha.

</pre>which represents quite a different state of affairs from <a href=#e14d12>Example 14.12</a>. The meaning of <a href=#e14d12>Example 14.12 </a>can also be conveyed by a termset:

<p>

<cx "fa'u, compared to termsets"><cx "termsets, compared to fa'u"><pre><a name=e14d15>14.15) la djeimyz. ce'e la meris. pe'e .e la djordj. ce'e la martas. prami

James [plus] Mary [joint] and George [plus] Martha loves.

</pre>at the expense of re-ordering the list of names so as to make the pairs explicit. This op­tion is not available when one of the lists is only described rather than enumerated:

<p>

<pre><a name=e14d16>14.16) la djeimyz. fa'u la djordj. prami re sorme

James and-respectively George love two sisters.

</pre>which conveys that James loves one sister and George the other, though we are not able to tell which of the sisters is which.

<p>

### <a name=s15><h3>More about non-logical connectives</h3>

<p>

<lx "jo'e"><lx "ku'a"><lx "pi'u"><cx "set operations"><cx "union, of sets"><cx "intersection, of sets"><cx "cross-product, of sets">The final three JOI cmavo, “jo'e”, “ku'a”, and “pi'u”, are probably only useful when talking explicitly about sets. They represent three standard set operators usually called “union”, “intersection”, and “cross product” (also known as “Cartesian prod­uct”). The union of two sets is a set containing all the members that are in either set; the intersection of two sets is a set containing all the members that are in both sets. The cross product of two sets is the set of all possible ordered pairs, where each ordered pair contains a single element from the first set followed by a single element from the sec­ond. This may seem very abstract; hopefully, the following examples will help:

<p>

<ex "rich and German"><pre><a name=e15d1>15.1) lo'i ricfu ku jo'e lo'i dotco cu barda

The-set-of rich-things union the-set-of German-things is large.

<a name=e15d2>15.2) lo'i ricfu ku ku'a lo'i dotco cu cmalu

The set-of rich-things intersection the-set-of German-things is small.

</pre><cx "union of sets, compared with or"><cx "intersection of sets, compared with and">There is a parallelism between logic and set theory that makes <a href=#e15d1>Example 15.1 </a>and <a href=#e15d2>Ex­ample 15.2 </a>equivalent respectively to:

<p>

<pre><a name=e15d3>15.3) lo'i ricfu ja dotco cu barda

The-set-of rich-or-German-things is large.

</pre>and

<p>

<pre><a name=e15d4>15.4) lo'i ricfu je dotco cu cmalu

The-set-of rich-and-German-things is small.

</pre><p>The following example uses “se remei”, which is a set (not a mass) of two elements:

<p>

<cx "pi'u, contrasted with .e"><cx "e, contrasted with pi'u"><cx "cross-product, contrasted with and"><cx "and, contrasted with cross-product"><pre><a name=e15d5>15.5) la djeimyz. ce[bo] la djordj. pi'u la meris. cebo la martas.

cu prami se remei

James and-set George cross-product Mary and-set Martha

are-lover type-of-pairs.

</pre>means that each of the pairs James/Mary, George/Mary, James/Martha, and George/Martha love each other. Therefore it is similar in meaning to <a href=#e14d13>Example 14.13</a>; however, that example speaks only of the men loving the women, not vice versa.

<p>

<cx "joiks, grouping"><lx "JOI"><cx "non-logical connectives, grouping">Joiks may be combined with “bo” or with “ke” in the same way as eks and jeks; this allows grouping of non-logical connections between sumti and tanru units, in complete parallelism with logical connections:

<p>

<pre><a name=e15d6>15.6) mi joibo do ce la djan. joibo la djein.

cu gunma se remei

(I massed-with you) and (John massed-with Jane)

are-a-mass type-of-two-set

</pre>asserts that there is a set of two items each of which is a mass.

<p>

<cx "non-logical connection, of termsets"><cx "termsets, non-logical connection of">Non-logical connection is permitted at the joint of a termset; this is useful for associ­ating more than one sumti or tagged sumti with each side of the non-logical con­nection. The place structure of “casnu” is:

<p>

<dl compact><dt>casnu: <dd>the mass x1 discusses/talks about x2

</dl>so the x1 place must be occupied by a mass (for reasons not explained here); however, different components of the mass may discuss in different languages. To associate each participant with his or her language, we can say:

<p>

<ex "discuss in language"><pre><a name=e15d7>15.7) mi ce'e bau la lojban.

pe'e joi do ce'e bau la gliban. nu'u casnu

( I [plus] in-language Lojban

massed-with you [plus] in-language English ) discuss.

</pre><p>Like all non-logical connectives, the usage shown in <a href=#e15d7>Example 15.7 </a>cannot be me­chanically converted into a non-logical connective placed at another location in the bridi. The forethought equivalent of <a href=#e15d7>Example 15.7 </a>is:

<p>

<pre><a name=e15d8>15.8) nu'i joigi mi bau la lojban gi do bau la gliban. nu'u casnu

</pre><cx "non-logical forethought termsets, connecting tagged sumti"><cx "tagged sumti termsets, connecting with non-logical forethought connectives"><cx "respectively, with different relationships">Non-logical forethought termsets are also useful when the things to be non-logically connected are sumti preceded with tense or modal (BAI) tags:

<p>

<pre><a name=e15d9>15.9) la djan. fa'u la frank. cusku nu'i bau la lojban.

nu'u fa'u bai tu’a la djordj. [nu'u]

John respectively-with Frank express [start termset] in-language Lojban

[joint] respectively-with under-compulsion-by George.

John and Frank speak in Lojban and under George's compulsion, respectively.

</pre><a href=#e14d17>Example 14.17 </a>associates speaking in Lojban with John, and speaking under George's compulsion with Frank. We do not know what language Frank uses, or whether John speaks under anyone's compulsion.

<p>

<cx "ijoik, definition"><lx "I"><lx "JOI"><cx "non-logical connectives, sentence"><cx "sentences, connecting non-logically"><cx "ice'o, contrasted with .ibabo"><cx "sequence of events, expressing non-time-related sequences">Joiks may be prefixed with “.i” to produce ijoiks, which serve to non-logically con­nect sentences. The ijoik “.ice'o” indicates that the event of the second bridi follows that of the first bridi in some way other than a time relation­ship (which is handled with a tense):

<p>

<ex "to-do list"><ex "list of things to do"><pre><a name=e15d10>15.10) mi ba gasnu la'edi'e

.i tu'e kanji lo ni cteki

.ice'o lumci le karce

.ice'o dzukansa le gerku tu'u

I [future] do the-referent-of-the-following:

( Compute the quantity of taxes.

And-then wash the car.

And-then walkingly-accompany the dog. )

List of things to do:

Figure taxes.

Wash car.

Walk dog.

</pre><lx "TUhE"><lx "TUhU"><lx "di'e"><lx "tu'u"><lx "tu'e"><cx "lists, use of tu'e/tu'u in"><cx "di'e, effect of tu'e/tu'u on"><cx "tu'e, effect on di'e"><cx "tu'e, use in lists"><a href=#e15d10>Example 15.10 </a>represents a list of things to be done in priority order. The order is im­por­tant, hence the need for a sequence connective, but does not necessarily represent a time order (the dog may end up getting walked first). Note the use of “tu'e” and “tu'u” as gen­eral brackets around the whole list. This is related to, but distinct from, their use in <a href=#s8>Sec­tion 8</a>, because there is no logical connective between the introductory phrase “mi ba gasnu la'edi'e” and the rest. The brackets effectively show how large an utterance the word “di'e”, which means “the following utterance”, refers to.

Similarly, “.ijoi” is used to connect sentences that represent the components of a joint event such as a joint cause: the Lojban equivalent of “Fran hit her head and fell out of the boat, so that she drowned” would join the events “Fran hit her head” and “Fran fell out of the boat” with “.ijoi”.

<p>

<cx "nai, effect on joiks"><cx "joiks, effect of nai on"><cx "non-logical connectives, effect of nai on"><lx "nai"><cx "scalar negation of non-logical connective">The following “nai”, if present, does not negate either of the things to be con­nected, but instead specifies that some other connection (logical or non-logical) is ap­plicable: it is a scalar negation:

<p>

<pre><a name=e15d11>15.11) mi jo'unai do cu remei

I in-common-with [not!] you are-a-twosome

</pre><p>The result of “mi jo'u do” would be two individuals, not a mass, therefore “jo'u” is not applicable; “joi” would be the correct connective.

<p>

<cx "connective questions, non-logical"><cx "connective answers, non-logical">There is no joik question cmavo as such; however, joiks and ijoiks may be ut­tered in isolation in response to a logical connective question, as in the following ex­change:

<p>

<ex "coffee mixed with tea"><pre><a name=e15d12>15.12) do djica tu'a

loi ckafi ji loi tcati

You desire something-about

a-mass-of coffee [what connective?] a-mass-of tea?

Do you want coffee or tea?

<a name=e15d13>15.13) joi

Mixed-mass-and.

Both as a mass (i.e, mixed together).

</pre><ex "ugh">Ugh. (Or in Lojban: .a'unaisairo'o.)

<p>

### <a name=s16><h3>Interval connectives and forethought non-logical connection</h3>

<p>

<lx "BIhI"><lx "bi'i"><lx "bi'o"><lx "mi'i"><cx "non-logical connectives, intervals"><cx "intervals, expressed as endpoints">In addition to the non-logical connectives of selma'o JOI explained in <a href=#s14>Sections 14 </a>and <a href=#s15>15</a>, there are three other connectives which can appear in joiks: “bi'i”, “bi'o”, and “mi'i”, all of selma'o BIhI. The first two cmavo are used to specify intervals: ab­stract ob­jects defined by two endpoints. The cmavo “bi'i” is correct if the endpoints are independ­ent of order, whereas “bi'o” or “sebi'o” are used when order matters.

<p>

An example of “bi'i” in sumti connection:

<p>

<ex "between Dresden and Frankfurt"><lx "bi'i"><pre><a name=e16d1>16.1) mi ca sanli la drezdn. bi'i la frankfurt.

I [present] stand-on-surface Dresden [interval] Frankfurt.

I am standing between Dresden and Frankfurt.

</pre><cx "non-logical connectives, un-ordered intervals">In <a href=#e16d1>Example 16.1</a>, it is all the same whether I am standing between Dresden and Frank­furt or between Frankfurt and Dresden, so “bi'i” is the appropriate interval connective. The sumti “la drezdn. bi'i la frankfurt.” falls into the x2 place of “sanli”, which is the surface I stand on; the interval specifies that surface by its limits. (Obviously, I am not standing on the whole of the interval; the x2 place of “sanli” specifies a surface which is typically larger in extent than just the size of the stander's feet.)

<p>

<lx "bi'o"><ex "from one to two o'clock"><pre><a name=e16d2>16.2) mi cadzu ca la pacac. bi'o la recac.

I walk simultaneous-with First-hour [ordered-interval] Second-hour.

I walk from one o'clock to two o'clock.

</pre><cx "non-logical connectives, ordered intervals">In <a href=#e16d2>Example 16.2</a>, on the other hand, it is essential that “la pacac.” comes before “la re­cac.”; otherwise we have an 11-hour (or 23-hour) interval rather than a one-hour inter­val. In this use of an interval, the whole interval is probably intended, or at least most of it.

<p>

<a href=#e16d2>Example 16.2 </a>is equivalent to:

<p>

<lx "sebi'o"><pre><a name=e16d3>16.3) mi cadzu ca la recac. sebi'o la pacac.

I walk simultaneous-with Second-hour [reverse] [ordered] First-hour.

</pre><p>English cannot readily express “sebi'o”, but its meaning can be understood by reversing the two sumti.

<p>

<lx "mi'i"><cx "intervals, expressed as center and distance">The third cmavo of selma'o BIhI, namely “mi'i”, expresses an interval seen from a different viewpoint: not a pair of endpoints, but a center point and a distance. For exam­ple:

<p>

<ex "bomb destroyed fifty miles"><pre><a name=e16d4>16.4) le jbama pu daspo la .uacintyn. mi'i lo minli

be li muno

The bomb [past] destroys Washington [center] what-is measured-in-miles

by 50.

The bomb destroyed Washington and fifty miles around.

</pre><p>Here we have an interval whose center is Washington and whose distance, or radius, is fifty miles.

<p>

<cx "closed interval"><cx "open interval"><cx "interval, closed"><cx "interval, open"><cx "interval, inclusion of endpoints"><cx "endpoints, inclusion in interval"><lx "ga'o"><lx "ke'i"><lx "GAhO">In <a href=#e16d1>Example 16.1</a>, is it possible that I am standing in Dresden (or Frankfurt) it­self? Yes. The connectives of selma'o BIhI are ambiguous about whether the endpoints them­selves are included in or excluded from the interval. Two auxiliary cmavo “ga'o” and “ke'i” (of cmavo GAhO) are used to indicate the status of the endpoints: “ga'o” means that the endpoint is included, “ke'i” that it is excluded:

<p>

<ex "between Dresden and Frankfurt"><pre><a name=e16d5>16.5) mi ca sanli la drezdn. ga'o bi'i ga'o la frankfurt.

I [present] stand Dresden [inclusive] [interval] [inclusive] Frankfurt.

I am standing between Dresden and Frankfurt, inclusive of both.

<a name=e16d6>16.6) mi ca sanli la drezdn. ga'o bi'i ke'i la frankfurt.

I [present] stand Dresden [inclusive] [interval] [exclusive] Frankfurt.

I am standing between Dresden (inclusive) and Frankfurt (exclusive).

<a name=e16d7>16.7) mi ca sanli la drezdn. ke'i bi'i ga'o la frankfurt.

I [present] stand Dresden [exclusive] [interval] [inclusive] Frankfurt.

I am standing between Dresden (exclusive) and Frankfurt (inclusive).

<a name=e16d8>16.8) mi ca sanli la drezdn. ke'i bi'i ke'i la frankfurt.

I [present] stand Dresden [exclusive] [interval] [exclusive] Frankfurt.

I am standing between Dresden and Frankfurt, exclusive of both.

</pre><cx "GAhO, grammar of">As these examples should make clear, the GAhO cmavo that applies to a given endpoint is the one that stands physically adjacent to it: the left-hand endpoint is referred to by the first GAhO, and the right-hand endpoint by the second GAhO. It is ungrammatical to have just one GAhO.

<p>

<cx "ga'o, etymology of"><cx "ke'i, etymology of">(Etymologically, “ga'o” is derived from “ganlo”, which means “closed”, and “ke'i” from “kalri”, which means “open”. In mathematics, inclusive intervals are re­ferred to as closed intervals, and exclusive intervals as open ones.)

<p>

<cx "BIhI, grammar of">BIhI joiks are grammatical anywhere that other joiks are, including in tanru connec­tion and (as ijoiks) between sentences. No meanings have been found for these uses.

<p>

<cx "negated intervals, meaning of"><cx "nai, effect on intervals"><cx "intervals, effect of nai on">Negated intervals, marked with a “-nai” following the BIhI cmavo, indicate an inter­val that includes everything but what is between the endpoints (with respect to some un­derstood scale):

<p>

<ex "except from 10 to 12"><pre><a name=e16d9>16.9) do dicra .e'a mi ca la daucac. bi'onai la gaicac.

You disturb (allowed) me at 10 not-from <dots>…</dots>to 12

You can contact me except from 10 to 12.

</pre><p>The complete syntax of joiks is:

<p>

<lx "se"><lx "nai"><lx "JOI"><lx "BIhI"><lx "GAhO"><cx "joiks, syntax of"><dl compact><dt><dd>[se] JOI [nai]

[se] BIhI [nai]

GAhO [se] BIhI [nai] GAhO

</dl><cx "intervals, forethought"><lx "gi"><cx "joigik, definition"><lx "GI"><lx "JOI">Notice that the colloquial English translations of “bi'i” and “bi'o” have forethought form: “between <dots>…</dots>and” for “bi'i”, and “from <dots>…</dots>to” for “bi'o”. In Lojban too, non-logical con­nectives can be expressed in forethought. Rather than using a separate selma'o, the fore­thought logical connectives are constructed from the afterthought ones by suffixing “gi”. Such a compound cmavo is not unnaturally called a “joigik”; the syntax of joigiks is any of:

<p>

<cx "joigiks, syntax of"><lx "se"><lx "nai"><lx "GI"><lx "BIhI"><lx "JOI"><lx "GAhO"><dl compact><dt><dd>[se] JOI [nai] GI

[se] BIhI [nai] GI

GAhO [se] BIhI [nai] GAhO GI

</dl><cx "joigiks, connection types">Joigiks may be used to non-logically connect bridi, sumti, and bridi-tails; and also in termsets.

<p>

<a href=#e14d3>Example 14.3 </a>in forethought becomes:

<p>

<ex "carry the piano"><pre><a name=e16d10>16.10) joigi la djan. gi la .alis. bevri le pipno

[Together] John and Alice carry the piano.

</pre><p>The first “gi” is part of the joigik; the second “gi” is the regular gik that separates the two things being connected in all forethought forms.

<p>

<a href=#e16d6>Example 16.6 </a>can be expressed in forethought as:

<p>

<ex "between Dresden and Frankfurt"><pre><a name=e16d11>16.11) mi ca sanli ke'i bi'i ga'o gi la drezdn. gi la frankfurt.

I [present] stand [exclusive] between [inclusive] Dresden and Frankfurt.

I am standing between Dresden (exclusive) and Frankfurt (inclusive).

</pre><cx "forethought intervals, GAhO position"><cx "GAhO position in forethought intervals">In forethought, unfortunately, the GAhOs become physically separated from the end­points, but the same rule applies: the first GAhO refers to the first endpoint.

<p>

### <a name=s17><h3>Logical and non-logical connectives within mekso</h3>

<p>

<cx "logical connection in mathematical expressions"><cx "non-logical connection in mathematical expressions"><cx "mathematical expressions, connectives in">Lojban has a separate grammar embedded within the main grammar for repre­senting mathematical expressions (or mekso in Lojban) such as “2 + 2”. Mathematical expres­sions are explained fully in <a href=chap18.html>Chapter 18</a>. The basic components of mekso are op­erands, like “2”, and operators, like “+”. Both of these may be either logically or non-logically connected.

<p>

<lx "bo"><lx "BO"><lx "A"><lx "GA"><lx "JA"><lx "GUhA"><lx "JOI"><cx "eks, connecting operands"><cx "geks, connecting operands"><cx "operands, connecting"><cx "operators, connecting"><cx "jeks, connecting operators"><cx "guheks, connecting operators"><cx "bo, in jeks for operators"><cx "bo, in joiks for operators"><cx "connecting operators, with bo in connective">Operands are connected in afterthought with eks and in forethought with geks, just like sumti. Operators, on the other hand, are connected in afterthought with jeks and in forethought with guheks, just like tanru components. (However, jeks and joiks with “bo” are not allowed for operators.) This parallelism is no accident.

<p>

<lx "KE"><lx "BO"><lx "bo"><cx "connecting operands, with bo in connective"><cx "connecting operands, with ke in connective"><cx "connecting operators, with ke in connective"><lx "ke"><lx "ke'e"><cx "operators, analogue of tanru in">In addition, eks with “bo” and with “ke <dots>…</dots>ke'e” are allowed for grouping logi­cally connected operands, and “ke <dots>…</dots>ke'e” is allowed for grouping logically connected opera­tors, although there is no analogue of tanru among the operators.

<p>

Only a few examples of each kind of mekso connection will be given. Despite the large number of rules required to support this feature, it is of relatively minor im­portance in either the mekso or the logical-connective scheme of things. These exam­ples are drawn from <a href=chap18.html>Chapter 18</a>, and contain many mekso features not explained in this chapter.

<p>

<a href=#e17d1>Example 17.1 </a>exhibits afterthought logical connection between operands:

<p>

<ex "three of four people"><pre><a name=e17d1>17.1) vei ci .a vo [ve'o] prenu cu klama le zarci

( Three or four ) people go-to the market.

</pre><a href=#e17d2>Example 17.2 </a>is equivalent in meaning, but uses forethought connection:

<p>

<pre><a name=e17d2>17.2) vei ga ci gi vo [ve'o] prenu cu klama le zarci

( Either 3 or 4 ) people go-to the market.

</pre><lx "ve'o">Note that the mekso in <a href=#e17d1>Example 17.1 </a>and <a href=#e17d2>Example 17.2 </a>are being used as quantifiers. Lojban requires that any mekso other than a simple number be enclosed in “vei” and “ve'o” parentheses when used as a quantifier. The right parenthesis mark, “ve'o”, is an elidable terminator.

<p>

Simple examples of logical connection between operators are hard to come by. A contrived example is:

<p>

<pre><a name=e17d3>17.3) li re su'i je pi'i re du li vo

The-number 2 plus and times 2 equals the-number 4.

2 + 2 = 4 and 2 x 2 = 4.

</pre><p>The forethought form of <a href=#e17d3>Example 17.3 </a>is:

<p>

<pre><a name=e17d4>17.4) li re ge su'i gi pi'i re du li vo

The-number two both plus and times two equals the-number four.

Both 2 + 2 = 4 and 2 x 2 = 4.

</pre><cx "mathematical intervals"><lx "bi'i"><lx "ga'o"><lx "ke'i">Non-logical connection with joiks or joigiks is also permitted between oper­ands and between operators. One use for this construct is to connect operands with “bi'i” to create mathematical intervals:

<p>

<ex "zero to one"><pre><a name=e17d5>17.5) li no ga'o bi'i ke'i pa

the-number zero (inclusive) from-to (exclusive) one

[0,1)

the numbers from zero to one, including zero but not including one

</pre><cx "compound subscript"><lx "ce'o">You can also combine two operands with “ce'o”, the sequence connective of selma'o JOI, to make a compound subscript:

<p>

<ex "x{b,d}"><pre><a name=e17d6>17.6) xy. boi xi vei by. ce'o dy. [ve'o]

“x” sub (“b” sequence “d” )

x<sub>b,d</sub>

</pre><lx "boi">Note that the “boi” in <a href=#e17d6>Example 17.6 </a>is not elidable, because the “xi” subscript needs something to attach to.

<p>

### <a name=s18><h3>Tenses, modals, and logical connection</h3>

<p>

<lx "PU">The tense and modal systems of Lojban interact with the logical connective system. No one chapter can explain all of these simultaneously, so each chapter must present its own view of the area of interaction with emphasis on its own concepts and terminology. In the examples of this chapter, the many tenses of various selma'o as well as the modals of selma'o BAI are represented by the simple time cmavo “pu”, “ca”, and “ba” (of sel­ma'o PU) representing the past, the present, and the future respectively. Pre­ceding a sel­bri, these cmavo state the time when the bridi was, is, or will be true (analogous to Eng­lish verb tenses); preceding a sumti, they state that the event of the main bridi is before, simultaneous with, or after the event given by the sumti (which is generally a “le nu” ab­straction; see <a href=chap11.html>Chapter 11</a>).

<p>

<cx "logical connection, interaction with tenses"><cx "logically connected tenses, definition">The two types of interaction between tenses and logical connectives are logi­cally connected tenses and tensed logical connections. The former are fairly simple. Jeks may be used between tense cmavo to specify two connected bridi that differ only in tense:

<p>

<ex "once and future king"><pre><a name=e18d1>18.1) la .artr. pu nolraitru

.ije la .artr. ba nolraitru

Arthur [past] is-a-noblest-governor.

And Arthur [future] is-a-noblest-governor.

Arthur was a king, and Arthur will be a king.

</pre>can be reduced to:

<p>

<pre><a name=e18d2>18.2) la .artr. pu je ba nolraitru

Arthur [past] and [future] is-a-noblest-governor.

Arthur was and will be king.

</pre><a href=#e18d1>Example 18.1 </a>and <a href=#e18d2>Example 18.2 </a>are equivalent in meaning; neither says anything about whether Arthur is king now.

<p>

<cx "non-logically connected tenses">Non-logical connection with joiks is also possible between tenses:

<p>

<ex "breathe"><pre><a name=e18d3>18.3) mi pu bi'o ba vasxu

I [past] from <dots>…</dots>to [future] breathe.

I breathe from a past time until a future time.

</pre><p>The full tense system makes more interesting tense intervals expressible, such as “from a medium time ago until a long time from now”.

<p>

<cx "forethought connection, in tenses"><cx "tenses, forethought connection in"><cx "grouping, of connection in tenses"><cx "tenses, grouping of connectives in">No forethought connections between tenses are permitted by the grammar, nor is there any way to override the default left-grouping rule; these limitations are imposed to keep the tense grammar simpler. Whatever can be said with tenses or modals can be said with subordinate bridi stating the time, place, or mode explicitly, so it is reasonable to try to remove at least some complications.

<p>

<cx "tensed logical connection">Tensed logical connections are both more complex and more important than logical connections between tenses. Consider the English sentence:

<p>

<ex "went and bought"><pre><a name=e18d4>18.4) I went to the market, and I bought food.

</pre><p>The verbatim translation of <a href=#e18d4>Example 18.4</a>, namely:

<p>

<pre><a name=e18d5>18.5) mi pu klama le zarci .ije mi pu tervecnu lo cidja

I [past] go-to the market. And I [past] buy items-of food.

</pre>fails to fully represent a feature of the English, namely that the buying came after the go­ing. (It also fails to represent that the buying was a consequence of the going, which can be expressed by a modal that is discussed in <a href=chap9.html>Chapter 9</a>.) However, the tense infor­mation — that the event of my going to the market preceded the event of my buying food — can be added to the logical connective as follows. The “.ije” is replaced by “.ijebo”, and the tense cmavo “ba” is inserted between “.ije” and “bo”:

<p>

<lx ".ijebabo"><lx "ba"><pre><a name=e18d6>18.6) mi pu klama le zarci .ijebabo mi pu tervecnu lo cidja

I [past] go-to the market. And [later] I [past] buy items-of food.

</pre><p>Here the “pu” cmavo in the two bridi-tails express the time of both actions with respect to the speaker: in the past. The “ba” relates the two items to one another: the second item is later than the first item. The grammar does not permit omitting the “bo”; if it were omit­ted, the “ba” and the second “pu” would run together to form a compound tense “bapu” applying to the second bridi-tail only.

<p>

<lx "A"><lx "BO"><cx "tensed logical connective, in ek…bo">Adding tense or modal information to a logical connective is permitted only in the following situations:

<p>

Between an ek (or joik) and “bo”, as in:

<p>

<ex "simultaneously"><pre><a name=e18d7>18.7) la .djan .ecabo la .alis. klama le zarci

John and [simultaneous] Alice go-to the market.

John and Alice go to the market simultaneously.

</pre><lx "A"><lx "KE"><cx "tensed logical connective, in ek…ke"><lx "JOI"><lx "KE"><cx "tensed logical connective, in joik…ke">Between an ek (or joik) and “ke”, as in:

<p>

<ex "and earlier"><pre><a name=e18d8>18.8) mi dzukla le zarci .epuke le zdani .a le ckule [ke'e]

I walk-to the market and [earlier] ( the house or the school ).

I walk to the market and, before that, to the house or the school.

</pre><lx "GIhA"><lx "BO"><cx "tensed logical connective, in gihek…bo">Between a gihek and “bo”, as in:

<p>

<ex "and then"><pre><a name=e18d9>18.9) mi dunda le cukta gi'ebabo lebna lo rupnu vau do

I give the book and [later] take some currency-units from/to you.

I give you the book and then take some dollars (pounds, yen) from you.

</pre><lx "GIhA"><lx "KE"><cx "tensed logical connective, in gihek…ke">Between a gihek and “ke”, as in:

<p>

<ex "and simultaneously"><pre><a name=e18d10>18.10) mi dzukla le zarci gi'ecake cusku zo'e la djan. [ke'e]

I walk-to the market and [simultaneous] express something to-John.

I walk to the market and at the same time talk to John.

</pre><lx "JA"><lx "I"><lx "BO"><cx "tensed logical connective, in ijek…bo"><cx "tensed logical connective, in ijoik…bo">Between an ijek (or ijoik) and “bo”, as in:

<p>

<ex "and then"><pre><a name=e18d11>18.11) mi viska pa nanmu .ijebabo mi viska pa ninmu

I see a man. And [later] I see a woman.

I see a man, and then I see a woman.

</pre><lx "JA"><lx "JOI"><lx "I"><lx "TUhE"><cx "tensed logical connective, in ijek…tu'e"><cx "tensed logical connective, in ijoik…tu'e">Between an ijek (or ijoik) and “tu'e”, as in:

<p>

<ex "and then"><pre><a name=e18d12>18.12) mi viska pa nanmu .ijebatu'e mi viska pa ninmu [tu'u]

I see a man. And [later] I see a woman.

I see a man, and then I see a woman.

</pre><lx "JOI"><lx "JA"><lx "BO"><cx "tensed logical connective, in jek…bo"><cx "tensed logical connective, in joik…bo">And finally, between a jek (or joik) and “bo”, as in:

<p>

<ex "doctor and then rich"><pre><a name=e18d13>18.13) mi mikce jebabo ricfu

I-am-a doctor and [later] rich

I am a doctor and future rich person.

</pre><lx "BO"><lx "KE"><lx "TUhE"><cx "bo, contrasted with ke for tensed logical connection"><cx "ke, contrasted with bo for tensed logical connection"><cx "bo, contrasted with tu'e for tensed logical connection"><cx "tu'e, contrasted with bo for tensed logical connection"><lx "bo"><lx "ke"><lx "tu'e">As can be seen from <a href=#e18d11>Example 18.11 </a>and <a href=#e18d12>Example 18.12</a>, the choice between “bo” and “ke” (or “tu'e”) is arbitrary when there are only two things to be connected. If there were no tense information to include, of course neither would be required; it is only the rule that tense information must always be sandwiched between the logical connective and a following “bo”, “ke”, or “tu'e” that requires the use of one of these grouping cmavo in <a href=#e18d7>Example 18.7 </a>and <a href=#e18d{9}>Examples 18.9 </a>through <a href=#e18d13>18.13</a>.

<p>

<cx "non-logical connectives, including tense"><cx "tensed non-logical connectives"><cx "forethought connectives, with tense"><cx "tensed logical connectives, forethought"><cx "tensed non-logical connectives, forethought"><cx "tensed connectives, in mathematical expressions"><cx "mathematical expressions, tensed connection in">Non-logical connectives with “bo” and “ke” can include tense information in exactly the same way as logical connectives. Forethought connectives, however (except as noted below) are unable to do so, as are termsets or tense connectives. Mathematical operands and operators can also include tense information in their logical connectives as a result of their close parallelism with sumti and tanru components respectively:

<p>

<pre><a name=e18d14>18.14) vei ci .ebabo vo [ve'o] tadni cu zvati le kumfa

( 3 and [future] 4 ) students are-at the room.

Three and, later, four students were in the room.

</pre>is a simple example. <cx "tense, in forethought bridi-tail connection, special rule"><cx "forethought bridi-tail connection, special rule for tense">There is a special grammatical rule for use when a tense applies to both of the selbri in a forethought bridi-tail connection: the entire forethought construc­tion can just be preceded by a tense. For example:

<p>

<ex "went and bought"><lx "pu ge"><pre><a name=e18d15>18.15) mi pu ge klama le zarci gi tervecnu lo cidja

I [past] both go-to the market and buy some food

I went to the market and bought some food.

</pre><a href=#e18d15>Example 18.15 </a>is similar to <a href=#e18d5>Example 18.5</a>. There is no time relationship specified be­tween the going and the buying; both are simply set in the past.

<p>

### <a name=s19><h3>Abstractor connection and connection within abstractions</h3>

<p>

<cx "logical connection of abstractors"><cx "abstraction, logical connection of"><cx "jeks, connecting abstractors"><lx "NU"><lx "JA">Last and (as a matter of fact) least: a logical connective is allowed between ab­strac­tion markers of selma'o NU. As usual, the connection can be expanded to a bridi connec­tion between two bridi which differ only in abstraction marker. Jeks are the ap­propriate connective. <a href=#e19d1>Example 19.1 </a>and <a href=#e19d2>Example 19.2 </a>are equivalent in meaning:

<p>

<ex "quality and quantity"><pre><a name=e19d1>19.1) le ka la frank. ciska cu xlali .ije le ni la frank. ciska

cu xlali

The quality-of Frank's writing is bad, and the quantity of Frank's writing

is bad.

<a name=e19d2>19.2) le ka je ni la frank. ciska cu xlali

The quality and quantity of Frank's writing is bad.

</pre><cx "forethought connection, in abstractions"><cx "abstractions, forethought connection in"><cx "grouping, of connection in abstractions"><cx "abstractions, grouping of connectives in">As with tenses and modals, there is no forethought and no way to override the left-grouping rule.

<p>

<cx "logical connection in abstractions, inner bridi contrasted with outer bridi"><cx "logical connection inside an abstraction, contrasted with outside">Logical connectives and abstraction are related in another way as well, though. Since an abstraction contains a bridi, the bridi may have a logical connection inside it. Is it le­gitimate to split the outer bridi into two, joined by the logical connection? Abso­lutely not. For example:

<p>

<ex "Jupiter life"><pre><a name=e19d3>19.3) mi jinvi le du'u loi jmive cu zvati gi'onai na zvati vau la .iupiter.

I opine the fact-that a-mass-of living-things (is-at or-else isn't-at) Jupiter.

I believe there either is or isn't life on Jupiter.

</pre>is true, since the embedded sentence is a tautology, but:

<p>

<pre><a name=e19d4>19.4) mi jinvi le du'u loi jmive cu zvati la .iupiter.

.ijonai mi jinvi le du'u loi jmive cu zvati la .iupiter.

I opine the fact-that a-mass-of living-things is-at Jupiter

or-else I opine the fact-that a-mass-of living-things isn't-at Jupiter

</pre>is false, since I have no evidence one way or the other (“jinvi” requires some sort of evi­dence, real or fancied, unlike “krici”).

<p>

### <a name=s20><h3>Constructs and appropriate connectives</h3>

<p>

<cx "connectives, table by constructs connected">The following table specifies, for each kind of construct that can be logically or non-logically connected in Lojban, what kind of connective is required for both af­terthought and (when possible) forethought modes. An asterisk (\*) indicates that tensed connection is permitted.

<p>

A dash indicates that connection of the specified type is not possible.

<p>

<pre>construct afterthought forethought afterthought forethought

logical logical non-logical non-logical

bridi ijek\* gek ijoik\* joigik

sumti ek\* gek joik\* joigik

bridi-tails gihek\* gek — joigik

termsets ek\* gek joik\* joigik

tanru parts jek guhek joik\* —

operands ek\* gek joik\* joigik

operators jek guhek joik —

tenses/modals jek — joik —

abstractors jek — joik —

### </pre><a name=s21><h3>Truth functions and corresponding logical connectives</h3>

<p>

<cx "truth functions, table of logical connectives"><cx "logical connectives, table by truth function value">The following table specifies, for each truth function, the most-often used cmavo or compound cmavo which expresses it for each of the six types of logical connective. (Other compound cmavo are often possible: for example, “se.a” means the same as “a”, and could be used instead.)

<p>

<pre>truth ek jek gihek gek–gik guhek–gik

TTTF .a ja gi'a ga–gi gu'a–gi

TTFT .anai janai gi'anai ga–ginai gu'a–ginai

TTFF .u ju gi'u gu–gi gu'u–gi

TFTT na.a naja nagi'a ganai–gi gu'anai–gi

TFTF se.u seju segi'u segu–gi segu'u–gi

TFFT .o jo gi'o go–gi gu'o–gi

TFFF .e je gi'e ge–gi gu'e–gi

FTTT na.anai najanai nagi'anai ganai–ginai gu'anai–ginai

FTTF .onai jonai gi'onai go–ginai gu'o–ginai

FTFT se.unai sejunai segi'unai segu–ginai segu'u–ginai

FTFF .enai jenai gi'enai ge–ginai gu'e–ginai

FFTT na.u naju nagi'u gunai–gi gu'unai–gi

FFTF na.e naje nagi'e genai–gi gu'enai–gi

FFFT na.enai najenai nagi'enai genai–ginai gu'enai–ginai

</pre><p>Note: Ijeks are exactly the same as the corresponding jeks, except for the prefixed “.i”.

<p>

### <a name=s22><h3>Rules for making logical and non-logical connectives</h3>

<p>

<cx "logical connectives, syntax rules summary"><cx "non-logical connectives, syntax rules summary">The full set of rules for inserting “na”, “se”, and “nai” into any connective is:

* <p>

Afterthought logical connectives (eks, jeks, giheks, ijeks):

* <p>
* Negate first construct:<dl compact><dt>

<dd>Place “na” before the connective cmavo (but after the “.i” of an ijek).

* </dl><p>Negate second construct:<dl compact><dt>

<dd>Place “nai” after the connective cmavo.

* </dl><p>Exchange constructs: <dl compact><dt>

<dd>Place “se” before the connective cmavo (after “na” if any).

</dl><p>Forethought logical connectives (geks, guheks):

* <p>
* Negate first construct:

<dl compact><dt><dd>Place “nai” after the connective cmavo.

* </dl><p>Negate second construct:

<dl compact><dt><dd>Place “nai” after the “gi”.

* </dl><p>Exchange constructs:

<dl compact><dt><dd>Place “se” before the connective cmavo.

</dl><p>Non-logical connectives (joiks, joigiks):

* <p>
* Negate connection:

<dl compact><dt><dd>Place “nai” after the connective cmavo (but before the “gi” of a joigik).

* </dl><p>Exchange constructs:

<dl compact><dt><dd>Place “se” before the connective cmavo.

### </dl><a name=s23><h3>Locations of other tables</h3>

<p>

<a href=#s1>Section 1</a>: a table explaining the meaning of each truth function in English.

<p>

<a href=#s2>Section 2</a>: a table relating the truth functions to the four basic vowels.

<p>

<a href=#s13>Section 13</a>: a table of the connective question cmavo.

<p>

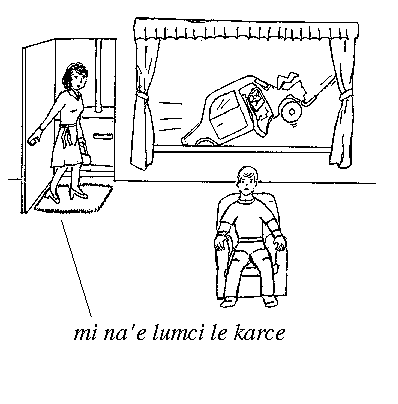
<a href=#s14>Section 14</a>: a table of the meanings of JOI cmavo when used to connect sumti.

<p>

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## <h2>Chapter 15

## <br>

## “No” Problems: On Lojban Negation</h2>

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<p>

### <a name=s1><h3>Introductory</h3>

<p>

The grammatical expression of negation is a critical part of Lojban's claim to being logical. The problem of negation, simply put, is to come up with a complete defi­nition of the word “not”. For Lojban's unambiguous grammar, this means further that meanings of “not” with different grammatical effect must be different words, and even different grammatical structures.

<p>

Logical assertions are implicitly required in a logical language; thus, an appa­ratus for expressing them is built into Lojban's logical connectives and other structures.

<p>

In natural languages, especially those of Indo-European grammar, we have sentences composed of two parts which are typically called “subject” and “predicate”. In the state­ment

<p>

<pre><a name=e1d1>1.1) John goes to the store

</pre>“John” is the subject, and “goes to the store” is the predicate. Negating <a href=#e1d1>Example 1.1 </a>to produce

<p>

<pre><a name=e1d2>1.2) John doesn't go to the store.

</pre>has the effect of declaring that the predicate does not hold for the subject. <a href=#e1d2>Example 1.2 </a>says nothing about whether John goes somewhere else, or whether someone else besides John goes to the store.

<p>

We will call this kind of negation “natural language negation”. This kind of negation is difficult to manipulate by the tools of logic, because it doesn't always follow the rules of logic. Logical negation is bi-polar: either a statement is true, or it is false. If a state­ment is false, then its negation must be true. Such negation is termed contradic­tory nega­tion.

<p>

Let's look at some examples of how natural language negation can violate the rules of contradictory negation.

<p>

<pre><a name=e1d3>1.3) Some animals are not white.

<a name=e1d4>1.4) Some animals are white.

</pre><p>Both of these statements are true; yet one is apparently the negation of the other. An­other example:

<p>

<pre><a name=e1d5>1.5) I mustn't go to the dance.

<a name=e1d6>1.6) I must go to the dance.

</pre><p>At first thought, <a href=#e1d5>Example 1.5 </a>negates <a href=#e1d6>Example 1.6</a>. Thinking further, we realize that there is an intermediate state wherein I am permitted to go to the dance, but not obli­gated to do so. Thus, it is possible that both statements are false.

<p>

Sometimes order is significant:

<p>

<pre><a name=e1d7>1.7) The falling rock didn't kill Sam.

<a name=e1d8>1.8) Sam wasn't killed by the falling rock.

</pre><p>Our minds play tricks on us with this one. Because <a href=#e1d7>Example 1.7 </a>is written in what is called the “active voice”, we immediately get confused about whether “the falling rock” is a suitable subject for the predicate “did kill Sam”. “Kill” implies volition to us, and rocks do not have volition. This confusion is employed by opponents of gun con­trol who use the argument “Guns don't kill people; people kill people.”

<p>

Somehow, we don't have the same problem with <a href=#e1d8>Example 1.8</a>. The subject is Sam, and we determine the truth or falsity of the statement by whether he was or wasn't killed by the falling rock.

<p>

<a href=#e1d8>Example 1.8 </a>also helps us focus on the fact that there are at least two question­able facts implicit in this sentence: whether Sam was killed, and if so, whether the fal­ling rock killed him. If Sam wasn't killed, the question of what killed him is moot.

<p>

This type of problem becomes more evident when the subject of the sentence turns out not to exist:

<p>

<pre><a name=e1d9>1.9) The King of Mexico didn't come to dinner.

<a name=e1d10>1.10) The King of Mexico did come to dinner.

</pre><p>In the natural languages, we would be inclined to say that both of these statements are false, since there is no King of Mexico.

<p>

The rest of this chapter is designed to explain the Lojban model of negation.

<p>

### <a name=s2><h3>bridi negation</h3>

<p>

In discussing Lojban negation, we will call the form of logical negation that simply denies the truth of a statement “bridi negation”. Using bridi negation, we can say the equivalent of “I haven't stopped beating my wife” without implying that I ever started, nor even that I have a wife, meaning simply “It isn't true that I have stopped beating my wife.” Since Lojban uses bridi as smaller components of complex sentences, bridi nega­tion is permitted in these components as well at the sentence level.

<p>

For the bridi negation of a sentence to be true, the sentence being negated must be false. A major use of bridi negation is in making a negative response to a yes/no question; such responses are usually contradictory, denying the truth of the entire sen­tence. A negative answer to

<p>

<pre><a name=e2d1>2.1) Did you go to the store?

</pre>is taken as a negation of the entire sentence, equivalent to

<p>

<pre><a name=e2d2>2.2) No, I didn't go to the store.

</pre><p>The most important rule about bridi negation is that if a bridi is true, its negation is false, and vice versa.

<p>

The simplest way to express a bridi negation is to use the cmavo “na” of sel­ma'o NA before the selbri of the affirmative form of the bridi (but after the “cu”, if there is one):

<p>

<pre><a name=e2d3>2.3) mi klama le zarci

I go-to the store.

</pre>when negated becomes:

<p>

<pre><a name=e2d4>2.4) mi na klama le zarci

I [false] go-to the store.

</pre><p>Note that we have used a special convention to show in the English that a bridi nega­tion is present. We would like to use the word “not”, because this highlights the natural­ness of putting the negation marker just before the selbri, and makes the form easier to learn. But there is a major difference between Lojban's bridi negation with “na” and natu­ral language negation with “not”. In English, the word “not” can apply to a single word, to a phrase, to an English predicate, or to the entire sentence. In addition, “not” may indi­cate either contradictory negation or another form of negation, depend­ing on the sentence. Lojban's internal bridi negation, on the other hand, always applies to an entire bridi, and is always a contradictory negation; that is, it contradicts the claim of the whole bridi.

<p>

Because of the ambiguity of English “not”, we will use “[false]” in the transla­tion of Lojban examples to remind the reader that we are expressing a contradictory negation. Here are more examples of bridi negation:

<p>

<pre><a name=e2d5>2.5) mi [cu] na ca klama le zarci

I [false] now am-a-go-er to the market.

I am not going to the market now.

<a name=e2d6>2.6) lo ca nolraitru be le fasygu'e

cu na krecau

The-actual present noblest-governor of the French country

[false] is-hair-without.

The current king of France isn't bald.

<a name=e2d7>2.7) ti na barda prenu co melbi mi

This [false] is a big-person of-type (beautiful to me).

This isn't a big person who is beautiful to me.

</pre><p>Although there is this fundamental difference between Lojban's internal bridi nega­tion and English negation, we note that in many cases, especially when there are no exis­tential or quantified variables (the cmavo “da”, “de”, and “di” of selma'o KOhA, ex­plained in <a href=chap16.html>Chapter 16</a>) in the bridi, you can indeed translate Lojban “na” as “not” (or “isn't” or “doesn't”, as appropriate).

<p>

The most important rule about bridi negation is that if a bridi is true, its nega­tion is false, and vice versa.

<p>

In Lojban, there are several structures that implicitly contain bridi, so that Loj­ban sentences may contain more than one occurrence of “na”. For example:

<p>

<pre><a name=e2d8>2.8) mi na gleki le nu

na klama le nu dansu

I [false] am-happy-about the event-of

([false] going-to the event-of dancing).

It is not the case that I am happy about it not being

the case that I am going to the dance.

I am not happy about not going to the dance.

In the previous example, we used internal negations in abstraction bridi; bridi negation may also be found in descriptions within sumti. For example:

<a name=e2d9>2.9) mi nelci le na melbi

I am fond of the-one-described-as ([false] beautiful)

I am fond of the one who isn't beautiful.

</pre><p>A more extreme (and more indefinite) example is:

<p>

<pre><a name=e2d10>2.10) mi nelci lo na ca nolraitru be le frasygu'e

I am-fond-of one-who-is ([false] the current king of the French-country).

I am fond of one who isn't the current king of France.

</pre><p>The claim of <a href=#e2d10>Example 2.10 </a>could apply to anyone except a person who is fond of no one at all, since the relation within the description is false for everyone. You cannot readily express these situations in colloquial English.

<p>

Negation with “na” applies to an entire bridi, and not to just part of a selbri. There­fore, you won't likely have reason to put “na” inside a tanru. In fact, the grammar cur­rently does not allow you to do so (except in a lujvo and in elaborate constructs in­volving GUhA, the forethought connector for selbri). Any situation where you might want to do so can be expressed in a less-compressed non-tanru form. This grammatical restriction helps ensure that bridi negation is kept separate from other forms of nega­tion.

<p>

The grammar of “na” allows multiple adjacent negations, which cancel out, as in normal logic:

<p>

<pre><a name=e2d11>2.11) ti na na barda prenu co melbi mi

This [false] [false] is-a-big person that is (beautiful to me).

</pre>which is the same as:

<p>

<pre><a name=e2d12>2.12) ti barda prenu co melbi mi

This is a big-person that is (beautiful to me).

</pre><p>When a selbri is tagged with a tense or a modal, negation with “na” is permit­ted in two positions: before or after the tag. No semantic difference between these forms has yet been defined, but this is not finally determined, since the interactions between tenses/modals and bridi negation have not been fully explored. In particular, it remains to be seen whether sentences using less familiar tenses, such as:

<p>

<pre><a name=e2d13>2.13) mi [cu] ta'e klama le zarci

I habitually go to the market.

</pre>mean the same thing with “na” before the “ta'e”, as when the negation occurs after­wards; we'll let future, Lojban-speaking, logicians decide on how they relate to each other.

<p>

A final caution on translating English negations into Lojban: if you translate the English literally, you'll get the wrong one. With English causal statements, and other statements with auxiliary clauses, this problem is more likely.

<p>

Thus, if you translate the English:

<p>

<pre><a name=e2d14>2.14) I do not go to the market because the car is broken.

</pre>as:

<p>

<pre><a name=e2d15>2.15) mi na klama le zarci ki'u lenu le karce cu spofu

I [false] go-to the market because the car is broken.

It is false that: “I go to the market because the car is broken.”

</pre>you end up negating too much.

<p>

Such mistranslations result from the ambiguity of English compounded by the messiness of natural language negation. A correct translation of the normal interpreta­tion of <a href=#e2d14>Example 2.14 </a>is:

<p>

<pre><a name=e2d16>2.16) lenu mi na klama le zarci cu se krinu

lenu le karce cu spofu

The event-of (my [false] going-to the market) is justified by

the event-of (the car being broken).

My not going to the market is because the car is broken.

</pre><p>In <a href=#e2d16>Example 2.16</a>, the negation is clearly confined to the event abstraction in the x1 sumti, and does not extend to the whole sentence. The English could also have been expressed by two separate sentences joined by a causal connective (which we'll not go into here).

<p>

The problem is not confined to obvious causals. In the English:

<p>

<pre><a name=e2d17>2.17) I was not conscripted into the Army with the help of my uncle the Senator.

</pre>we do not intend the uncle's help to be part of the negation. We must thus move the nega­tion into an event clause or use two separate sentences. The event-clause version would look like:

<p>

<pre><a name=e2d18>2.18) The event-of (my [false] being-conscripted-into the Army) was aided by my uncle the Senator.

</pre><p>It is possible that someone will want to incorporate bridi negations into lujvo. For this reason, the rafsi “-nar-” has been reserved for “na”. However, before using this rafsi, make sure that you intend the contradictory bridi negation, and not the scalar ne­gation described in <a href=#s3>Section 3</a>, which will be much more common in tanru and lujvo.

<p>

### <a name=s3><h3>Scalar negation</h3>

<p>

Let us now consider some other types of negation. For example, when we say:

<p>

<pre><a name=e3d1>3.1) The chair is not brown.

</pre>we make a positive inference — that the chair is some other color. Thus, it is legitimate to respond:

<p>

<pre><a name=e3d2>3.2) It is green.

</pre><p>Whether we agree that the chair is brown or not, the fact that the statement refers to color has significant effect on how we interpret some responses. If we hear the follow­ing ex­change:

<p>

<pre><a name=e3d3>3.3) The chair is not brown.

Correct. The chair is wooden.

</pre>we immediately start to wonder about the unusual wood that isn't brown. If we hear the exchange:

<p>

<pre><a name=e3d4>3.4) Is the chair green?

No, it is in the kitchen.

</pre>we are unsettled because the response seems to be a non-sequitur. But since it might be true and it is a statement about the chair, one can't say it is entirely irrelevant!

<p>

What is going on in these statements is something called “scalar negation”. As the name suggests, scalar negation presumes an implied scale. A negation of this type not only states that one scalar value is false, but implies that another value on the scale must be true. This can easily lead to complications. The following exchange seems rea­sonably natural (a little suspension of disbelief in such inane conversation will help):

<p>

<pre><a name=e3d5>3.5) That isn't a blue house.

Right! That is a green house.

</pre><p>We have acknowledged a scalar negation by providing a correct value which is another color in the set of colors permissible for houses. While a little less likely, the following exchange is also natural:

<p>

<pre><a name=e3d6>3.6) That isn't a blue house.

Right! That is a blue car.

</pre><p>Again, we have acknowledged a scalar negation, and substituted a different object in the universe of discourse of things that can be blue.

<p>

Now, if the following exchange occurs:

<p>

<pre><a name=e3d7>3.7) That isn't a blue house.

Right! That is a green car.

</pre>we find the result unsettling. This is because it seems that two corrections have been ap­plied when there is only one negation. Yet out of context, “blue house” and “green car” seem to be reasonably equivalent units that should be mutually replaceable in a sentence. It's just that we don't have a clear way in English to say:

<p>

<pre><a name=e3d8>3.8) That isn't a “blue-house”.

</pre>aloud so as to clearly imply that the scalar negation is affecting the pair of words as a sin­gle unit.

<p>

Another even more confusing example of scalar negation is to the sentence:

<p>

<pre><a name=e3d9>3.9) John didn't go to Paris from Rome.

</pre><p>Might <a href=#e3d9>Example 3.9 </a>imply that John went to Paris from somewhere else? Or did he go somewhere else from Rome? Or perhaps he didn't go anywhere at all: maybe someone else did, or maybe there was no event of going whatsoever. One can devise circum­stances where any one, two or all three of these statements might be inferred by a lis­tener.

<p>

In English, we have a clear way of distinguishing scalar negation from predi­cate ne­gation that can be used in many situations. We can use the partial word “non-” as a prefix. But this is not always considered good usage, even though it would render many state­ments much clearer. For example, we can clearly distinguish

<p>

<pre><a name=e3d10>3.10) That is a non-blue house.

</pre>from the related sentence

<p>

<pre><a name=e3d11>3.11) That is a blue non-house.

</pre><a href=#e3d10>Example 3.10 </a>and <a href=#e3d11>Example 3.11 </a>have the advantage that, while they contain a negative indication, they are in fact positive assertions. They say what is true by excluding the false; they do not say what is false.

<p>

We can't always use “non-” though, because of the peculiarities of English's gram­mar. It would sound strange to say:

<p>

<pre><a name=e3d12>3.12) John went to non-Paris from Rome.

</pre>or

<p>

<pre><a name=e3d13>3.13) John went to Paris from non-Rome.

</pre>although these would clarify the vague negation. Another circumlocution for English scalar negation is “other than”, which works where “non-” does not, but is wordier.

<p>

Finally, we have natural language negations that are called polar negations, or oppo­sites:

<p>

<pre><a name=e3d14>3.14) John is moral

<a name=e3d15>3.15) John is immoral

</pre><p>To be immoral is much more than to just be not moral: it implies the opposite condi­tion. Statements like <a href=#e3d15>Example 3.15 </a>are strong negations which not only deny the truth of a statement, but assert its opposite. Since, “opposite” implies a scale, polar negations are a special variety of scalar negations.

<p>

To examine this concept more closely, let us draw a linear scale, showing two exam­ples of how the scale is used:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Affirmations | | (positive) | |  | | Negations | | (negative) | |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
| All | | Most | | Some | | Few | | None | |
| Excellent | | Good | | Fair | | Poor | | Awful | |

<p>

</pre><p>Some scales are more binary than the examples we diagrammed. Thus we have “not necessary” or “unnecessary” being the polar opposite of necessary. Another scale, espe­cially relevant to Lojban, is interpreted based on situations modified by one's phi­losophy: “not true” may be equated with “false” in a bi-valued truth-functional logic, while in tri-valued logic an intermediate between “true” and “false” is permitted, and in fuzzy logic a continuous scale exists from true to false. The meaning of “not true” re­quires a knowl­edge of which variety of truth scale is being considered.

<p>

We will define the most general form of scalar negation as indicating only that the particular point or value in the scale or range is not valid and that some other (unspecified) point on the scale is correct. This is the intent expressed in most contexts by “not mild”, for example.

<p>

Using this paradigm, contradictory negation is less restrictive than scalar ne­gation — it says that the point or value stated is incorrect (false), and makes no state­ment about the truth of any other point or value, whether or not on the scale.

<p>

In English, scalar negation semantically includes phrases such as “other than”, “reverse of”, or “opposite from” expressions and their equivalents. More commonly, scalar negation is expressed in English by the prefixes “non-”, “un-”, “il-”, and “im-”. Just which form and permissible values are implied by a scalar negation is dependent on the semantics of the word or concept which is being negated, and on the context. Much confusion in English results from the uncontrolled variations in meaning of these phrases and prefixes.

<p>

In the examples of <a href=#s4>Section 4</a>, we will translate the general case of scalar nega­tion using the general formula “other than” when a phrase is scalar-negated, and “non-” when a single word is scalar-negated.

<p>

### <a name=s4><h3>selbri and tanru negation</h3>

<p>

All the scalar negations illustrated in <a href=#s3>Section 3 </a>are expressed in Lojban using the cmavo “na'e” (of selma'o NAhE). The most common use of “na'e” is as a prefix to the selbri:

<p>

<pre><a name=e4d1>4.1) mi klama le zarci

I go to the market.

<a name=e4d2>4.2) mi na'e klama le zarci

I non-go to the market.

</pre><p>Comparing these two, we see that the negation operator being used in <a href=#e4d2>Example 4.2 </a>is “na'e”. But what exactly does “na'e” negate? Does the negation include only the gismu “klama”, which is the entire selbri in this case, or does it include the “le zarci” as well? In Lojban, the answer is unambiguously “only the gismu”. The cmavo “na'e” always applies only to what follows it.

<p>

<a href=#e4d2>Example 4.2 </a>looks as if it were parallel to:

<p>

<pre><a name=e4d3>4.3) mi na klama le zarci

I [false] go-to the market.

</pre>but in fact there is no real parallelism at all. A negation using “na” denies the truth of a relationship, but a selbri negation with “na'e” asserts that a relationship exists other than that stated, one which specifically involves the sumti identified in the statement. The grammar allotted to “na'e” allows us to unambiguously express scalar negations in terms of scope, scale, and range within the scale. Before we explain the scalar aspects, let us show how the scope of “na'e” is determined.

<p>

In tanru, we may wish to negate an individual element before combining it with an­other to form the tanru. We in effect need a shorter-than-selbri-scope negation, for which we can use “na'e” as well. The positive sentence

<p>

<pre><a name=e4d4>4.4) mi cadzu klama le zarci

I walking-ly go to the market.

</pre>can be subjected to selbri negation in several ways. Two are:

<p>

<pre><a name=e4d5>4.5) mi na'e cadzu klama le zarci

I (other-than-walkingly)-go-to the market.

<a name=e4d6>4.6) mi cadzu na'e klama le zarci

I walkingly-(other-than-go-to) the market.

</pre><p>These negations show the default scope of “na'e” is close-binding on an individual brivla in a tanru. <a href=#e4d5>Example 4.5 </a>says that I am going to the market, but in some kind of a non-walking manner. (As with most tanru, there are a few other possible interpretations, but we'll assume this one — see <a href=chap5.html>Chapter 5 </a>for a discussion of tanru meaning).

<p>

In neither <a href=#e4d5>Example 4.5 </a>nor <a href=#e4d6>Example 4.6 </a>does the “na'e” negate the entire sel­bri. While both sentences contain negations that deny a particular relationship between the sumti, they also have a component which makes a positive claim about such a rela­tion­ship. This is clearer in <a href=#e4d5>Example 4.5</a>, which says that I am going, but in a non-walk­ing manner. In <a href=#e4d6>Example 4.6</a>, we have claimed that the relationship between me and the mar­ket in some way involves walking, but is not one of “going to” (perhaps we are walking around the market, or walking-in-place while at the market).

<p>

The “scale”, or actually the “set”, implied in Lojban tanru negations is any­thing which plausibly can be substituted into the tanru. (Plausibility here is interpreted in the same way that answers to a “mo” question must be plausible — the result must not only have the right number of places and have sumti values appropriate to the place structure, it must also be appropriate or relevant to the context.) This minimal condition allows a speaker to be intentionally vague, while still communicating meaningful in­formation. The speaker who uses selbri negation is denying one relationship, while minimally asserting a different relationship.

<p>

We also need a scalar negation form that has a scope longer than a single brivla. There exists such a longer-scope selbri negation form, as exemplified by (each Lojban sentence in the next several examples is given twice, with parentheses in the second copy showing the scope of the “na'e”):

<p>

<pre><a name=e4d7>4.7) mi na'eke cadzu klama [ke'e] le zarci

mi na'e (ke cadzu klama [ke'e]) le zarci

I other-than-(walkingly-go-to) the market.

</pre><p>This negation uses the same “ke” and “ke'e” delimiters (the “ke'e” is always elidable at the end of a selbri) that are used in tanru. The sentence clearly negates the entire selbri. The “ke'e”, whether elided or not, reminds us that the negation does not include the trail­ing sumti. While the trailing-sumti place-structure is defined as that of the final brivla, the trailing sumti themselves are not part of the selbri and are thus not negated by “na'e”.

<p>

Negations of just part of the selbri are also permitted:

<p>

<pre><a name=e4d8>4.8) mi na'eke sutra cadzu ke'e klama le zarci

mi na'e (ke sutra cadzu ke'e) klama le zarci

I other-than-(quickly-walkingly) go-to the market.

</pre><p>In <a href=#e4d8>Example 4.8</a>, only the “sutra cadzu” tanru is negated, so the speaker is indeed going to the market, but not by walking quickly.

<p>

Negations made with “na'e” or “na'eke” also include within their scope any sumti at­tached to the brivla or tanru with “be” or “bei”. Such attached sumti are consid­ered part of the brivla or tanru:

<p>

<pre><a name=e4d9>4.9) mi na'e ke sutra cadzu be le mi birka ke'e klama le zarci

I other-than-(quickly walking-on-my-arms-ly) go-to the market.

</pre><p>Note that <a href=#e4d10>Example 4.10 </a>and <a href=#e4d11>Example 4.11 </a>do not express the same thing:

<p>

<pre><a name=e4d10>4.10) mi na'eke sutra cadzu [ke'e] lemi birka

mi na'e (ke sutra cadzu [ke'e]) lemi birka

I other-than-(quickly-walk-on) my-arms.

<a name=e4d11>4.11) mi na'eke sutra cadzu be lemi birka [ke'e]

mi na'e (ke sutra cadzu be lemi birka [ke'e])

I other-than-(quickly-walk-on my-arms).

</pre><p>The translations show that the negation in <a href=#e4d10>Example 4.10 </a>is more restricted in scope; i.e. less of the sentence is negated with respect to x1 (“mi”).

<p>

Logical scope being an important factor in Lojban's claims to be unambiguous, let us indicate the relative precedence of “na'e” as an operator. Grouping with “ke” and “ke'e”, of course, has an overt scope, which is its advantage. “na'e” is very close bind­ing to its brivla. Internal binding of tanru, with “bo”, is not as tightly bound as “na'e”. “co”, the tanru inversion operator has a scope that is longer than all other tanru con­structs.

<p>

In short, “na'e” and “na'eke” define a type of negation, which is shorter in scope than bridi negation, and which affects all or part of a selbri. The result of “na'e” negation re­mains an assertion of some specific truth and not merely a denial of another claim.

<p>

The similarity becomes striking when it is noticed that the rafsi “-nal-”, repre­senting “na'e” when a tanru is condensed into a lujvo, forms an exact parallel to the English usage of “non-”. Turning a series of related negations into lujvo gives:

<p>

<pre><a name=e4d12>4.12) na'e klama becomes nalkla

na'e cadzu klama becomes naldzukla

na'e sutra cadzu klama becomes nalsu'adzukla

nake sutra cadzu ke'e klama becomes nalsu'adzuke'ekla

</pre><p>Note: “-kem-” is the rafsi for “ke”, but it is omitted in the final lujvo as superfluous — “ke'e” is its own rafsi, and its inclusion in the lujvo implies a “ke” after the “-nal-”, since it needs to close something; only a “ke” immediately after the negation would make the “ke'e” meaningful in the tanru expressed in this lujvo.

<p>

In a lujvo, it is probably clearest to translate “-nal-” as “non-”, to match the English combining forms, except when the “na'e” has single word scope and English uses “un-” or “im-” to negate that single word. Translation style should determine the use of “other than”, “non-”, or another negator for “na'e” in tanru; the translator must render the Lojban into English so it is clear in context. Let's go back to our simplest example:

<p>

<pre><a name=e4d13>4.13) mi na'e klama le zarci

I am other-than-(going-to) the market.

?I am not going-to the market.

<a name=e4d14>4.14) mi nalkla le zarci

I am-a-non-go-er-to the market.

</pre><p>Note that to compare with the English translation form using “non-”, we've translated the Lojban as if the selbri were a noun. Since Lojban “klama” is indifferently a noun, verb, or adjective, the difference is purely a translation change, not a true change in meaning. The English difference seems significant, though, due to the strongly different English gram­matical forms and the ambiguity of English negation.

<p>

Consider the following highly problematic sentence:

<p>

<pre><a name=e4d15>4.15) lo ca nolraitru be le fasygu'e cu krecau

An-actual currently noblest-governor of the French country is-hair-without.

The current King of France is bald.

</pre><p>The selbri “krecau” negates with “na'e” as:

<p>

<pre><a name=e4d16>4.16) lo ca nolraitru be le fasygu'e

cu na'e krecau

An-actual currently noblest-governor of the French country

is-other-than hair-without.

The current King of France is other-than-bald.

</pre>or, as a lujvo:

<p>

<pre><a name=e4d17>4.17) lo ca nolraitru be le fasygu'e

cu nalkrecau

An-actual currently noblest-governor of the French country

is-non-hair-without.

The current King of France is a non-bald-one.

</pre><a href=#e4d16>Example 4.16 </a>and <a href=#e4d17>Example 4.17 </a>express the predicate negation forms using a negation word (“na'e”) or rafsi (“-nal-”); yet they make positive assertions about the current King of France; ie., that he is other-than-bald or non-bald. This follows from the close bind­ing of “na'e” to the brivla. The lujvo form makes this overt by absorbing the negative marker into the word.

<p>

Since there is no current King of France, it is false to say that he is bald, or non-bald, or to make any other affirmative claim about him. Any sentence about the current King of France containing only a selbri negation is as false as the sentence without the negation. No amount of selbri negations have any effect on the truth value of the sentence, which is invariably “false”, since no affirmative statement about the current King of France can be true. On the other hand, bridi negation does produce a truth:

<p>

<pre><a name=e4d18>4.18) lo ca nolraitru be le fasygu'e

cu na krecau

An-actual current noblest-governor of the French Country

[false] is-hair-without.

It is false that the current King of France is bald.

</pre><p>Note: “lo” is used in these sentences because negation relates to truth condi­tions. To meaningfully talk about truth conditions in sentences carrying a description, it must be clear that the description actually applies to the referent. A sentence using “le” instead of “lo” can be true even if there is no current king of France, as long as the speaker and the listener agree to describe something as the current king of France. (See the explanations of “le” in <a href=chap6.html>Chapter 6</a>.)

<p>

### <a name=s5><h3>Expressing scales in selbri negation</h3>

<p>

In expressing a scalar negation, we can provide some indication of the scale, range, frame-of-reference, or universe of discourse that is being dealt with in an asser­tion. As stated in <a href=#s4>Section 4</a>, the default is the set of plausible alternatives. Thus if we say:

<p>

<pre><a name=e5d1>5.1) le stizu cu na'e xunre

The chair is a non-(red-thing).

</pre>the pragmatic interpretation is that we mean a different color and not

<p>

<pre><a name=e5d2>5.2) le stizu cu dzukla be le zarci

The chair walkingly-goes-to-the-market.

</pre><p>However, if we have reason to be more explicit (an obtuse or contrary listener, or simply an overt logical analysis), we can clarify that we are referring to a color by saying:

<p>

<pre><a name=e5d3>5.3) le stizu cu na'e xunre skari

The chair is of a non-(red)-color (as perceived by something under

some conditions).

</pre><p>We might also have reduced the pragmatic ambiguity by making the two trailing sumti values explicit (the “as perceived by” and “under conditions” places have been added to the place structure of “xunre”). But assume we have a really stubborn listener (an artificially semi-intelligent computer?) who will find a way to misinterpret <a href=#e5d3>Example 5.3 </a>even with three specific sumti provided.

<p>

In this case, we use a sumti tagged with the sumti tcita “ci'u”, which translates roughly as “on a scale of X”, where “X” is the sumti. For maximal clarity, the tagged sumti can be bound into the negated selbri with “be”. To clarify <a href=#e5d3>Example 5.3</a>, we might say:

<p>

<pre><a name=e5d4>5.4) le stizu cu na'e xunre be ci'u loka skari

The chair is a non-(red on-a-scale-of-colorness)-thing.

</pre><p>We can alternately use the sumti tcita “teci'e”, based on “ciste”, which trans­lates roughly as “of a system of components X”, for universes of discourse; in this case, we would express <a href=#e5d3>Example 5.3 </a>as:

<p>

<pre><a name=e5d5>5.5) le stizu cu na'e xunre be teci'e le skari

The chair is a non-(red of-a-system-with-components-the-colors)-thing.

</pre><p>Other places of “ciste” can be brought out using the grammar of selma'o BAI modals, allowing slightly different forms of expression, thus:

<p>

<pre><a name=e5d6>5.6) le stizu cu na'e xunre be ci'e lo'i skari

The chair is a non-(red of-a-system-which-is-the-set-of-colors)-thing.

</pre><p>The cmavo “le'a”, also in selma'o BAI, can be used to specify a category:

<p>

<pre><a name=e5d7>5.7) le stizu cu na'e xunre be le'a lo'i skari

The chair is a non-(red of-a-category-which-is-the-set-of-colors)-thing.

</pre>which is minimally different in meaning from <a href=#e5d6>Example 5.6</a>.

<p>

The cmavo “na'e” is not the only member of selma'o NAhE. If we want to ex­press a scalar negation which is a polar opposite, we use the cmavo “to'e”, which is grammati­cally equivalent to “na'e”:

<p>

<pre><a name=e5d8>5.8) le stizu cu to'e xunre be ci'u loka skari

The chair is a ( opposite-of red ) on-scale a-property-of color-ness.

</pre><p>Likewise, the midpoint of a scale can be expressed with the cmavo “no'e”, also gram­matically equivalent to “na'e”. Here are some parallel examples of “na'e”, “no'e”, and “to'e”:

<p>

<pre><a name=e5d9>5.9) ta melbi

That is-beautiful.

<a name=e5d10>5.10) ta na'e melbi

That is-non-beautiful.

That is other than beautiful.

That is ugly [in one sense].

<a name=e5d11>5.11) ta no'e melbi

That is-neutrally beautiful.

That is plain/ordinary-looking (neither ugly nor beautiful).

<a name=e5d12>5.12) ta to'e melbi

That is-opposite-of beautiful.

That is ugly/very ugly/repulsive.

</pre><p>The cmavo “to'e” has the assigned rafsi “-tol-” and “-to'e-”; the cmavo “no'e” has the assigned rafsi “-nor-” and “-no'e-”. The selbri in <a href=#e5d10>Example 5.10 </a>through <a href=#e5d12>Example 5.12 </a>could be replaced by the lujvo “nalmle”, “normle”, and “tolmle” respectively.

<p>

This large variety of scalar negations is provided because different scales have dif­ferent properties. Some scales are open-ended in both directions: there is no “ultimately ugly” or “ultimately beautiful”. Other scales, like temperature, are open at one end and closed at the other: there is a minimum temperature (so-called “absolute zero”) but no maximum temperature. Still other scales are closed at both ends.

<p>

Correspondingly, some selbri have no obvious “to'e” — what is the opposite of a dog? — while others have more than one, and need “ci'u” to specify which opposite is meant.

<p>

### <a name=s6><h3>sumti negation</h3>

<p>

There are two ways of negating sumti in Lojban. We have the choice of quanti­fying the sumti with zero, or of applying the sumti-negator “na'ebo” before the sumti. It turns out that a zero quantification serves for contradictory negation. As the cmavo we use im­plies, “na'ebo” forms a scalar negation.

<p>

Let us show examples of each.

<p>

<pre><a name=e6d1>6.1) no lo ca nolraitru be le fasygu'e

cu krecau

Zero of those who are currently noblest-governors of the French country

are-hair-without.

No current king of France is bald.

</pre><p>Is <a href=#e6d1>Example 6.1 </a>true? Yes, because it merely claims that of the current Kings of France, however many there may be, none are bald, which is plainly true, since there are no such current Kings of France.

<p>

Now let us look at the same sentence using “na'ebo” negation:

<p>

<pre><a name=e6d2>6.2) na'ebo lo ca nolraitru

be le fasygu'e cu krecau

[Something] other-than-(the-current-noblest-governor

of the French country) is-hair-without.

Something other than the current King of France is bald.

</pre><a href=#e6d2>Example 6.2 </a>is true provided that something reasonably describable as “other than a cur­rent King of France”, such as the King of Saudi Arabia, or a former King of France, is in fact bald.

<p>

In place of “na'ebo”, you may also use “no'ebo” and “to'ebo”, to be more spe­cific about the sumti which would be appropriate in place of the stated sumti. Good examples are hard to come by, but here's a valiant try:

<p>

<pre><a name=e6d3>6.3) mi klama to'ebo la bastn.

I go to the-opposite-of Boston.

I go to Perth.

</pre>(Boston and Perth are nearly, but not quite, antipodal cities. In a purely United States context, San Francisco might be a better “opposite”.) Coming up with good examples is difficult, because attaching “to'ebo” to a description sumti is usually the same as at­taching “to'e” to the selbri of the description.

<p>

It is not possible to transform sumti negations of either type into bridi nega­tions or scalar selbri negations. Negations of sumti will be used in Lojban conversation. The in­ability to manipulate these negations logically will, it is hoped, prevent the logi­cal errors that result when natural languages attempt corresponding manipulations.

<p>

### <a name=s7><h3>Negation of minor grammatical constructs</h3>

<p>

We have a few other constructs that can be negated, all of them based on ne­gating individual words. For such negation, we use the suffix-combining negator, which is “nai”. “nai”, by the way, is almost always written as a compound into the previous word that it is negating, although it is a regular separate-word cmavo and the sole member of selma'o NAI.

<p>

Most of these negation forms are straightforward, and should be discussed and inter­preted in connection with an analysis of the particular construct being negated. Thus, we will not go into much detail here.

<p>

The following are places where “nai” is used:

<p>

When attached to tenses and modals (see <a href=chap10.html>Chapter 10</a>), the “nai” suffix usually indi­cates a contradictory negation of the tagged bridi. Thus “punai” as a tense inflection means “not-in-the-past”, or “not-previously”, without making any implication about any other time period unless explicitly stated. As a result,

<p>

<pre><a name=e7d1>7.1) mi na pu klama le zarci

I [false] [past] go-to the store.

I didn't go to the store.

</pre>and

<p>

<pre><a name=e7d2>7.2) mi punai klama le zarci

I [past-not] go-to the store.

I didn't go to the store.

</pre>mean exactly the same thing, although there may be a difference of emphasis.

<p>

Tenses and modals can be logically connected, with the logical connectives contain­ing contradictory negations; this allows negated tenses and modals to be ex­pressed posi­tively using logical connectives. Thus “punai je ca” means the same thing as “pu naje ca”.

<p>

As a special case, a “-nai” attached to the interval modifiers of selma'o TAhE, ROI, or ZAhO (explained in <a href=chap10.html>Chapter 10</a>) signals a scalar negation:

<p>

<pre><a name=e7d3>7.3) mi paroinai dansu le bisli

I [once] [not] dance-on the ice

</pre>means that I dance on the ice either zero or else two or more times within the relevant time interval described by the bridi. <a href=#e7d3>Example 7.3 </a>is very different from the English use of “not once”, which is an emphatic way of saying “never” — that is, exactly zero times.

<p>

In indicators and attitudinals of selma'o UI or CAI, “nai” denotes a polar nega­tion. As discussed in <a href=chap13.html>Chapter 13</a>, most indicators have an implicit scale, and “nai” changes the indicator to refer to the opposite end of the scale. Thus “.uinai” expresses unhappiness, and “.ienai” expresses disagreement (not ambivalence, which is expressed with the neu­tral or undecided intensity as “.iecu'i”).

<p>

Vocative cmavo of selma'o COI are considered a kind of indicator, but one which identifies the listener. Semantically, we could dispense with about half of the COI selma'o words based on the scalar paradigm. For example, “co'o” could be ex­pressed as “coinai”. However, this is not generally done.

<p>

Most of the COI cmavo are used in what are commonly called protocol situa­tions. These protocols are used, for example, in radio conversations, which often take place in a noisy environment. The negatives of protocol words tend to convey diametri­cally oppo­site communications situations (as might be expected). Therefore, only one protocol vocative is dependent on “nai”: negative acknowledgement, which is “je'enai” (“I didn't get that”).

<p>

Unlike the attitudinal indicators, which tend to be unimportant in noisy situa­tions, the protocol vocatives become more important. So if, in a noisy environment, a protocol lis­tener makes out only “nai”, he or she can presume it is a negative acknow­ledgement and repeat transmission or otherwise respond accordingly. <a href=chap13.html>Chapter 13 </a>pro­vides more detail on this topic.

<p>

The abstractors of selma'o NU follow the pattern of the tenses and modals. NU al­lows negative abstractions, especially in compound abstractions connected by logical connectives: “su'ujeninai”, which corresponds to “su'u jenai ni” just as “punai je ca” cor­responds to “pu naje ca”. It is not clear how much use logically connected abstrac­tors will be: see <a href=chap13.html>Chapter 13</a>.

<p>

A “nai” attached to a non-logical connective (of selma'o JOI or BIhI) is a sca­lar ne­gation, and says that the bridi is false under the specified mixture, but that another con­nective is applicable. Non-logical connectives are discussed in <a href=chap14.html>Chapter 14</a>.

<p>

### <a name=s8><h3>Truth questions</h3>

<p>

One application of negation is in answer to truth questions (those which expect the answers “Yes” or “No”). The truth question cmavo “xu” is in selma'o UI; placed at the beginning of a sentence, it asks whether the sentence as a whole is true or false.

<p>

<pre><a name=e8d1>8.1) xu la djan. pu klama la paris. .e la rom.

Is it true that: ( John previously went-to [both] Paris and Rome. )

</pre><p>You can now use each of the several kinds of negation we've discussed in answer to this (presuming the same question and context for each answer).

<p>

The straightforward negative answer is grammatically equivalent to the ex­panded sentence with the “na” immediately after the “cu” (and before any tense/modal):

<p>

<pre><a name=e8d2>8.2) na go'i

[false] [repeat previous]

No.

</pre>which means

<p>

<pre><a name=e8d3>8.3) la djan. [cu] na pu klama la paris. .e la rom.

John [false] previously went-to [both] Paris and Rome.

It's not true that John went to Paris and Rome.

</pre><p>The respondent can change the tense, putting the “na” in either before or after the new tense:

<p>

<pre><a name=e8d4>8.4) na ba go'i

[false] [future] [repeat previous]

</pre>meaning

<p>

<pre><a name=e8d5>8.5) la djan. [cu] na ba klama la paris. .e la rom.

John [false] later-will-go-to [both] Paris and Rome.

It is false that John will go to Paris and Rome.

</pre>or alternatively

<p>

<pre><a name=e8d6>8.6) ba na go'i

[false] [future] [repeat previous]

</pre>meaning

<p>

<pre><a name=e8d7>8.7) la djan. [cu] ba na klama la paris. .e la rom.

John later-will [false] go-to [both] Paris and Rome.

</pre><p>We stated in <a href=#s3>Section 3 </a>that sentences like <a href=#e8d5>Example 8.5 </a>and <a href=#e8d7>Example 8.7 </a>appear to be se­mantically identical, but that subtle semantic distinctions may eventually be found.

<p>

You can also use a scalar negation with “na'e”, in which case, it is equivalent to put­ting a “na'eke” immediately after any tense:

<p>

<pre><a name=e8d8>8.8) na'e go'i

other-than [repeat previous]

</pre>which means

<p>

<pre><a name=e8d9>8.9) la djan. [cu] pu na'eke klama [ke'e] la paris. .e la rom.

John previously other-than(went-to) [both] Paris and Rome.

</pre><p>He might have telephoned the two cities instead of going there. The unnecessary “ke” and “ke'e” would have been essential if the selbri had been a tanru.

<p>

### <a name=s9><h3>Affirmations</h3>

<p>

There is an explicit positive form for both selma'o NA (“ja'a”) and selma'o NAhE (“je'a”), each of which would supplant the corresponding negator in the gram­matical po­sition used, allowing one to assert the positive in response to a negative question or statement without confusion. Assuming the same context as in <a href=#s8>Section 8</a>:

<p>

<pre><a name=e9d1>9.1) xu na go'i

Is-it-true-that [false] [repeat previous]?

</pre>or equivalently

<p>

<pre><a name=e9d2>9.2) xu la djan. [cu] na pu klama la paris. .e la rom.

Is it true that: John [false] previously-went-to [both] Paris and Rome.]

</pre><p>The obvious, but incorrect, positive response to this negative question is:

<p>

<pre><a name=e9d3>9.3) go'i

[repeat previous]

</pre><p>A plain “go'i” does not mean “Yes it is”; it merely abbreviates repeating the previous statement unmodified, including any negators present; and <a href=#e9d3>Example 9.3 </a>actually states that it is false that John went to both Paris and Rome.

<p>

When considering:

<p>

<pre><a name=e9d4>9.4) na go'i

[false] [repeat previous]

</pre>as a response to a negative question like <a href=#e9d2>Example 9.2</a>, Lojban designers had to choose between two equally plausible interpretations with opposite effects. Does <a href=#e9d4>Example 9.4 </a>create a double negative in the sentence by adding a new “na” to the one already there (forming a double negative and hence a positive statement), or does the “na” replace the previous one, leaving the sentence unchanged?

<p>

It was decided that substitution, the latter alternative, is the preferable choice, since it is then clear whether we intend a positive or a negative sentence without per­forming any manipulations. This is the way English usually works, but not all languages work this way — Russian, Japanese, and Navajo all interpret a negative reply to a negative question as positive.

<p>

The positive assertion cmavo of selma'o NA, which is “ja’a”, can also replace the “na” in the context, giving:

<p>

<pre><a name=e9d5>9.5) ja'a go'i

(John truly-(previously went-to) [both] Paris and Rome.)

</pre>“ja'a” can replace “na” in a similar manner wherever the latter is used:

<p>

<pre><a name=e9d6>9.6) mi ja’a klama le zarci

I indeed go to the store.

</pre>“je'a” can replace “na'e” in exactly the same way, stating that scalar negation does not apply, and that the relation indeed holds as stated. In the absence of a negation con­text, it emphasizes the positive:

<p>

<pre><a name=e9d7>9.7) ta je'a melbi

that is-indeed beautiful.

### </pre><a name=s10><h3>Metalinguistic negation forms</h3>

<p>

The question of truth or falsity is not entirely synonymous with negation. Con­sider the English sentence

<p>

<pre><a name=e10d1>10.1) I have not stopped beating my wife.

</pre><p>If I never started such a heinous activity, then this sentence is neither true nor false. Such a negation simply says that something is wrong with the non-negated statement. Gener­ally, we then use either tone of voice or else a correction to express a preferred true claim: “I never have beaten my wife.”

<p>

Negations which follow such a pattern are called “metalinguistic negations”. In natu­ral languages, the mark of metalinguistic negation is that an indication of a correct state­ment always, or almost always, follows the negation. Tone of voice or emphasis may be further used to clarify the error.

<p>

Negations of every sort must be expressible in Lojban; errors are inherent to human thought, and are not excluded from the language. When such negations are metalinguistic, we must separate them from logical claims about the truth or falsity of the statement, as well as from scalar negations which may not easily express (or imply) the preferred claim. Because Lojban allows concepts to be so freely combined in tanru, limits on what is plausible or not plausible tend to be harder to determine.

<p>

Mimicking the muddled nature of natural language negation would destroy this sepa­ration. Since Lojban does not use tone of voice, we need other means to metalin­guisti­cally indicate what is wrong with a statement. When the statement is entirely in­appropri­ate, we need to be able to express metalinguistic negation in a more non-spe­cific fashion.

<p>

Here is a list of some different kinds of metalinguistic negation with English-lan­guage examples:

<p>

<pre><a name=e10d2>10.2) I have not <i>*stopped*</i> beating my wife

(I never started — failure of presupposition).

<a name=e10d3>10.3) 5 is not blue

(color does not apply to abstract concepts -- failure of category).

<a name=e10d4>10.4) The current King of France is not bald.

(there is no current King of France --- existential failure)

<a name=e10d5>10.5) I do not have THREE children.

(I have two --- simple undue quantity)

<a name=e10d6>10.6) I have not held THREE jobs previously, but four.

(inaccurate quantity; the difference from the previous example is that

someone who has held four jobs has also held three jobs)

<a name=e10d7>10.7) It is not good, but bad.

(undue quantity negation indicating that the value on a scale for measuring

the predicate is incorrect)

<a name=e10d8>10.8) She is not PRETTY; she is beautiful

(undue quantity transferred to a non-numeric scale)

<a name=e10d9>10.9) The house is not blue, but green.

(the scale/category being used is incorrect, but a related category applies)

<a name=e10d10>10.10) The house is not blue, but is colored.

(the scale/category being used is incorrect, but a broader category applies)

<a name=e10d11>10.11) The cat is not blue, but long-haired.

(the scale/category being used is incorrect, but an unrelated category

applies)

<a name=e10d12>10.12) A: He ain't coming today.

B: “Ain't” ain't a word.

(solecism, or improper grammatical action)

<a name=e10d13>10.13) I haven't STOOPED beating my wife; I've STOPPED.

(spelling or mispronunciation error)

<a name=e10d14>10.14) Not only was it a sheep, it was a black sheep.

(non-contradictory correction)

</pre><p>The set of possible metalinguistic errors is open-ended.

<p>

Many of these forms have a counterpart in the various examples that we've discussed under logical negation. Metalinguistic negation doesn't claim that the sen­tence is false or true, though. Rather, it claims that, due to some error in the statement, “true” and “false” don't really apply.

<p>

Because one can metalinguistically negate a true statement intending a non-contra­dictory correction (say, a spelling error); we need a way (or ways) to metalin­guistically negate a statement which is independent of our logical negation schemes using “na”, “na'e” and kin. The cmavo “na'i” is assigned this function. If it is present in a statement, it indicates metalinguistically that something in the statement is incorrect. This metalin­guistic negation must override any evaluation of the logic of the statement. It is equally allowed in both positive and negative statements.

<p>

Since “na'i” is not a logical operator, multiple occurrences of “na'i” need not be as­sumed to cancel each other. Indeed, we can use the position of “na'i” to indicate metalin­guistically what is incorrect, preparatory to correcting it in a later sentence; for this rea­son, we give “na'i” the grammar of UI. The inclusion of “na'i” anywhere in a sentence makes it a non-assertion, and suggests one or more pitfalls in assigning a truth value.

<p>

Let us briefly indicate how the above-mentioned metalinguistic errors can be identi­fied. Other metalinguistic problems can then be marked by devising analogies to these examples:

<p>

Existential failure can be marked by attaching “na'i” to the descriptor “lo” or the “poi” in a “da poi”-form sumti. (See Chapter 6 and <a href=chap16.html>Chapter 16 </a>for details on these con­structions.) Remember that if a “le” sumti seems to refer to a non-existent referent, you may not understand what the speaker has in mind — the appropriate response is then “ki'a”, asking for clarification.

<p>

Presupposition failure can be marked directly if the presupposition is overt; if not, one can insert a “mock presupposition” to question with the sumti tcita (selma'o BAI) word “ji'u”; “ji'uku” thus explicitly refers to an unexpressed assumption, and “ji'una'iku” metalinguistically says that something is wrong with that assumption. (See <a href=chap10.html>Chapter 10</a>.)

<p>

Scale errors and category errors can be similarly expressed with selma'o BAI. “le'a” has meaning “of category/class/type X”, “ci'u” has meaning “on scale X”, and “ci'e”, based on “ciste”, can be used to talk about universes of discourse defined either as sys­tems or sets of components, as shown in <a href=#s8>Section 8</a>. “kai” and “la'u” also exist in BAI for discussing other quality and quantity errors.

<p>

We have to make particular note of potential problems in the areas of undue quantity and incorrect scale/category. Assertions about the relationships between gismu are among the basic substance of the language. It is thus invalid to logically require that if something is blue, that it is colored, or if it is not-blue, then it is some other color. In Lojban, “blanu” (“blue”) is not explicitly defined as a “skari” (“color”). Similarly, it is not implicit that the opposite of “good” is “bad”.

<p>

This mutual independence of gismu is only an ideal. Pragmatically, people will cate­gorize things based on their world-views. We will write dictionary definitions that will relate gismu, unfortunately including some of these world-view assumptions. Loj­banists should try to minimize these assumptions, but this seems a likely area where logical rules will break down (or where Sapir-Whorf effects will be made evident). In terms of nega­tion, however, it is vital that we clearly preserve the capability of denying a presumably obvious scale or category assumption.

<p>

Solecisms, grammatical and spelling errors will be marked by marking the of­fending word or phrase with “na'i” (in the manner of any selma'o UI cmavo). In this sense, “na'i” becomes equivalent to the English metalinguistic marker “[sic]”. Purists may choose to use ZOI or LOhU/LEhU quotes or “sa'a”-marked corrections to avoid repeating a truly unparsable passage, especially if a computer is to analyze the speech/text. See <a href=chap19.html>Chapter 19 </a>for explanations of these usages.

<p>

In summary, metalinguistic negation will typically take the form of referring to a previous statement and marking it with one or more “na'i” to indicate what metalin­guistic errors have been made, and then repeating the statement with corrections. Refer­ences to previous statements may be full repetitions, or may use members of selma'o GOhA. “na'i” at the beginning of a statement merely says that something is inappropri­ate about the statement, without specificity.

<p>

In normal use, metalinguistic negation requires that a corrected statement fol­low the negated statement. In Lojban, however, it is possible to completely and unam­biguously specify metalinguistic errors without correcting them. It will eventually be seen whether an uncorrected metalinguistic negation remains an acceptable form in Lojban. In such a statement, metalinguistic expression would involve an ellipsis not unlike that of tenseless expression.

<p>

Note that metalinguistic negation gives us another kind of legitimate negative answer to a “xu” question (see <a href=#s8>Section 8</a>). “na'i” will be used when something about the ques­tioned statement is inappropriate, such as in questions like “Have you stopped beating your wife?”:

<p>

<pre><a name=e10d15>10.15) xu do sisti lezu'o do rapydarxi ledo fetspe

Have you ceased the activity of repeat-hitting your female-spouse?

</pre><p>Responses could include:

<p>

<pre><a name=e10d16>10.16) na'i go'i

The bridi as a whole is inappropriate in some way.

<a name=e10d17>10.17) go'i na'i

The selbri (sisti) is inappropriate in some way.

</pre><p>One can also specifically qualify the metalinguistic negation, by explicitly re­peating the erroneous portion of the bridi to be metalinguistically negated, or adding on of the selma'o BAI qualifiers mentioned above:

<p>

<pre><a name=e10d18>10.18) go'i ji'una'iku

Some presupposition is wrong with the previous bridi.

</pre><p>Finally, one may metalinguistically affirm a bridi with “jo'a”, another cmavo of sel­ma'o UI. A common use for “jo'a” might be to affirm that a particular construc­tion, though unusual or counterintuitive, is in fact correct; another usage would be to disagree with — by overriding — a respondent's metalinguistic negation.

<p>

### <a name=s11><h3>Summary — Are All Possible Questions About Negation Now An­swered?</h3>

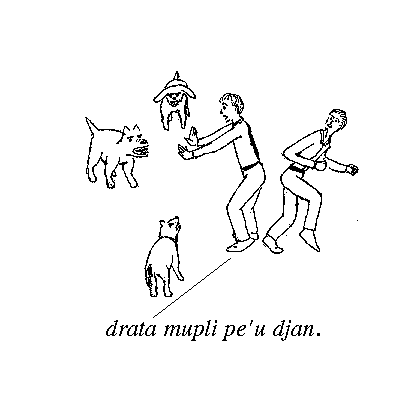
<p>

<pre><a name=e11d1>11.1) na go'i .ije na'e go'i .ije na'i go'i

</body></html>

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## <h2>Chapter 16

## <br>

## “Who Did You Pass On The Road? Nobody”: Lojban And Logic</h2>

###### <h6>$Revision: 4.0 $<br> mkhtml: 1.1</h6></p></center>

<p>

### <a name=s1><h3>What's wrong with this picture?</h3>

<p>

<cx "nobody, interpretation of">The following brief dialogue is from <a href=chap7.html>Chapter 7 </a>of <cite>Through The Looking Glass </cite>by Lewis Carroll.

<p>

<pre><a name=e1d1>1.1) “Who did you pass on the road?” the King went on, holding out his hand to the Messenger for some more hay.

<a name=e1d2>1.2) “Nobody,” said the Messenger.

<a name=e1d3>1.3) “Quite right,” said the King: “this young lady saw him too. So of course No­body walks slower than you. ”

<a name=e1d4>1.4) “I do my best,” the Messenger said in a sulky tone. “I'm sure nobody walks much faster than I do!”

<a name=e1d5>1.5) “He can't do that,” said the King, “or else he'd have been here first.”

</pre><p>This nonsensical conversation results because the King insists on treating the word “nobody” as a name, a name of somebody. However, the essential nature of the English word “nobody” is that it doesn't refer to somebody; or to put the matter another way, there isn't anybody to which it refers.

<p>

<cx "nobody, ambiguous interpretations of">The central point of contradiction in the dialogue arises in <a href=#e1d3>Example 1.3</a>, when the King says “<dots>… </dots>Nobody walks slower than you”. This claim would be plausible if “Nobody” were really a name, since the Messenger could only pass someone who does walk more slowly than he. But the Messenger interprets the word “nobody” in the ordi­nary English way, and says (in <a href=#e1d4>Example 1.4</a>) “<dots>… </dots>nobody walks much faster than I do” (i.e., I walk faster, or as fast as, almost everyone), which the King then again misunder­stands. Both the King and the Messenger are correct according to their respective un­der­standings of the ambiguous word “nobody/Nobody”.

<p>

<cx "nobody, Lojban contrasted with English">There are Lojban words or phrases corresponding to the problematic English words “somebody”, “nobody”, “anybody”, “everybody” (and their counterparts “some/no/any/everyone” and “some/no/any/everything”), but they obey rules which can often be surprising to English-speakers. The dialogue above simply cannot be translated into Lojban without distortion: the name “Nobody” would have to be represented by a Lojban name, which would spoil the perfection of the wordplay. As a matter of fact, this is the desired result: a logical language should not allow two conversationalists to affirm “Nobody walks slower than the Messenger” and “Nobody walks faster than the Messen­ger” and both be telling the truth. (Unless, of course, nobody but the Messenger walks at all, or everyone walks at exactly the same speed.)

<p>

<cx "logic, resolving ambiguities of “nobody”">This chapter will explore the Lojban mechanisms that allow the correct and consis­tent construction of sentences like those in the dialogue. There are no new gram­matical constructs explained in this chapter; instead, it discusses the way in which ex­isting facili­ties that allow Lojban-speakers to resolve problems like the above, using the concepts of modern logic. However, we will not approach the matter from the view­point of logicians, although readers who know something of logic will discover familiar notions in Lojban guise.

<p>

<cx "logic, limits of">Although Lojban is called a logical language, not every feature of it is “logical”. In particular, the use of “le” is incompatible with logical reasoning based on the description selbri, because that selbri may not truthfully apply: you cannot conclude from my state­ment that

<p>

<pre><a name=e1d6>1.6) mi viska le nanmu

I see the-one-I-refer-to-as-the man.

I see the man/men.

</pre>that there really is a man; the only thing you can conclude is that there is one thing (or more) that I choose to refer to as a man. You cannot even tell which man is meant for sure without asking me (although communication is served if you already know from the context).

<p>

<cx "logic, and attitudinals"><cx "attitudinals, and logic">In addition, the use of attitudinals (see <a href=chap13.html>Chapter 13</a>) often reduces or removes the ability to make deductions about the bridi to which those attitudinals are applied. From the fact that I hope George will win the election, you can conclude nothing about George's actual victory or defeat.

<p>

### <a name=s2><h3>Existential claims, prenexes, and variables</h3>

<p>

Let us consider, to begin with, a sentence that is not in the dialogue:

<p>

<ex "something sees me"><pre><a name=e2d1>2.1) Something sees me.

</pre><p>There are two plausible Lojban translations of <a href=#e2d1>Example 2.1</a>. The simpler one is:

<p>

<lx "zo'e"><pre><a name=e2d2>2.2) [zo'e] viska mi

Something-unspecified sees me.

</pre><cx "zo'e, as a translation for “something”"><cx "something, unspecified definite with “zo'e”">The cmavo “zo'e” indicates that a sumti has been omitted (indeed, even “zo'e” itself can be omitted in this case, as explained in <a href=chap7.html>Chapter 7</a>) and the listener must fill in the cor­rect value from context. In other words, <a href=#e2d2>Example 2.2 </a>means “‘You-know-what’ sees me.”

<p>

However, <a href=#e2d1>Example 2.1 </a>is just as likely to assert simply that there is someone who sees me, in which case a correct translation is:

<p>

<lx "da"><cx "da, as a translation for “something”"><pre><a name=e2d3>2.3) da zo'u da viska mi

There-is-an-X such-that X sees me.

</pre><cx "existential claims, definition"><cx "da, contrasted with zo'e"><cx "zo'e, contrasted with da"><a href=#e2d3>Example 2.3 </a>does not presuppose that the listener knows who sees the speaker, but sim­ply tells the listener that there is someone who sees the speaker. Statements of this kind are called “existential claims”. (Formally, the one doing the seeing is not restricted to being a person; it could be an animal or — in principle — an inanimate object. We will see in <a href=#s4>Section 4 </a>how to represent such restrictions.)

<p>

<lx "zo'u"><lx "ZOhU"><cx "prenex, explanation"><cx "prenex, syntax of"><cx "variables, logical"><cx "logical variables, notation convention"><a href=#e2d3>Example 2.3 </a>has a two-part structure: there is the part “da zo'u”, called the prenex, and the part “da viska mi”, the main bridi. Almost any Lojban bridi can be pre­ceded by a prenex, which syntactically is any number of sumti followed by the cmavo “zo'u” (of selma'o ZOhU). For the moment, the sumti will consist of one or more of the cmavo “da”, “de”, and “di” (of selma'o KOhA), glossed in the literal translations as “X”, “Y”, and “Z” respectively. By analogy to the terminology of symbolic logic, these cmavo are called “variables”.

<p>

Here is an example of a prenex with two variables:

<p>

<ex "somebody loves somebody"><pre><a name=e2d4>2.4) da de zo'u da prami de

There-is-an-X there-is-a-Y such that X loves Y.

Somebody loves somebody.

</pre><cx "somebody, contrasted with somebody else"><cx "logical variables, effect of using multiple different">In <a href=#e2d4>Example 2.4</a>, the literal interpretation of the two variables “da” and “de” as “there-is-an-X” and “there-is-a-Y” tells us that there are two things which stand in the relation­ship that one loves the other. It might be the case that the supposed two things are really just a single thing that loves itself; nothing in the Lojban version of <a href=#e2d4>Example 2.4 </a>rules out that interpretation, which is why the colloquial translation does not say “Somebody loves somebody else.” The things referred to by different variables may be different or the same. (We use “somebody” here rather than “something” for naturalness; lovers and be­loveds are usually persons, though the Lojban does not say so.)

<p>

<cx "logical variables, with multiple appearances in bridi">It is perfectly all right for the variables to appear more than once in the main bridi:

<p>

<ex "somebody loves self"><pre><a name=e2d5>2.5) da zo'u da prami da

There-is-an-X such that X loves X

Somebody loves himself/herself.

</pre><cx "da prami da, contrasted with da prami de"><cx "da prami de, contrasted with da prami da">What <a href=#e2d5>Example 2.5 </a>claims is fundamentally different from what <a href=#e2d4>Example 2.4 </a>claims, be­cause “da prami da” is not structurally the same as “da prami de”. However,

<p>

<cx "logical variables, effect of global substitution"><pre><a name=e2d6>2.6) de zo'u de prami de

There-is-a-Y such that Y loves Y

</pre>means exactly the same thing as <a href=#e2d5>Example 2.5</a>; it does not matter which variable is used as long as they are used consistently.

<p>

It is not necessary for a variable to be a sumti of the main bridi directly:

<p>

<ex "somebody's dog"><pre><a name=e2d7>2.7) da zo'u le da gerku cu viska mi

There-is-an-X such-that the of-X dog sees me

Somebody's dog sees me

</pre>is perfectly correct even though the “da” is used only in a possessive construction. (Possessives are explained in <a href=chap8.html>Chapter 8</a>.)

<p>

<cx "logical variable, when not in main bridi">It is very peculiar, however, even if technically grammatical, for the variable not to appear in the main bridi at all:

<p>

<ex "Ralph"><pre><a name=e2d8>2.8) da zo'u la ralf. gerku

There is something such that Ralph is a dog.

</pre>has a variable bound in a prenex whose relevance to the claim of the following bridi is completely unspecified.

<p>

### <a name=s3><h3>Universal claims</h3>

<p>

What happens if we substitute “everything” for “something” in <a href=#e2d1>Example 2.1</a>? We get:

<p>

<pre><a name=e3d1>3.1) Everything sees me.

</pre><cx "universal claims, explanation">Of course, this example is false, because there are many things which do not see the speaker. It is not easy to find simple truthful examples of so-called universal claims (those which are about everything), so bear with us for a while. (Indeed, some Lojban­ists tend to avoid universal claims even in other languages, since they are so rarely true in Lojban.)

<p>

The Lojban translation of <a href=#e3d1>Example 3.1 </a>is

<ex "everything sees me"><pre><a name=e3d2>3.2) ro da zo'u da viska mi

For-every X : X sees me.

</pre><lx "ro"><lx "ro da"><cx "everything, expressing with “ro da”">When the variable cmavo “da” is preceded by “ro”, the combination means “For every X” rather than “There is an X”. Superficially, these English formulations look totally unre­lated: <a href=#s6>Section 6 </a>will bring them within a common viewpoint. For the moment, ac­cept the use of “ro da” for “everything” on faith.

<p>

Here is a universal claim with two variables:

<p>

<ex "everything loves everything"><pre><a name=e3d3>3.3) ro da ro de zo'u da prami de

For-every X, for-every Y : X loves Y.

Everything loves everything.

</pre><p>Again, X and Y can represent the same thing, so <a href=#e3d3>Example 3.3 </a>does not mean “Everything loves everything else.” Furthermore, because the claim is universal, it is about every thing, not merely every person, so we cannot use “everyone” or “everybody” in the translation.

<p>

<cx "mixed claim, definition"><cx "existential, mixed claim with universal"><cx "universal, mixed claim with existential">Note that “ro” appears before both “da” and “de”. If “ro” is omitted before ei­ther variable, we get a mixed claim, partly existential like those of <a href=#s2>Section 2</a>, partly universal.

<p>

<ex "everything sees something"><pre><a name=e3d4>3.4) ro da de zo'u da viska de

For-every X, there-is-a-Y : X sees Y.

Everything sees something.

</pre><ex "something sees everything"><pre><a name=e3d5>3.5) da ro de zo'u da viska de

There-is-an-X such-that-for-every-Y : X sees Y.

Something sees everything.

</pre><cx "logical variables, effect of order in prenex"><a href=#e3d{4}>Examples 3.4 </a>and <a href=#e3d5>3.5 </a>mean completely different things. <a href=#e3d4>Example 3.4 </a>says that for eve­rything, there is something which it sees, not necessarily the same thing seen for every seer. <a href=#e3d5>Example 3.5</a>, on the other hand, says that there is a particular thing which can see everything that there is (including itself). Both of these are fairly silly, but they are dif­ferent kinds of silliness.

<p>

There are various possible translations of universal claims in English: some­times we use “anybody/anything” rather than “everybody/everything”. Often it makes no differ­ence which of these is used: when it does make a difference, it is a rather subtle one which is explained in <a href=#s8>Section 8</a>.

<p>

### <a name=s4><h3>Restricted claims: “da poi”</h3>

<p>

<cx "universal claims, restricting"><cx "restricted claims, definition">The universal claims of <a href=#s3>Section 3 </a>are not only false but absurd: there is really very little to be said that is both true and non-trivial about every object whatsoever. Further­more, we have been glossing over the distinction between “everything” and “everybody” and the other pairs ending in “-thing” and “-body”. It is time to bring up the most useful feature of Lojban variables: the ability to restrict their ranges.

<p>

<cx "relative clauses, use in restricting existential claims"><cx "existential claims, restricting"><lx "poi"><lx "da poi"><lx "ku'o"><lx "vau">In Lojban, a variable “da”, “de”, or “di” may be followed by a “poi” relative clause in order to restrict the range of things that the variable describes. Relative clauses are de­scribed in detail in <a href=chap8.html>Chapter 8</a>, but the kind we will need at present consist of “poi” fol­lowed by a bridi (often just a selbri) terminated with “ku'o” or “vau” (which can usually be elided). Consider the difference between

<p>

<pre><a name=e4d1>4.1) da zo'u da viska la djim.

There-is-an-X : X sees Jim.

Something sees Jim.

</pre>and

<p>

<pre><a name=e4d2>4.2) da poi prenu zo'u da viska la djim.

There-is-an-X which is-a-person : X sees Jim.

Someone sees Jim.

</pre><cx "something, contrasted with someone">In <a href=#e4d1>Example 4.1</a>, the variable “da” can refer to any object whatever; there are no restric­tions on it. In <a href=#e4d2>Example 4.2</a>, “da” is restricted by the “poi prenu” relative clause to per­sons only, and so “da poi prenu” translates as “someone.” (The difference between “someone” and “somebody” is a matter of English style, with no real counterpart in Lojban.) If <a href=#e4d2>Ex­ample 4.2 </a>is true, then <a href=#e4d1>Example 4.1 </a>must be true, but not necessarily vice versa.

<p>

<cx "relative clauses, use in restricting universal claims"><cx "universal claims, restricting">Universal claims benefit even more from the existence of relative clauses. Consider

<p>

<ex "everything breathes"><pre><a name=e4d3>4.3) ro da zo'u da vasxu

For-every X : X breathes

Everything breathes

</pre>and

<p>

<cx "dog breathes"><pre><a name=e4d4>4.4) ro da poi gerku zo'u da vasxu

For-every X which is-a-dog : X breathes.

Every dog breathes.

Each dog breathes.

All dogs breathe.

</pre><a href=#e4d3>Example 4.3 </a>is a silly falsehood, but <a href=#e4d4>Example 4.4 </a>is an important truth (at least if ap­plied in a timeless or potential sense: see <a href=chap10.html>Chapter 10</a>). Note the various colloquial translations “every dog”, “each dog”, and “all dogs”. They all come to the same thing in Lojban, since what is true of every dog is true of all dogs. “All dogs” is treated as an English plural and the others as singular, but Lojban makes no distinction.

<p>

If we make an existential claim about dogs rather than a universal one, we get:

<p>

<pre><a name=e4d5>4.5) da poi gerku zo'u da vasxu

There-is-an-X which is-a-dog : X breathes.

Some dog breathes.

### </pre><a name=s5><h3>Dropping the prenex</h3>

<p>

<cx "prenex, considerations for dropping">It isn't really necessary for every Lojban bridi involving variables to have a prenex on the front. In fact, none of the examples we've seen so far required prenexes at all! The rule for dropping the prenex is simple: if the variables appear in the same order within the bridi as they did in the prenex, then the prenex is superfluous. However, any “ro” or “poi” appearing in the prenex must be transferred to the first occurrence of the variable in the main part of the bridi. Thus, <a href=#e2d3>Example 2.3 </a>becomes just:

<p>

<pre><a name=e5d1>5.1) da viska mi

There-is-an-X-which sees me.

Something sees me.

</pre>and <a href=#e4d4>Example 4.4 </a>becomes:

<p>

<pre><a name=e5d2>5.2) ro da poi gerku cu vasxu

For-every X which is-a-dog, it-breathes.

Every dog breathes.

</pre><cx "prenex, purpose of"><cx "prenex, effect of order of variables in">You might well suppose, then, that the purpose of the prenex is to allow the variables in it to appear in a different order than the bridi order, and that would be cor­rect. Consider

<p>

<cx "everyone bitten by dog"><pre><a name=e5d3>5.3) ro da poi prenu ku'o de poi gerku ku'o zo'u de batci da

For-every X which is-a-person, there-is-a-Y which is-a-dog: Y bites X.

</pre><p>The prenex of <a href=#e5d3>Example 5.3 </a>is like that of <a href=#e3d4>Example 3.4 </a>(but with relative clauses): it notes that the following bridi is true of every person with respect to some dog, not nec­essarily the same dog for each. But in the main bridi part, the “de” appears before the “da”. There­fore, the true translation is

<p>

<pre><a name=e5d4>5.4) Every person is bitten by some dog (or other).

</pre><p>If we tried to omit the prenex and move the “ro” and the relative clauses into the main bridi, we would get:

<p>

<pre><a name=e5d5>5.5) de poi gerku cu batci ro da poi prenu

There-is-a-Y which is-a-dog which-bites every Y which is-a-person

Some dog bites everyone.

</pre><ex "Fido">which has the structure of <a href=#e3d5>Example 3.5</a>: it says that there is a dog (call him Fido) who bites, has bitten, or will bite every person that has ever existed! We can safely rule out Fido's existence, and say that <a href=#e5d5>Example 5.5 </a>is false, while agreeing to <a href=#e5d3>Example 5.3</a>.

<p>

<cx "universal claims, dangers of using">Even so, <a href=#e5d3>Example 5.3 </a>is most probably false, since some people never experi­ence dogbite. Examples like 5.3 and 4.4 (might there be some dogs which never have breathed, because they died as embryos?) indicate the danger in Lojban of universal claims even when restricted. In English we are prone to say that “Everyone says” or that “Everybody does” or that “Everything is” when in fact there are obvious counter­examples which we are ignoring for the sake of making a rhetorical point. Such state­ments are plain false­hoods in Lojban, unless saved by a context (such as tense) which implicitly restricts them.

<p>

<cx "se, using to re-order logical variables"><cx "re-ordering logical variables with se"><lx "se"><lx "SE">How can we express <a href=#e5d3>Example 5.3 </a>in Lojban without a prenex? Since it is the order in which variables appear that matters, we can say:

<p>

<pre><a name=e5d6>5.6) ro da poi prenu cu se batci de poi gerku

Every-X which is-a-person is-bitten-by some-Y which is-a-dog.

</pre>using the conversion operator “se” (explained in <a href=chap5.html>Chapter 5</a>) to change the selbri “batci” (“bites”) into “se batci” (“is bitten by”). The translation given in <a href=#e5d4>Example 5.4 </a>uses the corresponding strategy in English, since English does not have prenexes (except in strained “logician's English”). This implies that a sentence with both a universal and an existential variable can't be freely converted with “se”; one must be careful to preserve the order of the variables.

<p>

<cx "logical variable with ro, in multiple appearances"><cx "logical variable with poi, in multiple appearances"><cx "ro, dropping from multiple appearances on logical variables"><cx "poi, dropping from multiple appearances on logical variables"><lx "ro"><lx "poi">If a variable occurs more than once, then any “ro” or “poi” decorations are moved only to the first occurrence of the variable when the prenex is dropped. For ex­ample,

<p>

<ex "weapon against self"><pre><a name=e5d7>5.7) di poi prenu zo'u

ti xarci di di

There-is-a-Z which is-a-person :

this-thing is-a-weapon for-use-against-Z by-Z

This is a weapon for someone to use against himself/herself.

</pre>(in which “di” is used rather than “da” just for variety) loses its prenex as follows:

<p>

<pre><a name=e5d8>5.8) ti xarci di poi prenu ku'o di

This-thing is-a-weapon-for-use-against some-Z which is-a-person by-Z.

</pre><cx "prenex, dropping for terseness">As the examples in this section show, dropping the prenex makes for terseness of ex­pression often even greater than that of English (Lojban is meant to be an unambi­guous language, not necessarily a terse or verbose one), provided the rules are observed.

<p>

### <a name=s6><h3>Variables with generalized quantifiers</h3>

<p>

<lx "PA"><cx "quantifiers, with logical variables">So far, we have seen variables with either nothing in front, or with the cmavo “ro” in front. Now “ro” is a Lojban number, and means “all”; thus “ro prenu” means “all per­sons”, just as “re prenu” means “two persons”. In fact, unadorned “da” is also taken to have an implicit number in front of it, namely “su'o”, which means “at least one”. Why is this? Consider <a href=#e2d3>Example 2.3 </a>again, this time with an explicit “su'o”:

<p>

<cx "something, expressing using “su'o”"><ex "something sees me"><lx "su'o"><pre><a name=e6d1>6.1) su'o da zo'u da viska mi

For-at-least-one X : X sees me.

Something sees me.

</pre><p>From this version of <a href=#e2d3>Example 2.3</a>, we understand the speaker's claim to be that of all the things that there are, at least one of them sees him or her. The corresponding univer­sal claim, <a href=#e3d2>Example 3.2</a>, says that of all the things that exist, every one of them can see the speaker.

<p>

<cx "numbers, on logical variables">Any other number can be used instead of “ro” or “su'o” to precede a variable. Then we get claims like:

<p>

<pre><a name=e6d2>6.2) re da zo'u da viska mi

For-two-Xes : X sees me.

Two things see me.

</pre><cx "numbers, Lojban contrasted with English on exactness"><cx "numbers, English contrasted with Lojban on exactness">This means that exactly two things, no more or less, saw the speaker on the relevant occa­sion. In English, we might take “Two things see me” to mean that at least two things see the speaker, but there might be more; in Lojban, though, that claim would have to be made as:

<p>

<pre><a name=e6d3>6.3) su'ore da zo'u da viska mi

For-at-least-two Xes : X sees me.

</pre>which would be false if nothing, or only one thing, saw the speaker, but not otherwise. We note the “su'o” here meaning “at least”; “su'o” by itself is short for “su'opa” where “pa” means “one”, as is explained in <a href=chap18.html>Chapter 18</a>.

<p>

<cx "prenex, removing when numeric quantifiers present">The prenex may be removed from <a href=#e6d{2}>Examples 6.2 </a>and <a href=#e6d3>6.3 </a>as from the others, leading to:

<p>

<pre><a name=e6d4>6.4) re da viska mi

Two Xes see me.

</pre>and

<p>

<pre><a name=e6d5>6.5) su'ore da viska mi

At-least-two Xes see me.

</pre>respectively, subject to the rules prescribed in <a href=#s5>Section 5</a>.

<p>

<lx "ro prenu"><ex "all persons"><cx "indefinite description, definition"><cx "indefinite description, compared with restricted variable"><cx "restricted variable, compared with indefinite description">Now we can explain the constructions “ro prenu” for “all persons” and “re prenu” for “two persons” which were casually mentioned at the beginning of this Sec­tion. In fact, “ro prenu”, a so-called “indefinite description”, is shorthand for “ro DA poi prenu”, where “DA” represents a fictitious variable that hasn't been used yet and will not be used in future. (Even if all three of “da”, “de”, and “di” have been used up, it does not matter, for there are ways of getting more variables, discussed in <a href=#s14>Section 14</a>.) So in fact

<p>

<pre><a name=e6d6>6.6) re prenu viska mi

Two persons see me.

</pre>is short for

<p>

<pre><a name=e6d7>6.7) re da poi prenu cu viska mi

Two Xes which are-persons see me.

</pre>which in turn is short for:

<p>

<pre><a name=e6d8>6.8) re da poi prenu zo'u da viska mi

For-two Xes which are-persons : X sees me.

</pre><cx "order of variables, in moving to prenex">Note that when we move more than one variable to the prenex (along with its at­tached relative clause), we must make sure that the variables are in the same order in the prenex as in the bridi proper.

<p>

### <a name=s7><h3>Grouping of quantifiers</h3>

<p>

<cx "indefinite sumti, multiple in sentence"><cx "distribution of quantified sumti">Let us consider a sentence containing two quantifier expressions neither of which is “ro” or “su'o” (remembering that “su'o” is implicit where no explicit quantifier is given):

<p>

<ex "three dogs bite two men"><pre><a name=e7d1>7.1) ci gerku cu batci re nanmu

Three dogs bite two men.

</pre><cx "indefinite sumti, meaning when multiple in sentence"><cx "multiple indefinite sumti, meaning">The question raised by <a href=#e7d1>Example 7.1 </a>is, does each of the dogs bite the same two men, or is it possible that there are two different men per dog, for six men altogether? If the former interpretation is taken, the number of men involved is fixed at two; but if the lat­ter, then the speaker has to be taken as saying that there might be any number of men between two and six inclusive. Let us transform <a href=#e7d1>Example 7.1 </a>step by step as we did with <a href=#e6d6>Example 6.6</a>:

<p>

<pre><a name=e7d2>7.2) ci da poi gerku cu batci re de poi nanmu

Three Xes which are-dogs bite two Ys which are-men.

</pre>(Note that we need separate variables “da” and “de”, because of the rule that says each indefinite description gets a variable never used before or since.)

<p>

<pre><a name=e7d3>7.3) ci da poi gerku ku'o re de poi nanmu zo'u da batci de

For-three Xes which are-dogs, for-two Ys which are-men : X bites Y.

</pre><p>Here we see that indeed each of the dogs is said to bite two men, and it might be differ­ent men each time; a total of six biting events altogether.

<p>

<cx "multiple indefinite sumti, effect of re-ordering in sentence">How then are we to express the other interpretation, in which just two men are in­volved? We cannot just reverse the order of variables in the prenex to

<p>

<pre><a name=e7d4>7.4) re de poi nanmu ku'o ci da poi gerku zo'u da batci de

For-two Ys which are-men, for-three Xes which are-dogs, X bites Y

</pre>for although we have now limited the number of men to exactly two, we end up with an indeterminate number of dogs, from three to six. The distinction is called a “scope dis­tinction”: in <a href=#e7d2>Example 7.2</a>, “ci gerku” is said to have wider scope than “re nanmu”, and therefore precedes it in the prenex. In <a href=#e7d4>Example 7.4 </a>the reverse is true.

<p>

<cx "multiple indefinite sumti, expressing with equal scope"><lx "ce'e"><lx "CEhE"><lx "nu'i"><lx "nu'u"><lx "NUhI"><lx "NUhU"><cx "multiple indefinite sumti scope, in termset"><cx "termset, effect on scope of multiple indefinite sumti">The solution is to use a termset, which is a group of terms either joined by “ce'e” (of selma'o CEhE) between each term, or else surrounded by “nu'i” (of selma'o NUhI) on the front and “nu'u” (of selma'o NUhU) on the rear. Terms (which are either sumti or sumti prefixed by tense or modal tags) that are grouped into a termset are un­derstood to have equal scope:

<p>

<pre><a name=e7d5>7.5) ci gerku ce'e re nanmu cu batci

nu'i ci gerku re nanmu [nu'u] cu batci

Three dogs [plus] two men, bite.

</pre>which picks out two groups, one of three dogs and the other of two men, and says that every one of the dogs bites each of the men. The second Lojban version uses fore­thought; note that “nu'u” is an elidable terminator, and in this case can be freely elided.

<p>

<cx "quantified sumti, different types contrasted for scope for distribution"><cx "sumti with lo, compared to indefinite sumti"><cx "indefinite sumti, compared to sumti with lo"><cx "ro, effect of order when multiple in sentence">What about descriptors, like “ci lo gerku”, “le nanmu” or “re le ci mlatu”? They too can be grouped in termsets, but usually need not be, except for the “lo” case which func­tions like the case without a descriptor. Unless an actual quantifier precedes it, “le nanmu” means “ro le nanmu”, as is explained in <a href=chap6.html>Chapter 6</a>. Two sumti with “ro” quantifi­ers are independent of order, so:

<p>

<pre><a name=e7d6>7.6) [ro] le ci gerku cu batci [ro] le re nanmu

[All of] the three dogs bite [all of] the two men.

</pre>means that each of the dogs specified bites each of the men specified, for six acts of bit­ing altogether. However, if there is an explicit quantifier before “le” other than “ro”, the problems of this section reappear.

<p>

### <a name=s8><h3>The problem of “any”</h3>

<p>

Consider the English sentence

<p>

<ex "anyone who goes, walks"><cx "any, as a translation problem"><pre><a name=e8d1>8.1) Anyone who goes to the store, walks across the field.

</pre><p>Using the facilities already discussed, a plausible translation might be

<p>

<pre><a name=e8d2>8.2) ro da poi klama le zarci cu cadzu le foldi

All X such-that-it goes-to the store walks-on the field.

Everyone who goes to the store walks across the field.

</pre><cx "any, as a restricted universal claim"><cx "anyone, contrasted with everyone in assumption of existence"><cx "everyone, contrasted with anyone in assumption of existence">But there is a subtle difference between <a href=#e8d1>Example 8.1 </a>and <a href=#e8d2>Example 8.2</a>. <a href=#e8d2>Example 8.2 </a>tells us that, in fact, there are people who go to the store, and that they walk across the field. A sumti of the type “ro da poi klama” requires that there are things which “klama”: Lojban universal claims always imply the corresponding existential claims as well. <a href=#e8d1>Example 8.1</a>, on the other hand, does not require that there are any people who go to the store: it simply states, conditionally, that if there is anyone who goes to the store, he or she walks across the field as well. This conditional form mirrors the true Lojban translation of <a href=#e8d1>Example 8.1</a>:

<p>

<pre><a name=e8d3>8.3) ro da zo'u ganai da klama le zarci gi cadzu le foldi

For-every X: if X is-a-goer-to the store then X is-a-walker-on the field.

</pre><cx "any, as a universal claim, later restricted">Although <a href=#e8d3>Example 8.3 </a>is a universal claim as well, its universality only implies that there are objects of some sort or another in the universe of discourse. Because the claim is con­ditional, nothing is implied about the existence of goers-to-the-store or of walk­ers-on-the-field, merely that any entity which is one is also the other.

<p>

<cx "any, as an existential claim">There is another use of “any” in English that is not universal but existential. Consider

<p>

<cx "need any box"><cx "any box"><pre><a name=e8d4>8.4) I need any box that is bigger than this one.

</pre><a href=#e8d4>Example 8.4 </a>does not at all mean that I need every box bigger than this one, for indeed I do not; I require only one box. But the naive translation

<p>

<pre><a name=e8d5>8.5) mi nitcu da poi tanxe gi'e bramau ti

I need some-X which is-a-box and is-bigger-than this-one

</pre>does not work either, because it asserts that there really is such a box, as the prenex para­phrase demonstrates:

<p>

<pre><a name=e8d6>8.6) da poi tanxe gi'e bramau ti zo'u mi nitcu da

There-is-an-X which is-a-box and is-bigger-than this : I need X.

</pre><p>What to do? Well, the x2 place of “nitcu” can be filled with an event as well as an ob­ject, and in fact <a href=#e8d5>Example 8.5 </a>can also be paraphrased as:

<p>

<pre><a name=e8d7>8.7) mi nitcu lo nu mi ponse lo tanxe poi bramau ti

I need an event-of I possess some box(es) which-are bigger-than this-one.

</pre><p>Rewritten using variables, <a href=#e8d7>Example 8.7 </a>becomes

<p>

<pre><a name=e8d8>8.8) mi nitcu lo nu da zo'u

da se ponse mi gi'e tanxe gi'e bramau ti

I need an event-of there-being an-X such-that

X is-possessed-by me and is-a-box and is-bigger-than this-thing.

</pre><cx "prenex, internal to a bridi"><cx "logical variable, implicit placement in smallest enclosing bridi prenex"><cx "logical variable, explicitly placing in outer prenex">So we see that a prenex can be attached to a bridi that is within a sentence. By de­fault, a variable always behaves as if it is bound in the prenex which (notionally) is at­tached to the smallest enclosing bridi, and its scope does not extend beyond that bridi. However, the variable may be placed in an outer prenex explicitly:

<p>

<pre><a name=e8d9>8.9) da poi tanxe gi'e bramau ti zo'u

mi nitcu le nu mi ponse da

There-is-an-X which is-a-box and is-bigger-than this-one such-that :

I need the event-of my possessing X.

</pre><cx "existential variable, in abstraction contrasted with in main bridi"><cx "existential variable, in main bridi contrasted with in abstraction">But what are the implications of <a href=#e8d7>Example 8.7 </a>and <a href=#e8d9>Example 8.9</a>? The main dif­ference is that in <a href=#e8d9>Example 8.9</a>, the “da” is said to exist in the real world of the outer bridi; but in <a href=#e8d7>Example 8.7</a>, the existence is only within the inner bridi, which is a mere event that need not necessarily come to pass. So <a href=#e8d9>Example 8.9 </a>means

<p>

<pre><a name=e8d10>8.10) There's a box, bigger than this one, that I need.

</pre><cx "any, expressing as existential by variable in subordinate bridi">which is what <a href=#e8d6>Example 8.6 </a>says, whereas <a href=#e8d7>Example 8.7 </a>turns out to be an effective trans­lation of our original <a href=#e8d1>Example 8.1</a>. So uses of “any” that aren't universal end up being reflected by variables bound in the prenex of a subordinate bridi.

<p>

### <a name=s9><h3>Negation boundaries</h3>

<p>

<cx "“there is a Y”, notation convention">This section, as well as <a href=#s10>Section 10 </a>through <a href=#s12>Section 12</a>, are in effect a con­tinuation of <a href=chap15.html>Chapter 15</a>, introducing features of Lojban negation that require an under­standing of prenexes and variables. In the examples below, “there is a Y” and the like must be under­stood as “there is at least one Y, possibly more”.

<p>

<cx "bridi negation, two forms of">As explained in <a href=chap15.html>Chapter 15</a>, the negation of a bridi is usually accomplished by in­serting “na” at the beginning of the selbri:

<p>

<lx "na"><pre><a name=e9d1>9.1) mi na klama le zarci

I [false] go-to the store.

It is false that I go to the store.

I don't go to the store.

</pre><lx "naku">The other form of bridi negation is expressed by using the compound cmavo “naku” in the prenex, which is identified and compounded by the lexer before looking at the sentence grammar. In Lojban grammar, “naku” is then treated like a sumti. In a prenex, “naku” means precisely the same thing as the logician's “it is not the case that” in a simi­lar English context. (Outside of a prenex, “naku” is also grammatically treated as a single entity — the equivalent of a sumti — but does not have this exact meaning; we'll discuss these other situations in <a href=#s11>Section 11</a>.)

<p>

<cx "bridi negation, naku in prenex compared to na before selbri"><cx "bridi negation, na before selbri compared to naku in prenex"><cx "external bridi negation, definition"><cx "internal bridi negation, definition"><cx "internal bridi negation, compared to external bridi negation"><cx "external bridi negation, compared to internal bridi negation">To represent a bridi negation using a prenex, remove the “na” from before the selbri and place “naku” at the left end of the prenex. This form is called “external bridi nega­tion”, as opposed to “internal bridi negation” using “na”. The prenex version of <a href=#e9d1>Example 9.1 </a>is

<p>

<pre><a name=e9d2>9.2) naku zo'u la djan. klama

It is not the case that: John comes.

It is false that: John comes.

</pre><cx "negation in prenex, effects of position">However, “naku” can appear at other points in the prenex as well. Compare

<p>

<ex "nothing sits"><pre><a name=e9d3>9.3) naku de zo'u de zutse

It is not the case that: for some Y, Y sits.

It is false that: for at least one Y, Y sits.

It is false that something sits.

Nothing sits.

</pre>with

<p>

<pre><a name=e9d4>9.4) su'ode naku zo'u de zutse

For at least one Y, it is false that: Y sits.

There is something that doesn't sit.

</pre><p>The relative position of negation and quantification terms within a prenex has a dras­tic effect on meaning. Starting without a negation, we can have:

<p>

<ex "everybody loves something"><pre><a name=e9d5>9.5) roda su'ode zo'u da prami de

For every X, there is a Y, such that X loves Y.

Everybody loves at least one thing (each, not necessarily the same thing).

</pre>or:

<p>

<ex "something is loved by everybody"><pre><a name=e9d6>9.6) su'ode roda zo'u da prami de

There is a Y, such that for each X, X loves Y.

There is at least one particular thing that is loved by everybody.

</pre><p>The simplest form of bridi negation to interpret is one where the negation term is at the beginning of the prenex:

<p>

<pre><a name=e9d7>9.7) naku roda su'ode zo'u da prami de

It is false that: for every X, there is a Y, such that : X loves Y.

It is false that: everybody loves at least one thing.

(At least) someone doesn't love anything.

</pre>the negation of <a href=#e9d5>Example 9.5</a>, and

<p>

<pre><a name=e9d8>9.8) naku su'ode roda zo'u da prami de

It is false that: there is a Y such that for each X, X loves Y.

It is false that: there is at least one thing that is loved by everybody.

There isn't any one thing that everybody loves.

</pre>the negation of <a href=#e9d6>Example 9.6</a>.

<p>

<cx "negation boundary, effect of moving"><cx "inversion of quantifiers, in moving negation boundary"><cx "inversion of quantifiers, definition">The rules of formal logic require that, to move a negation boundary within a prenex, you must “invert any quantifier” that the negation boundary passes across. In­verting a quantifier means that any “ro” (all) is changed to “su'o” (at least one) and vice versa. Thus, <a href=#e9d7>Example 9.7 </a>and <a href=#e9d8>Example 9.8 </a>can be restated as, respectively:

<p>

<pre><a name=e9d9>9.9) su'oda naku su'ode zo'u da prami de

For some X, it is false that: there is a Y such that : X loves Y.

There is somebody who doesn't love anything.

</pre>and:

<p>

<pre><a name=e9d10>9.10) rode naku roda zo'u da prami de

For every Y, it is false that: for every X, X loves Y.

For each thing, it is not true that everybody loves it.

</pre><p>Another movement of the negation boundary produces:

<p>

<pre><a name=e9d11>9.11) su'oda rode naku zo'u da prami de

There is an X such that, for every Y, it is false that X loves Y.

There is someone who, for each thing, doesn't love that thing.

and

<a name=e9d12>9.12) rode su'oda naku zo'u da prami de

For every Y, there is an X, such that it is false that: X loves Y.

For each thing there is someone who doesn't love it.

</pre><cx "inversion of quantifiers on passing negation boundary, rationale for">Investigation will show that, indeed, each transformation preserves the meanings of <a href=#e9d7>Ex­ample 9.7 </a>and <a href=#e9d8>Example 9.8</a>.

<p>

<cx "zero, relation to negation boundary"><cx "negation boundary, and zero">The quantifier “no” (meaning “zero of”) also involves a negation boundary. To trans­form a bridi containing a variable quantified with “no”, we must first expand it. Consider

<p>

<pre><a name=e9d13>9.13) noda rode zo'u da prami de

There is no X, for every Y, such that X loves Y.

Nobody loves everything.

</pre>which is negated by:

<p>

<pre><a name=e9d14>9.14) naku noda rode zo'u da prami de

It is false that: there is no X that, for every Y, X loves Y.

It is false that there is nobody who loves everything.

</pre><cx "expanding “no” quantifier"><cx "“no” quantifier, expanding"><cx "noda, expanding to naku su'oda"><cx "naku su'oda, as expansion of noda">We can simplify <a href=#e9d14>Example 9.14 </a>by transforming the prenex. To move the ne­gation phrase within the prenex, we must first expand the “no” quantifier. Thus “for no x” means the same thing as “it is false for some x”, and the corresponding Lojban “noda” can be replaced by “naku su'oda”. Making this substitution, we get:

<p>

<pre><a name=e9d15>9.15) naku naku su'oda rode zo'u da prami de

It is false that it is false that: for an X, for every Y: X loves Y.

</pre><p>Adjacent negation boundaries in the prenex can be dropped, so this means the same as:

<p>

<pre><a name=e9d16>9.16) su'oda rode zo'u da prami de

There is an X such that, for every Y, X loves Y.

At least one person loves everything.

</pre>which is clearly the desired contradiction of <a href=#e9d13>Example 9.13</a>.

<p>

<cx "interactions between quantifiers and negation, effect"><cx "double negatives, effect of interactions between quantifiers and negation on">The interactions between quantifiers and negation mean that you cannot elimi­nate double negatives that are not adjacent. You must first move the negation phrases so that they are adjacent, inverting any quantifiers they cross, and then the double negative can be eliminated.

<p>

### <a name=s10><h3>bridi negation and logical connectives</h3>

<p>

<cx "negation and logical connectives, caveat for logic chapter discussions"><cx "logical connectives and negation, caveat for logic chapter discussions"><cx "bridi negation and logical connectives"><cx "logical connectives and bridi negation">A complete discussion of logical connectives appears in <a href=chap14.html>Chapter 14</a>. What is said here is intentionally quite incomplete and makes several oversimplifications.

<p>

A logical connective is a cmavo or compound cmavo. In this chapter, we will make use of the logical connectives “and” and “or” (where “or” really means “and/or”, “either or both”). The following simplified recipes explain how to make some logical connec­tives:

<p>

* <cx "logical connective recipes, simplified for logic chapter discussion"><dl compact><dt><dd>To logically connect two Lojban sumti with “and”, put them both in the bridi and separate them with the cmavo “.e”.
* <p><dt><dd>To logically connect two Lojban bridi with “and”, replace the regular separator cmavo “.i” with the compound cmavo “.ije”.
* <p><dt><dd>To logically connect two Lojban sumti with “or”, put them both in the bridi and separate them with the cmavo “.a”.
* <p><dt><dd>To logically connect two Lojban bridi with “or”, replace the regular separa­tor cmavo “.i” with the compound cmavo “.ija”.

</dl><p>More complex logical connectives also exist; in particular, one may place “na” be­fore “.e” or “.a”, or between “.i” and “je” or “ja”; likewise, one may place “nai” at the end of a connective. Both “na” and “nai” have negative effects on the sumti or bridi being connected. Specifically, “na” negates the first or left-hand sumti or bridi, and “nai” ne­gates the second or right-hand one.

<p>

Whenever a logical connective occurs in a sentence, that sentence can be ex­panded into two sentences by repeating the common terms and joining the sentences by a logical connective beginning with “.i”. Thus the following sentence:

<p>

<pre><a name=e10d1>10.1) mi .e do klama ti

I and you come here.

</pre>can be expanded to:

<p>

<pre><a name=e10d2>10.2) mi klama ti .ije do klama ti

I come here, and, you come here.

</pre><p>The same type of expansion can be performed for any logical connective, with any valid combination of “na” or “nai” attached. No change in meaning occurs under such a transformation.

<p>

Clearly, if we know what negation means in the expanded sentence forms, then we know what it means in all of the other forms. But what does negation mean between sen­tences?

<p>

<cx "negation between sentences, compared with bridi negation"><cx "bridi negation, compared with negation between sentences"><cx "negation between sentences, meaning of">The mystery is easily solved. A negation in a logical expression is identical to the corresponding bridi negation, with the negator placed at the beginning of the pre­nex. Thus:

<p>

<pre><a name=e10d3>10.3) mi .enai do prami roda

I, and not you, love everything.

</pre>expands to:

<p>

<pre><a name=e10d4>10.4) mi prami roda .ijenai do prami roda

I love everything, and-not, you love everything.

</pre>and then into prenex form as:

<p>

<pre><a name=e10d5>10.5) roda zo'u mi prami da .ije naku zo'u do prami da

For each thing: I love it, and it is false that you love (the same) it.

</pre><cx "quantifier scope, in multiple connected sentences">By the rules of predicate logic, the “ro” quantifier on “da” has scope over both sen­tences. That is, once you've picked a value for “da” for the first sentence, it stays the same for both sentences. (The “da” continues with the same fixed value until a new paragraph or a new prenex resets the meaning.)

<p>

Thus the following example has the indicated translation:

<p>

<pre><a name=e10d6>10.6) su'oda zo'u mi prami da

.ije naku zo'u do prami da

For at least one thing: I love that thing.

And it is false that: you love that (same) thing.

There is something that I love that you don't.

</pre><cx "prenex manipulation, rules">If you remember only two rules for prenex manipulation of negations, you won't go wrong:

<p>

* <cx "prenex manipulation, moving naku past bound variable"><dl compact><dt><dd>Within a prenex, whenever you move “naku” past a bound variable (da, de, di, etc.), you must invert the quantifier.
* </dl><cx "prenex manipulation, importing na from selbri"><cx "prenex manipulation, exporting na from left of prenex"><dl compact><dt><dd>A “na” before the selbri is always transformed into a “naku” at the left-hand end of the prenex, and vice versa.

### </dl><a name=s11><h3>Using “naku” outside a prenex</h3>

<p>

Let us consider the English sentence

<p>

<ex "some do not go to school"><pre><a name=e11d1>11.1) Some children do not go to school.

</pre><p>We cannot express this directly with “na”; the apparently obvious translation

<p>

<pre><a name=e11d2>11.2) su'oda poi verba na klama

su'ode poi ckule

At-least-one X which-are child(ren) [false] go-to

at-least-one Y which-are school(s).

</pre>when converted to the external negation form produces:

<p>

<pre><a name=e11d3>11.3) naku zo'u su'oda poi verba cu klama su'ode poi ckule

It is false that some which are children go-to some which are schools.

All children don't go to some school (not just some children).

</pre><cx "negation, form for emulating natural language negation"><cx "naku, outside of prenex"><cx "contradictory negation, using naku before selbri">Lojban provides a negation form which more closely emulates natural lan­guage ne­gation. This involves putting “naku” before the selbri, instead of a “na”. “naku” is clearly a contradictory negation, given its parallel with prenex bridi negation. Using “naku”, <a href=#e11d1>Ex­ample 11.1 </a>can be expressed as:

<p>

<pre><a name=e11d4>11.4) su'oda poi verba naku klama su'ode poi ckule

Some which-are children don't go-to some which-are schools.

Some children don't go to a school.

</pre><cx "naku, compared with sumti in grammar">Although it is not technically a sumti, “naku” can be used in most of the places where a sumti may appear. We'll see what this means in a moment.

<p>

<cx "naku, as creating a negation boundary"><cx "naku, effect on moving quantifiers"><cx "quantifiers, effect of moving naku"><cx "inverting quantifiers, with movement relative to naku">When you use “naku” within a bridi, you are explicitly creating a negation boundary. As explained in <a href=#s9>Section 9</a>, when a prenex negation boundary expressed by “naku” moves past a quantifier, the quantifier has to be inverted. The same is true for “naku” in the bridi proper. We can move “naku” to any place in the sentence where a sumti can go, inverting any quantifiers that the negation boundary crosses. Thus, the following are equivalent to <a href=#e11d4>Example 11.4 </a>(no good English translations exist):

<p>

<pre><a name=e11d5>11.5) su'oda poi verba cu klama rode poi ckule naku

For some children, for every school, they don't go to it.

<a name=e11d6>11.6) su'oda poi verba cu klama naku su'ode poi ckule

Some children don't go to (some) school(s).

<a name=e11d7>11.7) naku roda poi verba cu klama su'ode poi ckule

It is false that all children go to some school(s).

</pre><p>In <a href=#e11d5>Example 11.5</a>, we moved the negation boundary rightward across the quantifier of “de”, forcing us to invert it. In <a href=#e11d7>Example 11.7 </a>we moved the negation boundary across the quantifier of “da”, forcing us to invert it instead. <a href=#e11d6>Example 11.6 </a>merely switched the selbri and the negation boundary, with no effect on the quantifiers.

<p>

<cx "inverting quantifiers, with movement relative to fixed negation">The same rules apply if you rearrange the sentence so that the quantifier crosses an otherwise fixed negation. You can't just convert the selbri of <a href=#e11d4>Example 11.4 </a>and rearrange the sumti to produce

<p>

<pre><a name=e11d8>11.8) su'ode poi ckule ku'o naku se klama roda poi verba

Some schools aren't gone-to-by every child.

</pre><cx "conversion with se, effect of naku negation boundary on"><cx "naku negation boundary, effect on conversion with se"><cx "naku negation, rationale for considering an advanced technique">or rather, <a href=#e11d8>Example 11.8 </a>means something completely different from <a href=#e11d4>Example 11.4</a>. Con­version with “se” under “naku” negation is not symmetric; not all sumti are treated iden­tically, and some sumti are not invariant under conversion. Thus, internal negation with “naku” is considered an advanced technique, used to achieve stylistic compatibility with natural languages.

<p>

It isn't always easy to see which quantifiers have to be inverted in a sentence. <a href=#e11d4>Exam­ple 11.4 </a>is identical in meaning to:

<p>

<pre><a name=e11d9>11.9) su'o verba naku klama su'o ckule

Some children don't go-to some school.

</pre><cx "indefinite sumti, as implicit quantification">but in <a href=#e11d9>Example 11.9</a>, the bound variables “da” and “de” have been hidden.

<p>

<cx "exporting negation to prenex, internal bridi negation contrasted with “naku”"><cx "exporting negation to prenex, “naku” contrasted with internal bridi negation">It is trivial to export an internal bridi negation expressed with “na” to the pre­nex, as we saw in <a href=#s9>Section 9</a>; you just move it to the left end of the prenex. In compari­son, it is non-trivial to export a “naku” to the prenex because of the quantifiers. The rules for ex­porting “naku” require that you export all of the quantified variables (implicit or explicit) along with “naku”, and you must export them from left to right, in the same order that they appear in the sentence. Thus <a href=#e11d4>Example 11.4 </a>goes into prenex form as:

<p>

<pre><a name=e11d10>11.10) su'oda poi verba ku'o naku

su'ode poi ckule zo'u da klama de

For some X which is a child, it is not the case that

there is a Y which is a school such that: X goes to Y.

</pre><p>We can now move the “naku” to the left end of the prenex, getting a contra­dictory negation that can be expressed with “na”:

<p>

<pre><a name=e11d11>11.11) naku roda poi verba

su'ode poi ckule zo'u da klama de

It is not the case that for all X's which are children,

there is a Y which is a school such that: X goes to Y.

</pre>from which we can restore the quantified variables to the sentence, giving:

<p>

<pre><a name=e11d12>11.12) naku zo'u roda poi verba cu klama su'ode poi ckule

It is not the case that all children go to some school.

</pre>or more briefly

<p>

<pre><a name=e11d13>11.13) ro verba cu na klama su'o ckule

All children [false] go-to some school(s).

</pre><cx "conversion of sentence with quantified variables, technique">As noted in <a href=#s5>Section 5</a>, a sentence with two different quantified variables, such as <a href=#e11d13>Ex­ample 11.13</a>, cannot always be converted with “se” without first exporting the quantified variables. When the variables have been exported, the sentence proper can be converted, but the quantifier order in the prenex must remain unchanged:

<p>

<pre><a name=e11d14>11.14) roda poi verba

su'ode poi ckule zo'u de na se klama da

It is not the case that for all X's which are children,

there is a Y which is a school such that: Y is gone to by X.

</pre><cx "selbri placement among sumti, effect of multiple quantification on"><cx "multiple quantification, effect on selbri placement among sumti">While you can't freely convert with “se” when you have two quantified vari­ables in a sentence, you can still freely move sumti to either side of the selbri, as long as the order isn't changed. If you use “na” negation in such a sentence, nothing special need be done. If you use “naku” negation, then quantified variables that cross the nega­tion boundary must be inverted.

<p>

<cx "negation manipulation, “naku” contrasted with “na” in difficulty of"><cx "negation manipulation, “na” contrasted with “naku” in difficulty of">Clearly, if all of Lojban negation was built on “naku” negation instead of “na” nega­tion, logical manipulation in Lojban would be as difficult as in natural languages. In <a href=#s12>Sec­tion 12</a>, for example, we'll discuss DeMorgan's Law, which must be used when­ever a sumti with a logical connection is moved across a negation boundary.

<p>

<cx "naku, in linked sumti places">Since “naku” has the grammar of a sumti, it can be placed almost anywhere a sumti can go, including “be” and “bei” clauses; it isn't clear what these mean, and we recom­mend avoiding such constructs.

<p>

<cx "naku, multiple in sentence"><cx "double negation, and naku">You can put multiple “naku”s in a sentence, each forming a separate negation bound­ary. Two adjacent “naku”s in a bridi are a double negative and cancel out:

<p>

<pre><a name=e11d15>11.15) mi naku naku le zarci cu klama

</pre><p>Other expressions using two “naku”s may or may not cancel out. If there is no quan­tified variable between them, then the “naku”s cancel.

<p>

Negation with internal “naku” is clumsy and non-intuitive for logical manipu­lations, but then, so are the natural language features it is emulating.

<p>

### <a name=s12><h3>Logical Connectives and DeMorgan's Law</h3>

<p>

<cx "logical connectives within negation, effects of expansion on"><cx "negations with logical connectives, effects on expansion of sentence">DeMorgan's Law states that when a logical connective between terms falls within a negation, then expanding the negation requires a change in the connective. Thus (where “p” and “q” stand for terms or sentences) “not (p or q)” is identical to “not p and not q”, and “not (p and q)” is identical to “not p or not q”. The corresponding changes for the other two basic Lojban connectives are: “not (p equivalent to q)” is identical to “not p exclusive-or not q”, and “not (p whether-or-not q)” is identical to both “not p whether-or-not q” and “not p whether-or-not not q”. In any Lojban sentence having one of the basic connectives, you can substitute in either direction from these identities. (These basic con­nectives are explained in <a href=chap14.html>Chapter 14</a>.)

<p>

The effects of DeMorgan's Law on the logical connectives made by modifying the basic connectives with “nai”, “na” and “se” can be derived directly from these rules; modify the basic connective for DeMorgan's Law by substituting from the above iden­tities, and then, apply each “nai”, “na” and “se” modifier of the original connectives. Cancel any double negatives that result.

<p>

<cx "distributing a negation"><cx "DeMorgan's Law, and distributing a negation"><cx "DeMorgan's Law, and moving a logical connective relative to “naku”">When do we apply DeMorgan's Law? Whenever we wish to “distribute” a ne­gation over a logical connective; and, for internal “naku” negation, whenever a logical connec­tive moves in to, or out of, the scope of a negation — when it crosses a negation bound­ary.

<p>

<cx "DeMorgan's Law, sample applications"><lx "ga"><lx "ge"><lx "gi"><lx "nai">Let us apply DeMorgan's Law to some sample sentences. These sentences make use of forethought logical connectives, which are explained in <a href=chap14.html>Chapter 14</a>. It suf­fices to know that “ga” and “gi”, used before each of a pair of sumti or bridi, mean “either” and “or” respectively, and that “ge” and “gi” used similarly mean “both” and “and”. Furthermore, “ga”, “ge”, and “gi” can all be suffixed with “nai” to negate the bridi or sumti that fol­lows.

<p>

<lx "na"><lx "naku zo'u"><cx "na, and negation boundary"><cx "naku zo'u, and negation boundary"><cx "bridi negation, and negation boundary"><cx "bridi negation, and DeMorgan's Law">We have defined “na” and “naku zo'u” as, respectively, internal and external bridi negation. These forms being identical, the negation boundary always remains at the left end of the prenex. Thus, exporting or importing negation between external and internal bridi negation forms never requires DeMorgan's Law to be applied. <a href=#e12d1>Example 12.1 </a>and <a href=#e12d2>Example 12.2 </a>are exactly equivalent:

<p>

<ex "go to Paris or Rome"><pre><a name=e12d1>12.1) la djan. na klama ga la paris. gi la rom.

John [false] goes-to either Paris or Rome.

<a name=e12d2>12.2) naku zo'u la djan. klama ga la paris. gi la rom.

It-is-false that: John goes-to either Paris or Rome.

</pre><cx "negator, movement from bridi to sumti"><cx "logically connected sentences, and DeMorgan's Law"><cx "DeMorgan's Law, and logically connected sentences">It is not an acceptable logical manipulation to move a negator from the bridi level to one or more sumti. However, <a href=#e12d1>Example 12.1 </a>and related examples are not sumti negations, but rather expand to form two logically connected sentences. In such a situa­tion, DeMor­gan's Law must be applied. For instance, <a href=#e12d2>Example 12.2 </a>expands to:

<p>

<pre><a name=e12d3>12.3) ge la djan. la paris. na klama

gi la djan. la rom. na klama

[It is true that] both John, to-Paris, [false] goes,

and John, to-Rome, [false] goes.

</pre><p>The “ga” and “gi”, meaning “either-or”, have become “ge” and “gi”, meaning “both-and”, as a consequence of moving the negators into the individual bridi.

<p>

<cx "bridi-tail logical connection, and DeMorgan's Law"><cx "DeMorgan's Law, and bridi-tail logical connection">Here is another example of DeMorgan's Law in action, involving bridi-tail logical connection (explained in <a href=chap14.html>Chapter 14</a>):

<p>

<pre><a name=e12d4>12.4) la djein. le zarci na ge dzukla gi bajrykla

Jane to-the market [false] both walks and runs.

<a name=e12d5>12.5) la djein. le zarci ganai dzukla ginai bajrykla

Jane to-the market either [false] walks or [false] runs.

Jane to-the market if walks then ([false] runs).

</pre>(Placing “le zarci” before the selbri makes sure that it is properly associated with both parts of the logical connection. Otherwise, it is easy to erroneously leave it off one of the two sentences.)

<p>

<cx "transformations with logical connectives, steps">It is wise, before freely doing transformations such as the one from <a href=#e12d4>Example 12.4 </a>to <a href=#e12d5>Example 12.5</a>, that you become familiar with expanding logical connectives to separate sentences, transforming the sentences, and then recondensing. Thus, you would prove the transformation correct by the following steps. By moving its “na” to the be­ginning of the prenex as a “naku”, <a href=#e12d4>Example 12.4 </a>becomes:

<p>

<pre><a name=e12d6>12.6) naku zo'u la djein. le zarci ge dzukla gi bajrykla

It is false that : Jane to-the market (both walks and runs).

</pre><p>And by dividing the bridi with logically connected selbri into two bridi,

<p>

<pre><a name=e12d7>12.7) naku zo'u ge la djein. le zarci dzukla

gi la djein. le zarci bajrykla

It-is-false-that: both (Jane to-the market walks)

and (Jane to-the market runs).

</pre>is the result.

<p>

At this expanded level, we apply DeMorgan's Law to distribute the negation in the prenex across both sentences, to get

<p>

<pre><a name=e12d8>12.8) ga la djein. le zarci na dzukla gi la djein. le zarci na bajrykla

Either Jane to-the market [false] walks, or Jane to-the market [false] runs.

</pre>which is the same as

<p>

<pre><a name=e12d9>12.9) ganai la djein. le zarci dzukla ginai la djein. le zarci bajrykla

If Jane to-the market walks, then Jane to-the market [false] runs.

If Jane walks to the market, then she doesn't run.

</pre>which then condenses down to <a href=#e12d5>Example 12.5</a>.

<p>

<cx "internal naku negations, and DeMorgan's Law"><cx "DeMorgan's Law, and internal naku negations">DeMorgan's Law must also be applied to internal “naku” negations:

<p>

<pre><a name=e12d10>12.10) ga la paris. gi la rom. naku se klama la djan.

(Either Paris or Rome) is-not gone-to-by John.

<a name=e12d11>12.11) la djan. naku klama ge la paris. gi la rom.

John doesn't go-to both Paris and Rome.

</pre><p>That <a href=#e12d10>Example 12.10 </a>and <a href=#e12d11>Example 12.11 </a>mean the same should become evident by studying the English. It is a good exercise to work through the Lojban and prove that they are the same.

<p>

### <a name=s13><h3>selbri variables</h3>

<p>

<lx "GOhA"><lx "bu'a"><lx "bu'e"><lx "bu'i"><cx "logical variables, for selbri"><cx "selbri logical variables">In addition to the variables “da”, “de”, and “di” that we have seen so far, which function as sumti and belong to selma'o KOhA, there are three corresponding variables “bu'a”, “bu'e”, and “bu'i” which function as selbri and belong to selma'o GOhA. These new variables allow existential or universal claims which are about the relationships be­tween objects rather than the objects themselves. We will start with the usual silly exam­ples; the literal translation will represent “bu'a”, “bu'e” and “bu'i” with F, G, and H re­spectively.

<p>

<ex "some relationship"><pre><a name=e13d1>13.1) su'o bu'a zo'u la djim. bu'a la djan.

For-at-least-one relationship-F : Jim stands-in-relationship-F to-John.

There's some relationship between Jim and John.

</pre><cx "selbri variables, prenex form as indefinite description">The translations of <a href=#e13d1>Example 13.1 </a>show how unidiomatic selbri variables are in Eng­lish; Lojban sentences like <a href=#e13d1>Example 13.1 </a>need to be totally reworded in English. Fur­thermore, when a selbri variable appears in the prenex, it is necessary to precede it with a quantifier such as “su'o”; it is ungrammatical to just say “bu'a zo'u”. This rule is necessary because only sumti can appear in the prenex, and “su'o bu'a” is technically a sumti — in fact, it is an indefinite description like “re nanmu”, since “bu'a” is grammati­cally equiva­lent to a brivla like “nanmu”. However, indefinite descriptions involving the bu'a-series cannot be imported from the prenex.

<p>

<cx "selbri variables, form when not in prenex">When the prenex is omitted, the preceding number has to be omitted too:

<p>

<pre><a name=e13d2>13.2) la djim. bu'a la djan.

Jim stands-in-at-least-one-relationship to-John.

</pre><cx "selbri variables, quantified">As a result, if the number before the variable is anything but “su'o”, the prenex is re­quired:

<p>

<pre><a name=e13d3>13.3) ro bu'a zo'u la djim. bu'a la djan.

For-every relationship-F : Jim stands-in-relationship-F to-John.

Every relationship exists between Jim and John.

</pre><a href=#e13d1>Example 13.1 </a>and <a href=#e13d2>Example 13.2 </a>are almost certainly true: Jim and John might be broth­ers, or might live in the same city, or at least have the property of being jointly human. <a href=#e13d3>Example 13.3 </a>is palpably false, however; if Jim and John were related by every possible relationship, then they would have to be both brothers and father-and-son, which is im­possible.

<p>

### <a name=s14><h3>A few notes on variables</h3>

<p>

<cx "quantifier, on previously quantified variable">A variable may have a quantifier placed in front of it even though it has al­ready been quantified explicitly or implicitly by a previous appearance, as in:

<p>

<ex "three cats white, and two big"><pre><a name=e14d1>14.1) ci da poi mlatu cu blaci .ije re da cu barda

Three Xs which-are cats are white, and two Xs are big.

</pre><p>What does <a href=#e14d1>Example 14.1 </a>mean? The appearance of “ci da” quantifies “da” as referring to three things, which are restricted by the relative clause to be cats. When “re da” ap­pears later, it refers to two of the those three things — there is no saying which ones. Further uses of “da” alone, if there were any, would refer once more to the three cats, so the re­quantification of “da” is purely local.

<p>

<cx "prenex scope, for sentences joined by ijeks"><cx "prenex scope, for sentences joined by .i"><cx "prenex scope, informal"><cx "prenex scope, in embedded bridi"><cx "prenex scope, in relative clauses"><cx "prenex scope, in abstractions">In general, the scope of a prenex that precedes a sentence extends to following sen­tences that are joined by ijeks (explained in <a href=chap14.html>Chapter 14</a>) such as the “.ije” in <a href=#e14d1>Exam­ple 14.1</a>. Theoretically, a bare “.i” terminates the scope of the prenex. Informally, how­ever, variables may persist for a while even after an “.i”, as if it were an “.ije”. Prenexes that precede embedded bridi such as relative clauses and abstractions extend only to the end of the clause, as explained in <a href=#s8>Section 8</a>. A prenex preceding “tu'e <dots>…</dots>tu'u” long-scope brackets persists until the “tu'u”, which may be many sentences or even paragraphs later.

<p>

<cx "logical variables, creating more by subscripting"><cx "subscripts, use with logical variables">If the variables “da”, “de”, and “di” (or the selbri variables “bu'a”, “bu'e”, and “bu'i”) are insufficient in number for handling a particular problem, the Lojban ap­proach is to add a subscript to any of them. Each possible different combination of a subscript and a variable cmavo counts as a distinct variable in Lojban. Subscripts are explained in full in <a href=chap19.html>Chapter 19</a>, but in general consist of the cmavo “xi” (of selma'o XI) followed by a num­ber, one or more lerfu words forming a single string, or a general mathematical expres­sion enclosed in parentheses.

<p>

A quantifier can be prefixed to a variable that has already been bound either in a pre­nex or earlier in the bridi, thus:

<p>

<pre><a name=e14d2>14.2) ci da poi prenu cu se ralju pa da

Three Xs which are-persons are-led-by one-of X

Three people are led by one of them.

</pre><p>The “pa da” in <a href=#e14d2>Example 14.2 </a>does not specify the number of things to which “da” re­fers, as the preceding “ci da” does. Instead, it selects one of them for use in this sumti only. The number of referents of “da” remains three, but a single one (there is no way of knowing which one) is selected to be the leader.

<p>

### <a name=s15><h3>Conclusion</h3>

<p>

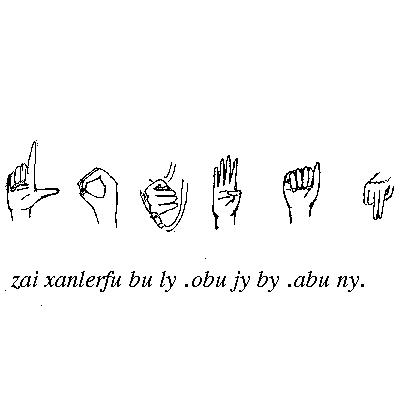
<cx "logic and Lojban, more aspects">This chapter is incomplete. There are many more aspects of logic that I neither fully understand nor feel competent to explain, neither in abstract nor in their Lojban realiza­tion. Lojban was designed to be a language that makes predicate logic speakable, and achieving that goal completely will need to wait for someone who understands both logic and Lojban better than I do. I can only hope to have pointed out the areas that are well-understood (and by implication, those that are not).

<p>

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## <h2>Chapter 17

## <br>

## As Easy As A-B-C? The Lojban Letteral System And Its Uses</h2>

###### <h6>$Revision: 4.1 $<br> mkhtml: 1.1</h6></p></center>

<p>

### <a name=s1><h3>What's a letteral, anyway?</h3>

<p>

<cx "Brown, James Cooke, and “letteral”"><cx "letteral, definition"><cx "letter, alphabet">James Cooke Brown, the founder of the Loglan Project, coined the word “letteral” (by analogy with “numeral”) to mean a letter of the alphabet, such as “f” or “z”. A typical example of its use might be

<p>

<ex "fourteen “e”s"><pre><a name=e1d1>1.1) There are fourteen occurrences of the letteral

“e” in this sentence.

</pre><cx "lerfu, definition">(Don't forget the one within quotation marks.) Using the word “letteral” avoids confu­sion with “letter”, the kind you write to someone. Not surprisingly, there is a Lojban gismu for “letteral”, namely “lerfu”, and this word will be used in the rest of this chap­ter.

<p>

<cx "Latin, alphabet of Lojban"><cx "alphabet, Latin used for Lojban">Lojban uses the Latin alphabet, just as English does, right? Then why is there a need for a chapter like this? After all, everyone who can read it already knows the al­phabet. The answer is twofold:

<p>

<cx "alphabet, words for letters in, rationale">First, in English there are a set of words that correspond to and represent the English lerfu. These words are rarely written down in English and have no standard spellings, but if you pronounce the English alphabet to yourself you will hear them: ay, bee, cee, dee <dots>…</dots>. They are used in spelling out words and in pronouncing most acro­nyms. The Loj­ban equivalents of these words are standardized and must be documented somehow.

<p>

<cx "alphabets, words for non-Lojban letters, rationale">Second, English has names only for the lerfu used in writing English. (There are also English names for Greek and Hebrew lerfu: English-speakers usually refer to the Greek lerfu conventionally spelled “phi” as “fye”, whereas “fee” would more nearly represent the name used by Greek-speakers. Still, not all English-speakers know these English names.) Lojban, in order to be culturally neutral, needs a more comprehensive system that can handle, at least potentially, all of the world's alphabets and other writ­ing systems.

<p>

Letterals have several uses in Lojban: in forming acronyms and abbreviations, as mathematical symbols, and as pro-sumti — the equivalent of English pronouns.

<p>

<cx "lerfu, contrasted with lerfu word"><cx "lerfu word, contrasted with lerfu"><cx "letter, contrasted with word for the letter">In earlier writings about Lojban, there has been a tendency to use the word “lerfu” for both the letterals themselves and for the Lojban words which represent them. In this chapter, that tendency will be ruthlessly suppressed, and the term “lerfu word” will in­variably be used for the latter. The Lojban equivalent would be “lerfu valsi” or “lervla”.

<p>

### <a name=s2><h3>A to Z in Lojban, plus one</h3>

<p>

<cx "lerfu words, Lojban coverage requirement">The first requirement of a system of lerfu words for any language is that they must represent the lerfu used to write the language. The lerfu words for English are a motley crew: the relationship between “doubleyou” and “w” is strictly historical in na­ture; “aitch” represents “h” but has no clear relationship to it at all; and “z” has two distinct lerfu words, “zee” and “zed”, depending on the dialect of English in question.

<p>

<cx "lerfu words, formation rules"><cx "lerfu words, for vowels"><cx "lerfu words, for consonants"><cx "lerfu word, for “ ' ”"><lx "BY">All of Lojban's basic lerfu words are made by one of three rules:

* <p>
* <dl compact><dt><dd>to get a lerfu word for a vowel, add “bu”;
* to get a lerfu word for a consonant, add “y”;
* the lerfu word for “ ' ”is “.y'y”.

</dl><cx "lerfu words, table of Lojban">Therefore, the following table represents the basic Lojban alphabet:

<p>

<pre> ' a b c d e

.y'y. .abu by. cy. dy. .ebu

f g i j k l

fy. gy. .ibu jy. ky. ly.

m n o p r s

my. ny. .obu py. ry. sy.

t u v x y z

ty. .ubu vy. xy. .ybu zy.

</pre><cx "lerfu words for vowels, pause requirement before"><cx "lerfu words, consonant words contrasted with vowel words"><cx "lerfu words, vowel words contrasted with consonant words"><cx "lerfu words, composed of single cmavo"><cx "lerfu words, composed of compound cmavo"><lx "bu"><lx "BU"><cx "bu, effect on preceding word">There are several things to note about this table. The consonant lerfu words are a sin­gle syllable, whereas the vowel and “ ' ” lerfu words are two syllables and must be pre­ceded by pause (since they all begin with a vowel). Another fact, not evident from the table but important nonetheless, is that “by” and its like are single cmavo of selma'o BY, as is “.y'y”. The vowel lerfu words, on the other hand, are compound cmavo, made from a single vowel cmavo plus the cmavo “bu” (which belongs to its own selma'o, BU). All of the vowel cmavo have other meanings in Lojban (logical connectives, sen­tence separator, hesitation noise), but those meanings are irrelevant when “bu” follows.

<p>

Here are some illustrations of common Lojban words spelled out using the al­phabet above:

<p>

<pre><a name=e2d1>2.1) ty. .abu ny. ry. .ubu

“t” “a” “n” “r” “u”

<a name=e2d2>2.2) ky. .obu .y'y. .abu

“k” “o” “ ' ” “a”

</pre><cx "spelling out words, Lojban contrasted with English in usefulness"><cx "lerfu words, effect of systematic formulation">Spelling out words is less useful in Lojban than in English, for two reasons: Lojban spelling is phonemic, so there can be no real dispute about how a word is spelled; and the Lojban lerfu words sound more alike than the English ones do, since they are made up systematically. The English words “fail” and “vale” sound similar, but just hearing the first lerfu word of either, namely “eff” or “vee”, is enough to dis­criminate easily between them — and even if the first lerfu word were somehow con­fused, neither “vail” nor “fale” is a word of ordinary English, so the rest of the spelling determines which word is meant. Still, the capability of spelling out words does exist in Lojban.

<p>

<cx "lerfu words ending with “y”, pause after, rationale">Note that the lerfu words ending in “y” were written (in <a href=#e2d1>Example 2.1 </a>and <a href=#e2d2>Ex­ample 2.2</a>) with pauses after them. It is not strictly necessary to pause after such lerfu words, but failure to do so can in some cases lead to ambiguities:

<p>

<pre><a name=e2d3>2.3) mi cy. claxu

I lerfu-“c” without

I am without (whatever is referred to by) the letter “c”.

</pre>without a pause after “cy” would be interpreted as:

<p>

<pre><a name=e2d4>2.4) micyclaxu

(Observative:) doctor-without

Something unspecified is without a doctor.

</pre><p>A safe guideline is to pause after any cmavo ending in “y” unless the next word is also a cmavo ending in “y”. The safest and easiest guideline is to pause after all of them.

<p>

### <a name=s3><h3>Upper and lower cases</h3>

<p>

<cx "upper-case letters, Lojban usage contrasted with English"><cx "upper-case letters, English usage contrasted with Lojban"><cx "lower-case letters, Lojban usage contrasted with English"><cx "lower-case letters, English usage contrasted with Lojban"><cx "stress, irregular marked with upper-case"><cx "capital letters, use in Lojban"><cx "lower case letters, use in Lojban">Lojban doesn't use lower-case (small) letters and upper-case (capital) letters in the same way that English does; sentences do not begin with an upper-case letter, nor do names. However, upper-case letters are used in Lojban to mark irregular stress within names, thus:

<p>

<pre><a name=e3d1>3.1) .iVAN.

the name “Ivan” in Russian/Slavic pronunciation.

</pre><cx "upper-case, lerfu word for"><cx "lower-case, lerfu word for"><lx "ga'e"><lx "to'a"><cx "case, upper/lower specification">It would require far too many cmavo to assign one for each upper-case and one for each lower-case lerfu, so instead we have two special cmavo “ga'e” and “to'a” rep­resent­ing upper case and lower case respectively. They belong to the same selma'o as the basic lerfu words, namely BY, and they may be freely interspersed with them.

<p>

<lx "ga'e"><cx "lower-case word, effect on following lerfu words">The effect of “ga'e” is to change the interpretation of all lerfu words following it to be the upper-case version of the lerfu. An occurrence of “to'a” causes the interpre­tation to revert to lower case. Thus, “ga'e .abu” means not “a” but “A”, and Ivan's name may be spelled out thus:

<p>

<pre><a name=e3d2>3.2) .ibu ga'e vy. .abu ny. to'a

i [upper] V A N [lower]

</pre>The cmavo and compound cmavo of this type will be called “shift words”.

<p>

<cx "shift word, scope">How long does a shift word last? Theoretically, until the next shift word that contra­dicts it or until the end of text. In practice, it is common to presume that a shift word is only in effect until the next word other than a lerfu word is found.

<p>

<cx "shift word, for single letter"><lx "LAU"><cx "shift, single-letter, grammar of">It is often convenient to shift just a single letter to upper case. The cmavo “tau”, of selma'o LAU, is useful for the purpose. A LAU cmavo must always be imme­diately fol­lowed by a BY cmavo or its equivalent: the combination is grammatically equivalent to a single BY. (See <a href=#s14>Section 14 </a>for details.)

<p>

<cx "chemical elements, use of single-letter shift for">A likely use of “tau” is in the internationally standardized symbols for the chemical elements. Each element is represented using either a single upper-case lerfu or one upper-case lerfu followed by one lower-case lerfu:

<p>

<pre><a name=e3d3>3.3) tau sy.

[single shift] S

S (chemical symbol for sulfur)

</pre><pre><a name=e3d4>3.4) tau sy. .ibu

[single shift] S i

Si (chemical symbol for silicon)

</pre><cx "single-letter shift, as toggle">If a shift to upper-case is in effect when “tau” appears, it shifts the next lerfu word only to lower case, reversing its usual effect.

<p>

### <a name=s4><h3>The universal “bu”</h3>

<p>

<cx "bu, for extension of lerfu word set"><cx "lerfu word set extension, with bu">So far we have seen “bu” only as a suffix to vowel cmavo to produce vowel lerfu words. Originally, this was the only use of “bu”. In developing the lerfu word system, however, it proved to be useful to allow “bu” to be attached to any word what­soever, in order to allow arbitrary extensions of the basic lerfu word set.

<p>

<cx "bu, grammar of"><cx "bu, and compound cmavo"><cx "bu, interaction with ba'e"><cx "ba'e, interaction with bu"><cx "za'e, interaction with bu"><cx "zei, interaction with bu"><cx "zo, interaction with bu"><cx "zoi, interaction with bu"><cx "la'o, interaction with bu"><cx "lo'u, interaction with bu"><cx "si, interaction with bu"><cx "sa, interaction with bu"><cx "su, interaction with bu"><cx "fa'o, interaction with bu"><lx "ba'e"><lx "za'e"><lx "zei"><lx "zo"><lx "zoi"><lx "la'o"><lx "lo'u"><lx "si"><lx "sa"><lx "su"><lx "fa'o">Formally, “bu” may be attached to any single Lojban word. Compound cmavo do not count as words for this purpose. The special cmavo “ba'e”, “za'e”, “zei”, “zo”, “zoi”, “la'o”, “lo'u”, “si”, “sa”, “su”, and “fa'o” may not have “bu” attached, because they are interpreted before “bu” detection is done; in particular,

<p>

<ex "word “bu”"> <pre><a name=e4d1>4.1) zo bu

the word “bu”

</pre><cx "bu, effect of multiple"><lx "bubu"><cx "name, pause requirement in lerfu words">is needed when discussing “bu” in Lojban. It is also illegal to attach “bu” to itself, but more than one “bu” may be attached to a word; thus “.abubu” is legal, if ugly. (Its mean­ing is not defined, but it is presumably different from “.abu”.) It does not matter if the word is a cmavo, a cmene, or a brivla. All such words suffixed by “bu” are treated gram­matically as if they were cmavo belonging to selma'o BY. However, if the word is a cmene it is always necessary to precede and follow it by a pause, because otherwise the cmene may absorb preceding or following words.

<p>

<cx "unusual characters, words for"><cx "smiley face, word for"><cx "logograms, words for"><ex "smiley face"><ex "happy face">The ability to attach “bu” to words has been used primarily to make names for vari­ous logograms and other unusual characters. For example, the Lojban name for the “happy face” is “.uibu”, based on the attitudinal “.ui” that means “happiness”. Like­wise, the “smiley face”, written “:-)” and used on computer networks to indicate humor, is called “zo'obu” The existence of these names does not mean that you should insert “.uibu” into running Lojban text to indicate that you are happy, or “zo'obu” when some­thing is funny; instead, use the appropriate attitudinal directly.

<p>

<cx "“&”, word for"><cx "ampersand character, word for"><ex "ampersand">Likewise, “joibu” represents the ampersand character, “&&amp;”, based on the cmavo “joi” meaning “mixed and”. Many more such lerfu words will probably be in­vented in future.

<p>

<cx "pause, symbol for"><cx "syllable break, symbol for"><cx "pause, word for"><cx "syllable break, word for"><cx "“.”, word for"><cx "“,” , word for">The “.”and “,”characters used in Lojbanic writing to represent pause and sylla­ble break respectively have been assigned the lerfu words “denpa bu” (literally, “pause bu”) and “slaka bu” (literally, “syllable bu”). The written space is mandatory here, be­cause “denpa” and “slaka” are normal gismu with normal stress: “denpabu” would be a fu'ivla (word borrowed from another language into Lojban) stressed “denPAbu”. No pause is required between “denpa” (or “slaka”) and “bu”, though.

<p>

### <a name=s5><h3>Alien alphabets</h3>

<p>

As stated in <a href=#s1>Section 1</a>, Lojban's goal of cultural neutrality demands a standard set of lerfu words for the lerfu of as many other writing systems as possible. When we meet these lerfu in written text (particularly, though not exclusively, mathematical text), we need a standard Lojbanic way to pronounce them.

<p>

There are certainly hundreds of alphabets and other writing systems in use around the world, and it is probably an unachievable goal to create a single system which can ex­press all of them, but if perfection is not demanded, a usable system can be created from the raw material which Lojban provides.

<p>

<cx "letters, non-Lojban, representation with names"><ex "alpha">One possibility would be to use the lerfu word associated with the language it­self, Lojbanized and with “bu” added. Indeed, an isolated Greek “alpha” in running Lojban text is probably most easily handled by calling it “.alfas. bu”. Here the Greek lerfu word has been made into a Lojbanized name by adding “s” and then into a Lojban lerfu word by adding “bu”. Note that the pause after “.alfas.” is still needed.

<p>

<cx "letters, non-Lojban, representation with consonant-word + bu">Likewise, the easiest way to handle the Latin letters “h”, “q”, and “w” that are not used in Lojban is by a consonant lerfu word with “bu” attached. The following as­sign­ments have been made:

<p>

<pre> .y'y.bu h

ky.bu q

vy.bu w

</pre><ex "quack">As an example, the English word “quack” would be spelled in Lojban thus:

<p>

<pre><a name=e5d1>5.1) ky.bu .ubu .abu cy. ky.

“q” “u” “a” “c” “k”

</pre><cx "letters, sound contrasted with symbol for spelling"><cx "letters, symbol contrasted with sound for spelling">Note that the fact that the letter “c” in this word has nothing to do with the sound of the Lojban letter “c” is irrelevant; we are spelling an English word and English rules con­trol the choice of letters, but we are speaking Lojban and Lojban rules control the pro­nuncia­tions of those letters.

<p>

A few more possibilities for Latin-alphabet letters used in languages other than Eng­lish:

<p>

<pre> ty.bu þ&thorn; (thorn)

dy.bu ð&edh; (edh)

<cx "letters, non-Lojban, representation with consonant-word + bu, drawback">However, this system is not ideal for all purposes. For one thing, it is verbose. The na­tive lerfu words are often quite long, and with “bu” added they become even longer: the worst-case Greek lerfu word would be “.Omikron. bu”, with four syllables and two man­datory pauses. In addition, alphabets that are used by many languages have separate sets of lerfu words for each language, and which set is Lojban to choose?

</pre><cx "language shift, rationale for"><cx "language shift, effect on following words"><cx "language shift, choice of Lojban-lerfu-word counterpart"><cx "letters, non-Lojban, representation with language-shift">The alternative plan, therefore, is to use a shift word similar to those intro­duced in <a href=#s3>Section 3</a>. After the appearance of such a shift word, the regular lerfu words are re-inter­preted to represent the lerfu of the alphabet now in use. After a shift to the Greek alpha­bet, for example, the lerfu word “ty” would represent not Latin “t” but Greek “tau”. Why “tau”? Because it is, in some sense, the closest counterpart of “t” within the Greek lerfu system. In principle it would be all right to map “ty.” to “phi” or even “omega”, but such an arbitrary relationship would be extremely hard to remember.

<p>

<cx "language shift, interaction with bu"><cx "bu, interaction with language shift">Where no obvious closest counterpart exists, some more or less arbitrary choice must be made. Some alien lerfu may simply not have any shifted equivalent, forcing the speaker to fall back on a “bu” form. Since a “bu” form may mean different things in dif­ferent alphabets, it is safest to employ a shift word even when “bu” forms are in use.

<p>

Shifts for several alphabets have been assigned cmavo of selma'o BY:

<p>

<cx "Latin alphabet, language shift word for"><cx "Greek alphabet, language shift word for"><cx "Hebrew alphabet, language shift word for"><cx "Arabic alphabet, language shift word for"><cx "Cyrillic alphabet, language shift word for"><pre> lo'a Latin/Roman/Lojban alphabet

ge'o Greek alphabet

je'o Hebrew alphabet

jo'o Arabic alphabet

ru'o Cyrillic alphabet

</pre><lx "zai"><lx "LAU"><cx "language shift, formation of shift alphabet name"><cx "language shift, compound"><cx "language shift, based on name + bu">The cmavo “zai” (of selma'o LAU) is used to create shift words to still other alpha­bets. The BY word which must follow any LAU cmavo would typically be a name repre­senting the alphabet with “bu” suffixed:

<p>

<ex "Devanagari"><pre><a name=e5d2>5.2) zai .devanagar. bu

Devanagari (Hindi) alphabet

</pre><ex "katakana"><ex "Japanese katakana"><pre><a name=e5d3>5.3) zai .katakan. bu

Japanese katakana syllabary

</pre><ex "hiragana"><ex "Japanese hiragana"><pre><a name=e5d4>5.4) zai .xiragan. bu

Japanese hiragana syllabary

</pre><cx "language shift, standardization of">Unlike the cmavo above, these shift words have not been standardized and probably will not be until someone actually has a need for them. (Note the “.”characters marking lead­ing and following pauses.)

<p>

<ex "italic"><ex "bold"><cx "font, specifying for letters"><cx "face, specifying for letters"><cx "shift words, for font"><cx "shift words, for face"><lx "ce'a"><lx "LAU">In addition, there may be multiple visible representations within a single al­phabet for a given letter: roman vs. italics, handwriting vs. print, Bodoni vs. Helvetica. These tradi­tional “font and face” distinctions are also represented by shift words, indi­cated with the cmavo “ce'a” (of selma'o LAU) and a following BY word:

<p>

<ex "Helvetica font"><pre><a name=e5d5>5.5) ce'a .xelveticas. bu

Helvetica font

</pre><ex "handwriting"><pre><a name=e5d6>5.6) ce'a .xancisk. bu

handwriting

</pre><ex "12-point"><ex "font"><pre><a name=e5d7>5.7) ce'a .pavrel. bu

12-point font size

</pre><cx "shift words, canceling effect"><lx "na'a"><lx "BY"><cx "canceling letter shifts"><cx "na'a, contrasted with lo'a"><cx "lo'a, contrasted with na'a">The cmavo “na'a” (of selma'o BY) is a universal shift-word cancel: it returns the in­terpretation of lerfu words to the default of lower-case Lojban with no specific font. It is more general than “lo'a”, which changes the alphabet only, potentially leaving font and case shifts in place.

<p>

Several sections at the end of this chapter contain tables of proposed lerfu word as­signments for various languages.

<p>

### <a name=s6><h3>Accent marks and compound lerfu words</h3>

<p>

<cx "diacritical marks, as lerfu"><cx "letters, non-Lojban, representation of diacritical marks on"><ex "accent mark, a diacritical mark"><ex "umlaut, a diacritical mark"><ex "circumflex, a diacritical mark"><ex "cedilla, a diacritical mark"><ex "tilde, a diacritical mark">Many languages that make use of the Latin alphabet add special marks to some of the lerfu they use. French, for example, uses three accent marks above vowels, called (in English) “acute”, “grave”, and “circumflex”. Likewise, German uses a mark called “umlaut”; a mark which looks the same is also used in French, but with a different name and meaning.

<p>

<cx "diacritical marks, problem of position">These marks may be considered lerfu, and each has a corresponding lerfu word in Lojban. So far, no problem. But the marks appear over lerfu, whereas the words must be spoken (or written) either before or after the lerfu word representing the basic lerfu. Typewriters (for mechanical reasons) and the computer programs that emulate them usu­ally require their users to type the accent mark before the basic lerfu, whereas in speech the accent mark is often pronounced afterwards (for example, in German “a umlaut” is preferred to “umlaut a”).

<p>

<cx "diacritical marks, specifying with tei…foi"><lx "tei"><lx "foi"><lx "TEI"><lx "FOI">Lojban cannot settle this question by fiat. Either it must be left up to default inter­pretation depending on the language in question, or the lerfu-word compounding cmavo “tei” (of selma'o TEI) and “foi” (of selma'o FOI) must be used. These cmavo are always used in pairs; any number of lerfu words may appear between them, and the whole is treated as a single compound lerfu word. The French word “é&eacute;té&eacute;”, with acute accent marks on both “e” lerfu, could be spelled as:

<p>

<ex "accent mark"><ex "ete"><pre><a name=e6d1>6.1) tei .ebu .akut. bu foi ty. tei .akut. bu .ebu foi

(“e” acute ) “t” ( acute “e” )

</pre><cx "diacritical marks, order of specification within tei…foi">and it does not matter whether “akut. bu” appears before or after “.ebu”; the “tei<dots>…</dots>foi” grouping guarantees that the acute accent is associated with the correct lerfu. Of course, the level of precision represented by <a href=#e6d1>Example 6.1 </a>would rarely be required: it might be needed by a Lojban-speaker when spelling out a French word for exact transcription by another Lojban-speaker who did not know French.

<p>

<cx "diacritical marks, problem with multiple on one lerfu">This system breaks down in languages which use more than one accent mark on a single lerfu; some other convention must be used for showing which accent marks are written where in that case. The obvious convention is to represent the mark nearest the basic lerfu by the lerfu word closest to the word representing the basic lerfu. Any re­maining ambiguities must be resolved by further conventions not yet established.

<p>

<cx "diacritical marks, considered as forming distinct letters"><cx "accented letters, considered as distinct from unaccented"><cx "compound letters, native language, representing as distinct letters"><ex "Spanish ll"><ex "Spanish ch">Some languages, like Swedish and Finnish, consider certain accented lerfu to be completely distinct from their unaccented equivalents, but Lojban does not make a formal distinction, since the printed characters look the same whether they are reckoned as sepa­rate letters or not. In addition, some languages consider certain 2-letter combi­nations (like “ll” and “ch” in Spanish) to be letters; this may be represented by enclos­ing the combina­tion in “tei<dots>…</dots>foi”.

<p>

<cx "lerfu words, forming new for non-Lojban letters using bu">In addition, when discussing a specific language, it is permissible to make up new lerfu words, as long as they are either explained locally or well understood from context: thus Spanish “ll” or Croatian “lj” could be called “libu”, but that usage would not neces­sarily be universally understood.

<p>

<a href=#s19>Section 19 </a>contains a table of proposed lerfu words for some common accent marks.

<p>

### <a name=s7><h3>Punctuation marks</h3>

<p>

<cx "punctuation lerfu words, mechanism for creating"><lx "lau"><lx "LAU"><cx "lau, effect on following lerfu word">Lojban does not have punctuation marks as such: the denpa bu and the slaka bu are really a part of the alphabet. Other languages, however, use punctuation marks ex­ten­sively. As yet, Lojban does not have any words for these punctuation marks, but a mechanism exists for devising them: the cmavo “lau” of selma'o LAU. “lau” must al­ways be followed by a BY word; the interpretation of the BY word is changed from a lerfu to a punctuation mark. Typically, this BY word would be a name or brivla with a “bu” suffix.

<p>

<cx "punctuation lerfu words, rationale for lau">Why is “lau” necessary at all? Why not just use a “bu”-marked word and an­nounce that it is always to be interpreted as a punctuation mark? Primarily to avoid am­biguity. The “bu” mechanism is extremely open-ended, and it is easy for Lojban users to make up “bu” words without bothering to explain what they mean. Using the “lau” cmavo flags at least the most important of such nonce lerfu words as having a special function: punctua­tion. (Exactly the same argument applies to the use of “zai” to signal an alphabet shift or “ce'a” to signal a font shift.)

<p>

<cx "punctuation lerfu words, interaction with different alphabet systems">Since different alphabets require different punctuation marks, the interpretation of a “lau”-marked lerfu word is affected by the current alphabet shift and the current font shift.

<p>

### <a name=s8><h3>What about Chinese characters?</h3>

<p>

<cx "Chinese characters, contrasted with alphabets and syllabaries"><cx "kanji, contrasted with alphabets and syllabaries"><cx "hiragana, contrasted with kanji"><cx "syllabaries, lerfu word representation"><cx "Amharic writing">Chinese characters (“han<sup>4</sup>zi<sup>4</sup>” in Chinese, “kanji” in Japanese) represent an entirely different approach to writing from alphabets or syllabaries. (A syllabary, such as Japanese hiragana or Amharic writing, has one lerfu for each syllable of the spoken language.) Very roughly, Chinese characters represent single elements of meaning; also very roughly, they represent single syllables of spoken Chinese. There is in principle no limit to the number of Chinese characters that can exist, and many thousands are in regular use.

<p>

It is hopeless for Lojban, with its limited lerfu and shift words, to create an al­phabet which will match this diversity. However, there are various possible ways around the problem.

<p>

<cx "Chinese characters, representing based on pinyin spelling"><cx "kanji, representing based on romaji spelling"><cx "pinyin, as a basis for Chinese characters in Lojban lerfu words"><cx "romaji, as a basis for kanji characters in Lojban lerfu words">First, both Chinese and Japanese have standard Latin-alphabet representations, known as “pinyin” for Chinese and “romaji” for Japanese, and these can be used. Thus, the word “han<sup>4</sup>zi<sup>4</sup>” is conventionally written with two characters, but it may be spelled out as:

<p>

<ex "han^{4}zi^{4}"><pre><a name=e8d1>8.1) .y'y.bu .abu ny. vo zy. .ibu vo

“h” “a” “n” 4 “z” “i” 4

</pre><cx "numeric digits in lerfu words, grammar considerations"><cx "lerfu words with numeric digits, grammar considerations">The cmavo “vo” is the Lojban digit “4”. It is grammatical to intersperse digits (of sel­ma'o PA) into a string of lerfu words; as long as the first cmavo is a lerfu word, the whole will be interpreted as a string of lerfu words. In Chinese, the digits can be used to represent tones. Pinyin is more usually written using accent marks, the mechanism for which was explained in <a href=#s6>Section 6</a>.

<p>

The Japanese company named “Mitsubishi” in English is spelled the same way in romaji, and could be spelled out in Lojban thus:

<p>

<ex "Mitsubishi"><pre><a name=e8d2>8.2) my. .ibu ty. sy. .ubu by. .ibu sy. .y'y.bu .ibu

“m” “i” “t” “s” “u” “b” “i” “s” “h” “i”

</pre><cx "Chinese characters, representing based on strokes"><cx "kanji, representing based on strokes">Alternatively, a really ambitious Lojbanist could assign lerfu words to the in­dividual strokes used to write Chinese characters (there are about seven or eight of them if you are a flexible human being, or about 40 if you are a rigid computer program), and then repre­sent each character with a “tei”, the stroke lerfu words in the order of writing (which is standardized for each character), and a “foi”. No one has as yet attempted this project.

<p>

### <a name=s9><h3>lerfu words as pro-sumti</h3>

<p>

<cx "lerfu string, definition">So far, lerfu words have only appeared in Lojban text when spelling out words. There are several other grammatical uses of lerfu words within Lojban. In each case, a single lerfu word or more than one may be used. Therefore, the term “lerfu string” is in­troduced: it is short for “sequence of one or more lerfu words”.

<p>

<cx "lerfu string, as pro-sumti">A lerfu string may be used as a pro-sumti (a sumti which refers to some previ­ous sumti), just like the pro-sumti “ko'a”, “ko'e”, and so on:

<p>

<ex "A loves B"><pre><a name=e9d1>9.1) .abu prami by.

A loves B

</pre><p>In <a href=#e9d1>Example 9.1</a>, “.abu” and “by.” represent specific sumti, but which sumti they repre­sent must be inferred from context.

<p>

<cx "lerfu string, as pro-sumti assigned by goi"><lx "goi">Alternatively, lerfu strings may be assigned by “goi”, the regular pro-sumti as­sign­ment cmavo:

<p>

<pre><a name=e9d2>9.2) le gerku goi gy. cu xekri .i gy. klama le zdani

The dog, or G, is black. G goes to the house.

</pre><cx "lerfu string as pro-sumti, assumption of reference">There is a special rule that sometimes makes lerfu strings more advantageous than the regular pro-sumti cmavo. If no assignment can be found for a lerfu string (especially a single lerfu word), it can be assumed to refer to the most recent sumti whose name or de­scription begins in Lojban with that lerfu. So <a href=#e9d2>Example 9.2 </a>can be rephrased:

<p>

<pre><a name=e9d3>9.3) le gerku cu xekri. .i gy. klama le zdani

The dog is black. G goes to the house.

</pre>(A less literal English translation would use “D” for “dog” instead.)

<p>

Here is an example using two names and longer lerfu strings:

<p>

<ex "Steven Mark Jones"><ex "Alexander Pavlovitch Kuznetsov"><pre><a name=e9d4>9.4) la stivn. mark. djonz. merko .i la .aleksandr. paliitc. kuzNIETsyf. rusko

.i symyjy. tavla .abupyky. bau la lojban.

Steven Mark Jones is-American. Alexander Pavlovitch Kuznetsov is-Russian.

SMJ talks-to APK in Lojban.

</pre><p>Perhaps Alexander's name should be given as “ru'o.abupyky” instead.

<p>

<cx "lerfu strings as pro-sumti, for multiple sumti separated by boi">What about

<p>

<ex "A gives BC"><pre><a name=e9d5>9.5) .abu dunda by. cy.

A gives B C

</pre><lx "boi"><lx "BOI"><cx "boi, eliding from lerfu strings">Does this mean that A gives B to C? No. “by. cy.” is a single lerfu string, although writ­ten as two words, and represents a single pro-sumti. The true interpretation is that A gives BC to someone unspecified. To solve this problem, we need to introduce the eli­dable terminator “boi” (of selma'o BOI). This cmavo is used to terminate lerfu strings and also strings of numerals; it is required when two of these appear in a row, as here. (The other reason to use “boi” is to attach a free modifier — subscript, parenthesis, or what have you — to a lerfu string.) The correct version is:

<p>

<ex "A gives B to C"><pre><a name=e9d6>9.6) .abu [boi] dunda by. boi cy. [boi]

A gives B to C

</pre>where the two occurrences of “boi” in brackets are elidable, but the remaining occur­rence is not. Likewise:

<p>

<pre><a name=e9d7>9.7) xy. boi ro [boi] prenu cu prami

X all persons loves.

X loves everybody.

</pre><cx "boi, required between pro-sumti lerfu string and quantifier"><cx "pro-sumti lerfu strings, interaction with quantifiers and boi">requires the first “boi” to separate the lerfu string “xy.” from the digit string “ro”.

<p>

### <a name=s10><h3>References to lerfu</h3>

<p>

<cx "lerfu, reference to"><cx "pro-sumti lerfu string, effect on reference to lerfu itself">The rules of <a href=#s9>Section 9 </a>make it impossible to use unmarked lerfu words to refer to lerfu themselves. In the sentence:

<p>

<pre><a name=e10d1>10.1) .abu. cu lerfu

A is-a-letteral.

</pre><lx "me'o"><lx "LI"><cx "lerfu, referring to with me'o">the hearer would try to find what previous sumti “.abu” refers to. The solution to this problem makes use of the cmavo “me'o” of selma'o LI, which makes a lerfu string into a sumti representing that very string of lerfu. This use of “me'o” is a special case of its mathematical use, which is to introduce a mathematical expression used literally rather than for its value.

<p>

<ex "“a” is letteral"><pre><a name=e10d2>10.2) me'o .abu cu lerfu

the-expression “a” is-a-letteral.

</pre><p>Now we can translate <a href=#e1d1>Example 1.1 </a>into Lojban:

<p>

<ex "four “e”s"><pre><a name=e10d3>10.3) dei vasru vo lerfu

po'u me'o .ebu

this-sentence contains four letterals

which-are the-expression “e”.

This sentence contains four “e”s.

</pre><p>Since the Lojban sentence has only four “e” lerfu rather than fourteen, the translation is not a literal one — but <a href=#e10d3>Example 10.3 </a>is a Lojban truth just as <a href=#e1d1>Example 1.1 </a>is an English truth. Coincidentally, the colloquial English translation of <a href=#e10d3>Example 10.3 </a>is also true!

<p>

<cx "quotation, contrasted with me'o for representing lerfu"><cx "me'o, contrasted with quotation for representing lerfu"><cx "me'o, contrasted with lu…li'u for representing lerfu"><cx "lu, contrasted with me'o for representing lerfu"><cx "representing lerfu, lu contrasted with me'o"><cx "me'o, compared with la'e lu"><cx "la'e lu, compared with me'o"><lx "me'o"><lx "lu"><lx "la'e">The reader might be tempted to use quotation with “lu <dots>…</dots>li'u” instead of “me'o”, pro­ducing:

<p>

<pre><a name=e10d4>10.4) lu .abu li'u cu lerfu

[quote] .abu [unquote] is-a-letteral.

</pre>(The single-word quote “zo” cannot be used, because “.abu” is a compound cmavo.) But <a href=#e10d4>Example 10.4 </a>is false, because it says:

<p>

<ex "word “abu”"> <pre><a name=e10d5>10.5) The word “.abu” is a letteral

</pre>which is not the case; rather, the thing symbolized by the word “.abu” is a letteral. In Loj­ban, that would be:

<p>

<pre><a name=e10d6>10.6) la'e lu .abu li'u cu lerfu

The-referent-of [quote] .abu [unquote] is-a-letteral.

</pre>which is correct.

<p>

### <a name=s11><h3>Mathematical uses of lerfu strings</h3>

<p>

<cx "mathematics, use of lerfu strings in"><cx "lerfu strings, uses in mathematics">This chapter is not about Lojban mathematics, which is explained in <a href=chap18.html>Chapter 18</a>, so the mathematical uses of lerfu strings will be listed and exemplified but not ex­plained.

<p>

* <cx "lerfu string, as mathematical variable"><cx "mathematical variables, lerfu strings as">A lerfu string as mathematical variable:

<p>

<pre><a name=e11d1>11.1) li .abu du li by. su'i cy.

the-number a equals the-number b plus c

*a* = *b* + *c*

* </pre><cx "lerfu string, as function name"><cx "function name, lerfu string as">A lerfu string as function name (preceded by “ma'o” of selma'o MAhO):

<p>

<ex "function f of x"><pre><a name=e11d2>11.2) li .y.bu du li ma'o fy. boi xy.

the-number y equals the number the-function f of x

*y* = *f*(*x*)

</pre><p>Note the “boi” here to separate the lerfu strings “fy” and “xy”.

<p>

* <cx "lerfu string, as selbri"><cx "selbri, lerfu string as">A lerfu string as selbri (followed by a cmavo of selma'o MOI):

<p>

<ex "Nth rat"><pre><a name=e11d3>11.3) le vi ratcu ny.moi le'i mi ratcu

the here rat is-nth-of the-set-of my rats

This rat is my Nth rat.

* </pre><cx "lerfu string, as utterance ordinal"><cx "utterance ordinal, lerfu string as">A lerfu string as utterance ordinal (followed by a cmavo of selma'o MAI):

<p>

<ex "Nthly"><pre><a name=e11d4>11.4) ny.mai

Nthly

* </pre><cx "lerfu string, as subscript"><cx "subscript, lerfu string as">A lerfu string as subscript (preceded by “xi” of selma'o XI):

<p>

<ex "x sub k"><pre><a name=e11d5>11.5) xy. xi ky.

x sub k

* </pre><cx "lerfu string, as quantifier"><cx "quantifier, lerfu string as">A lerfu string as quantifier (enclosed in “vei <dots>…</dots>ve'o” parentheses):

<p>

<ex "n people"><lx "vei"><pre><a name=e11d6>11.6) vei ny. [ve'o] lo prenu

(“n” ) persons

</pre><cx "lerfu strings as quantifiers, avoiding interaction with sumti quantified">The parentheses are required because “ny. lo prenu” would be two separate sumti, “ny.” and “lo prenu”. In general, any mathematical expression other than a simple num­ber must be in parentheses when used as a quantifier; the right parenthesis mark, the cmavo “ve'o”, can usually be elided.

<p>

<cx "lerfu string interpretation, contrasted with mathematical interpretation"><cx "lerfu juxtaposition interpretation, contrasted with mathematical interpretation">All the examples above have exhibited single lerfu words rather than lerfu strings, in accordance with the conventions of ordinary mathematics. A longer lerfu string would still be treated as a single variable or function name: in Lojban, “.abu by. cy.” is not the multiplication “a × b × c” but is the variable “abc”. (Of course, a local convention could be employed that made the value of a variable like “abc”, with a multi-lerfu-word name, equal to the values of the variables “a”, “b”, and “c” multiplied together.)

<p>

<cx "mathematical texts, effect on lerfu shift scope"><cx "lerfu shift scope, exception for mathematical texts">There is a special rule about shift words in mathematical text: shifts within mathe­matical expressions do not affect lerfu words appearing outside <dl compact><dt>mathematical expres­sions, and vice versa. <dd>

### </dl><a name=s12><h3>Acronyms</h3>

<p>

<cx "acronym, definition">An acronym is a name constructed of lerfu. English examples are “DNA”, “NATO”, “CIA”. In English, some of these are spelled out (like “DNA” and “CIA”) and others are pronounced more or less as if they were ordinary English words (like “NATO”). Some acronyms fluctuate between the two pronunciations: “SQL” may be “ess cue ell” or “sequel”.

<p>

<cx "acronyms, using names based on lerfu words"><cx "lerfu words, as a basis for acronym names">In Lojban, a name can be almost any sequence of sounds that ends in a conso­nant and is followed by a pause. The easiest way to Lojbanize acronym names is to glue the lerfu words together, using “ ' ”wherever two vowels would come together (pauses are illegal in names) and adding a final consonant:

<p>

<ex "DNA"><ex "CIA"><ex "IBM"><ex "NATO"><ex "SQL"><ex "NYC"><pre><a name=e12d1>12.1) la dyny'abub. .i la ny'abuty'obub.

.i la cy'ibu'abub. .i la sykybulyl.

.i la .ibubymym. .i la ny'ybucyc.

DNA. NATO.

CIA. SQL.

IBM. NYC.

</pre><cx "acronym names from lerfu words, assigning final consonant">There is no fixed convention for assigning the final consonant. In <a href=#e12d1>Example 12.1</a>, the last consonant of the lerfu string has been replicated into final position.

<p>

<cx "acronyms names based on lerfu words, omitting bu"><cx "bu, omitting in acronyms names based on lerfu words">Some compression can be done by leaving out “bu” after vowel lerfu words (except for “.y.bu”, wherein the “bu” cannot be omitted without ambiguity). Compres­sion is moderately important because it's hard to say long names without introducing an invol­untary (and illegal) pause:

<p>

<pre><a name=e12d2>12.2) la dyny'am. .i la ny'aty'om.

.i la cy'i'am. .i la sykybulym.

.i la .ibymym. .i la ny'ybucym.

DNA. NATO.

CIA. SQL.

IBM. NYC.

</pre><p>In <a href=#e12d2>Example 12.2</a>, the final consonant “m” stands for “merko”, indicating the source cul­ture of these acronyms.

<p>

<cx "acronyms names based on lerfu words, using “z” instead of “ ' ”in"><cx "“z” instead of “ ' ”, in acronyms names based on lerfu words">Another approach, which some may find easier to say and which is compatible with older versions of the language that did not have a “ ' ”character, is to use the con­sonant “z” instead of “ ' ”:

<p>

<pre><a name=e12d3>12.3) la dynyzaz. .i la nyzatyzoz.

.i la cyzizaz. .i la sykybulyz.

.i la .ibymyz. .i la nyzybucyz.

DNA. NATO.

CIA. SQL.

IBM. NYC.

</pre><cx "lerfu strings, as acronyms using “me”"><cx "acronyms, as lerfu strings using “me”"><lx "me">One more alternative to these lengthy names is to use the lerfu string itself pre­fixed with “me”, the cmavo that makes sumti into selbri:

<p>

<pre><a name=e12d4>12.4) la me dy ny. .abu

that-named what-pertains-to “d” “n” “a”

</pre><p>This works because “la”, the cmavo that normally introduces names used as sumti, may also be used before a predicate to indicate that the predicate is a (meaningful) name:

<p>

<pre><a name=e12d5>12.5) la cribe cu ciska

That-named “Bear” writes.

Bear is a writer.

</pre><a href=#e12d5>Example 12.5 </a>does not of course refer to a bear (“le cribe” or “lo cribe”) but to some­thing else, probably a person, named “Bear”. Similarly, “me dy ny. .abu” is a predicate which can be used as a name, producing a kind of acronym which can have pauses be­tween the individual lerfu words.

<p>

### <a name=s13><h3>Computerized character codes</h3>

<p>

<cx "character codes, definition"><cx "characters, definition"><cx "lerfu words, using computer encoding schemes with se'e"><cx "character encoding schemes, application to lerfu words"><cx "letter encoding schemes, application to lerfu words"><lx "se'e"><lx "BY">Since the first application of computers to non-numerical information, charac­ter sets have existed, mapping numbers (called “character codes”) into selected lerfu, digits, and punctuation marks (collectively called “characters”). Historically, these character sets have only covered the English alphabet and a few selected punctuation marks. Interna­tional efforts have now created Unicode, a unified character set that can represent essen­tially all the characters in essentially all the world's writing systems. Lojban can take ad­vantage of these encoding schemes by using the cmavo “se'e” (of selma'o BY). This cmavo is conventionally followed by digit cmavo of selma'o PA rep­resenting the charac­ter code, and the whole string indicates a single character in some computerized character set:

<p>

<ex "American dollars"><ex "$&dollar;"><pre><a name=e13d1>13.1) me'o se'ecixa cu lerfu la .asycy'i'is.

loi merko rupnu

The-expression [code] 36 is-a-letteral in-set ASCII

for-the-mass-of American currency-units.

The character code 36 in ASCII represents American dollars.

“$&dollar;” represents American dollars.

</pre><cx "ASCII, application to lerfu words">Understanding <a href=#e13d1>Example 13.1 </a>depends on knowing the value in the ASCII character set (one of the simplest and oldest) of the “$&dollar;” character. Therefore, the “se'e” convention is only intelligible to those who know the underlying character set. For precisely specify­ing a particular character, however, it has the advantages of unambiguity and (relative) cul­tural neutrality, and therefore Lojban provides a means for those with access to de­scrip­tions of such character sets to take advantage of them.

<p>

<cx "Unicode"><cx "peace symbol">As another example, the Unicode character set (also known as ISO 10646) rep­resents the international symbol of peace, an inverted trident in a circle, using the base-16 value 262E. In a suitable context, a Lojbanist may say:

<p>

<pre><a name=e13d2>13.2) me'o se'erexarerei sinxa le ka panpi

The-expression [code] 262E is-a-sign-of the quality-of being-at-peace.

</pre><cx "se'e, and number base convention">When a “se'e” string appears in running discourse, some metalinguistic convention must specify whether the number is base 10 or some other base, and which char­acter set is in use.

<p>

### <a name=s14><h3>List of all auxiliary lerfu-word cmavo</h3>

<p>

<cx "lerfu word cmavo, list of auxiliary"><pre> cmavo selma'o meaning

bu BU makes previous word into a lerfu word

ga'e BY upper case shift

to'a BY lower case shift

tau LAU case-shift next lerfu word only

lo'a BY Latin/Lojban alphabet shift

ge'o BY Greek alphabet shift

je'o BY Hebrew alphabet shift

jo'o BY Arabic alphabet shift

ru'o BY Cyrillic alphabet shift

se'e BY following digits are a character code

na'a BY cancel all shifts

zai LAU following lerfu word specifies alphabet

ce'a LAU following lerfu word specifies font

lau LAU following lerfu word is punctuation

tei TEI start compound lerfu word

foi FOI end compound lerfu word

</pre><cx "LAU, grammar of following BY cmavo">Note that LAU cmavo must be followed by a BY cmavo or the equivalent, where “equivalent” means: either any Lojban word followed by “bu”, another LAU cmavo (and its required sequel), or a “tei <dots>…</dots>foi” compound cmavo.

<p>

### <a name=s15><h3>Proposed lerfu words — introduction</h3>

<p>

<cx "lerfu words, list of proposed, notation convention">The following sections contain tables of proposed lerfu words for some of the stan­dard alphabets supported by the Lojban lerfu system. The first column of each list is the lerfu (actually, a Latin-alphabet name sufficient to identify it). The second column is the proposed name-based lerfu word, and the third column is the proposed lerfu word in the system based on using the cmavo of selma'o BY with a shift word.

<p>

<cx "proposed lerfu words, as working basis">These tables are not meant to be authoritative (several authorities within the Lojban community have niggled over them extensively, disagreeing with each other and some­times with themselves). They provide a working basis until actual usage is available, rather than a final resolution of lerfu word problems. Probably the system presented here will evolve somewhat before settling down into a final, conventional form.

<p>

For Latin-alphabet lerfu words, see <a href=#s2>Section 2 </a>(for Lojban) and <a href=#s5>Section 5 </a>(for non-Lojban Latin-alphabet lerfu).

<p>

### <a name=s16><h3>Proposed lerfu words for the Greek alphabet</h3>

<p>

<cx "lerfu words, proposed for Greek alphabet"><cx "Greek alphabet, proposed lerfu words for"><pre> alpha .alfas. bu .abu

beta .betas. bu by

gamma .gamas. bu gy

delta .deltas. bu dy

epsilon .Epsilon. bu .ebu

zeta .zetas. bu zy

eta .etas. bu .e'ebu

theta .tetas. bu ty. bu

iota .iotas. bu .ibu

kappa .kapas. bu ky

lambda .lymdas. bu ly

mu .mus. bu my

nu .nus. bu ny

xi .ksis. bu ksis. bu

omicron .Omikron. bu .obu

pi .pis. bu py

rho .ros. bu ry

sigma .sigmas. bu sy

tau .taus. bu ty

upsilon .Upsilon. bu .ubu

phi .fis. bu py. bu

chi .xis. bu ky. bu

psi .psis. bu psis. bu

omega .omegas. bu .o'obu

rough .dasei,as. bu .y'y

smooth .psiles. bu xutla bu

### </pre><a name=s17><h3>Proposed lerfu words for the Cyrillic alphabet</h3>

<p>

<cx "lerfu words, proposed for Cyrillic alphabet"><cx "Cyrillic alphabet, proposed lerfu words for">The second column in this listing is based on the historical names of the letters in Old Church Slavonic. Only those letters used in Russian are shown; other languages require more letters which can be devised as needed.

<p>

<pre> a .azys. bu .abu

b .bukys. bu by

v .vedis. bu vy

g .glagolis. bu gy

d .dobros. bu dy

e .iestys. bu .ebu

zh .jivet. bu jy

z .zemlias. bu zy

i .ije,is. bu .ibu

short i .itord. bu .itord. bu

k .kakos. bu ky

l .liudi,ies. bu ly

m .myslites. bu my

n .naciys. bu ny

o .onys. bu .obu

p .pokois. bu py

r .riytsis. bu ry

s .slovos. bu sy

t .tvriydos. bu ty

u .ukys. bu .ubu

f .friytys. bu fy

kh .xerys. bu xy

ts .tsis. bu tsys. bu

ch .tcriyviys. bu tcys. bu

sh .cas. bu cy

shch .ctas. bu ctcys. bu

hard sign .ier. bu jdari bu

yeri .ierys. bu .y.bu

soft sign .ieriys. bu ranti bu

reversed e .ecarn. bu .ecarn. bu

yu .ius. bu .iubu

ya .ias. bu .iabu

### </pre><a name=s18><h3>Proposed lerfu words for the Hebrew alphabet</h3>

<p>

<cx "lerfu words, proposed for Hebrew alphabet"><cx "Hebrew alphabet, proposed lerfu words for"><pre> aleph .alef. bu .alef. bu

bet .bet. bu by

gimel .gimel. bu gy

daled .daled. bu dy

he .xex. bu .y'y

vav .vav. bu vy

zayin .zai,in. bu zy

khet .xet. bu xy. bu

tet .tet. bu ty. bu

yud .iud. bu .iud. bu

kaf .kaf. bu ky

lamed .LYmed. bu ly

mem .mem. bu my

nun .nun. bu ny

samekh .samex. bu samex. bu

ayin .ai,in. bu .ai,in bu

pe .pex. bu py

tzadi .tsadik. bu tsadik. bu

quf .kuf. bu ky. bu

resh .rec. bu ry

shin .cin. bu cy

sin .sin. bu sy

taf .taf. bu ty.

dagesh .daGEC. bu daGEC. bu

hiriq .xirik. bu .ibu

tzeirekh .tseirex. bu .eibu

segol .seGOL. bu .ebu

qubbutz .kubuts. bu .ubu

qamatz .kamats. bu .abu

patach .patax. bu .a'abu

sheva .cyVAS. bu .y.bu

kholem .xolem. bu .obu

shuruq .curuk. bu .u'ubu

### </pre><a name=s19><h3>Proposed lerfu words for some accent marks and multiple letters</h3>

<p>

<cx "lerfu words, proposed for accent marks"><cx "lerfu words, proposed for diacritic marks"><cx "lerfu words, proposed for multiple letters"><cx "accent marks, proposed lerfu words for"><cx "diacritic marks, proposed lerfu words for"><cx "multiple letters, proposed lerfu words for"><p>

This list is intended to be suggestive, not complete: there are lerfu such as Polish “dark” l and Maltese h-bar that do not yet have symbols.

<p>

<cx "over-ring, proposed lerfu word for"><cx "over-dot, proposed lerfu word for"><cx "macron, proposed lerfu word for"><cx "ligatured fi, proposed lerfu word for"><cx "Dutch ij, proposed lerfu word for"><cx "cedilla, proposed lerfu word for"><cx "umlaut, proposed lerfu word for"><cx "tilde, proposed lerfu word for"><pre>acute .akut. bu

or .pritygal. bu [pritu galtu]

grave .grav. bu

or .zulgal. bu [zunle galtu]

circumflex .cirkumfleks. bu

or .midgal. bu [midju galtu]

tilde .tildes. bu

macron .makron. bu

breve .brevis. bu

over-dot .garmoc. bu [gapru mokca]

umlaut/trema .relmoc. bu [re mokca]

over-ring .garjin. bu [gapru djine]

cedilla .seDIlys. bu

double-acute .re'akut. bu [re akut.]

ogonek .ogoniek. bu

hacek .xatcek. bu

ligatured fi tei fy. ibu foi

Danish/Latin ae tei .abu .ebu foi

Dutch ij tei .ibu jy. foi

German es-zed tei sy. zy. foi

### </pre><a name=s20><h3>Proposed lerfu words for radio communication</h3>

<p>

<cx "lerfu words, proposed for noisy environments"><cx "lerfu words, proposed for radio communication"><cx "radio communication, proposed lerfu words for"><cx "noisy environments, proposed lerfu words for"><cx "ICAO Phonetic Alphabet, proposed lerfu words for"><cx "Phonetic Alphabet, proposed lerfu words for">There is a set of English words which are used, by international agreement, as lerfu words (for the English alphabet) over the radio, or in noisy situations where the utmost clarity is required. Formally they are known as the “ICAO Phonetic Alphabet”, and are used even in non-English-speaking countries.

<p>

This table presents the standard English spellings and proposed Lojban ver­sions. The Lojbanizations are not straightforward renderings of the English sounds, but make some concessions both to the English spellings of the words and to the Lojban pronunciations of the lerfu (thus “carlis. bu”, not “tcarlis. bu”).

<p>

<pre> Alfa .alfas. bu November .novembr. bu

Bravo .bravos. bu Oscar .oskar. bu

Charlie .carlis. bu Papa .paPAS. bu

Delta .deltas. bu Quebec .keBEK. bu

Echo .ekos. bu Romeo .romios. bu

Foxtrot .fokstrot. bu Sierra .sieras. bu

Golf .golf. bu Tango .tangos. bu

Hotel .xoTEL. bu Uniform .Uniform. bu

India .indias. bu Victor .viktas. bu

Juliet .juliet. bu Whiskey .uiskis. bu

Kilo .kilos. bu X-ray .eksreis. bu

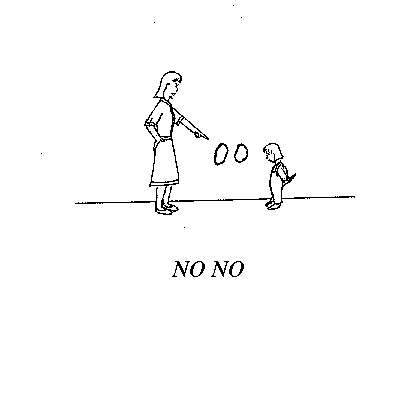
Lima .limas. bu Yankee .iankis. bu

Mike .maik. bu Zulu .zulus. bu

</body></html>

<center><p align=center>

<img src=chap18.gif alt=[Cartoon] align=center width=405 height=405>



## <h2>Chapter 18

## <br>

## lojbau mekso: Mathematical Expressions in Lojban</h2>

###### <h6>$Revision: 4.3 $<br> mkhtml: 1.1</h6></p></center>

<p>

### <a name=s1><h3>Introductory</h3>

<cx "mekso, definition"><cx "mathematical expression, abbreviation notation"><cx "mathematical expression, definition (see also “mekso”)">lojbau mekso (“Lojbanic mathematical-expression”) is the part of the Lojban lan­guage that is tailored for expressing statements of a mathematical character, or for adding numerical information to non-mathematical statements. Its formal design goals include:

<p>

<cx "mekso, design goals"><cx "mekso goal, for mathematical writing"><dl compact><dt>1) <dd>representing all the different forms of expression used by mathematicians in their normal modes of writing, so that a reader can unambiguously read off mathematical text as written with minimal effort and expect a listener to un­derstand it;

</dl><cx "mekso goal, expandable"><cx "mekso goal, for common use"><dl compact><dt>2) <dd>providing a vocabulary of commonly used mathematical terms which can readily be expanded to include newly coined words using the full resources of Lojban;

</dl><cx "mekso goal, unambiguous"><dl compact><dt>3) <dd>permitting the formulation, both in writing and in speech, of unambiguous mathematical text;

</dl><cx "mekso goal, coverage"><cx "mekso goal, precision"><dl compact><dt>4) <dd>encompassing all forms of quantified expression found in natural languages, as well as encouraging greater precision in ordinary language situations than natural languages allow.

</dl><cx "mekso goals, mathematical notation form"><cx "Polish notation, and mekso goals"><cx "reverse Polish notation, and mekso goals">Goal 1 requires that mekso not be constrained to a single notation such as Pol­ish no­tation or reverse Polish notation, but make provision for all forms, with the most com­monly used forms the most easily used.

<p>

<cx "mekso goals, and non-mathematical expression">Goal 2 requires the provision of several conversion mechanisms, so that the bound­ary between mekso and full Lojban can be crossed from either side at many points.

<p>

<cx "mekso goals, and ambiguity"><cx "mathematical notation, international uniqueness of">Goal 3 is the most subtle. Written mathematical expression is culturally unam­bigu­ous, in the sense that mathematicians in all parts of the world understand the same written texts to have the same meanings. However, international mathematical notation does not prescribe unique forms. For example, the expression

<p>

<pre><a name=e1d1>1.1) <math>3*x* + 2*y*</math>

</pre><cx "mathematical notation, and omitted operators">contains omitted multiplication operators, but there are other possible interpretations for the strings “3*x*” and “2*y*” than as mathematical multiplication. Therefore, the Lojban ver­bal (spoken and written) form of <a href=#e1d1>Example 1.1 </a>must not omit the multiplication op­erators.

<p>

<cx "mekso chapter, table notation convention"><cx "mekso chapter, completeness">The remainder of this chapter explains (in as much detail as is currently possi­ble) the mekso system. This chapter is by intention complete as regards mekso compo­nents, but only suggestive about uses of those components — as of now, there has been no really comprehensive use made of mekso facilities, and many matters must await the test of us­age to be fully clarified.

<p>

### <a name=s2><h3>Lojban numbers</h3>

<p>

The following cmavo are discussed in this section:

<p>

<lx "PA"><pre> pa PA 1 xa PA 6

re PA 2 ze PA 7

ci PA 3 bi PA 8

vo PA 4 so PA 9

mu PA 5 no PA 0

</pre><cx "numbers, expressing simple"><cx "digits, cmavo for"><cx "numbers, as compound cmavo"><cx "ten, expressing as number"><cx "hundred, expressing as number">The simplest kind of mekso are numbers, which are cmavo or compound cmavo. There are cmavo for each of the 10 decimal digits, and numbers greater than 9 are made by stringing together the cmavo. Some examples:

<p>

<ex "123"><pre><a name=e2d1>2.1) pa re ci

one two three

123

one hundred and twenty three

<a name=e2d2>2.2) pa no

one zero

10

ten

<a name=e2d3>2.3) pa re ci vo mu xa ze bi so no

one two three four five six seven eight nine zero

1234567890

one billion, two hundred and thirty-four million, five hundred and

sixty-seven thousand, eight hundred and ninety.

</pre><cx "numbers, greater than 9">Therefore, there are no separate cmavo for “ten”, “hundred”, etc.

<p>

<cx "number words, pattern in">There is a pattern to the digit cmavo (except for “no”, 0) which is worth ex­plaining. The cmavo from 1 to 5 end in the vowels “a”, “e”, “i”, “o”, “u” respectively; and the cmavo from 6 to 9 likewise end in the vowels “a”, “e”, “i”, and “o” respec­tively. None of the digit cmavo begin with the same consonant, to make them easy to tell apart in noisy environments.

<p>

### <a name=s3><h3>Signs and numerical punctuation</h3>

<p>

<lx "PA">The following cmavo are discussed in this section:

<p>

<pre> ma'u PA positive sign

ni'u PA negative sign

pi PA decimal point

fi'u PA fraction slash

ra'e PA repeating decimal

ce'i PA percent sign

ki'o PA comma between digits

</pre><cx "signed numbers, expressing"><lx "mau"><lx "ni'u"><cx "positive numbers, explicit expression"><cx "negative numbers, expressing">A number can be given an explicit sign by the use of “ma'u” and “ni'u”, which are the positive and negative signs as distinct from the addition, subtraction, and nega­tion operators. For example:

<p>

<ex "-1"><lx "pa"><pre><a name=e3d1>3.1) ni'u pa

negative-sign 1

-1

</pre><cx "signs on numbers, grammar">Grammatically, the signs are part of the number to which they are attached. It is also pos­sible to use “ma'u” and “ni'u” by themselves as numbers; the meaning of these num­bers is explained in <a href=#s8>Section 8</a>.

<p>

<cx "numerical punctuation"><cx "punctuation, in numbers"><cx "decimal point, as numerical punctuation">Various numerical punctuation marks are likewise expressed by cmavo, as il­lustrated in the following examples:

<p>

<ex "3.1415"><lx "pi"><pre><a name=e3d2>3.2) ci pi pa vo pa mu

three point one four one five

3.1415

</pre><cx "decimal point, effect of different notations">(In some cultures, a comma is used instead of a period in the symbolic version of <a href=#e3d2>Ex­am­ple 3.2</a>; “pi” is still the Lojban representation for the decimal point.)

<p>

<ex "2/7"><lx "fi'u"><pre><a name=e3d3>3.3) re fi'u ze

two fraction seven

2/7

</pre><cx "fractions, expressing with numerical punctuation"><cx "fractions, numerator default"><cx "reciprocal, expression of mathematical"><a href=#e3d3>Example 3.3 </a>is the name of the number two-sevenths; it is not the same as “the result of 2 divided by 7” in Lojban, although numerically these two are equal. If the denominator of the fraction is present but the numerator is not, the numerator is taken to be 1, thus ex­pressing the reciprocal of the following number:

<p>

<pre><a name=e3d4>3.4) fi'u ze

fraction seven

1/7

</pre><cx "repeating decimals, expressing with numerical punctuation"><lx "ra'e"><pre><a name=e3d5>3.5) pi ci mu ra'e pa vo re bi mu ze

point three five repeating one four two eight five seven

<math>.35142857142857<dots>…</dots></math>

</pre><cx "repeating decimals, marking start of repeating portion">Note that the “ra'e” marks unambiguously where the repeating portion “142857” begins.

<p>

<lx "ce'i"><cx "percent, as numerical punctuation"><pre><a name=e3d6>3.6) ci mu ce'i

three five percent

35%

</pre><cx "commas in numbers, as numerical punctuation"><lx "ki'o"><pre><a name=e3d7>3.7) pa ki'o re ci vo ki'o mu xa ze

one comma two three four comma five six seven

1,234,567

</pre><cx "commas in numbers, effect of other notation conventions">(In some cultures, spaces are used in the symbolic representation of <a href=#e3d7>Example 3.7</a>; “ki'o” is still the Lojban representation.)

<p>

<cx "commas in numbers, with elided digits">It is also possible to have less than three digits between successive “ki'o”s, in which case zeros are assumed to have been elided:

<p>

<pre><a name=e3d8>3.8) pa ki'o re ci ki'o vo

one comma two three comma four

1,023,004

</pre><p>In the same way, “ki'o” can be used after “pi” to divide fractions into groups of three:

<p>

<pre><a name=e3d9>3.9) pi ki'o re re

point comma two two

.022

<a name=e3d10>3.10) pi pa ki'o pa re ki'o pa

point one comma one two comma one

.001012001

### </pre><a name=s4><h3>Special numbers</h3>

<p>

The following cmavo are discussed in this section:

<p>

<cx "numbers, special"><pre> ci'i PA infinity

ka'o PA imaginary *i*, sqrt(-1)

pai PA π, pi (approx <math>3.14159<dots>…</dots></math>)

te'o PA exponential e (approx <math>2.71828<dots>…</dots></math>)

fi'u PA golden ratio, φ, phi, (1 + sqrt(5))/2 (approx. <math>1.61803<dots>…</dots></math>)

</pre><cx "fraction, meaning with elided numerator and denominator">The last cmavo is the same as the fraction sign cmavo: a fraction sign with neither nu­merator nor denominator represents the golden ratio.

<p>

Numbers can have any of these digit, punctuation, and special-number cmavo of Sections 2, 3, and 4 in any combination:

<p>

<ex "infinity"><lx "ci'i"><pre><a name=e4d1>4.1) ma'u ci'i

<math>+<font face="Symbol">∞&#165;</font><!–infty–></math>

</pre><cx "complex numbers, expressing"><lx "ka'o"><pre><a name=e4d2>4.2) ci ka'o re

<math>3i2 </math>(a complex number equivalent to “<math>3 + 2i</math>”)

</pre><cx "ka'o, as special number compared with as numerical punctuation">Note that “ka'o” is both a special number (meaning “i”) and a number punctuation mark (separating the real and the imaginary parts of a complex number).

<p>

<ex "transfinite cardinal"><ex "aleph null"><lx "ci'i"><pre><a name=e4d3>4.3) ci'i no

infinity zero

<math><font face="Symbol">ℵ&#192;</font><!–aleph–><sub>0</sub></math> (a transfinite cardinal)

</pre><p>The special numbers “pai” and “te'o” are mathematically important, which is why they are given their own cmavo:

<p>

<pre><a name=e4d4>4.4) pai

pi, π

<a name=e4d5>4.5) te'o

e

</pre><cx "numerical punctuation, undefined">However, many combinations are as yet undefined:

<p>

<pre><a name=e4d6>4.6) pa pi re pi ci

1.2.3

<a name=e4d7>4.7) pa ni'u re

1 negative-sign 2

</pre><cx "negative sign, contrasted with subtraction operator"><cx "subtraction operator, contrasted with negative sign"><a href=#e4d7>Example 4.7 </a>is not “1 minus 2”, which is represented by a different cmavo sequence alto­gether. It is a single number which has not been assigned a meaning. There are many such numbers which have no well-defined meaning; they may be used for ex­perimental pur­poses or for future expansion of the Lojban number system.

<p>

It is possible, of course, that some of these “oddities” do have a meaningful use in some restricted area of mathematics. A mathematician appropriating these structures for specialized use needs to consider whether some other branch of mathematics would use the structure differently.

<p>

More information on numbers may be found in <a href=#s8>Sections 8 </a>to <a href=#s12>12</a>.

<p>

### <a name=s5><h3>Simple infix expressions and equations</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> du GOhA equals

su'i VUhU plus

vu'u VUhU minus

pi'i VUhU times

te'a VUhU raised to the power

ny. BY letter “n”

vei VEI left parenthesis

ve'o VEhO right parenthesis

</pre><cx "mathematical notation, infix"><ex "1 + 1 = 2"><lx "su'i"><lx "VUhU">Let us begin at the beginning: one plus one equals two. In Lojban, that sen­tence translates to:

<p>

<pre><a name=e5d1>5.1) li pa su'i pa du li re

The-number one plus one equals the-number two.

<math>1 + 1 = 2</math>

</pre><cx "mathematical equality, expressing"><cx "du, grammar of"><a href=#e5d1>Example 5.1</a>, a mekso sentence, is a regular Lojban bridi that exploits mekso features. “du” is the predicate meaning “x1 is mathematically equal to x2”. It is a cmavo for con­ciseness, but it has the same grammatical uses as any brivla. Outside mathematical con­texts, “du” means “x1 is identical with x2” or “x1 is the same object as x2”.

<p>

<cx "article, number"><cx "the, for talking about numbers themselves"><lx "li"><cx "number article, explanation of use"><cx "numbers, talking about contrasted with using for quantification"><cx "numbers, using for quantification contrasted with talking about">The cmavo “li” is the number article. It is required whenever a sentence talks about numbers as numbers, as opposed to using numbers to quantify things. For exam­ple:

<p>

<pre><a name=e5d2>5.2) le ci prenu

the three persons

</pre>requires no “li” article, because the “ci” is being used to specify the number of “prenu”. However, the sentence

<p>

<ex "3 grams"><pre><a name=e5d3>5.3) levi sfani cu grake li ci

This fly masses-in-grams the-number three.

This fly has a mass of 3 grams.

</pre><cx "measurements, expressing"><cx "units of measurement, expressing">requires “li” because “ci” is being used as a sumti. Note that this is the way in which measurements are stated in Lojban: all the predicates for units of length, mass, tem­pera­ture, and so on have the measured object as the first place and a number as the sec­ond place. Using “li” for “le” in <a href=#e5d2>Example 5.2 </a>would produce

<p>

<pre><a name=e5d4>5.4) li ci prenu

The-number 3 is-a-person.

</pre>which is grammatical but nonsensical: numbers are not persons.

<p>

<lx "su'i"><lx "VUhU"><cx "mathematical operators"><cx "addition, a mathematical operator"><cx "positive sign, contrasted with addition operator"><cx "addition operator, contrasted with positive sign">The cmavo “su'i” belongs to selma'o VUhU, which is composed of mathemati­cal op­erators, and means “addition”. As mentioned before, it is distinct from “ma'u” which means the positive sign as an indication of a positive number:

<p>

<ex "+1 + -1 = 0"><pre><a name=e5d5>5.5) li ma'u pa su'i ni'u pa du

li no

The-number positive-sign one plus negative-sign one equals

the-number zero.

<math>+1 + -1 = 0</math>

</pre><p>Of course, it is legal to have complex mekso on both sides of “du”:

<p>

<cx "du, with complex mekso on both sides"><pre><a name=e5d6>5.6) li mu su'i pa du li ci su'i ci

The-number five plus one equals the-number three plus three.

<math>5 + 1 = 3 + 3</math>

</pre><cx "operators of VUhU, grammar of operands"><cx "VUhU operands"><cx "operands, contrasted with general sumti"><cx "general sumti, contrasted with operands"><cx "li, as converter of mekso into sumti"><cx "conversion of mekso into sumti"><cx "conversion into sumti from mekso">Why don't we say “li mu su'i li pa” rather than just “li mu su'i pa”? The answer is that VUhU operators connect mekso operands (numbers, in <a href=#e5d6>Example 5.6</a>), not general sumti. “li” is used to make the entire mekso into a sumti, which then plays the roles applicable to other sumti: in <a href=#e5d6>Example 5.6</a>, filling the places of a bridi.

<p>

<cx "calculator mathematics, as default in Lojban"><cx "operator precedence, in Lojban default"><cx "operator left-right grouping, as Lojban default"><cx "precedence, mathematical default">By default, Lojban mathematics is like simple calculator mathematics: there is no notion of “operator precedence”. Consider the following example, where “pi'i” means “times”, the multiplication operator:

<p>

<lx "pi'i"><pre><a name=e5d7>5.7) li ci su'i vo pi'i mu du li reci

The-number three plus four times five equals the-number two-three.

<math>3 + 4 &times;× 5 = 23</math>

</pre><p>Is the Lojban version of <a href=#e5d7>Example 5.7 </a>true? No! “<math>3 + 4 &times; × 5</math>” is indeed 23, because the usual conventions of mathematics state that multiplication takes precedence over addi­tion; that is, the multiplication “<math>4&times; × 5</math>” is done first, giving 20, and only then the addi­tion “<math>3 + 20</math>”. But VUhU operators by default are done left to right, like other Lojban group­ing, and so a truthful bridi would be:

<p>

<pre><a name=e5d8>5.8) li ci su'i vo pi'i mu du li cimu

The-number three plus four times five equals the-number three-five.

<math>3 + 4 &times;× 5 = 35</math>

</pre><cx "default operator precedence, contrasted with mekso goal">Here we calculate <math>3 + 4</math> first, giving 7, and then calculate <math>7 &times;×× 5</math> second, leading to the re­sult 35. While possessing the advantage of simplicity, this result violates the design goal of matching the standards of mathematics. What can be done?

<p>

<cx "mathematical notation, and operator precedence"><cx "operator precedence, and mathematical notation"><cx "operator precedence, effect of pragmatic convention">There are three solutions, all of which will probably be used to some degree. The first solution is to ignore the problem. People will say “li ci su'i vo pi'i mu” and mean 23 by it, because the notion that multiplication takes precedence over addition is too deeply ingrained to be eradicated by Lojban parsing, which totally ignores seman­tics. This con­vention essentially allows semantics to dominate syntax in this one area.

<p>

<cx "operator precedence, rationale for default left-grouping"><cx "operator precedence in other languages">(Why not hard-wire the precedences into the grammar, as is done in computer pro­gramming languages? Essentially because there are too many operators, known and un­known, with levels of precedence that vary according to usage. The programming lan­guage 'C' has 13 levels of precedence, and its list of operators is not even extensible. For Lojban this approach is just not practical. In addition, hard-wired precedence could not be overridden in mathematical systems such as spreadsheets where the conventions are dif­ferent.)

<p>

<cx "operator precedence, generalized explicit specification">The second solution is to use explicit means to specify the precedence of op­erators. This approach is fully general, but clumsy, and will be explained in <a href=#s20>Section 20</a>.

<p>

<cx "operator precedence, scope modification with bi'e"><lx "bi'e"><lx "BIhE"><cx "bi'e, effect on following operator">The third solution is simple but not very general. When an operator is prefixed with the cmavo “bi'e” (of selma'o BIhE), it becomes automatically of higher precedence than other operators not so prefixed. Thus,

<p>

<pre><a name=e5d9>5.9) li ci su'i vo bi'e pi'i mu du li reci

The-number three plus our-times-five equals the-number two-three.

<math>3 + 4 ×&times; 5 = 23</math>

</pre>is a truthful Lojban bridi. If more than one operator has a “bi'e” prefix, grouping is from the right; multiple “bi'e” prefixes on a single operator are not allowed.

<p>

<cx "operator precedence, specifying by parenthesis"><cx "parenthesis, mathematical"><lx "vei"><lx "ve'o">In addition, of course, Lojban has the mathematical parentheses “vei” and “ve'o”, which can be used just like their written equivalents “(” and “)” to group expres­sions in any way desired:

<p>

<lx "te'a"><lx "ny"><ex "(n + 1)(n + 1) = n^2 + 2n + 1"><pre><a name=e5d10>5.10) li vei ny. su'i pa ve'o pi'i vei ny. su'i pa [ve'o] du

li ny. [bi'e] te'a re su'i re bi'e pi'i ny. su'i pa

The-number (“n” plus one ) times (“n” plus one ) equals

the-number n-power-two plus two-times-“n” plus 1.

<math>(n + 1)(n + 1) = n<sup>2</sup>+ 2n + 1</math>

</pre><cx "lerfu strings, in mathematical expressions"><cx "lerfu strings, interpretation of contrasted with normal mathematical interpretation">There are several new usages in <a href=#e5d10>Example 5.10</a>: “te'a” means “raised to the power”, and we also see the use of the lerfu word “ny”, representing the letter “n”. In mekso, letters stand for just what they do in ordinary mathematics: variables. The parser will accept a string of lerfu words (called a “lerfu string”) as the equivalent of a single lerfu word, in agreement with computer-science conventions; “abc” is a single variable, not the equiva­lent of “<math>a ×&times; b ×&times; c</math>”. (Of course, a local convention could state that the value of a variable like “<math>abc</math>”, with a multi-lerfu name, was equal to the values of the variables “<math>a</math>”, “<math>b</math>”, and “<math>c</math>” multiplied together.)

<p>

<cx "times, explicit expression of"><cx "times, implicit expression of"><cx "multiplication, explicit expression of"><cx "multiplication, implicit expression of">The explicit operator “pi'i” is required in the Lojban verbal form whereas mul­tiplica­tion is implicit in the symbolic form. Note that “ve'o” (the right parenthesis) is an elidable terminator: the first use of it in <a href=#e5d10>Example 5.10 </a>is required, but the second use (marked by square brackets) could be elided. Additionally, the first “bi'e” (also marked by square brackets) is not necessary to get the proper grouping, but it is included here for symmetry with the other one.

<p>

### <a name=s6><h3>Forethought operators (Polish notation, functions)</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> boi BOI numeral/lerfu string terminator

va'a VUhU negation/additive inverse

pe'o PEhO forethought flag

ku'e KUhE forethought terminator

ma'o MAhO convert operand to operator

py. BY letter “p”

xy. BY letter “x”

zy. BY letter “z”

fy. BY letter “f”

</pre><cx "infix mathematical notation, shortcomings of"><cx "mathematical notation, infix shortcomings">The infix form explained so far is reasonable for many purposes, but it is lim­ited and rigid. It works smoothly only where all operators have exactly two operands, and where precedences can either be assumed from context or are limited to just two levels, with some help from parentheses.

<p>

<cx "Polish notation, definition"><cx "forethought mathematical notation (see also Polish)"><cx "mathematical notation, forethought (see also Polish)">But there are many operators which do not have two operands, or which have a vari­able number of operands. The preferred form of expression in such cases is the use of “forethought operators”, also known as Polish notation. In this style of writing mathe­matics, the operator comes first and the operands afterwards:

<p>

<ex "sum of 1, 2, 3"><pre><a name=e6d1>6.1) li su'i paboi reboi ci[boi] du li xa

The-number the-sum-of one two three equals the-number six.

<math><r>sum</r>(1,2,3) = 6</math>

</pre><cx "Polish notation, separating operands in"><cx "Polish notation, and use of boi"><lx "boi"><cx "boi, in Polish notation">Note that the normally elidable number terminator “boi” is required after “pa” and “re” because otherwise the reading would be “pareci” = 123. It is not required after “ci” but is inserted here in brackets for the sake of symmetry. The only time “boi” is required is, as in <a href=#e6d1>Example 6.1</a>, when there are two consecutive numbers or lerfu strings.

<p>

<lx "ku'e"><cx "Polish notation, end-of-operands indicator">Forethought mekso can use any number of operands, in <a href=#e6d1>Example 6.1, </a>three. How do we know how many operands there are in ambiguous circumstances? The usual Lojban solution is employed: an elidable terminator, namely “ku'e”. Here is an exam­ple:

<p>

<lx "va'a"><ex "plus negative of"><pre><a name=e6d2>6.2) li py. su'i va'a ny. ku'e su'i zy du li xy.

The-number “p” plus negative-of (“n”) plus “z” equals the-number “x”.

<math>p + -n + z = x</math>

</pre>where we know that “va'a” is a forethought operator because there is no operand pre­ced­ing it.

<p>

<cx "va'a, contrasted with vu'u and ni'u"><cx "vu'u, contrasted with va'a and ni'u"><cx "ni'u, contrasted with va'a and vu'u"><cx "negation operator, contrasted with subtraction operator"><cx "subtraction operator, contrasted with negation operator"><cx "negation operator, contrasted with negative sign"><cx "negative sign, contrasted with negation operator"><lx "vu'u"><lx "ni'u">““va'a” is the numerical negation operator, of selma'o VUhU. In contrast, j “vu'u” is not used for numerical negation, but only for subtraction, as it always has two or more oper­ands. Do not confuse “va'a” and “vu'u”, which are operators, with “ni'u”, which is part of a number.

<p>

<cx "Polish notation, operator …ku'e compared with parenthesization"><cx "Polish notation, vei …ve'o contrasted with operator …ku'e"><cx "vei …ve'o, contrasted with operator …ku'e in Polish notation"><cx "operator …ku'e in Polish notation, contrasted with vei …ve'o">In <a href=#e6d2>Example 6.2</a>, the operator “va'a” and the terminator “ku'e” serve in ef­fect as pa­rentheses. (The regular parentheses “vei” and “ve'o” are NOT used for this purpose.) If the “ku'e” were omitted, the “su'i zy” would be swallowed up by the “va'a” forethought operator, which would then appear to have two operands, “ny” and “su'i zy.”, where the latter is also a forethought expression.

<p>

<cx "functional notation, standard">Forethought mekso is also useful for matching standard functional notation. How do we represent “z = f(x)”? The answer is:

<p>

<ex "z = f(x)"><lx "ma'o"><pre><a name=e6d3>6.3) li zy du li ma'o fy.boi xy.

The-number z equals the-number the-operator f x.

<math>z = f(x)</math>

</pre><cx "lerfu strings as functions, in mathematics"><cx "lerfu strings as variables, in mathematics">Again, no parentheses are used. The construct “ma'o fy.boi” is the equivalent of an op­erator, and appears in forethought here (although it could also be used as a regular infix operator). In mathematics, letters sometimes mean functions and sometimes mean vari­ables, with only the context to tell which. Lojban chooses to accept the variable inter­pre­tation as the default, and uses the special flag “ma'o” to mark a lerfu string as an operator. The cmavo “xy.” and “zy.” are variables, but “fy.” is an operator (a function) because “ma'o” marks it as such. The “boi” is required because otherwise the “xy.” would look like part of the operator name. (The use of “ma'o” can be generalized from lerfu strings to any mekso operand: see <a href=#s21>Section 21</a>.)

<p>

<lx "pe'o"><cx "Polish notation, explicitly marking as">When using forethought mekso, the optional marker “pe'o” may be placed in front of the operator. This usage can help avoid confusion by providing clearly marked “pe'o” and “ku'e” pairs to delimit the operand list. <a href=#e6d{1}>Examples 6.1 </a>to <a href=#e6d3>6.3</a>, respectively, with explicit “pe'o” and “ku'e”:

<p>

<pre><a name=e6d4>6.4) li pe'o su'i paboi reboi ciboi ku'e du li xa

<a name=e6d5>6.5) li py. su'i pe'o va'a ny. ku'e su'i zy du li xy.

<a name=e6d6>6.6) li zy du li pe'o ma'o fy.boi xy. ku'e

</pre><cx "Polish notation, operands with infix expressions"><cx "infix expressions, in operands being used in Polish notation">Note: When using forethought mekso, be sure that the operands really are op­erands: they cannot contain regular infix expressions unless parenthesized with “vei” and “ve'o”. An earlier version of the complex <a href=#e17d6>Example 17.6 </a>came to grief because I forgot this rule.

<p>

### <a name=s7><h3>Other useful selbri for mekso bridi</h3>

<p>

<cx "mathematical inequalities, expressing">So far our examples have been isolated mekso (it is legal to have a bare mekso as a sentence in Lojban) and equation bridi involving “du”. What about inequalities such as “<math>x < 5</math>”? The answer is to use a bridi with an appropriate selbri, thus:

<p>

<ex "x < 5"><pre><a name=e7d1>7.1) li xy. mleca li mu

The-number x is-less-than the-number 5.

</pre><p>Here is a partial list of selbri useful in mathematical bridi:

<p>

<pre> du: x1 is identical to x2, x3, x4, <dots>…</dots>

dunli: x1 is equal/congruent to x2 in/on property/quality/dimension/quantity x3

mleca: x1 is less than x2

zmadu: x1 is greater than x2

dubjavme'a: x1 is less than or equal to x2 [du ja mleca, equal or less]

dubjavmau: x1 is greater than or equal to x2 [du ja zmadu, equal or greater]

tamdu'i: x1 is similar to x2 [tarmi dunli, shape-equal]

turdu'i: x1 is isomorphic to x2 [stura dunli, structure-equal]

cmima: x1 is a member of set x2

gripau: x1 is a subset of set x2 [girzu pagbu, set-part]

na'ujbi: x1 is approximately equal to x2 [namcu jibni, number-near]

terci'e: x1 is a component with function x2 of system x3

</pre><cx "dunli, contrasted with du"><cx "du, contrasted with dunli">Note the difference between “dunli” and “du”; “dunli” has a third place that specifies the kind of equality that is meant. “du” refers to actual identity, and can have any num­ber of places:

<p>

<ex "p = x = z"><pre><a name=e7d2>7.2) py. du xy.boi zy.

“p” is-identical-to “x” “z”

<math>p = x = z</math>

</pre><p>Lojban bridi can have only one predicate, so the “du” is not repeated.

<p>

<cx "falsity of mathematical relation, expressing">Any of these selbri may usefully be prefixed with “na”, the contradictory ne­gation cmavo, to indicate that the relation is false:

<p>

<pre><a name=e7d3>7.3) li re su'i re na du li mu

The-number 2 + 2 is-not equal-to the-number 5.

<math>2 + 2 ≠ <font face="Symbol">&#189;</font><!–notequal–>5</math>

</pre><p>As usual in Lojban, negated bridi say what is false, and do not say anything about what might be true.

<p>

### <a name=s8><h3>Indefinite numbers</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> ro PA all

so'a PA almost all

so'e PA most

so'i PA many

so'o PA several

so'u PA a few

no'o PA the typical number of

da'a PA all but (one) of

piro PA+PA the whole of/all of

piso'a PA+PA almost the whole of

piso'e PA+PA most of

piso'i PA+PA much of

piso'o PA+PA a small part of

piso'u PA+PA a tiny part of

pino'o PA+PA the typical portion of

rau PA enough

du'e PA too many

mo'a PA too few

pirau PA+PA enough of

pidu'e PA+PA too much of

pimo'a PA+PA too little of

</pre><lx "PA"><cx "ro, compared with pa"><cx "indefinite numbers"><cx "numbers, indefinite"><lx "ro">Not all the cmavo of PA represent numbers in the usual mathematical sense. For ex­ample, the cmavo “ro” means “all” or “each”. This number does not have a defi­nite value in the abstract: “li ro” is undefined. But when used to count or quantify something, the parallel between “ro” and “pa” is clearer:

<p>

<pre><a name=e8d1>8.1) mi catlu pa prenu

I look-at one person

<a name=e8d2>8.2) mi catlu ro prenu

I look-at all persons

</pre><a href=#e8d1>Example 8.1 </a>might be true, whereas <a href=#e8d2>Example 8.2 </a>is almost certainly false.

<p>

<lx "so'a"><lx "so'e"><lx "so'i"><lx "so'o"><lx "so'u">The cmavo “so'a”, “so'e”, “so'i”, “so'o”, and “so'u” represent a set of indefinite num­bers less than “ro”. As you go down an alphabetical list, the magnitude decreases:

<p>

<pre><a name=e8d3>8.3) mi catlu so'a prenu

I look-at almost-all persons

<a name=e8d4>8.4) mi catlu so'e prenu

I look-at most persons

<a name=e8d5>8.5) mi catlu so'i prenu

I look-at many persons

<a name=e8d6>8.6) mi catlu so'o prenu

I look-at several persons

<a name=e8d7>8.7) mi catlu so'u prenu

I look-at a-few persons

</pre><cx "so'e, meaning of">The English equivalents are only rough: the cmavo provide space for up to five indefi­nite numbers between “ro” and “no”, with a built-in ordering. In particular, “so'e” does not mean “most” in the sense of “a majority” or “more than half”.

<p>

<lx "pi"><cx "pi, effect on indefinite numbers"><cx "portion of whole, expressing"><cx "indefinite numbers, effect of pi on"><ex "whole of">Each of these numbers, plus “ro”, may be prefixed with “pi” (the decimal point) in order to make a fractional form which represents part of a whole rather than some ele­ments of a totality. “piro” therefore means “the whole of”:

<p>

<ex "eat bread"><pre><a name=e8d8>8.8) mi citka piro lei nanba

I eat the-whole-of the-mass-of bread

</pre><cx "masses, expressing portions of">Similarly, “piso'a” means “almost the whole of”; and so on down to “piso'u”, “a tiny part of”. These numbers are particularly appropriate with masses, which are usually measured rather than counted, as <a href=#e8d8>Example 8.8 </a>shows.

<p>

<lx "no'o"><cx "typical value, contrasted with mathematical average">In addition to these cmavo, there is “no'o”, meaning “the typical value”, and “pino'o”, meaning “the typical portion”: Sometimes “no'o” can be translated “the aver­age value”, but the average in question is not, in general, a mathematical mean, median, or mode; these would be more appropriately represented by operators.

<p>

<pre><a name=e8d9>8.9) mi catlu no'o prenu

I look-at a-typical-number-of persons

<a name=e8d10>8.10) mi citka pino'o lei nanba

I eat a-typical-amount-of the-mass-of bread.

</pre><lx "da'a">““da'a” is a related cmavo meaning “all but”:

<p>

<pre><a name=e8d11>8.11) mi catlu da'a re prenu

I look-at all-but two persons

<a name=e8d12>8.12) mi catlu da'a so'u prenu

I look-at all-but a-few persons

</pre><a href=#e8d12>Example 8.12 </a>is similar in meaning to <a href=#e8d3>Example 8.3</a>.

<p>

<cx "da'a, default number for">If no number follows “da'a”, then “pa” is assumed; “da'a” by itself means “all but one”, or in ordinal contexts “all but the last”:

<p>

<pre><a name=e8d13>8.13) ro ratcu ka'e citka da'a ratcu

all rats can eat all-but-one rats.

All rats can eat all other rats.

</pre><ex "eat themselves">(The use of “da'a” means that <a href=#e8d13>Example 8.13 </a>does not require that all rats can eat them­selves, but does allow it. Each rat has one rat it cannot eat, but that one might be some rat other than itself. Context often dictates that “itself” is, indeed, the “other” rat.)

<p>

<cx "ma'u, with elided number"><cx "ni'u, with elided number"><lx "ma'u"><lx "ni'u">As mentioned in <a href=#s3>Section 3</a>, “ma'u” and “ni'u” are also legal numbers, and they mean “some positive number” and “some negative number” respectively.

<p>

<pre><a name=e8d14>8.14) li ci vu'u re du li ma'u

the-number 3 - 2 = some-positive-number

<a name=e8d15>8.15) li ci vu'u vo du li ni'u

the-number 3 - 4 = some-negative-number

<a name=e8d16>8.16) mi ponse ma'u rupnu

I possess a-positive-number-of currency-units.

</pre><cx "subjective amounts, expressing"><cx "indefinite values, subjective"><lx "rau"><lx "du'e"><lx "mo'a">All of the numbers discussed so far are objective, even if indefinite. If there are exactly six superpowers (“rairgugde”, “superlative-states”) in the world, then “ro rairgugde” means the same as “xa rairgugde”. It is often useful, however, to express subjective in­definite values. The cmavo “rau” (enough), “du'e” (too many), and “mo'a” (too few) are then appropriate:

<p>

<ex "enough currency"><pre><a name=e8d17>8.17) mi ponse rau rupnu

I possess enough currency-units.

</pre><lx "pi"><cx "subjective portions, expressing"><cx "indefinite portions, subjective">Like the “so'a”-series, “rau”, “du'e”, and “mo'a” can be preceded by “pi”; for example, “pirau” means “a sufficient part of.”

<p>

<cx "indefinite numbers, combined with definite"><cx "definite numbers, combined with indefinite">Another possibility is that of combining definite and indefinite numbers into a single number. This usage implies that the two kinds of numbers have the same value in the given context:

<p>

<ex "both dogs"><pre><a name=e8d18>8.18) mi viska le rore gerku

I saw the all-of/two dogs.

I saw both dogs.

<a name=e8d19>8.19) mi speni so'ici prenu

I am-married-to many/three persons.

I am married to three persons (which is “many” in the circumstances).

</pre><a href=#e8d19>Example 8.19 </a>assumes a mostly monogamous culture by stating that three is “many”.

<p>

### <a name=s9><h3>Approximation and inexact numbers</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> ji'i PA approximately

su'e PA at most

su'o PA at least

me'i PA less than

za'u PA more than

</pre><lx "ji'i"><cx "approximate numbers, expressing"><cx "ji'i, effect of placement">The cmavo “ji'i” (of selma'o PA) is used in several ways to indicate approxi­mate or rounded numbers. If it appears at the beginning of a number, the whole number is ap­proximate:

<p>

<ex "approximately 40"><pre><a name=e9d1>9.1) ji'i vo no

approximation four zero

approximately 40

</pre><cx "approximate numbers, expressing some exactness of">If “ji'i” appears in the middle of a number, all the digits following it are approximate:

<p>

<pre><a name=e9d2>9.2) vo no ji'i mu no

four zero approximation five zero

roughly 4050 (where the “four thousand” is exact, but the “fifty” is

approximate)

</pre><cx "truncation of number, expressing"><cx "rounded numbers, expressing">If “ji'i” appears at the end of a number, it indicates that the number has been rounded. In addition, it can then be followed by a sign cmavo (“ma'u” or “ni'u”), which indicate trun­cation towards positive or negative infinity respectively.

<p>

<pre><a name=e9d3>9.3) re pi ze re ji'i

two point seven two approximation

2.72 (rounded)

</pre><ex "rounded up"><pre><a name=e9d4>9.4) re pi ze re ji'i ma'u

two point seven two approximation positive-sign

2.72 (rounded up)

</pre><ex "rounded down"><pre><a name=e9d5>9.5) re pi ze pa ji'i ni'u

two point seven one approximation negative-sign

2.71 (rounded down)

</pre><cx "ji'i, with elided number"><a href=#e9d{3}>Examples 9.3 </a>through <a href=#e9d5>9.5 </a>are all approximations to “te'o” (exponential e). “ji'i” can also appear by itself, in which case it means “approximately the typical value in this context”.

<p>

<lx "su'e"><lx "su'o"><lx "me'i"><lx "za'u"><cx "inexact numbers with bounds">The four cmavo “su'e”, “su'o”, “me'i”, and “za'u”, also of selma'o PA, express inex­act numbers with upper or lower bounds:

<p>

<ex "at most"><pre><a name=e9d6>9.6) mi catlu su'e re prenu

I look-at at-most two persons.

</pre><ex "at least"><pre><a name=e9d7>9.7) mi catlu su'o re prenu

I look-at at-least two persons.

</pre><ex "less than"><pre><a name=e9d8>9.8) mi catlu me'i re prenu

I look-at less-than two persons.

</pre><ex "more than"><pre><a name=e9d9>9.9) mi catlu za'u re prenu

I look-at more-than two persons.

</pre><cx "less than, contrasted with more than, at least, at most"><cx "more than, contrasted with less than, at least, at most"><cx "at least, contrasted with more than, less than, at most"><cx "at most, contrasted with more than, at least, less than"><ex "exactly two"><cx "exact number, expressing"><cx "plural, Lojban equivalent of">Each of these is a subtly different claim: <a href=#e9d7>Example 9.7 </a>is true of two or any greater num­ber, whereas <a href=#e9d9>Example 9.9 </a>requires three persons or more. Likewise, <a href=#e9d6>Example 9.6 </a>refers to zero, one, or two; <a href=#e9d8>Example 9.8 </a>to zero or one. (Of course, when the context allows num­bers other than non-negative integers, “me'i re” can be any number less than 2, and like­wise with the other cases.) The exact quantifier, “exactly 2, neither more nor less” is just “re”. Note that “su'ore” is the exact Lojban equivalent of English plurals.

<p>

<cx "su'e, with elided number"><cx "su'o, with elided number"><cx "me'i, with elided number"><cx "za'u, with elided number">If no number follows one of these cmavo, “pa” is understood: therefore,

<p>

<pre><a name=e9d10>9.10) mi catlu su'o prenu

I look-at at-least [one] person.

</pre>is a meaningful claim.

<p>

<lx "pi"><cx "inexact portions with bounds">Like the numbers in <a href=#s8>Section 8</a>, all of these cmavo may be preceded by “pi” to make the corresponding quantifiers for part of a whole. For example, “pisu'o” means “at least some part of”. The quantifiers “ro”, “su'o”, “piro”, and “pisu'o” are particularly important in Lojban, as they are implicitly used in the descriptions introduced by the cmavo of sel­ma'o LA and LE, as explained in <a href=chap6.html>Chapter 6</a>. Descriptions in general are outside the scope of this chapter.

<p>

### <a name=s10><h3>Non-decimal and compound bases</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> ju'u VUhU to the base

dau PA hex digit A = 10

fei PA hex digit B = 11

gai PA hex digit C = 12

jau PA hex digit D = 13

rei PA hex digit E = 14

vai PA hex digit F = 15

pi'e PA compound base point

</pre><cx "radix, decimal (see also base)">In normal contexts, Lojban assumes that all numbers are expressed in the decimal (base 10) system. However, other bases are possible, and may be appropriate in particular cir­cumstances.

<p>

<cx "base, specifying"><cx "binary system, specifying numbers in (see also base)"><cx "octal system, specifying numbers in (see also base)">To specify a number in a particular base, the VUhU operator “ju'u” is suitable:

<p>

<pre><a name=e10d1>10.1) li pa no pa no ju'u re du li pa no

The-number 1010 base 2 equals the-number 10.

</pre><cx "base, assumed"><cx "base, changing permanently">Here, the final “pa no” is assumed to be base 10, as usual; so is the base specification. (The base may also be changed permanently by a metalinguistic specification; no stan­dard way of doing so has as yet been worked out.)

<p>

<cx "digits, rationale for having 16"><cx "hexadecimal system, specifying numbers in (see also base)">Lojban has digits for representing bases up to 16, because 16 is a base often used in computer applications. In English, it is customary to use the letters A-F as the base 16 digits equivalent to the numbers ten through fifteen. In Lojban, this ambiguity is avoided:

<p>

<ex "ABC base 16"><pre><a name=e10d2>10.2) li daufeigai ju'u paxa du li rezevobi

The-number ABC base 16 equals the-number 2748.

<a name=e10d3>10.3) li jaureivai ju'u paxa du li cimuxaze

The-number DEF base 16 equals the-number 3567.

</pre><cx "digits beyond 9, word pattern">Note the pattern in the cmavo: the diphthongs “au”, “ei”, “ai” are used twice in the same order. The digits for A to D use consonants different from those used in the deci­mal digit cmavo; E and F unfortunately overlap 2 and 4 — there was simply not enough available cmavo space to make a full differentiation possible. The cmavo are also in alphabetical order.

<p>

<cx "base point, in bases other than 10"><cx "decimal point, in bases other than 10">The base point “pi” is used in non-decimal bases just as in base 10:

<p>

<ex "F.8 base 16"><pre><a name=e10d4>10.4) li vai pi bi ju'u paxa du li pamu pi mu

The-number F.8 base 16 equals the-number 15.5.

</pre><cx "ju'u, grammar of"><lx "VUhU"><cx "base, non-constant">Since “ju'u” is an operator of selma'o VUhU, it is grammatical to use any operand as the left argument. Semantically, however, it is undefined to use anything but a numeral string on the left. The reason for making “ju'u” an operator is to allow reference to a base which is not a constant.

<p>

<ex "hours:minutes:seconds"><cx "base varying for each digit, separator for"><lx "pi'e"><cx "compound base, separator for"><cx "compound base, definition">There are some numerical values that require a “base” that varies from digit to digit. For example, times represented in hours, minutes, and seconds have, in effect, three “digits”: the first is base 24, the second and third are base 60. To express such numbers, the compound base separator “pi'e” is used:

<p>

<pre><a name=e10d5>10.5) ci pi'e rere pi'e vono

3:22:40

</pre><cx "compound base, expressing digits in">Each digit sequence separated by instances of “pi'e” is expressed in decimal notation, but the number as a whole is not decimal and can only be added and subtracted by spe­cial rules:

<p>

<pre><a name=e10d6>10.6) li ci pi'e rere pi'e vono su'i pi'e ci pi'e cici du li ci pi'e rexa pi'e paci

The-number 3:22:40 plus :3:33 equals the-number 3:26:13.

<math>3:22:40 + 0:3:33 = 3:26:13</math>

</pre><p>Of course, only context tells you that the first part of the numbers in <a href=#e10d5>Example 10.5 </a>and <a href=#e10d6>Example 10.6 </a>is hours, the second minutes, and the third seconds.

<p>

<cx "Mayan mathematics, as a system with base larger than 16"><cx "base greater than 16, expressing numbers in">The same mechanism using “pi'e” can be used to express numbers which have a base larger than 16. For example, base-20 Mayan mathematics might use digits from “no” to “paso”, each separated by “pi'e”:

<p>

<pre><a name=e10d7>10.7) li pa pi'e re pi'e ci ju'u reno du li vovoci

The-number 1;2;3 base 20 equals the-number 443.

</pre><cx "base greater than 16, compound single-digits contrasted with two digits"><cx "base greater than 16, two digits contrasted with compound single-digits">Carefully note the difference between:

<p>

<pre><a name=e10d8>10.8) pano ju'u reno

the-digit-10 base 20

</pre>which is equal to ten, and:

<p>

<pre><a name=e10d9>10.9) pa pi'e no ju'u reno

1;0 base 20

</pre>which is equal to twenty.

<p>

<cx "large-base decimal fraction, expressing">Both “pi” and “pi'e” can be used to express large-base fractions:

<p>

<pre><a name=e10d10>10.10) li pa pi'e vo pi ze ju'u reno du li re vo pi ci mu

The-number 1;4.7 base 20 equals the-number 24.35.

“</pre><cx "base, vague">“pi'e” is also used where the base of each digit is vague, as in the numbering of the ex­amples in this chapter:

<p>

<ex "sentence 10.11"><pre><a name=e10d11>10.11) dei jufra panopi'epapamoi

This-utterance is-a-sentence-type-of 10;11th-thing.

This is Sentence 10.11.

### </pre><a name=s11><h3>Special mekso selbri</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> mei MOI cardinal selbri

moi MOI ordinal selbri

si'e MOI portion selbri

cu'o MOI probability selbri

va'e MOI scale selbri

me ME make sumti into selbri

me'u MEhU terminator for ME

</pre><lx "MOI"><cx "numerical selbri, special">Lojban possesses a special category of selbri which are based on mekso. The sim­plest kind of such selbri are made by suffixing a member of selma'o MOI to a num­ber. There are five members of MOI, each of which serves to create number-based sel­bri with specific place structures.

<p>

<lx "mei"><cx "cardinal selbri, place structure"><cx "cardinal selbri, definition">“The cmavo “mei” creates cardinal selbri. The basic place structure is:

<p>

<dl compact><dt><dd>x1 is a mass formed from the set x2 of <math>n</math> members, one or more of which is/are x3

</dl><cx "set, expressing relation with mass formed from set"><cx "set, expressing relation with individuals forming set"><cx "individuals, expressing relation with set formed"><cx "individuals, expressing relation with mass formed"><cx "mass, expressing relation with set forming"><cx "mass, expressing relation with individuals forming">A cardinal selbri interrelates a set with a given number of members, the mass formed from that set, and the individuals which make the set up. The mass argument is placed first as a matter of convenience, not logical necessity.

<p>

Some examples:

<p>

<ex "three rats"><pre><a name=e11d1>11.1) lei mi ratcu cu cimei

those-I-describe-as-the-mass-of my rats are-a-threesome.

My rats are three.

I have three rats.

</pre><p>Here, the mass of my rats is said to have three components; that is, I have three rats.

<p>

Another example, with one element this time:

<p>

<ex "individual"><ex "singular me"><pre><a name=e11d2>11.2) mi poi pamei cu cusku dei

I who am-an-individual express this-sentence.

</pre><p>In <a href=#e11d2>Example 11.2</a>, “mi” refers to a mass, “the mass consisting of me”. Personal pronouns are vague between masses, sets, and individuals.

<p>

However, when the number expressed before “-mei” is an objective indefinite num­ber of the kind explained in <a href=#s8>Section 8</a>, a slightly different place structure is re­quired:

<p>

<cx "mei, place structure formed for objective indefinites"><cx "mass, expressing measurement standard for indefinites"><cx "set, expressing measurement standard for indefinites"><cx "individuals of set, expressing measurement standard for indefinites"><dl compact><dt><dd>x1 is a mass formed from a set x2 of <math>n </math>members, one or more of which is/are x3,

measured relative to the set x4.

</dl><p>An example:

<p>

<ex "fewsome"><ex "rats in park"><pre><a name=e11d3>11.3) lei ratcu poi zvati le panka cu so'umei fo

lo'i ratcu

the-mass-of rats which are-in the park are a-fewsome with-respect-to

the-set-of rats.

The rats in the park are a small number of all the rats there are.

</pre><lx "lo'i"><ex "set of all rats"><cx "lo'i, with elided quantifiers">In <a href=#e11d3>Example 11.3</a>, the x2 and x3 places are vacant, and the x4 place is filled by “lo'i ratcu”, which (because no quantifiers are explicitly given) means “the whole of the set of all those things which are rats”, or simply “the set of all rats.”

<p>

<ex "manysome"><pre><a name=e11d4>11.4) le'i ratcu poi zvati le panka cu se so'imei

The-set-of rats which-are in the park is-a manysome.

There are many rats in the park.

</pre><p>In <a href=#e11d4>Example 11.4</a>, the conversion cmavo “se” swaps the x1 and the x2 places, so that the new x1 is the set. The x4 set is unspecified, so the implication is that the rats are “many” with respect to some unspecified comparison set.

<p>

More explanations about the interrelationship of sets, masses, and individuals can be found in <a href=chap6.html>Chapter 6</a>.

<p>

<lx "moi"><cx "ordinal selbri, place structure"><cx "ordinal selbri, definition">“The cmavo “moi” creates ordinal selbri. The place structure is:

<p>

<dl compact><dt><dd>x1 is the (n)th member of set x2 when ordered by rule x3

</dl><p>Some examples:

<p>

<ex "first rat"><pre><a name=e11d5>11.5) ti pamoi le'i mi ratcu

This-one is the first-of the rats associated-with me.

This is my first rat.

</pre><ex "all-th"><pre><a name=e11d6>11.6) ta romoi le'i mi ratcu

That is-the-all-th-of the rats associated-with me.

That is my last rat.

</pre><ex "enough-th"><pre><a name=e11d7>11.7) mi raumoi le velskina porsi

I am-enough-th-in the movie-audience sequence

I am enough-th in the movie line.

</pre><a href=#e11d7>Example 11.7 </a>means, in the appropriate context, that my position in line is sufficiently far to the front that I will get a seat for the movie.

<p>

<lx "si'e"><cx "portion selbri, definition"><cx "portion selbri, place structure">“The cmavo “si'e” creates portion selbri. The place structure is:

<p>

<dl compact><dt><dd>x1 is an (n)th portion of mass x2

</dl><p>Some examples:

<p>

<cx "one-third of food"><pre><a name=e11d8>11.8) levi sanmi cu fi'ucisi'e lei mi djedi cidja

This-here meal is-a-slash-three-portion-of my day-food.

This meal is one-third of my daily food.

</pre><lx "cu'o"><cx "probability selbri, definition"><cx "probability selbri, place structure">“The cmavo “cu'o” creates probability selbri. The place structure is:

<p>

<dl compact><dt><dd>event x1 has probability (n) of occurring under conditions x2

</dl><cx "probability selbri, values">The number must be between 0 and 1 inclusive. For example:

<p>

<ex "probability .5"><ex "coin heads"><pre><a name=e11d9>11.9) le nu lo sicni cu sedja'o cu pimucu'o

The event of a coin being a head-displayer has probability .5.

</pre><lx "va'e"><cx "scale selbri, definition"><cx "scale selbri, place structure">The cmavo “va'e” creates a scale selbri. The place structure is:

<p>

<dl compact><dt><dd>x1 is at scale position (n) on the scale x2

</dl><cx "scale, granular contrasted with continuous"><cx "unreduced fractions, use in granular scales">If the scale is granular rather than continuous, a form like “cifi'uxa” (3/6) may be used; in this case, 3/6 is not the same as 1/2, because the third position on a scale of six positions is not the same as the first position on a scale of two positions . Here is an example:

<p>

<ex "8 out of ten"><ex "scale of redness"><pre><a name=e11d10>11.10) le vi rozgu cu sofi'upanova'e xunre

This rose is 8/10-scale red

This rose is 8 out of 10 on the scale of redness.

This rose is very red.

</pre><cx "subjective numbers, effect on place structure for cardinal selbri"><cx "subjective numbers, effect on place structure for ordinal selbri"><cx "subjective numbers, effect on place structure for portion selbri"><cx "subjective numbers, effect on place structure for probability selbri"><cx "subjective numbers, effect on place structure for scale selbri"><cx "cardinal selbri, place structure effect from subjective numbers"><cx "ordinal selbri, place structure effect from subjective numbers"><cx "portion selbri, place structure effect from subjective numbers"><cx "probability selbri, place structure effect from subjective numbers"><cx "scale selbri, place structure effect from subjective numbers"><lx "rau"><lx "du'e"><lx "mo'a">When the quantifier preceding any MOI cmavo includes the subjective num­bers “rau”, “du'e”, or “mo'a” (enough, too many, too few) then an additional place is added for “by standard”. For example:

<p>

<cx "too many rats"><pre><a name=e11d11>11.11) lei ratcu poi zvati le panka cu du'emei fo mi

The-mass-of rats which-are in the park are too-many by-standard me.

There are too many rats in the park for me.

</pre><cx "subjective numbers, rationale for effect on place structure">The extra place (which for “-mei” is the x4 place labeled by “fo”) is provided rather than using a BAI tag such as “ma'i” because a specification of the standard for judg­ment is essential to the meaning of subjective words like “enough”.

<p>

<cx "standard for subjective numbers, specifying"><cx "subjective numbers, specifying standard for">This place is not normally explicit when using one of the subjective numbers directly as a number. Therefore, “du'e ratcu” means “too many rats” without specifying any stan­dard.

<p>

<cx "numerical selbri, special, with lerfu strings"><cx "lerfu strings, with numerical selbri">It is also grammatical to substitute a lerfu string for a number:

<p>

<ex "nth rat"><pre><a name=e11d12>11.12) ta ny.moi le'i mi ratcu

That is-nth-of the-set-of my rats

That is my nth rat.

</pre><cx "numerical selbri, grammar"><cx "numerical selbri, restriction on numbers used for">More complex mekso cannot be placed directly in front of MOI, due to the re­sulting grammatical ambiguities. Instead, a somewhat artificial form of expression is required. <p>

<lx "me"><lx "ME">The cmavo “me” (of selma'o ME) has the function of making a sumti into a selbri. </pre><cx "numerical selbri, use of “me” with"><cx "numerical selbri, complex"><cx "“me”, effect of MOI on"><lx "me'u"><cx "numerical selbri, alternative to compensate for restriction on numbers">A whole “me” construction can have a member of MOI added to the end to create a com­plex mekso selbri:

<p>

<ex "(n+1)-th rat"><pre><a name=e11d14>11.13) ta me li ny. su'i pa me'u moi le'i mi ratcu

That is the-number n plus one-th-of the-set-of my rats.

That is my (n+1)-th rat.

</pre><p>Here the mekso “ny. su'i pa” is made into a sumti (with “li”) and then changed into a mekso selbri with “me” and “me'u moi”. The elidable terminator “me'u” is required here in order to keep the “pa” and the “moi” separate; otherwise, the parser will com­bine them into the compound “pamoi” and reject the sentence as ungrammatical.

<p>

<cx "numerical selbri, based on non-numerical sumti">It is perfectly possible to use non-numerical sumti after “me” and before a member of MOI, producing strange results indeed:

<p>

<ex "snowball's chance"><pre><a name=e11d15>11.14) le nu mi nolraitru

cu me le'e snime bolci be vi la xel. cu'o

The event-of me being-a-nobly-superlative-ruler

has-the-stereotypical snow type-of-ball at Hell probability.

I have a snowball's chance in Hell of being king.

</pre><cx "boi, exception before MOI"><cx "PA, exception on use of boi with MOI"><cx "MOI, use of boi before"><cx "boi, effect on elidability of me'u"><lx "me'u"><lx "boi"><lx "MOI"><lx "PA">Note: the elidable terminator “boi” is not used between a number and a member of MOI. As a result, the “me'u” in <a href=#e11d14>Example 11.13 </a>could also be replaced by a “boi”, which would serve the same function of preventing the “pa” and “moi” from joining into a compound.

<p>

### <a name=s12><h3>Number questions</h3>

<p>

The following cmavo is discussed in this section:

<p>

<pre> xo PA number question

</pre><lx "xo"><cx "questions, number"><cx "number questions">The cmavo “xo”, a member of selma'o PA, is used to ask questions whose answers are numbers. Like most Lojban question words, it fills the blank where the answer should go. (See <a href=chap19.html>Chapter 19 </a>for more on Lojban questions.)

<p>

<pre><a name=e12d1>12.1) li re su'i re du li xo

The-number 2 plus 2 equals the-number what?

What is <math>2 + 2</math>?

</pre><cx "police lineup"><pre><a name=e12d2>12.2) le xomoi prenu cu darxi do

The what-number-th person hit you?

Which person [as in a police lineup] hit you?

</pre><cx "digit questions"><cx "questions, digit">““xo” can also be combined with other digits to ask questions whose answers are al­ready partly specified. This ability could be very useful in writing tests of elementary arith­meti­cal knowledge:

<p>

<pre><a name=e12d3>12.3) li remu pi'i xa du li paxono

The-number 25 times 6 equals the-number 1?0

</pre><cx "numbers, as grammatically complete utterances"><cx "number questions, answers to">to which the correct reply would be “mu”, or 5. The ability to utter bare numbers as grammatical Lojban sentences is primarily intended for giving answers to “xo” ques­tions. (Another use, obviously, is for counting off physical objects one by one.)

<p>

### <a name=s13><h3>Subscripts</h3>

<p>

The following cmavo is discussed in this section:

<p>

<pre> xi XI subscript

</pre><cx “subscripts, external grammar of”>Subscripting is a general Lojban feature, not used only in mekso; there are many things that can logically be subscripted, and grammatically a subscript is a free modifier, us­able almost anywhere. In particular, of course, mekso variables (lerfu strings) can be sub­scripted:

<p>

<pre><a name=e13d1>13.1) li xy.boixici du li xy.boixipa su’i xy.boixire

The-number x-sub-3 equals the-number x-sub-1 plus x-sub-2.

<math>x<sub>3</sub>= x<sub>1</sub>+ x<sub>2</sub></math>

</pre>

Subscripts always begin with the flag “xi” (of selma'o XI). “xi” may be followed by a number, a lerfu string, or a general mekso expression in parentheses:

<p>

<pre><a name=e13d2>13.2) xy.boixino

*<math>x<sub>0*</sub></math>

<a name=e13d3>13.3) xy.boixiny.

*<math>x<sub>n*</sub></math>

<a name=e13d4>13.4) xy.boixi vei ny. su'i pa [ve'o]

*<math>x<sub>n+1*</math>

</pre><cx "subscripts on lerfu words, effect on elidability of boi"><cx "subscripts, effects on elidability of terminators"><cx "free modifiers, effects on elidability of terminators">Note that subscripts attached directly to lerfu words (variables) generally need a “boi” terminating the variable. Free modifiers, of which subscripts are one variety, generally require the explicit presence of an otherwise elidable terminator.

<p>

<cx "subscripts, before main expression"><cx "superscripts">There is no standard way of handling superscripts (other than those used as ex­po­nents) or for subscripts or superscripts that come before the main expression. If nec­essary, further cmavo could be assigned to selma'o XI for these purposes.

<p>

<cx "subscripts, terminator for"><lx "boi"><cx "subscripts, multiple as sub-subscript"><cx "sub-subscripts">The elidable terminator for a subscript is that for a general number or lerfu string, namely “boi”. By convention, a subscript following another subscript is taken to be a sub-subscript:

<p>

<pre><a name=e13d5>13.5) xy.boi xi by.boi xi vo

*xb*4*<math>*</sub></sub></math>

</pre><p>See <a href=#e17d10>Example 17.10 </a>for the standard method of specifying multiple subscripts on a sin­gle object.

<p>

More information on the uses of subscripts may be found in <a href=chap19.html>Chapter 19</a>.

<p>

### <a name=s14><h3>Infix operators revisited</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> tu'o PA null operand

ge'a VUhU null operator

gei VUhU exponential notation

</pre><lx "tu'o"><lx "ge'a">The infix operators presented so far have always had exactly two operands, and for more or fewer operands forethought notation has been required. However, it is pos­sible to use an operator in infix style even though it has more or fewer than two oper­ands, through the use of a pair of tricks: the null operand “tu'o” and the null operator “ge'a”. The first is suitable when there are too few operands, the second when there are too many. For exam­ple, suppose we wanted to express the numerical negation operator “va'a” in infix form. We would use:

<p>

<pre><a name=e14d1>14.1) li tu'o va'a ny. du li no vu'u ny.

The-number (null) additive-inverse n equals the-number zero minus *n*.

-*<math>-n* = 0 - *n*</math>

</pre><cx "tu'o, for infix operations with too few operands"><cx "null operand, for infix operations with too few operands"><cx "operands, too few for infix operation">The “tu'o” fulfills the grammatical requirement for a left operand for the infix use of “va'a”, even though semantically none is needed or wanted.

<p>

<lx "gei"><cx "gei, as a binary operator"><cx "scientific notation, with gei"><cx "exponential notation, with gei">Finding a suitable example of “ge'a” requires exhibiting a ternary operator, and ter­nary operators are not common. The operator “gei”, however, has both a binary and a ternary use. As a binary operator, it provides a terse representation of scientific (also called “exponential”) notation. The first operand of “gei” is the exponent, and the sec­ond operand is the mantissa or fraction:

<p>

<ex "3 × 10^8">×<pre><a name=e14d2>14.2) li cinonoki'oki'o du

li bi gei ci

The-number three-zero-zero-comma-comma equals

the-number eight scientific three.

<math>300,000,000 = 3 × &times; 10<sup>*8*</sup></math>

</pre><cx "scientific notation, rationale for order of places"><cx "gei, rationale for order of places">Why are the arguments to “gei” in reverse order from the conventional symbolic nota­tion? So that “gei” can be used in forethought to allow easy specification of a large (or small) imprecise number:

<p>

<ex "10^20"><pre><a name=e14d3>14.3) gei reno

(scientific) two-zero

<math>10<sup>20</sup></math>

</pre><cx "ge'a, for infix operations with too many operands"><cx "null operator, for infix operations with too many operands"><cx "operands, too many for infix operation"><cx "gei, as a ternary operator"><cx "exponential notation, with base other than 10"><cx "floating point numbers, expressing">Note, however, that although 10 is far and away the most common exponent base, it is not the only possible one. The third operand of “gei”, therefore, is the base, with 10 as the default value. Most computers internally store so-called “floating-point” numbers using 2 as the exponent base. (This has nothing to do with the fact that computers also represent all integers in base 2; the IBM 360 series used an exponent base of 16 for floating point, although each component of the number was expressed in base 2.) Here is a computer floating-point number with a value of 40:

<p>

<ex ".1010\_2 × 2^{110\_2}">×<pre><a name=e14d4>14.4) papano bi'eju'u re gei pipanopano bi'eju'u re

ge'a re

(one-one-zero base 2) scientific (point-one-zero-one-zero base 2)

with-base 2

<math>.1010 <sub>2</sub>&times;× 2<sup>110<sub>2</sub></sup></math>

### </pre><a name=s15><h3>Vectors and matrices</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> jo'i JOhI start vector

te'u TEhU end vector

pi'a VUhU matrix row combiner

sa'i VUhU matrix column combiner

</pre><cx "vector, definition"><cx "matrix, definition">A mathematical vector is a list of numbers, and a mathematical matrix is a ta­ble of numbers. Lojban considers matrices to be built up out of vectors, which are in turn built up out of operands.

<p>

<lx "jo'i"><lx "JOhI"><cx "vector indicator"><cx "jo'i, precedence of"><cx "vector, components of"><lx "te'u"><cx "vector indicator, terminator for">“jo'i”, the only cmavo of selma'o JOhI, is the vector indicator: it has a syntax remi­niscent of a forethought operator, but has very high precedence. The components must be simple operands rather than full expressions (unless parenthesized). A vector can have any number of components; “te'u” is the elidable terminator. An example:

<p>

<pre><a name=e15d1>15.1) li jo'i paboi reboi te'u su'i jo'i ciboi voboi du

li jo'i voboi xaboi

The-number array (one, two) plus array (three, four) equals

the-number array (four, six).

<math>(1,2) + (3,4) = (4,6)</math>

</pre><lx "pi'a"><lx "sa'i"><cx "matrix row operator"><cx "matrix column operator"><cx "matrix, as combination of vectors"><lx "ge'a"><cx "matrix, with ge'a for more than 2 rows/columns">Vectors can be combined into matrices using either “pi'a”, the matrix row op­erator, or “sa'i”, the matrix column operator. The first combines vectors representing rows of the matrix, and the second combines vectors representing columns of the ma­trix. Both of them allow any number of arguments: additional arguments are tacked on with the null operator “ge'a”.

<p>

<ex "magic square">Therefore, the “magic square” matrix

<p>

<dl compact><dt><dd>8 1 6

3 5 7

4 9 2

</dl>can be represented either as:

<p>

<pre><a name=e15d2>15.2) jo'i biboi paboi xa pi'a jo'i ciboi muboi ze ge'a jo'i voboi soboi re

the-vector (8 1 6) matrix-row the-vector (3 5 7), the-vector (4 9 2)

</pre>or as

<p>

<pre><a name=e15d3>15.3) jo'i biboi ciboi vo sa'i jo'i paboi muboi so ge'a jo'i xaboi zeboi re

the-vector (8 3 4) matrix-column the-vector (1 5 9), the-vector (6 7 2)

</pre><cx "outer product"><cx "inner product"><cx "vectors, use as operands"><cx "matrices, use as operands"><cx "vectors, use of parentheses with"><cx "matrices, use of parentheses with">The regular mekso operators can be applied to vectors and to matrices, since grammati­cally both of these are expressions. It is usually necessary to parenthesize matrices when used with operators in order to avoid incorrect groupings. There are no VUhU operators for the matrix operators of inner or outer products, but appropriate operators can be cre­ated using a suitable symbolic lerfu word or string prefixed by “ma'o”.

<p>

<cx "matrix, with more than 2 dimensions"><cx "subscript, to form matrices of more than 2 dimensions"><lx "xi">Matrices of more than two dimensions can be built up using either “pi'a” or “sa'i” with an appropriate subscript numbering the dimension. When subscripted, there is no difference between “pi'a” and “sa'i”.

<p>

### <a name=s16><h3>Reverse Polish notation</h3>

<p>

The following cmavo is discussed in this section:

<p>

<pre> fu'a FUhA reverse Polish flag

</pre><cx "RP, as abbreviation for reverse Polish notation">So far, the Lojban notational conventions have mapped fairly familiar kinds of mathematical discourse. The use of forethought operators may have seemed odd when applied to “+”, but when applied to “f” they appear as the usual functional notation. Now comes a sharp break. Reverse Polish (RP) notation represents something com­pletely dif­ferent; even mathematicians don't use it much. (The only common uses of RP, in fact, are in some kinds of calculators and in the implementation of some pro­gramming languages.)

<p>

<cx "reverse Polish notation, definition"><cx "reverse Polish notation, use of parentheses in"><cx "reverse Polish notation, marker"><cx "reverse Polish notation, terminator"><lx "fu'a">In RP notation, the operator follows the operands. (Polish notation, where the opera­tor precedes its operands, is another name for forethought mekso of the kind ex­plained in <a href=#s6>Section 6</a>.) The number of operands per operator is always fixed. No paren­theses are re­quired or permitted. In Lojban, RP notation is always explicitly marked by a “fu'a” at the beginning of the expression; there is no terminator. Here is a simple ex­ample:

<p>

<pre><a name=e16d1>16.1) li fu'a reboi ci su'i du li mu

the-number (RP!) two, three, plus equals the-number five.

</pre><p>The operands are “re” and “ci”; the operator is “su'i”.

<p>

Here is a more complex example:

<p>

<pre><a name=e16d2>16.2) li fu'a reboi ci pi'i voboi mu pi'i su'i du

li rexa

the-number (RP!) (two, three, times), (four, five, times), plus equals the-number two-six

</pre><p>Here the operands of the first “pi'i” are “re” and “ci”; the operands of the second “pi'i” are “vo” and “mu” (with “boi” inserted where needed), and the operands of the “su'i” are “reboi ci pi'i”, or 6, and “voboi mu pi'i”, or 20. As you can see, it is easy to get lost in the world of reverse Polish notation; on the other hand, it is especially easy for a me­chanical listener (who has a deep mental stack and doesn't get lost) to comprehend.

<p>

<cx "reverse Polish notation, operands of"><cx "reverse Polish notation, parentheses in operands of">The operands of an RP operator can be any legal mekso operand, including parenthe­sized mekso that can contain any valid syntax, whether more RP or something more con­ventional.

<p>

<cx "reverse Polish notation, number of operands"><lx "tu'o"><lx "ge'a"><cx "reverse Polish notation, with too few operands"><cx "reverse Polish notation, with too many operands"><lx "tu'o va'a"><lx "ge'a gei">In Lojban, RP operators are always parsed with exactly two operands. What about operators which require only one operand, or more than two operands? The null operand “tu'o” and the null operator “ge'a” provide a simple solution. A one-operand operator like “va'a” always appears in a reverse Polish context as “tu'o va'a”. The “tu'o” provides the second operand, which is semantically ignored but grammatically neces­sary. Likewise, the three-operand version of “gei” appears in reverse Polish as “ge'a gei”, where the “ge'a” effectively merges the 2nd and 3rd operands into a single oper­and. Here are some examples:

<p>

<pre><a name=e16d3>16.3) li fu'a ciboi muboi vu'u du

li fu'a reboi tu'o va'a

The-number (RP!) (three, five, minus) equals

the-number (RP!) two, null, negative-of.

<math>3 - 5 = -2</math>

<a name=e16d4>16.4) li cinoki'oki'o du

li fu'a biboi ciboi panoboi ge'a gei

The-number 30-comma-comma equals

the-number (RP!) 8, (3, 10, null-op), exponential-notation.

<math>30,000,000 = 3 × &times; 10<sup>8</sup></math>

### </pre><a name=s17><h3>Logical and non-logical connectives within mekso</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> .abu BY letter “a”

by BY letter “b”

cy BY letter “c”

fe'a VUhU nth root of (default square root)

lo'o LOhO terminator for LI

</pre><cx "operand connection, afterthought"><cx "operand connection, forethought"><cx "operator connection, afterthought"><cx "operator connection, forethought"><cx "forethought connection, of operands"><cx "forethought connection, of operators"><cx "afterthought connection, of operands"><cx "afterthought connection, of operators"><lx "A"><lx "GA">As befits a logical language, Lojban has extensive provision for logical con­nectives within both operators and operands. Full details on logical and non-logical connectives are provided in <a href=chap14.html>Chapter 14</a>. Operands are connected in afterthought with selma'o A and in forethought with selma'o GA, just like sumti. Operators are connected in afterthought with selma'o JA and in forethought with selma'o GUhA, just like tanru components. This parallelism is no accident.

<p>

<cx "connection of operands, grouping"><cx "connection of operators, grouping"><lx "BO"><lx "KE">In addition, A+BO and A+KE constructs are allowed for grouping logically con­nected operands, and “ke <dots>…</dots>ke'e” is allowed for grouping logically connected op­erators, although there are no analogues of tanru among the operators.

<p>

Despite the large number of rules required to support this feature, it is of rela­tively minor importance in the mekso scheme of things. <a href=#e17d1>Example 17.1 </a>exhibits after­thought logical connection between operands:

<p>

<ex "three or four people"><pre><a name=e17d1>17.1) vei ci .a vo ve'o prenu cu klama le zarci

( Three or four ) people go-to the market.

</pre><a href=#e17d2>Example 17.2 </a>is equivalent in meaning, but uses forethought connection:

<p>

<pre><a name=e17d2>17.2) vei ga ci gi vo ve'o prenu cu klama le zarci

( Either 3 or 4 ) people go-to the market.

</pre><cx "mekso, complex used as quantifier"><cx "parentheses, for complex mekso used as quantifier">Note that the mekso here are being used as quantifiers. Lojban requires that any mekso other than a simple number be enclosed in parentheses when used as a quantifier. This rule prevents ambiguities that do not exist when using “li”.

<p>

<cx "li, terminator for"><lx "lo'o"><cx "logical connection, effect on elidability of lo'o"><cx "lo'o, effect of logical connective on elidability of">By the way, “li” has an elidable terminator, “lo'o”, which is needed when a “li” sumti is followed by a logical connective that could seem to be within the mekso. For example:

<p>

<pre><a name=e17d3>17.3) li re su'i re du

li vo lo'o .onai lo nalseldjuno namcu

The-number two plus two equals

the-number four or else a non-known number.

</pre><p>Omitting the “lo'o” would cause the parser to assume that another operand followed the “.onai” and reject “lo” as an invalid operand.

<p>

Simple examples of logical connection between operators are hard to come by. A contrived example is:

<p>

<pre><a name=e17d4>17.4) li re su'i je pi'i re du li vo

The-number two plus and times two equals the-number four.

<math>2 + 2 = 4 </math> and <math>2 ×&times; 2 = 4</math>.

</pre><p>The forethought-connection form of <a href=#e17d4>Example 17.4 </a>is:

<p>

<pre><a name=e17d5>17.5) li re ge su'i gi pi'i re du li vo

The-number two both plus and times two equals the-number four.

Both <math>2 + 2 = 4 </math>and <math>2 ×&times; 2 = 4</math>.

</pre><p>Here is a classic example of operand logical connection:

<p>

<ex "quadratic formula"><cx "Polish notation mixed with infix"><cx "infix notation mixed with Polish"><pre><a name=e17d6>17.6) go li .abu bi'epi'i vei xy. te'a re ve'o su'i by. bi'epi'i xy.

su'i cy. du li no

gi li xy. du li vei va'a by. ku'e su'i ja vu'u

fe'a vei by. bi'ete'a re vu'u vo bi'epi'i .abu bi'epi'i cy. ve'o [ku'e] ve'o

fe'i re bi'epi'i .abu

If-and-only-if the-number “a”-times-( “x” power two ) plus “b”-times-“x”

plus “c” equals the-number zero

then the-number x equals the-number [ the-negation-of( b ) plus or minus

the-root-of (“b”-power-2 minus four-times-“a”-times-“c” ) ]

divided-by two-times-“a”.

Iff *<math>ax*<sup>2</sup>+ *bx* + *c* = 0</math>,

then <math>x =**

-b &plusmn; <font face="Symbol">&#214;</font><!–sqrt–>(b<sup>2</sup>- 4ac)</math>

———————–

</pre><cx "Polish notation mixed with infix, example"><cx "infix notation mixed with Polish, example">Note the mixture of styles in <a href=#e17d6>Example 17.6</a>: the negation of b and the square root are rep­resented by forethought and most of the operator precedence by prefixed “bi'e”, but ex­plicit parentheses had to be added to group the numerator properly. In addition, the square root parentheses cannot be removed here in favor of simple “fe'a” and “ku'e” bracketing, because infix operators are present in the operand. Getting <a href=#e17d6>Example 17.6 </a>to parse per­fectly using the current parser took several tries: a more relaxed style would dispense with most of the “bi'e” cmavo and just let the standard precedence rules be understood.

<p>

<lx "JOI"><lx "BIhI"><cx "non-logical connection of operands"><cx "non-logical connection of operators">Non-logical connection with JOI and BIhI is also permitted between operands and between operators. One use for this construct is to connect operands with “bi'o” to create intervals:

<p>

<pre><a name=e17d7>17.7) li no ga'o bi'o ke'i pa

the-number zero (inclusive) from-to (exclusive) one

<math>[0,1)</math>

the numbers from zero to one, including zero but not including one

</pre><lx "mi'i">Intervals defined by a midpoint and range rather than beginning and end points can be expressed by “mi'i”:

<p>

<cx "open interval, expressed with mi'i"><cx "closed interval, expressed with mi'i"><pre><a name=e17d8>17.8) li pimu ga'o mi'i ke'i pimu

the-number 0.5 ±plus-or-minus 0.5

</pre>which expresses the same interval as <a href=#e17d7>Example 17.7</a>. Note that the “ga'o” and “ke'i” still refer to the endpoints, although these are now implied rather than expressed. Another way of expressing the same thing:

<p>

<pre><a name=e17d9>17.9) li pimu su'i ni'upimu bi'o ma'upimu

the-number 0.5 plus [-0.5 from-to +0.5]

</pre><cx "connection of operands, precedence over operator">Here we have the sum of a number and an interval, which produces another interval cen­tered on the number. As <a href=#e17d9>Example 17.9 </a>shows, non-logical (or logical) connection of op­erands has higher precedence than any mekso operator.

<p>

<cx "compound subscript"><cx "subscript, multiple for same base word">You can also combine two operands with “ce'o”, the sequence connective of selma'o JOI, to make a compound subscript:

<p>

<ex "x{b,d}"><pre><a name=e17d10>17.10) xy. xi vei by. ce'o dy. [ve'o]

“x” sub (“b” sequence “d” )

<math>x*<sub>b,d</math>*

### </pre><a name=s18><h3>Using Lojban resources within mekso</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> na'u NAhU selbri to operator

ni'e NIhE selbri to operand

mo'e MOhE sumti to operand

te'u TEhU terminator for all three

</pre><lx "te'u"><cx "na'u, terminator for"><cx "ni'e, terminator for"><cx "mo'e, terminator for">One of the mekso design goals requires the ability to make use of Lojban's vo­cabu­lary resources within mekso to extend the built-in cmavo for operands and opera­tors. There are three relevant constructs: all three share the elidable terminator “te'u” (which is also used to terminate vectors marked with “jo'i”).

<p>

<lx "na'u"><cx "selbri, converting into an operator"><cx "operator, converting selbri into"><cx "conversion, selbri into operator"><cx "selbri place structure, effect on operator formed by"><cx "operator derived from selbri, effect of selbri place structure on">The cmavo “na'u” makes a selbri into an operator. In general, the first place of the selbri specifies the result of the operator, and the other unfilled places specify the oper­ands:

<p>

<ex "tan(pi/2) = infinity"><pre><a name=e18d1>18.1) li na'u tanjo te'u vei pai fe'i re [ve'o] du li ci'i

The-number the-operator tangent ( piπ / 2 ) = the-number infinity.

<math>tan(πpi/2) = ∞<font face="Symbol">&#165;</font><!–infty–></math>

</pre>“tanjo” is the gismu for “x1 is the tangent of x2”, and the “na'u” here makes it into an operator which is then used in forethought.

<p>

<lx "ni'e"><cx "selbri, converting into an operand"><cx "operand, converting selbri into"><cx "conversion, selbri into operand"><cx "formulae, expressing based on pure dimensions">The cmavo “ni'e” makes a selbri into an operand. The x1 place of the selbri generally represents a number, and therefore is often a “ni” abstraction, since “ni” ab­stractions rep­resent numbers. The “ni'e” makes that number available as a mekso oper­and. A common application is to make equations relating pure dimensions:

<p>

<ex "Length × Width × Depth = Volume">××<pre><a name=e18d2>18.2) li ni'e ni clani [te'u] pi'i ni'e ni ganra [te'u] pi'i

ni'e ni condi te'u du li ni'e ni canlu

The-number quantity-of length times quantity-of width times

quantity-of depth equals the-number quantity-of volume.

Length ×&times; Width ×&times; Depth = Volume

</pre><lx "mo'e"><cx "sumti, converting into an operand"><cx "operand, converting sumti into"><cx "conversion, sumti into operand"><cx "dimensioned numbers, expressing">The cmavo “mo'e” operates similarly to “ni'e”, but makes a sumti (rather than a selbri) into an operand. This construction is useful in stating equations involving dimensioned numbers:

<p>

<ex "2 rats + 2 rabbits = 4 animals"><pre><a name=e18d3>18.3) li mo'e re ratcu su'i mo'e re ractu du li mo'e vo danlu

The-number two rats plus two rabbits equals the-number four animals.

2 rats + 2 rabbits = 4 animals.

</pre><cx "folk quantifiers, expressing"><ex "pride of lions">Another use is in constructing Lojbanic versions of so-called “folk quantifiers”, such as “a pride of lions”:

<p>

<pre><a name=e18d4>18.4) mi viska vei mo'e lo'e lanzu ve'o cinfo

I see ( the-typical family )-number-of lions.

I see a pride of lions.

### </pre><a name=s19><h3>Other uses of mekso</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> me'o LI the mekso

nu'a NUhA operator to selbri

mai MAI utterance ordinal

mo'o MAI higher order utterance ordinal

roi ROI quantified tense

</pre><p>So far we have seen mekso used as sumti (with “li”), as quantifiers (often parenthe­sized), and in MOI and ME-MOI selbri. There are a few other minor uses of mekso within Loj­ban.

<p>

<lx "me'o"><cx "me'o, contrasted with li"><cx "li, contrasted with me'o"><cx "mathematical expression, referring to">The cmavo “me'o” has the same grammatical use as “li” but slightly different se­mantics. “li” means “the number which is the value of the mekso <dots>…</dots>”, whereas “me'o” just means “the mekso <dots>…</dots>” So it is true that:

<p>

<pre><a name=e19d1>19.1) li re su'i re du li vo

The-number two plus two equals the-number four.

<math>2 + 2 = 4</math>

</pre>but false that:

<p>

<pre><a name=e19d2>19.2) me'o re su'i re du me'o vo

The-mekso two plus two equals the-mekso four.

“2 + 2” = “4”

</pre><cx "li, relation to me'o compared with la/zo relation"><cx "me'o, relation to li compared with la/zo relation">since the expressions “2 + 2” and “4” are not the same. The relationship between “li” and “me'o” is related to that between “la djan.”, the person named John, and “zo .djan.”, the name “John”.

<p>

<lx "nu'a"><cx "selbri, converting operator into"><cx "operator, converting into selbri"><cx "conversion, operator into selbri"><cx "selbri, place structure of converted operator">The cmavo “nu'a” is the inverse of “na'u”, and allows a mekso operator to be used as a normal selbri, with the place structure:

<p>

<dl compact><dt><dd>x1 is the result of applying (operator) to x2, x3, <dots>…</dots>

</dl>for as many places as may be required. For example:

<p>

<pre><a name=e19d3>19.3) li ni'umu cu nu'a va'a li ma'umu

The-number <math>-5 </math>is-the-negation-of the-number <math>+5</math>.

</pre>uses “nu'a” to make the operator “va'a” into a two-place bridi.

<p>

<cx "questions, operator"><cx "answers, to operator questions"><cx "na'u, use in asking operator questions"><cx "nu'a, use in answering operator questions">Used together, “nu'a” and “na'u” make it possible to ask questions about mekso op­erators, even though there is no specific cmavo for an operator question, nor is it gram­matical to utter an operator in isolation. Consider <a href=#e19d4>Example 19.4</a>, to which <a href=#e19d5>Exam­ple 19.5 </a>is one correct answer:

<p>

<pre><a name=e19d4>19.4) li re na'u mo re du li vo

The-number two what-operator? two equals the-number four

<math>2 ? 2 = 4</math>

<a name=e19d5>19.5) nu'a su'i

plus

</pre><p>In <a href=#e19d4>Example 19.4</a>, “na'u mo” is an operator question, because “mo” is the selbri question cmavo and “na'u” makes the selbri into an operator. <a href=#e19d5>Example 19.5 </a>makes the true an­swer “su'i” into a selbri (which is a legal utterance) with the inverse cmavo “nu'a”. Me­chani­cally speaking, inserting <a href=#e19d5>Example 19.5 </a>into <a href=#e19d4>Example 19.4 </a>produces:

<p>

<pre><a name=e19d6>19.6) li re na'u nu'a su'i re du li vo

The-number two (the-operator the-selbri plus) two equals the-number four.

</pre>where the “na'u nu'a” cancels out, leaving a truthful bridi.

<p>

<lx "mai"><lx "MAI"><ex "firstly"><cx "text, sub-division numbering with -mai"><cx "section numbering"><cx "digit string, definition of">Numerical free modifiers, corresponding to English “firstly”, “secondly”, and so on, can be created by suffixing a member of selma'o MAI to a digit string or a lerfu string. (Digit strings are compound cmavo beginning with a cmavo of selma'o PA, and contain­ing only cmavo of PA or BY; lerfu strings begin with a cmavo of selma'o BY, and like­wise contain only PA or BY cmavo.) Here are some examples:

<p>

<pre><a name=e19d7>19.7) pamai

firstly

<a name=e19d8>19.8) remai

secondly

<a name=e19d9>19.9) romai

all-ly

lastly

19.10) ny.mai

nth-ly

<a name=e19d10><a name=e19d11>19.11) pasomo'o

nineteenthly (higher order)

<a href=#s19>Section 19</a>

</pre><lx "mo'o"><lx "MAI"><ex "firstly"><cx "text, division numbering with -mai"><cx "mai, contrasted with mo'o"><cx "mo'o, contrasted with mai"><cx "chapter numbering">The difference between “mai” and “mo'o” is that “mo'o” enumerates larger subdivisions of a text. Each “mo'o” subdivision can then be divided into pieces and internally num­bered with “mai”. If this chapter were translated into Lojban, each section would be num­bered with “mo'o”. (See Chapter 19 for more on these words.)

<p>

<cx "tense, numerical"><lx "roi"><ex "once">A numerical tense can be created by suffixing a digit string with “roi”. This usage generates tenses corresponding to English “once”, “twice”, and so on. This topic belongs to a detailed discussion of Lojban tenses, and is explained further in <a href=chap10.html>Chapter 10</a>.

<p>

<lx "boi"><cx "ROI, exception on use of boi before"><cx "MAI, exception on use of boi before"><cx "boi, exception before MAI"><cx "boi, exception before ROI"><cx "numerical tenses, effect on use of boi">Note: the elidable terminator “boi” is not used between a number and a mem­ber of MAI or ROI.

<p>

### <a name=s20><h3>Explicit operator precedence</h3>

<p>

As mentioned earlier, Lojban does provide a way for the precedences of op­erators to be explicitly declared, although current parsers do not understand these decla­rations.

<p><lx "ti'o"><lx "SEI">The declaration is made in the form of a metalinguistic comment using “ti'o”, a member of selma'o SEI. “sei”, the other member of SEI, is used to insert metalinguistic comments on a bridi which give information about the discourse which the bridi com­prises. The format of a “ti'o” declaration has not been formally established, but pre­suma­bly would take the form of mentioning a mekso operator and then giving it either an ab­solute numerical precedence on some pre-established scale, or else specifying relative prece­dences between new operators and existing operators.

<p>

<cx "operator precedence, plans for future">In future, we hope to create an improved machine parser that can understand decla­rations of the precedences of simple operators belonging to selma'o VUhU. Origi­nally, all operators would have the same precedence. Declarations would have the ef­fect of raising the specified cmavo of VUhU to higher precedence levels. Complex op­erators formed with “na'u”, “ni'e”, or “ma'o” would remain at the standard low prece­dence; declarations with respect to them are for future implementation efforts. It is probable that such a parser would have a set of “commonly assumed precedences” built into it (selectable by a spe­cial “ti'o” declaration) that would match mathematical intui­tion: times higher than plus, and so on.

<p>

### <a name=s21><h3>Miscellany</h3>

<p>

A few other points:

<p>

<cx "conversion, of operator places"><cx "se, use with operators"><lx "se">“se” can be used to convert an operator as if it were a selbri, so that its argu­ments are exchanged. For example:

<p>

<pre><a name=e21d1>21.1) li ci se vu'u vo du li pa

The-number three (inverse) minus four equals the-number one.

3 subtracted from 4 equals 1.

</pre><lx "SE">The other converters of selma'o SE can also be used on operators with more than two op­erands, and they can be compounded to create (probably unintelligible) operators as needed.

<p>

<lx "NAhE"><cx "negation, of operator">Members of selma'o NAhE are also legal on an operator to produce a scalar negation of it. The implication is that some other operator would apply to make the bridi true:

<p>

<pre><a name=e21d2>21.2) li ci na'e su'i vo du li pare

The-number 3 non-plus 4 equals the-number 12.

</pre><ex "opposite-of-minus"><pre><a name=e21d3>21.3) li ci to'e vu'u re du li mu

The-number 3 opposite-of-minus 2 equals the-number 5.

</pre><p>The sense in which “plus” is the opposite of “minus” is not a mathematical but rather a linguistic one; negated operators are defined only loosely.

<p>

<lx "la'e"><lx "lu'e"><cx "referent, of operand"><cx "symbol, for operand"><lx "bo"><cx "negation, of operand">““la'e” and “lu'e” can be used on operands with the usual semantics to get the referent of or a symbol for an operand. Likewise, a member of selma'o NAhE followed by “bo” serves to scalar-negate an operand, implying that some other operand would make the bridi true:

<p>

<pre><a name=e21d4>21.4) li re su'i re du li na'ebo mu

The-number 2 plus 2 equals the-number non-5.

<math>2 + 2 = </math> something other than 5.

</pre><cx "digits, rafsi for"><cx "digits, names from">The digits 0-9 have rafsi, and therefore can be used in making lujvo. Additionally, all the rafsi have CVC form and can stand alone or together as names:

<p>

<pre><a name=e21d5>21.5) la zel. poi gunta la tebes. pu nanmu

Those-named “Seven” who attack that-named “Thebes” [past] are-men.

The Seven Against Thebes were men.

</pre><p>Of course, there is no guarantee that the name “zel.” is connected with the number rafsi: an alternative which cannot be misconstrued is:

<p>

<pre><a name=e21d6>21.6) la zemei poi gunta la tebes. pu nanmu

Those-named-the Sevensome who attack Thebes [past] are-men.

</pre><cx "PA, members with rafsi"><cx "rafsi, conventional meaning for frinu">Certain other members of PA also have assigned rafsi: “so'a”, “so'e”, “so'i”, “so'o”, “so'u”, “da'a”, “ro”, “su'e”, “su'o”, “pi”, and “ce'i”. Furthermore, although the cmavo “fi'u” does not have a rafsi as such, it is closely related to the gismu “frinu”, meaning “fraction”; therefore, in a context of numeric rafsi, you can use any of the rafsi for “frinu” to indicate a fraction slash.

<p>

<cx "rafsi, conventional meaning for cu'o">A similar convention is used for the cmavo “cu'o” of selma'o MOI, which is closely related to “cunso” (probability); use a rafsi for “cunso” in order to create lujvo based on “cu'o”. The cmavo “mei” and “moi” of MOI have their own rafsi, two each in fact: “mem”/“mei” and “mom”/“moi” respectively.

<p>

<cx "lambda calculus, operator and operand distinction in"><cx "algebra of functions, operator and operand distinction in"><lx "ni'enu'a"><cx "conversion, operator into operand"><cx "operator, converting into operand"><cx "operand, converting from operator">The grammar of mekso as described so far imposes a rigid distinction between op­erators and operands. Some flavors of mathematics (lambda calculus, algebra of func­tions) blur this distinction, and Lojban must have a method of doing the same. An opera­tor can be changed into an operand with “ni'enu'a”, which transforms the operator into a matching selbri and then the selbri into an operand.

<p>

<cx "conversion, operand into operator"><cx "operand, converting into operator"><cx "operator, converting from operand"><lx "ma'o"><lx "te'u">To change an operand into an operator, we use the cmavo “ma'o”, already in­troduced as a means of changing a lerfu string such as “fy.” into an operator. In fact, “ma'o” can be followed by any mekso operand, using the elidable terminator “te'u” if necessary.

<p>

<cx "ma'o, potential ambiguity caveat">There is a potential semantic ambiguity in “ma'o fy. [te'u]” if “fy.” is already in use as a variable: it comes to mean “the function whose value is always 'f’”. How­ever, mathematicians do not normally use the same lerfu words or strings as both func­tions and variables, so this case should not arise in practice.

<p>

### <a name=s22><h3>Four score and seven: a mekso problem</h3>

<p>

<ex "Gettysburg Address"><ex "Four score and seven"><cx "mekso, and literary translation">Abraham Lincoln's Gettysburg Address begins with the words “Four score and seven years ago”. This section exhibits several different ways of saying the number “four score and seven”. (A “score”, for those not familiar with the term, is 20; it is analogous to a “dozen” for 12.) The trivial way:

<p>

<pre><a name=e22d1>22.1) bize

eight seven

87

</pre><a href=#e22d1>Example 22.1 </a>is mathematically correct, but sacrifices the spirit of the English words, which are intended to be complex and formal.

<p>

<pre><a name=e22d2>22.2) vo pi'i reno su'i ze

four times twenty plus seven

<math>4 &times;× 20 + 7</math>

</pre><cx "score, as 20-year span"><a href=#e22d2>Example 22.2 </a>is also mathematically correct, but still misses something. “Score” is not a word for 20 in the same way that “ten” is a word for 10: it contains the implication of 20 objects. The original may be taken as short for “Four score years and seven years ago”. Thinking of a score as a twentysome rather than as 20 leads to:

<p>

<pre><a name=e22d3>22.3) mo'e voboi renomei su'i ze

the-number-of four twentysomes plus seven

</pre><p>In <a href=#e22d3>Example 22.3</a>, “voboi renomei” is a sumti signifying four things each of which are groups of twenty; the “mo'e” and “te'u” then make this sumti into a number in order to allow it to be the operand of “su'i”.

<p>

<cx "score, as alternate base for years"><cx "base-20 arithmetic, remnants of">Another approach is to think of “score” as setting a representation base. There are remnants of base-20 arithmetic in some languages, notably French, in which 87 is “quatre-vingt-sept”, literally “four-twenties-seven”. (This fact makes the Gettysburg Ad­dress hard to translate into French!) If “score” is the representation base, then we have:

<p>

<pre><a name=e22d4>22.4) vo pi'e ze ju'u reno

four ; seven base 20

<math>47<sub>20</sub></math>

</pre><p>Overall, <a href=#e22d3>Example 22.3 </a>probably captures the flavor of the English best. <a href=#e22d1>Example 22.1 </a>and <a href=#e22d2>Example 22.2 </a>are too simple, and <a href=#e22d4>Example 22.4 </a>is too tricky. Nevertheless, all four ex­amples are good Lojban. Pedagogically, these examples illustrate the richness of loj­bau mekso: anything that can be said at all, can probably be said in more than one way.

<p>

<p>

### <a name=s23><h3>mekso selma'o summary</h3>

<p>

Except as noted, each selma'o has only one cmavo.

<p>

<cx "mekso, list of selma'o for"><pre> BOI elidable terminator for numerals and lerfu strings

BY lerfu for variables and functions (see <a href=chap17.html>Chapter 17</a>)

FUhA reverse-Polish flag

GOhA includes “du” (mathematical equality) and other non-mekso cmavo

JOhI array flag

KUhE elidable terminator for forethought mekso

LI mekso articles (li and me'o)

MAhO make operand into operator

MOI creates mekso selbri (moi, mei, si'e, and cu'o, see <a href=#s11>Section 11</a>)

MOhE make sumti into operand

NAhU make selbri into operator

NIhE make selbri into operand

NUhA make operator into selbri

PA numbers (see <a href=#s25>Section 25</a>)

PEhO optional forethought mekso marker

TEhU elidable terminator for NAhU, NIhE, MOhE, MAhO, and JOhI

VEI left parenthesis

VEhO right parenthesis

VUhU operators (see <a href=#s24>Section 24</a>)

XI subscript flag

### </pre><a name=s24><h3>Complete table of VUhU cmavo, with operand structures</h3>

<p>

The operand structures specify what various operands (labeled *<math>a</math>, <math>b</math>, <math>c</math>,* <dots>…</dots>) mean. The implied context is forethought, since only forethought operators can have a variable num­ber of operands; however, the same rules apply to infix and RP uses of VUhU.

<p>

<cx "operators, list of simple"><dl compact><dt>su'i <dd>plus <math>(((*a* + *b*) + *c*) + <dots>…</dots>)</math>

pi'i times <math>(((*a* ×&times; *b*) ×&times; *c*) ×&times; <dots>…</dots>)</math>

vu'u minus <math>(((*a* - *b*) - *c*) - <dots>…</dots>)</math>

fe'i divided by <math>(((*a* / *b*) / *c*) / <dots>…</dots>)</math>

ju'u number base numeral string “a” interpreted in the base *b*

pa'i ratio the ratio of a to b, <math>a:b</math>

fa'i reciprocal/multiplicative inverse <math>1 / *a*</math>

gei scientific notation *<math>b* ×&times; (*c* </math>[default 10] to the *<math>a* </math>power<math>)</math>

ge'a null operator (no operands)

de'o logarithm log <i>*a* </i>to base <i>*b* </i>(default 10 or <i>*e*</i> as

appropriate)

te'a to the power/exponential *a* to the *b* power

fe'a nth root/inverse power *b*th root of *a* (default square root: *b* = 2)

cu'a absolute value/norm <math>| *a* |</math>

ne'o factorial *<math>a*!</math>

pi'a matrix row vector combiner (all operands are row vectors)

sa'i matrix column vector combiner (all operands are column vectors)

ri'o integral integral of *a* with respect to *b* over range *c*

sa'o derivative derivative of *a* with respect to *b* of degree *c* (default 1)

fu'u non-specific operator (variable)

si'i sigma (Σ) summation summation of *a* using variable *b* over range *c*

va'a negation of/additive inverse <math>-*a*</math>

re'a matrix transpose/dual *<math>a*\*</math>

### </dl><a name=s25><h3>Complete table of PA cmavo: digits, punctuation, and other num­bers.</h3>

<p>

* <cx "digits, list of decimal">Decimal digits:

<p>

<dl compact><dt> <dd>no, pa, re, ci, vo, mu, xa, ze, bi, so

0, 1, 2, 3, 4, 5, 6, 7, 8, 9

rafsi: non, pav, rel, cib, von, mum, xav, zel, biv, soz

* </dl><cx "digits, list of hexadecimal">Hexadecimal digits:

<p>

<dl compact><dt> <dd>dau, fei, gai, jau, rei, vai

A/10, B/11, C/12, D/13, E/14, F/15

* </dl><cx "numbers, list of special">Special numbers:

<p>

<dl compact><dt> <dd>pai, ka'o, te'o, ci'i

π, imaginary i, exponential e, infinity (∞)

* </dl><cx "punctuation, list of numerical">Number punctuation:

<p>

<dl compact><dt> <dd>pi, ce'i, fi'u

decimal point, percentage, fraction (not division)

rafsi: piz, cez, fi'u (from frinu; see <a href=#s20>Section 20</a>)

<p><dt> <dd>pi'e, ma'u, ni'u

mixed-base point, plus sign (not addition), minus sign (not subtraction)

<p><dt> <dd>ki'o, ra'e

thousands comma, repeating-decimal indicator

<p><dt> <dd>ji'i, ka'o

approximation sign, complex number separator

* </dl><cx "numbers, list of indefinite">Indefinite numbers:

<p>

<dl compact><dt> <dd>ro, so'a, so'e, so'i, so'o, so'u, da'a

all, almost all, most, many, several, few, all but

rafsi: rol, soj, sor or so'i, sos, sot, daz

<p><dt> <dd>su'e, su'o

at most, at least

rafsi: su'e, su'o

<p><dt> <dd>me'i, za'u

less than, more than

<p><dt> <dd>no'o

the typical number

* </dl><p>Subjective numbers:

<p>

<dl compact><dt> <dd>rau, du'e, mo'a

enough, too many, too few

* </dl><p>Miscellaneous:

<p>

<dl compact><dt> <dd>xo, tu'o

number question, null operand

### </dl><a name=s26><h3>Table of MOI cmavo, with associated rafsi and place structures</h3>

<p>

<lx "MOI"><cx "MOI, list of cmavo in"><pre> mei x1 is a mass formed from a set x2 of <math>n </math>members, one or more of

which is/are x3, [measured relative to the set x4/by standard x4]

rafsi: mem, mei

moi x1 is the (n)th member of set x2 when ordered by rule x3

[by standard x4]

rafsi: mom, moi

si'e x1 is an (n)th portion of mass x2 [by standard x3]

rafsi: none

cu'o event x1 has probability (n) of occurring under conditions x2

[by standard x3]

rafsi: cu'o (borrowed from cunso; see <a href=#s20>Section 20</a>)

va’e x1 is at scale position (n) on the scale x2

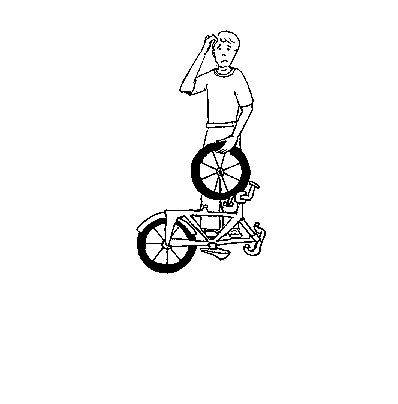
[by standard x3]

rafsi: none

</body></html>

<center><p align=center>

<img src=chap19.gif alt=[Cartoon] align=center width=405 height=405>



## <h2>Chapter 19

## <br>

## Putting It All Together: Notes on the Structure of Lojban Texts</h2>

###### <h6>$Revision: 4.1 $<br> mkhtml: 1.1</h6></p></center>

<p>

### Introductory</h3>

<p><cx "text, structure of"><a name=s1><h3>

This chapter is incurably miscellaneous. It describes the cmavo that specify the structure of Lojban texts, from the largest scale (paragraphs) to the smallest (single words). There are fewer examples than are found in other chapters of this book, since the linguistic mechanisms described are generally made use of in conversation or else in long documents.

<p>

This chapter is also not very self-contained. It makes passing reference to a great many concepts which are explained in full only in other chapters. The alternative would be a chapter on text structure which was as complex as all the other chapters put together. Lojban is a unified language, and it is not possible to understand any part of it (in full) before understanding every part of it (to some degree).

<p>

### Sentences: I</h3>

<p><cx "sentences, joining"><a name=s2><h3>

The following cmavo is discussed in this section:

<p>

<lx ".i"><lx "I"><pre> .i I sentence separator

</pre><cx "audio-visually isomorphic">Since Lojban is audio-visually isomorphic, there needs to be a spoken and written way of signaling the end of a sentence and the start of the following one. In written Eng­lish, a period serves this purpose; in spoken English, a tone contour (rising or falling) usually does the job, or sometimes a long pause. Lojban uses a single sepa­rator: the cmavo “.i” (of selma'o I):

<p>

<pre><a name=e2d1>2.1) mi klama le zarci .i do cadzu le bisli

I go to-the store. You walk on-the ice.

</pre><cx "sentences, separator for joining">The word “separator” should be noted. “.i” is not normally used after the last sentence nor before the first one, although both positions are technically grammatical. “.i” sig­nals a new sentence on the same topic, not necessarily by the same speaker. The rela­tionship between the sentences is left vague, except in stories, where the relationship usually is temporal, and the following sentence states something that happened after the previous sentence.

<p>

Note that although the first letter of an English sentence is capitalized, the cmavo “.i” is never capitalized. In writing, it is appropriate to place extra space before “.i” to make it stand out better for the reader. In some styles of Lojban writing, every “.i” is placed at the beginning of a line, possibly leaving space at the end of the previous line.

<p>

An “.i” cmavo may or may not be used when the speaker of the following sentence is different from the speaker of the preceding sentence, depending on whether the sentences are felt to be connected or not.

<p>

An “.i” cmavo can be compounded with a logical or non-logical connective (a jek or joik), a modal or tense connective, or both: these constructs are explained in <a href=chap9.html>Chapter 9</a>, <a href=chap10.html>Chapter 10</a>, and <a href=chap14.html>Chapter 14</a>. In all cases, the “.i” comes first in the com­pound. Attitudi­nals can also be attached to an “.i” if they are meant to apply to the whole sentence: see <a href=chap13.html>Chapter 13</a>.

<p>

<lx "bo"><lx "BO"><cx "sentences, close grouping">There exist a pair of mechanisms for binding a sequence of sentences closely to­gether. If the “.i” (with or without connectives) is followed by “bo” (of selma'o BO), then the two sentences being separated are understood to be more closely grouped than sen­tences connected by “.i” alone.

<p>

<lx "tu'e"><lx "tu'u"><lx "TUhE"><lx "TUhU"><cx "title, specifying with tu'e…tu'u">Similarly, a group of sentences can be preceded by “tu'e” (of selma'o TUhE) and followed by “tu'u” (of selma'o TUhU) to fuse them into a single unit. A common use of “tu'e <dots>…</dots>tu'u” is to group the sentences which compose a poem: the title sentence would precede the group, separated from it by “.i”. Another use might be a set of direc­tions, where each numbered direction might be surrounded by “tu'e <dots>…</dots>tu'u” and contain one or more sentences separated by “.i”. Grouping with “tu'e” and “tu'u” is analogous to group­ing with “ke” and “ke'e” to establish the scope of logical or non-logical connec­tives (see <a href=chap14.html>Chapter 14</a>).

<p>

### Paragraphs: NIhO</h3>

<p><cx "paragraphs, separating"><a name=s3><h3>

The following cmavo are discussed in this section:

<p>

<pre> ni'o NIhO new topic

no'i NIhO old topic

da'o DAhO cancel cmavo assignments

</pre><p>The paragraph is a concept used in writing systems for two purposes: to indi­cate changes of topic, and to break up the hard-to-read appearance of large blocks of text on the page. The former function is represented in both spoken and written Lojban by the cmavo “ni'o” and “no'i”, both of selma'o NIhO. Of these two, “ni'o” is the more common. By convention, written Lojban is broken into paragraphs just before any “ni'o” or “no'i”, but a very long passage on a single topic might be paragraphed before an “.i”. On the other hand, it is conventional in English to start a new paragraph in dia­logue when a new speaker starts, but this convention is not commonly observed in Loj­ban dialogues. Of course, none of these conventions affect meaning in any way.

<p>

<lx "ni'o"><lx "NIhO"><cx "old topic"><cx "paragraphs, separator">A “ni'o” can take the place of an “.i” as a sentence separator, and in addition signals a new topic or paragraph. Grammatically, any number of “ni'o” cmavo can ap­pear con­secutively and are equivalent to a single one; semantically, a greater number of “ni'o” cmavo indicates a larger-scale change of topic. This feature allows complexly structured text, with topics, subtopics, and sub-subtopics, to be represented clearly and unambigu­ously in both spoken and written Lojban. However, some conventional differ­ences do exist between “ni'o” in writing and in conversation.

<p>

<cx "indicator scope"><cx "discursive indicator"><lx "da'o"><lx "DAhO"><cx "paragraphs, effects on scope"><cx "pro-bridi, scope effect of new paragraph"><cx "pro-sumti, scope effect of new paragraph"><cx "indicators, scope effect of new paragraph"><cx "tense, scope effect of new paragraph"><cx "paragraph separation, written text">In written text, a single “ni'o” is a mere discursive indicator of a new subject, whereas “ni'oni'o” marks a change in the context. In this situation, “ni'oni'o” implicitly cancels the definitions of all pro-sumti of selma'o KOhA as well as pro-bridi of selma'o GOhA. (Explicit cancelling is expressed by the cmavo “da'o” of selma'o DAhO, which has the free grammar of an indicator – it can appear almost anywhere.) The use of “ni'oni'o” does not affect indicators (of selma'o UI) or tense references, but “ni'oni'oni'o”, indicating a drastic change of topic, would serve to reset both indicators and tenses. (See <a href=#s8>Section 8 </a>for a discussion of indicator scope.)

<p>

<cx "Arabian Nights"><cx "paragraph separation, spoken text">In spoken text, which is inherently less structured, these levels are reduced by one, with “ni'o” indicating a change in context sufficient to cancel pro-sumti and pro-bridi assignment. On the other hand, in a book, or in stories within stories such as “The Ara­bian Nights”, further levels may be expressed by extending the “ni'o” string as needed. Normally, a written text will begin with the number of “ni'o” cmavo needed to signal the largest scale division which the text contains. “ni'o” strings may be sub­scripted to label each context of discourse: see <a href=#s6>Section 6</a>.

<p>

<cx "previous topic"><lx "no'i"><lx "NIhO">“no'i” is similar in effect to “ni'o”, but indicates the resumption of a previous topic. In speech, it is analogous to (but much shorter than) such English discursive phrases as “But getting back to the point <dots>…</dots>”. By default, the topic resumed is that in effect before the last “ni'o”. When subtopics are nested within topics, then “no'i” would resume the previous subtopic and “no'ino'i” the previous topic. Note that “no'i” also resumes tense and pro-sumti assignments dropped at the previous “ni'o”.

<p>

<cx "subscripted topics">If a “ni'o” is subscripted, then a “no'i” with the same subscript is assumed to be a continuation of it. A “no'i” may also have a negative subscript, which would specify counting backwards a number of paragraphs and resuming the topic found thereby.

<p>

### Topic-comment sentences: ZOhU</h3>

<p><cx "topic-comment sentences"><a name=s4><h3>

The following cmavo is discussed in this section:

<p>

<pre> zo'u ZOhU topic/comment separator

</pre><p>The normal Lojban sentence is just a bridi, parallel to the normal English sen­tence which has a subject and a predicate:

<p>

<pre><a name=e4d1>4.1) mi klama le zarci

I went to the market.

</pre><cx "topic-comment, description">In Chinese, the normal sentence form is different: a topic is stated, and a comment about it is made. (Japanese also has the concept of a topic, but indicates it by attaching a suffix; other languages also distinguish topics in various ways.) The topic says what the sentence is about:

<p>

<ex "news"><pre><a name=e4d2>4.2) zhe<sup>4</sup> xiao<sup>1</sup>xi<sup>2 </sup>wo<sup>3</sup> zhi<sup>1</sup>dao le

this news I know [perfective]

As for this news, I knew it.

I've heard this news already.

</pre><lx "zo'u"><lx "ZOhU">The wide space in the first two versions of <a href=#e4d2>Example 4.2 </a>separate the topic (“this news”) from the comment (“I know already”).

<p>

Lojban uses the cmavo “zo'u” (of selma'o ZOhU) to separate topic (a sumti) from comment (a bridi):

<p>

<pre><a name=e4d3>4.3) le nuzba zu'o mi ba'o djuno

The news : I [perfective] know.

</pre><a href=#e4d3>Example 4.3 </a>is the literal Lojban translation of <a href=#e4d2>Example 4.2</a>. Of course, the topic-com­ment structure can be changed to a straightforward bridi structure:

<p>

<pre><a name=e4d4>4.4) mi ba'o djuno le nuzba

I [perfective] know the news.

</pre><a href=#e4d4>Example 4.4 </a>means the same as <a href=#e4d3>Example 4.3</a>, and it is simpler. However, often the po­sition of the topic in the place structure of the selbri within the comment is vague:

<p>

<ex "fish eat"><pre><a name=e4d5>4.5) le finpe zo'u citka

the fish : eat

</pre><p>Is the fish eating or being eaten? The sentence doesn't say. The Chinese equivalent of <a href=#e4d5>Example 4.5 </a>is:

<p>

<pre><a name=e4d6>4.6) yu<sup>2 </sup>chi<sup>1</sup>

fish eat

</pre>which is vague in exactly the same way.

<p>

Grammatically, it is possible to have more than one sumti before “zo'u”. This is not normally useful in topic-comment sentences, but is necessary in the other use of “zo'u”: to separate a quantifying section from a bridi containing quantified variables. This usage belongs to a discussion of quantifier logic in Lojban (see <a href=chap16.html>Chapter 16</a>), but an example would be:

<p>

<pre><a name=e4d7>4.7) roda poi prenu ku'o su'ode zo'u de patfu da

For-all X which-are-persons, there-exists-a-Y such-that Y is the father of X.

Every person has a father.

</pre><p>The string of sumti before “zo'u” (called the “prenex”: see <a href=chap16.html>Chapter 16</a>) may contain both a topic and bound variables:

<p>

<pre><a name=e4d8>4.8) loi patfu roda poi prenu ku'o

su'ode zo'u de patfu da

For-the-mass-of fathers for-all X which-are-persons,

there-exists-a-Y such-that Y is the father of X.

As for fathers, every person has one.

</pre><cx "topic/comment, multiple sentence">To specify a topic which affects more than one sentence, wrap the sentences in “tu'e <dots>…</dots>tu'u” brackets and place the topic and the “zo'u” directly in front. This is the ex­ception to the rule that a topic attaches directly to a sentence:

<p>

<pre><a name=e4d9>4.9) loi jdini zo'u tu'e do ponse .inaja do djica [tu'u]

The-mass-of money : ( [if] you possess, then you want )

Money: if you have it, you want it.

</pre><p>Note: In Lojban, you do not “want money”; you “want to have money” or something of the sort, as the x2 place of “djica” demands an event. As a result, the straightforward ren­dering of <a href=#e4d8>Example 4.8 </a>without a topic is not:

<p>

<pre><a name=e4d10>4.10) do ponse loi jdini .inaja do djica ri

You possess money only-if you desire its-mere-existence.

</pre>where “ri” means “loi jdini” and is interpreted as “the mere existence of money”, but rather:

<p>

<pre><a name=e4d11>4.11) do ponse loi jdini .inaja do djica tu'a ri

You possess money only-if you desire something-about it.

</pre>namely, the possession of money. But topic-comment sentences like <a href=#e4d9>Example 4.9 </a>are in­herently vague, and this difference between “ponse” (which expects a physical object in x2) and “djica” is ignored. See <a href=#e9d3>Example 9.3 </a>for another topic/comment sentence.

<p>

The subject of an English sentence is often the topic as well, but in Lojban the sumti in the x1 place is not necessarily the topic, especially if it is the normal (unconverted) x1 for the selbri. Thus Lojban sentences don't necessarily have a “subject” in the English sense.

<p>

### Questions and answers</h3>

<p><cx "questions"><cx "answers"><a name=s5><h3>

The following cmavo are discussed in this section:

<p>

<pre> xu UI truth question

ma KOhA sumti question

mo GOhA bridi question

xo PA number question

ji A sumti connective question

ge'i GA forethought connective question

gi'i GIhA bridi-tail connective question

gu'i GUhA tanru forethought connective question

je'i JA tanru connective question

pei UI attitude question

fi'a FA place structure question

cu'e CUhE tense/modal question

pau UI question premarker

</pre><cx "questions, truth"><lx "xu"><lx "UI">Lojban questions are not at all like English questions. There are two basic types: truth questions, of the form “Is it true that <dots>…</dots>”, and fill-in-the-blank questions. Truth questions are marked by preceding the bridi, or following any part of it specifi­cally ques­tioned, with the cmavo “xu” (of selma'o UI):

<p>

<pre><a name=e5d1>5.1) xu do klama le zarci

[True or false?] You go to the store

Are you going to the store/Did you go to the store?

</pre>(Since the Lojban is tenseless, either colloquial translation might be correct.) Truth ques­tions are further discussed in <a href=chap15.html>Chapter 15</a>.

<p>

<cx "questions, fill-in-the-blank">Fill-in-the-blank questions have a cmavo representing some Lojban word or phrase which is not known to the questioner, and which the answerer is to supply. There are a variety of cmavo belonging to different selma'o which provide different kinds of blanks.

<p>

<lx "ma"><lx "KOhA"><cx "questions, sumti">Where a sumti is not known, a question may be formed with “ma” (of selma'o KOhA), which is a kind of pro-sumti:

<p>

<pre><a name=e5d2>5.2) ma klama le zarci

[What sumti?] goes-to the store

Who is going to the store?

</pre><p>Of course, the “ma” need not be in the x1 place:

<p>

<pre><a name=e5d3>5.3) do klama ma

You go-to [what sumti?]

Where are you going?

</pre><p>The answer is a simple sumti:

<p>

<pre><a name=e5d4>5.4) le zarci

The store.

</pre><p>A sumti, then, is a legal utterance, although it does not by itself constitute a bridi – it does not claim anything, but merely completes the open-ended claim of the previous bridi.

<p>

<cx "questions, multiple">There can be two “ma” cmavo in a single question:

<p>

<pre><a name=e5d5>5.5) ma klama ma

Who goes where?

</pre>and the answer would be two sumti, which are meant to fill in the two “ma” cmavo in order:

<p>

<pre><a name=e5d6>5.6) mi le zarci

I, to the store.

</pre><lx "fa'u"><lx "JOI">An even more complex example, depending on the non-logical connective “fa'u” (of selma'o JOI), which is like the English “and <dots>…</dots>respectively”:

<p>

<pre><a name=e5d7>5.7) ma fa'u ma klama ma fa'u ma

Who and who goes where and where, respectively?

</pre><p>An answer might be

<p>

<pre><a name=e5d8>5.8) la djan. la marcas. le zarci le briju

John, Marsha, the store, the office.

John and Marsha go to the store and the office,

respectively.

</pre>(Note: A mechanical substitution of <a href=#e5d8>Example 5.8 </a>into <a href=#e5d7>Example 5.7 </a>produces an un­gram­matical result, because “\* <dots>…</dots>le zarci fa'u le briju” is ungrammatical Lojban: the first “le zarci” has to be closed with its proper terminator “ku”, for reasons explained in <a href=chap14.html>Chapter 14</a>. This effect is not important: Lojban behaves as if all elided terminators have been supplied in both question and answer before inserting the latter into the for­mer. The ex­change is grammatical if question and answer are each separately gram­matical.)

<p>

<lx "mo"><lx "GOhA"><cx "questions, selbri">Questions to be answered with a selbri are expressed with “mo” of selma'o GOhA, which is a kind of pro-bridi:

<p>

<pre><a name=e5d9>5.9) la lojban. mo

Lojban [what selbri?]

What is Lojban?

</pre><cx "predicate answers">Here the answerer is to supply some predicate which is true of Lojban. Such questions are extremely open-ended, due to the enormous range of possible predicate answers. The an­swer might be just a selbri, or might be a full bridi, in which case the sumti in the answer override those provided by the questioner. To limit the range of a “mo” question, make it part of a tanru.

<p>

<cx "questions, number">Questions about numbers are expressed with “xo” of selma'o PA:

<p>

<pre><a name=e5d10>5.10) do viska xo prenu

You saw [what number?] persons.

How many people did you see?

</pre><p>The answer would be a simple number, another kind of non-bridi utterance:

<p>

<pre><a name=e5d11>5.11) vomu

Forty-five.

</pre><p>Fill-in-the-blank questions may also be asked about: logical connectives (using cmavo “ji” of A, “ge'i” of GA, “gi'i” of GIhA, “gu'i” of GUhA, or “je'i” of JA, and re­ceiving an ek, gihek, ijek, or ijoik as an answer) — see <a href=chap14.html>Chapter 14</a>; attitudes (using “pei” of UI, and receiving an attitudinal as an answer) — see <a href=chap13.html>Chapter 13</a>; place struc­tures (using “fi'a” of FA, and receiving a cmavo of FA as an answer) — see <a href=chap9.html>Chapter 9</a>; tenses and modals (using “cu'e” of CUhE, and receiving any tense or BAI cmavo as an answer) — see <a href=chap9.html>Chapter 9 </a>and <a href=chap10.html>Chapter 10</a>.

<p>

Questions can be marked by placing “pau” (of selma'o UI) before the question bridi. See <a href=chap13.html>Chapter 13 </a>for details.

<p>

The full list of non-bridi utterances suitable as answers to questions is:

<p>

* <cx "utterances, non-bridi"><cx "linked arguments"><dl compact><dt><dd>any number of sumti (with elidable terminator “vau”, see <a href=chap6.html>Chapter 6</a>)
* an ek or gihek (logical connectives, see <a href=chap14.html>Chapter 14</a>)
* a number, or any mathematical expression placed in parentheses (see <a href=chap18.html>Chapter 18</a>)
* a bare “na” negator (to negate some previously expressed bridi), or corre­sponding “ja'a” affirmer (see <a href=chap15.html>Chapter 15</a>)
* a relative clause (to modify some previously expressed sumti, see <a href=chap8.html>Chapter 8</a>)
* a prenex/topic (to modify some previously expressed bridi, see <a href=chap16.html>Chapter 16</a>)
* linked arguments (beginning with “be” or “bei” and attached to some pre­viously expressed selbri, often in a description, see <a href=chap5.html>Chapter 5</a>)

</dl><p>At the beginning of a text, the following non-bridi are also permitted:

<p>

* <dl compact><dt><dd>one or more names (to indicate direct address without “doi”, see <a href=chap6.html>Chapter 6</a>)
* indicators (to express a prevailing attitude, see <a href=chap13.html>Chapter 13</a>)
* “nai” (to vaguely negate something or other, see <a href=chap15.html>Chapter 15</a>)

</dl><p>Where not needed for the expression of answers, most of these are made grammatical for pragmatic reasons: people will say them in conversation, and there is no reason to rule them out as ungrammatical merely because most of them are vague.

<p>

### Subscripts: XI</h3>

<p><cx "subscripts"><a name=s6><h3>

The following cmavo is discussed in this section:

<p>

<pre> xi XI subscript

</pre><lx "xi"><lx "XI"><cx "subscripting">The cmavo “xi” (of selma'o XI) indicates that a subscript (a number, a lerfu string, or a parenthesized mekso) follows. Subscripts can be attached to almost any construction and are placed following the construction (or its terminator word, which is generally re­quired). They are useful either to extend the finite cmavo list to infinite length, or to make more refined distinctions than the standard cmavo list permits. The remainder of this sec­tion mentions some places where subscripts might naturally be used.

<p>

Lojban gismu have at most five places:

<p>

<pre><a name=e6d1>6.1) mi cu klama le zarci le zdani le dargu le karce

I go to-the market from-the house via-the road using-the car.

</pre><p>Consequently, selma'o SE (which operates on a selbri to change the order of its places) and selma'o FA (which provides place number tags for individual sumti) have only enough members to handle up to five places. Conversion of <a href=#e6d1>Example 6.1</a>, using “xe” to swap the x1 and x5 places, would produce:

<p>

<pre><a name=e6d2>6.2) le karce cu xe klama le zarci le zdani le dargu

mi

The car is-a-transportation-means to-the market from-the house via-the road

for-me.

</pre><p>And reordering of the place structures might produce:

<p>

<pre><a name=e6d3>6.3) fo le dargu fi le zdani fa mi fe le zarci fu le karce cu klama

Via the road, from the house, I, to the market, using-the car, go.

</pre><a href=#e6d{1}>Examples 6.1 </a>to <a href=#e6d3>6.3 </a>all mean the same thing. But consider the lujvo “nunkla”, formed by applying the abstraction operator “nu” to “klama”:

<p>

<pre><a name=e6d4>6.4) la'edi'u cu nunkla

mi le zarci le zdani le dargu le karce

The-referent-of-the-previous-sentence is-an-event-of-going

by-me to-the market from-the house via-the road using-the car.

</pre><cx "subscripting, and sumti re-ordering"><cx "SE, after 5th place"><cx "FA, after 5th place"><lx "se"><lx "SE"><a href=#e6d4>Example 6.4 </a>shows that “nunkla” has six places: the five places of “klama” plus a new one (placed first) for the event itself. Performing transformations similar to that of <a href=#e6d2>Ex­ample 6.2 </a>requires an additional conversion cmavo that exchanges the x1 and x6 places. The solution is to use any cmavo of SE with a subscript “6” (see Chapter 19):

<p>

<pre><a name=e6d5>6.5) le karce cu sexixa nunkla mi

le zarci le zdani le dargu la'edi'u

The car is-a-transportation-means-in-the-event-of-going by-me

to-the market via-the road which-is-referred-to-by-the-last-sentence.

</pre><p>Likewise, a sixth place tag can be created by using any cmavo of FA with a subscript:

<p>

<pre><a name=e6d6>6.6) fu le dargu fo le zdani fe mi fa la'edi'u

fi le zarci faxixa le karce cu klama

Via the road, from the house, by me, the-referent-of-the-last-sentence,

to the market, using the car, is-an-event-of-going.

</pre><a href=#e6d{4}>Examples 6.4 </a>to <a href=#e6d6>6.6 </a>also all mean the same thing, and each is derived straightforwardly from any of the others, despite the tortured nature of the English glosses. In addition, any other member of SE or FA could be substituted into “sexixa” and “faxixa” without change of meaning: “vexixa” means the same thing as “sexixa”.

<p>

<cx "subscripting, and pro-sumti"><cx "da-series, after third"><cx "ko'a-series, after tenth">Lojban provides two groups of pro-sumti, both belonging to selma'o KOhA. The ko'a-series cmavo are used to refer to explicitly specified sumti to which they have been bound using “goi”. The da-series, on the other hand, are existentially or univer­sally quan­tified variables. (These concepts are explained more fully in <a href=chap16.html>Chapter 16</a>.) There are ten ko'a-series cmavo and 3 da-series cmavo available.

<p>

<lx "DA"><lx "da">If more are required, any cmavo of the ko'a-series or the da-series can be sub­scripted:

<p>

<pre><a name=e6d7>6.7) daxivo

X sub 4

</pre>is the 4th bound variable of the 1st sequence of the da-series, and

<p>

<pre><a name=e6d8>6.8) ko'ixipaso

something-3 sub 18

</pre>is the 18th free variable of the 3rd sequence of the ko'a-series. This convention allows 10 sequences of ko'a-type pro-sumti and 3 sequences of da-type pro-sumti, each with as many members as needed. Note that “daxivo” and “dexivo” are considered to be dis­tinct pro-sumti, unlike the situation with “sexixa” and “vexixa” above. Exactly similar treat­ment can be given to the bu'a-series of selma'o GOhA and to the gismu pro-bridi “broda”, “brode”, “brodi”, “brodo”, and “brodu”.

<p>

<p>

<cx "subscripting, mathematical">Subscripts on lerfu words are used in the standard mathematical way to extend the number of variables:

<p>

<pre><a name=e6d9>6.9) li xy.boixipa du li xy.boixire su'i xy.boixici

The-number x-sub-1 equals the-number x-sub-2 plus x-sub-3

*$x*<sub>1</sub> = *x*<sub>2</sub> + *x*<sub>3</sub>$

</pre>and can be used to extend the number of pro-sumti as well, since lerfu strings outside mathematical contexts are grammatically and semantically equivalent to pro-sumti of the ko'a-series. (In <a href=#e6d9>Example 6.9</a>, note the required terminator “boi” after each “xy.” cmavo; this terminator allows the subscript to be attached without ambiguity.)

<p>

<p>

<cx "subscripting, and names">Names, which are similar to pro-sumti, can also be subscripted to distinguish two in­dividuals with the same name:

<p>

<pre><a name=e6d10>6.10) la djan. xipa cusku lu mi'enai do li'u la djan. xire

John<sub>1</sub> expresses “I-am-not you” to John<sub>2</sub>.

<cx "subscripting, and tense">Subscripts on tenses allow talking about more than one time or place that is de­scribed by the same general cmavo. For example, “puxipa” could refer to one point in the past, and “puxire” a second point (earlier or later).

<p>

<p>

<cx "subscripting, and fuzzy truths">You can place a subscript on the word “ja'a”, the bridi affirmative of selma'o NA, to express so-called fuzzy truths. The usual machinery for fuzzy logic (statements whose truth value is not merely “true” or “false”, but is expressed by a number in the range 0 to 1) in Lojban is the abstractor “jei”:

<p>

<pre><a name=e6d11>6.11) li pimu jei mi ganra

The-number .5 is-the-truth-value-of my being-broad

</pre><p>However, by convention we can attach a subscript to “ja'a” to indicate fuzzy truth (or to “na” if we change the amount):

<p>

<pre><a name=e6d12>6.12) mi ja'a xipimu ganra

I truly-sub-.5 am-broad

</pre><cx "subscripting, and paragraph separators">Finally, as mentioned in <a href=#s2>Section 2</a>, “ni'o” and “no'i” cmavo with matching sub­scripts mark the start and the continuation of a given topic respectively. Different topics can be assigned to different subscripts.

<p>

Other uses of subscripts will doubtless be devised in future.

<p>

### Utterance ordinals: MAI</h3>

<p><cx "ordinals, utterance"><a name=s7><h3>

The following cmavo are discussed in this section:

<p>

<pre> mai MAI utterance ordinal, -thly

mo'o MAI higher order utterance ordinal

</pre><lx "mai"><lx "mo'o"><lx "MAI">Numerical free modifiers, corresponding to English “firstly”, “secondly”, and so on, can be created by suffixing “mai” or “mo'o” of selma'o MAI to a number or a lerfu string. Here are some examples:

<p>

<pre><a name=e7d1>7.1) mi klama pamai le zarci .e remai le zdani

I go-to (firstly) the store and (secondly) the market.

</pre><p>This does not imply that I go to the store before I go to the market: that meaning re­quires a tense. The sumti are simply numbered for convenience of reference. Like other free modifiers, the utterance ordinals can be inserted almost anywhere in a sentence without affecting its grammar or its meaning.

<p>

Any of the Lojban numbers can be used with MAI: “romai”, for example, means “all-thly” or “lastly”. Likewise, if you are enumerating a long list and have for­gotten which number is wanted next, you can say “ny.mai”, or “Nthly”.

<p>

The difference between “mai” and “mo'o” is that “mo'o” enumerates larger subdivi­sions of a text; “mai” was designed for lists of numbered items, whereas “mo'o” was in­tended to subdivide structured works. If this chapter were translated into Lojban, it might number each section with “mo'o”: this section would then be introduced with “zemo'o”, or “<a href=#s7>Section 7</a>.”

<p>

### <a name=s8><h3>Attitude scope markers: FUhE/FUhO</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> fu'e FUhE open attitudinal scope

fu'o FUhO close attitudinal scope

</pre><lx "UI">Lojban has a complex system of “attitudinals”, words which indicate the speaker's attitude to what is being said. The attitudinals include indicators of emotion, intensity markers, discursives (which show the structure of discourse), and evidentials (which indi­cate “how the speaker knows”). Most of these words belong to selma'o UI; the intensity markers belong to selma'o CAI for historical reasons, but the two selma'o are grammati­cally identical. The individual cmavo of UI and CAI are discussed in <a href=chap13.html>Chapter 13</a>; only the rules for applying them in discourse are presented here.

<p>

<cx "attitudinal, scope">Normally, an attitudinal applies to the preceding word only. However, if the preced­ing word is a structural cmavo which begins or ends a whole construction, then that whole construction is affected by the attitudinal:

<p>

<pre><a name=e8d1>8.1) mi viska le blanu .ia zdani [ku]

I see the blue [belief] house.

I see the house, which I believe to be blue.

<a name=e8d2>8.2) mi viska le blanu zdani .ia [ku]

I see the blue house [belief].

I see the blue thing, which I believe to be a house.

<a name=e8d3>8.3) mi viska le .ia blanu zdani [ku]

I see the [belief] blue house.

I see what I believe to be a blue house.

<a name=e8d4>8.4) mi viska le blanu zdani ku .ia

I see (the blue house ) [belief].

I see what I believe to be a blue house.

</pre><p>An attitudinal meant to cover a whole sentence can be attached to the preceding “.i”, ex­pressed or understood:

<p>

<pre><a name=e8d5>8.5) [.i] .ia mi viska le blanu zdani

[belief] I see the blue house.

I believe I see a blue house.

</pre>or to an explicit “vau” placed at the end of a bridi.

<p>

Likewise, an attitudinal meant to cover a whole paragraph can be attached to “ni'o” or “no'i”. An attitudinal at the beginning of a text applies to the whole text.

<p>

<lx "fu'e"><lx "FUhE"><lx "fu'o"><lx "FUhO">However, sometimes it is necessary to be more specific about the range of one or more attitudinals, particularly if the range crosses the boundaries of standard Lojban syn­tactic constructions. The cmavo “fu'e” (of selma'o FUhE) and “fu'o” (of selma'o FUhO) provide explicit scope markers. Placing “fu'e” in front of an attitudinal discon­nects it from what precedes it, and instead says that it applies to all following words until further notice. The notice is given by “fu'o”, which can appear anywhere and can­cels all in-force attitudinals. For example:

<p>

<pre><a name=e8d6>8.6) mi viska le fu'e .ia blanu zdani fu'o ponse

I see the [start] [belief] blue house [end] possessor.

I see the owner of what I believe to be a blue house.

</pre><p>Here, only the “blanu zdani” portion of the three-part tanru “blanu zdani ponse” is marked as a belief of the speaker. Naturally, the attitudinal scope markers do not affect the rules for interpreting multi-part tanru: “blanu zdani” groups first because tanru group from left to right unless overridden with “ke” or “bo”.

<p>

<cx "global attitudinals">Other attitudinals of more local scope can appear after attitudinals marked by FUhE; these attitudinals are added to the globally active attitudinals rather than super­seding them.

<p>

### Quotations: LU, LIhU, LOhU, LEhU</h3>

<p><cx "quotation"><a name=s9><h3>

The following cmavo are discussed in this section:

<p>

<pre> lu LU begin quotation

li'u LIhU end quotation

lo'u LOhU begin error quotation

le'u LEhU end error quotation

</pre><p>Grammatically, quotations are very simple in Lojban: all of them are sumti, and they all mean something like “the piece of text here quoted”:

<p>

<pre><a name=e9d1>9.1) mi pu cusku lu mi'e djan [li'u]

I [past] express [quote] I-am John [unquote]

I said, “I'm John”.

</pre><p>But in fact there are four different flavors of quotation in the language, involving six cmavo of six different selma'o. This being the case, quotation deserves some elabora­tion.

<p>

<cx "opening quotation"><lx "lu"><lx "LU"><lx "li'u"><lx "LIhU"><cx "quotation, of grammatical Lojban text">The simplest kind of quotation, exhibited in <a href=#e9d1>Example 9.1</a>, uses the cmavo “lu” (of selma'o LU) as the opening quotation mark, and the cmavo “li'u” (of selma'o LIhU) as the closing quotation mark. The text between “lu” and “li'u” must be a valid, parse­able Loj­ban text. If the quotation is ungrammatical, so is the surrounding expression. The cmavo “li'u” is technically an elidable terminator, but it's almost never possible to elide it except at the end of text.

<p>

<lx "lo'u"><lx "LOhU"><lx "le'u"><lx "LEhU"><cx "quotation, of parseable Lojban text"><cx "quotation, of ungrammatical Lojban text">The cmavo “lo'u” (of selma'o LOhU) and “le'u” (of selma'o LEhU) are used to sur­round a quotation that is not necessarily grammatical Lojban. However, the text must consist of morphologically correct Lojban words (as defined in <a href=chap4.html>Chapter 4</a>), so that the “le'u” can be picked out reliably. The words need not be meaningful, but they must be recognizable as cmavo, brivla, or cmene. Quotation with “lo'u” is essential to quot­ing ungrammatical Lojban for teaching in the language, the equivalent of the \* that is used in English to mark such errors:

<p>

<pre><a name=e9d2>9.2) lo'u mi du do du la djan. le'u na tergerna

la lojban.

[quote] mi du do du la djan. [unquote] is-not a-grammatical-structure

in Lojban.

</pre><cx "embedded quotation"><a href=#e9d2>Example 9.2 </a>is grammatical even though the embedded quotation is not. Similarly, “lo'u” quotation can quote fragments of a text which themselves do not constitute grammatical utterances:

<p>

<pre><a name=e9d3>9.3) lu le mlatu cu viska le finpe li'u zo'u lo'u viska le le'u

cu selbasti .ei lo'u viska lo le'u

[quote] le mlatu cu viska le finpe [unquote] : [quote] viska le [unquote]

is-replaced-by [obligation!] [quote] viska lo [unquote].

In the sentence “le mlatu viska le finpe”, “viska le” should be replaced by

“viska lo”.

</pre><p>Note the topic-comment formulation (<a href=#s4>Section 4</a>) and the indicator applying to the selbri only (<a href=#s8>Section 8</a>). Neither “viska le” nor “viska lo” is a valid Lojban utterance, and both require “lo'u” quotation.

<p>

<cx "pro-sumti, quotation of"><cx "pro-bridi, quotation of">Additionally, pro-sumti or pro-bridi in the quoting sentence can refer to words ap­pearing in the quoted sentence when “lu <dots>…</dots>li'u” is used, but not when “lo'u <dots>…</dots>le'u” is used:

<p>

<pre><a name=e9d4>9.4) la tcarlis. cusku lu le ninmu cu morsi li'u

.iku'i ri jmive

Charlie says [quote] the woman is-dead [unquote].

However, the-last-mentioned is-alive.

Charlie says “The woman is dead”, but she is alive.

</pre><p>In <a href=#e9d4>Example 9.4</a>, “ri” is a pro-sumti which refers to the most recent previous sumti, namely “le ninmu”. Compare:

<p>

<pre><a name=e9d5>9.5) la tcarlis. cusku lo'u le ninmu cu morsi le'u

.iku'i ri jmive

Charlie says [quote] le ninmu cu morsi [unquote].

However, the-last-mentioned is-alive.

Charlie says “le ninmu cu morsi”, but he is alive.

</pre><cx "uninterpreted sequence">In <a href=#e9d5>Example 9.5</a>, “ri” cannot refer to the referent of the alleged sumti “le ninmu”, be­cause “le ninmu cu morsi” is a mere uninterpreted sequence of Lojban words. Instead, “ri” ends up referring to the referent of the sumti “la tcarlis.”, and so it is Charlie who is alive.

<p>

<lx "si"><lx "sa"><lx "su"><cx "metalinguistic erasers, within ungrammatical-Lojban quotation"><cx "quotation, ungrammatical Lojban containing lo'u"><cx "quotation, ungrammatical Lojban containing le'u">The metalinguistic erasers “si”, “sa”, and “su”, discussed in <a href=#s13>Section 13</a>, do not oper­ate in text between “lo'u” and “le'u”. Since the first “le'u” terminates a “lo'u” quo­tation, it is not directly possible to have a “lo'u” quotation within another “lo'u” quota­tion. How­ever, it is possible for a “le'u” to occur within a “lo'u <dots>…</dots>le'u” quotation by preceding it with the cmavo “zo”, discussed in <a href=#s10>Section 10</a>. Note that “le'u” is not an elidable termina­tor; it is required.

<p>

### <a name=s10><h3>More on quotations: ZO, ZOI</h3>

<p>

The following cmavo are discussed in this section:

<p>

<pre> zo ZO quote single word

zoi ZOI non-Lojban quotation

la'o ZOI non-Lojban name

</pre><cx "strong quotation"><lx "zo"><lx "ZO"><cx "quotation, of single word">The cmavo “zo” (of selma'o ZO) is a strong quotation mark for the single fol­lowing word, which can be any Lojban word whatsoever. Among other uses, “zo” allows a metalinguistic word to be referenced without having it act on the surrounding text. The word must be a morphologically legal (but not necessarily meaningful) single Lojban word; compound cmavo are not permitted. For example:

<p>

<pre><a name=e10d1>10.1) zo si cu lojbo valsi

“si” is a Lojbanic word.

</pre><p>Since “zo” acts on a single word only, there is no corresponding terminator. Brevity, then, is a great advantage of “zo”, since the terminators for other kinds of quotation are rarely or never elidable.

<p>

<cx "phoneme stream"><lx "zoi"><lx "ZOI"><cx "quotation, of non-Lojban">The cmavo “zoi” (of selma'o ZOI) is a quotation mark for quoting non-Lojban text. Its syntax is “zoi X. text .X”, where X is a Lojban word (called the delimit­ing word) which is separated from the quoted text by pauses, and which is not found in the written text or spoken phoneme stream. It is common, but not required, to use the lerfu word (of selma'o BY) which corresponds to the Lojban name of the lan­guage being quoted:

<p>

<pre><a name=e10d2>10.2) zoi gy. John is a man .gy. cu glico jufra

“John is a man” is an English sentence.

</pre>where “gy” stands for “glico”. Other popular choices of delimiting words are “.kuot.”, a Lojban name which sounds like the English word “quote”, and the word “zoi” itself. An­other possibility is a Lojban word suggesting the topic of the quotation.

<p>

Within written text, the Lojban written word used as a delimiting word may not ap­pear, whereas within spoken text, the sound of the delimiting word may not be uttered. This leads to occasional breakdowns of audio-visual isomorphism: <a href=#e10d3>Example 10.3 </a>is fine in speech but ungrammatical as written, whereas <a href=#e10d4>Example 10.4 </a>is correct when written but ungrammatical in speech.

<p>

<pre><a name=e10d3>10.3) ?mi djuno fi le valsi po'u zoi gy. gyrations .gy.

I know about the word which-is “gyrations”.

<a name=e10d4>10.4) ?mi djuno fi le valsi po'u zoi jai. gyrations .jai

I know about the word which-is “gyrations”.

</pre><p>The text “gy” appears in the written word “gyrations”, whereas the sound represented in Lojban by “jai” appears in the spoken word “gyrations”. Such borderline cases should be avoided as a matter of good style.

<p>

<cx "quotation, of rafsi"><cx "rafsi, quotation of">It should be noted particularly that “zoi” quotation is the only way to quote rafsi, specifically CCV rafsi, because they are not Lojban words, and “zoi” quotation is the only way to quote things which are not Lojban words. (CVC and CVV rafsi look like names and cmavo respectively, and so can be quoted using other methods.) For example:

<p>

<pre><a name=e10d5>10.5) zoi ry. sku .ry. cu rafsi zo cusku

“sku” is a rafsi of “cusku”.

</pre><cx "lo'u, interaction with zoi"><cx "le'u, interaction with zoi"><cx "zoi, interaction with lo'u/le'u">(A minor note on interaction between “lo'u <dots>…</dots>le'u” and “zoi”: The text be­tween “lo'u” and “le'u” should consist of Lojban words only. In fact, non-Lojban mate­rial in the form of a “zoi” quotation may also appear. However, if the word “le'u” is used either as the delimiting word for the “zoi” quotation, or within the quotation itself, the outer “lo'u” quotation will be prematurely terminated. Therefore, “le'u” should be avoided as the de­limiting word in any “zoi” quotation.)

<p>

<cx "names, with zo versus la"><cx "zo, contrasted with la for names"><cx "la, contrasted with zo"><cx "quotation, referent versus symbol"><cx "referent, contrasted with symbol"><cx "symbol, contrasted with referent">Lojban strictly avoids any confusion between things and the names of things:

<p>

<pre><a name=e10d6>10.6) zo .bab. cmene la bab.

The-word “Bob” is-the-name-of the-one-named Bob.

</pre><lx "la'e"><lx "lu'e"><lx "LAhE">In <a href=#e10d6>Example 10.6</a>, “zo .bab.” is the word, whereas “la bab.” is the thing named by the word. The cmavo “la'e” and “lu'e” (of selma'o LAhE) convert back and forth between references and their referents:

<p>

<pre><a name=e10d7>10.7) zo .bab. cmene la'e zo .bab.

The-word “Bob” is-the-name-of the-referent-of the-word “Bob”.

<a name=e10d8>10.8) lu'e la bab. cmene la bab.

A-symbol-for Bob is-the-name-of Bob.

</pre><a href=#e10d{6}>Examples 10.6 </a>through <a href=#e10d8>10.8 </a>all mean approximately the same thing, except for differ­ences in emphasis. <a href=#e10d9>Example 10.9 </a>is different:

<p>

<pre><a name=e10d9>10.9) la bab. cmene la bab.

Bob is the name of Bob.

</pre>and says that Bob is both the name and the thing named, an unlikely situation. People are not names.

<p>

(In <a href=#e10d{6}>Examples 10.6 </a>through <a href=#e10d7>10.7</a>, the name “bab.” was separated from a pre­ceding “zo” by a pause, thus: “zo .bab.”. The reason for this extra pause is that all Loj­ban names must be separated by pause from any preceding word other than “la”, “lai”, “la'i” (all of selma'o LA) and “doi” (of selma'o DOI). There are numerous other cmavo that may pre­cede a name: of these, “zo” is one of the most common.)

<p>

<cx "Linnaean"><cx "Goethe"><lx "la'o"><lx "ZOI"><cx "names, non-Lojban"><cx "Linnaean binomials">The cmavo “la'o” also belongs to selma'o ZOI, and is mentioned here for com­plete­ness, although it does not signal the beginning of a quotation. Instead, “la'o” serves to mark non-Lojban names, especially the Linnaean binomial names (such as “Homo sapi­ens”) which are the internationally standardized names for species of animals and plants. Internationally known names which can more easily be recognized by spelling rather than pronunciation, such as “Goethe”, can also appear in Lojban text with “la'o”:

<p>

<pre><a name=e10d10>10.10) la'o dy. Goethe .dy. cu me la'o ly. Homo sapiens .ly.

Goethe is a Homo sapiens.

</pre><cx "cumbersome text">Using “la'o” for all names rather than Lojbanizing, however, makes for very cumber­some text. A rough equivalent of “la'o” might be “la me zoi”.

<p>

### Contrastive emphasis: BAhE</h3>

<p><cx "emphasis"><a name=s11><h3>

The following cmavo are discussed in this section:

<p>

<pre> ba'e BAhE emphasize next word

za'e BAhE next word is nonce

</pre><p>English often uses strong stress on a word to single it out for contrastive em­phasis, thus

<p>

<pre><a name=e11d1>11.1) I saw George.

</pre>is quite different from

<p>

<pre><a name=e11d2>11.2) I saw <i>*George*</i>.

</pre><p>The heavy stress on “<i>*George*</i>” (represented in writing by <i>*italics*</i>) indicates that I saw George rather than someone else. Lojban does not use stress in this way: stress is used only to help separate words (because every brivla is stressed on the penultimate sylla­ble) and in names to match other languages' stress patterns. Note that many other lan­guages do not use stress in this way either; typically word order is rearranged, produc­ing something like

<p>

<pre><a name=e11d3>11.3) It was George whom I saw.

</pre><lx "ba'e"><lx "BAhE">In Lojban, the cmavo “ba'e” (of selma'o BAhE) precedes a single word which is to be emphasized:

<p>

<pre><a name=e11d4>11.4) mi viska la ba'e .djordj.

I saw the-one-named [emphasis] “George”.

I saw <i>*George*</i>.

</pre><p>Note the pause before the name “djordj.”, which serves to separate it unambiguously from the “ba'e”. Alternatively, the “ba'e” can be moved to a position before the “la”, which in effect emphasizes the whole construct “la djordj.”:

<p>

<pre><a name=e11d5>11.5) mi viska ba'e la djordj.

I saw [emphasis] the-one-named “George”.

I saw <i>*George*</i>.

</pre><cx "emphasis marking">Marking a word with a cmavo of BAhE does not change the word's grammar in any way. Any word in a bridi can receive contrastive emphasis marking:

<p>

<pre><a name=e11d6>11.6) ba'e mi viska la djordj.

I, no one else, saw George.

<a name=e11d7>11.7) mi ba'e viska la djordj.

I saw (not heard or smelled) George.

</pre><p>Emphasis on one of the structural components of a Lojban bridi can also be achieved by rearranging it into an order that is not the speaker's or writer's usual order. Any sumti moved out of place, or the selbri when moved out of place, is emphatic to some degree.

<p>

<lx "za'e"><lx "BAhE"><cx "non-standard words, marking"><cx "words, marking non-standard">For completeness, the cmavo “za'e” should be mentioned, also of selma'o BAhE. It marks a word as possibly irregular, non-standard, or nonce (created for the occasion):

<p>

<pre><a name=e11d8>11.8) mi klama la za'e. .albeinias

I go-to so-called Albania

</pre><cx "appropriate standard">marks a Lojbanization of an English name, where a more appropriate standard form might be something like “la ctiipyris.”, reflecting the country's name in Albanian.

<p>

<cx "unabridged dictionary">Before a lujvo or fu'ivla, “za'e” indicates that the word has been made up on the spot and may be used in a sense that is not found in the unabridged dictionary (when we have an unabridged dictionary!).

<p>

### Parenthesis and metalinguistic commentary: TO, TOI, SEI</h3>

<p><cx "parenthesis, textual"><cx "metalinguistic commentary"><a name=s12><h3>

The following cmavo are discussed in this section:

<p>

<pre> to TO open parenthesis

to'i TO open editorial parenthesis

toi TOI close parenthesis

sei SEI metalinguistic bridi marker

</pre><lx "to"><lx "TO"><lx "toi"><lx "TOI">The cmavo “to” and “toi” are discursive (non-mathematical) parentheses, for insert­ing parenthetical remarks. Any text whatsoever can go within the parentheses, and it is completely invisible to its context. It can, however, refer to the context by the use of pro-sumti and pro-bridi: any that have been assigned in the context are still assigned in the parenthetical remarks, but the reverse is not true.

<p>

<pre><a name=e12d1>12.1) doi lisas. mi djica le nu to doi frank. ko sisti toi do viska le mlatu

O Lisa, I desire the event-of (O Frank, [imperative] stop!) you see the cat.

Lisa, I want you to (Frank! Stop!) see the cat.

</pre><a href=#e12d1>Example 12.1 </a>implicitly redefines “do” within the parentheses: the listener is changed by “doi frank.” When the context sentence resumes, however, the old listener, Lisa, is auto­matically restored.

<p>

<lx "to'i"><lx "TO"><cx "editorial commentary">There is another cmavo of selma'o TO: “to'i”. The difference between “to” and “to'i” is the difference between parentheses and square brackets in English prose. Re­marks within “to <dots>…</dots>toi” cmavo are implicitly by the same speaker, whereas remarks within “to'i <dots>…</dots>toi” are implicitly by someone else, perhaps an editor:

<p>

<pre><a name=e12d2>12.2) la frank. cusku lu mi prami do to'isa'a do du la djein. toi li'u

Frank expresses “I love you [you = Jane]”

</pre><cx "bracketed remark"><cx "actual confusion”><lx "sa'a"><lx "UI"><cx "editorial insertion">The “sa'a” suffix is a discursive cmavo (of selma'o UI) meaning “editorial in­sertion”, and indicating that the marked word or construct (in this case, the entire bracketed re­mark) is not part of the quotation. It is required whenever the “to'i <dots>…</dots>toi” remark is physi­cally within quotation marks, at least when speaking to literal-minded listeners; the con­vention may be relaxed if no actual confusion results.

<p>

Note: The parser believes that parentheses are attached to the previous word or con­struct, because it treats them as syntactic equivalents of subscripts and other such so-called “free modifiers”. Semantically, however, parenthetical remarks are not neces­sarily attached either to what precedes them or what follows them.

<p>

<lx "sei"><lx "SEI"><cx "embedded discursive"><cx "discursive, embedded"><cx "metalinguistic comment, with embedded discursive">The cmavo “sei” (of selma'o SEI) begins an embedded discursive bridi. Com­ments added with “sei” are called “metalinguistic”, because they are comments about the dis­course itself rather than about the subject matter of the discourse. This sense of the term “metalinguistic” is used throughout this chapter, and is not to be confused with the sense “language for expressing other languages”.

<p>

When marked with “sei”, a metalinguistic utterance can be embedded in an­other ut­terance as a discursive. In this way, discursives which do not have cmavo as­signed in selma'o UI can be expressed:

<p>

<pre><a name=e12d3>12.3) la frank. prami sei la frank. gleki la djein.

Frank loves (Frank is happy) Jane.

</pre><p>Using the happiness attitudinal, “.ui”, would imply that the speaker was happy. Instead, the speaker attributes happiness to Frank. It would probably be safe to elide the one who is happy, and say:

<p>

<pre><a name=e12d4>12.4) la frank. prami sei gleki la djein.

Frank loves (he is happy) Jane.

</pre><p>The grammar of the bridi following “sei” has an unusual limitation: the sumti must ei­ther precede the selbri, or must be glued into the selbri with “be” and “bei”:

<p>

<pre><a name=e12d5>12.5) la frank. prami sei gleki be fa la suzn. la djein.

Frank loves (Susan is happy) Jane.

</pre><p>This restriction allows the terminator cmavo “se'u” to almost always be elided.

<p>

<cx "metalinguistic levels"><cx "metalinguistic levels or reference"><cx "pro-sumti, and discursive utterances"><cx "reference, and discursive utterances">Since a discursive utterance is working at a “higher” level of abstraction than a non-discursive utterance, a non-discursive utterance cannot refer to a discursive utter­ance. Specifically, the various back-counting, reciprocal, and reflexive constructs in selma'o KOhA ignore the utterances at “higher” metalinguistic levels in determining their refer­ent. It is possible, and sometimes necessary, to refer to lower metalinguistic levels. For example, the English “he said” in a conversation is metalinguistic. For this purpose, quo­tations are considered to be at a lower metalinguistic level than the sur­rounding context (a quoted text cannot refer to the statements of the one who quotes it), whereas parenthetical remarks are considered to be at a higher level than the context.

<p>

Lojban works differently from English in that the “he said” can be marked in­stead of the quotation. In Lojban, you can say:

<p>

<ex "said John"><pre><a name=e12d6>12.6) la djan. cusku lu mi klama le zarci li'u

John expresses “I go to-the store”.

</pre>which literally claims that John uttered the quoted text. If the central claim is that John made the utterance, as is likely in conversation, this style is the most sensible. However, in written text which quotes a conversation, you don't want the “he said” or “she said” to be considered part of the conversation. If unmarked, it could mess up the anaphora counting. Instead, you can use:

<p>

<pre><a name=e12d7>12.7) lu mi klama le zarci seisa'a la djan. cusku be dei li'u

“I go to-the store (John expresses this-sentence)”.

“I go to the store”, said John.

</pre><p>And of course other orders are possible:

<p>

<pre><a name=e12d8>12.8) lu seisa'a la djan. cusku be dei mi klama le zarci

John said, “I go to the store”.

<a name=e12d9>12.9) lu mi klama seisa'a la djan cusku le zarci

“I go”, John said, “to the store”.

</pre><p>Note the “sa'a” following each “sei”, marking the “sei” and its attached bridi as an edi­torial insert, not part of the quotation. In a more relaxed style, these “sa'a” cmavo would probably be dropped.

<p>

<lx "se'u"><lx "SEhU">The elidable terminator for “sei” is “se'u” (of selma'o SEhU); it is rarely needed, ex­cept to separate a selbri within the “sei” comment from an immediately fol­lowing selbri (or component) outside the comment.

<p>

### Erasure: SI, SA, SU</h3>

<p><cx "erasure"><a name=s13><h3>

The following cmavo are discussed in this section:

<p>

<pre> si SI erase word

sa SA erase phrase

su SU erase discourse

</pre><lx "si"><lx "SI"><cx "erasure, word">The cmavo “si” (of selma'o SI) is a metalinguistic operator that erases the pre­ceding word, as if it had never been spoken:

<p>

<pre><a name=e13d1>13.1) ti gerku si mlatu

This is-a-dog, er, is-a-cat.

</pre>means the same thing as “ti mlatu”. Multiple “si” cmavo in succession erase the appro­priate number of words:

<p>

<pre><a name=e13d2>13.2) ta blanu zdani si si xekri zdani

That is-a-blue house, er, er, is-a-black house.

</pre><cx "erasure, zo">In order to erase the word “zo”, it is necessary to use three “si” cmavo in a row:

<p>

<pre><a name=e13d3>13.3) zo .bab. se cmene zo si si si la bab.

The-word “Bob” is-the-name-of the word “si”, er, er, Bob.

</pre><p>The first use of “si” does not erase anything, but completes the “zo” quotation. Two more “si” cmavo are then necessary to erase the first “si” and the “zo”.

<p>

Incorrect names can likewise cause trouble with “si”:

<p>

<cx "erasure, names"><pre><a name=e13d4>13.4) mi tavla fo la .esperanto si si .esperanton.

I talk in-language that-named “and” “speranto”, er, er, Esperanto.

</pre><p>The Lojbanized spelling “.esperanto” breaks up, as a consequence of the Lojban mor­phology rules (see <a href=chap4.html>Chapter 4</a>) into two Lojban words, the cmavo “.e” and the undefined fu'ivla “speranto”. Therefore, two “si” cmavo are needed to erase them. Of course, “.e speranto” is not grammatical after “la”, but recognition of “si” is done before gram­mati­cal analysis.

<p>

<cx "erasure, quotes">Even more messy is the result of an incorrect “zoi”:

<p>

<pre><a name=e13d5>13.5) mi cusku zoi fy. gy. .fy. si si si si zo .djan

I express [foreign] [quote] “gy” [unquote], er, er, er, er, “John”.

</pre><p>In <a href=#e13d5>Example 13.5</a>, the first “fy” is taken to be the delimiting word. The next word must be different from the delimiting word, and “gy.”, the Lojban name for the letter “g”, was chosen arbitrarily. Then the delimiting word must be repeated. For purposes of “si” era­sure, the entire quoted text is taken to be a word, so four words have been uttered, and four more “si” cmavo are needed to erase them altogether. Similarly, a stray “lo'u” quota­tion mark must be erased with “fy. le'u si si si”, by completing the quotation and then erasing it all with three “si” cmavo.

<p>

What if less than the entire “zo” or “zoi” construct is erased? The result is something which has a loose “zo” or “zoi” in it, without its expected sequels, and which is incurably ungrammatical. Thus, to erase just the word quoted by “zo”, it turns out to be necessary to erase the “zo” as well:

<p>

<pre><a name=e13d6>13.6) mi se cmene zo .djan. si si zo .djordj.

I am-named-by the-word “John”, er, er, the-word “George”.

</pre><p>The parser will reject “zo .djan. si .djordj.”, because in that context “djordj.” is a name (of selma'o CMENE) rather than a quoted word.

<p>

Note: The current machine parser does not implement “si” erasure.

<p>

<cx "starting marker"><cx "precise erasures"><lx "sa"><lx "SA"><cx "erasure, multiple word">As the above examples plainly show, precise erasures with “si” can be ex­tremely hard to get right. Therefore, the cmavo “sa” (of selma'o SA) is provided for erasing more than one word. The cmavo following “sa” should be the starting marker of some gram­matical construct. The effect of the “sa” is to erase back to and including the last starting marker of the same kind. For example:

<p>

<pre><a name=e13d7>13.7) mi viska le sa .i mi cusku zo .djan.

I see the <dots>… </dots>I say the-word “John”.

</pre><p>Since the word following “sa” is “.i”, the sentence separator, its effect is to erase the pre­ceding sentence. So <a href=#e13d7>Example 13.7 </a>is equivalent to:

<p>

<pre><a name=e13d8>13.8) mi cusku zo .djan.

</pre><p>Another example, erasing a partial description rather than a partial sentence:

<p>

<pre><a name=e13d9>13.9) mi viska le blanu zdan. sa le xekri zdani

I see the blue hou <dots>…</dots>the black house.

</pre><p>In <a href=#e13d9>Example 13.9</a>, “le blanu zdan.” is ungrammatical, but clearly reflects the speaker's original intention to say “le blanu zdani”. However, the “zdani” was cut off before the end and changed into a name. The entire ungrammatical “le” construct is erased and re­placed by “le xekri zdani”.

<p>

Note: The current machine parser does not implement “sa” erasure. Getting “sa” right is even more difficult (for a computer) than getting “si” right, as the behavior of “si” is defined in terms of words rather than in terms of grammatical constructs (possibly in­correct ones) and words are conceptually simpler entities. On the other hand, “sa” is gen­erally easier for human beings, because the rules for using it correctly are less finicky.

<p>

<cx "multiple speakers"><lx "su"><lx "SU"><cx "erasure, total">The cmavo “su” (of selma'o SU) is yet another metalinguistic operator that erases the entire text. However, if the text involves multiple speakers, then “su” will only erase the remarks made by the one who said it, unless that speaker has said noth­ing. Therefore “susu” is needed to eradicate a whole discussion in conversation.

<p>

Note: The current machine parser does not implement either “su” or “susu” erasure.

<p>

### Hesitation: Y</h3>

<p><cx "hesitation"><a name=s14><h3>

The following cmavo is discussed in this section:

<p>

<pre> .y. Y hesitation noise

</pre><lx ".y"><lx "Y">Speakers often need to hesitate to think of what to say next or for some extra-lin­guistic reason. There are two ways to hesitate in Lojban: to pause between words (that is, to say nothing) or to use the cmavo “.y.” (of selma'o Y). This resembles in sound the English hesitation noise written “uh” (or “er”), but differs from it in the re­quirement for pauses before and after. Unlike a long pause, it cannot be mistaken for having nothing more to say: it holds the floor for the speaker. Since vowel length is not significant in Lojban, the “y” sound can be dragged out for as long as necessary. Fur­thermore, the sound can be repeated, provided the required pauses are respected.

<p>

<cx "hesitation sound">Since the hesitation sound in English is outside the formal language, English-speak­ers may question the need for a formal cmavo. Speakers of other languages, how­ever, often hesitate by saying (or, if necessary, repeating) a word (“este” in some dia­lects of Spanish, roughly meaning “that is”), and Lojban's audio-visual isomorphism requires a written representation of all meaningful spoken behavior. Of course, “.y.” has no gram­matical significance: it can appear anywhere at all in a Lojban sentence except in the middle of a word.

<p>

### No more to say: FAhO</h3>

<p><cx "text, end-marker"><a name=s15><h3>

The following cmavo is discussed in this section:

<p>

<pre> fa'o FAhO end of text

</pre><lx "fa'o"><lx "FAhO"><cx "unconditional signal"><cx "computer interaction"><cx "end of file"><cx "yielding the floor">The cmavo “fa'o” (of selma'o FAhO) is the usually omitted marker for the end of a text; it can be used in computer interaction to indicate the end of input or output, or for explicitly giving up the floor during a discussion. It is outside the regular grammar, and the machine parser takes it as an unconditional signal to stop parsing unless it is quoted with “zo” or with “lo'u <dots>…</dots>le'u”. In particular, it is not used at the end of subordi­nate texts quoted with “lu <dots>…</dots>li'u” or parenthesized with “to <dots>…</dots>toi”.

<p>

### List of cmavo interactions</h3>

<p><cx "cmavo, interaction list"><cx "interaction list, cmavo"><a name=s16><h3>

The following list gives the cmavo and selma'o that are recognized by the ear­liest stages of the parser, and specifies exactly which of them interact with which oth­ers. All of the cmavo are at least mentioned in this chapter. The cmavo are written in lower case, and the selma'o in UPPER CASE.

<p>

* “zo” quotes the following word, no matter what it is.
* <p>
* “si” erases the preceding word unless it is a “zo”.
* <p>
* “sa” erases the preceding word and other words, unless the preceding word is a “zo”.
* <p>
* “su” is the same as “sa”, but erases more words.
* <p>
* “lo'u” quotes all following words up to a “le'u” (but not a “zo le'u”).
* <p>
* “le'u” is ungrammatical except at the end of a “lo'u quotation.
* <p>
* ZOI cmavo use the following word as a delimiting word, no matter what it is, but using “le'u” may create difficulties.
* <p>
* “zei” combines the preceding and the following word into a lujvo, but does not affect “zo”, “si”, “sa”, “su”, “lo'u”, ZOI cmavo, “fa'o”, and “zei”.
* <p>
* BAhE cmavo mark the following word, unless it is “si”, “sa”, or “su”, or unless it is preceded by “zo”. Multiple BAhE cmavo may be used in succes­sion.
* <p>
* “bu” makes the preceding word into a lerfu word, except for “zo”, “si”, “sa”, “su”, “lo'u”, ZOI cmavo, “fa'o”, “zei”, BAhE cmavo, and “bu”. Multiple “bu” cmavo may be used in succession.
* <p>
* UI and CAI cmavo mark the previous word, except for “zo”, “si”, “sa”, “su”, “lo'u”, ZOI, “fa'o”, “zei”, BAhE cmavo, and “bu”. Multiple UI cmavo may be used in succession. A following “nai” is made part of the UI.
* <p>
* “.y.”, “da'o”, “fu'e”, and “fu'o” are the same as UI, but do not absorb a following “nai”.

<p>

### List of Elidable Terminators</h3>

<p><cx "elidable terminators, list"><a name=s17><h3>

The following list shows all the elidable terminators of Lojban. The first col­umn is the terminator, the second column is the selma'o that starts the corresponding construc­tion, and the third column states what kinds of grammatical constructs are ter­minated. Each terminator is the only cmavo of its selma'o, which naturally has the same name as the cmavo.

<p>

<pre> be'o BE sumti attached to a tanru unit

boi PA/BY number or lerfu string

do'u COI/DOI vocative phrases

fe'u FIhO ad-hoc modal tags

ge'u GOI relative phrases

kei NU abstraction bridi

ke'e KE groups of various kinds

ku LE/LA description sumti

ku'e PEhO forethought mekso

ku'o NOI relative clauses

li'u LU quotations

lo'o LI number sumti

lu'u LAhE/NAhE+BO sumti qualifiers

me'u ME tanru units formed from sumti

nu'u NUhI forethought termsets

se'u SEI/SOI metalinguistic insertions

te'u various mekso conversion constructs

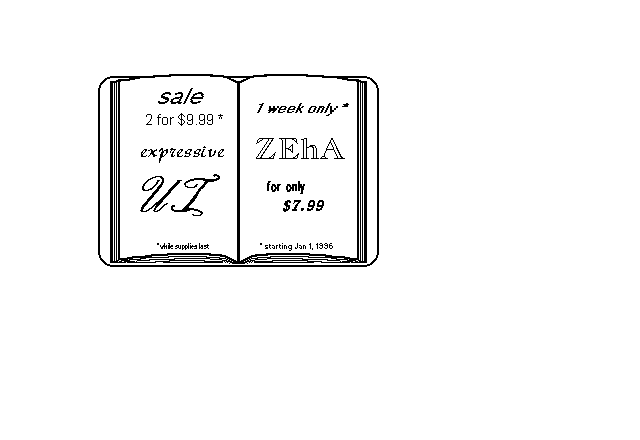
toi TO parenthetical remarks

tu'u TUhE multiple sentences or paragraphs

vau (none) simple bridi or bridi-tails

ve'o VEI mekso parentheses

</body></html>



## <h2>Chapter 20<br>

## A Catalogue of selma'o</h2>

###### <h6>$Revision: 4.1 $<br> mkhtml: 1.1</h6></p></center>

<p>

<cx "selma'o, cross-reference list of, selma'o catalog">The following paragraphs list all the selma'o of Lojban, with a brief explana­tion of what each one is about, and reference to the chapter number where each is ex­plained more fully. As usual, all selma'o names are given in capital letters (with “h” serving as the capital of “ ' ”) and are the names of a representative cmavo, often the most important or the first in alphabetical order. One example is given of each selma'o: for selma'o which have several uses, the most common use is shown.

##### <p>

#### <lx "A, selma'o catalog"><cx "connection, of sumti, selma'o catalog">selma'o A (<a href=chap14.html>Chapter 14</a>)

<p>

Specifies a logical connection (e.g. “and”, “or”, “if”), usually between sumti.

<p>

<dl compact><dt> <dd>la djan. .a la djein. klama le zarci

John and/or Jane goes to the store.

</dl><p>Also used to create vowel lerfu words when followed with “bu”.

<p>

#### <lx "BAI, selma'o catalog"><cx "sumti place, additional, selma'o catalog">selma'o BAI (<a href=chap9.html>Chapter 9</a>)

<p>

May be prefixed to a sumti to specify an additional place, not otherwise present in the place structure of the selbri, and derived from a single place of some other selbri.

<p>

<dl compact><dt> <dd>mi tavla bau la lojban.

I speak in-language Lojban.

#### </dl><lx "BAhE, selma'o catalog"><cx "emphasis, marking, selma'o catalog"><cx "nonce word, marking, selma'o catalog">selma'o BAhE (<a href=chap19.html>Chapter 19</a>)

<p>

Emphasizes the next single word, or marks it as a nonce word (one invented for the oc­casion.

<p>

<dl compact><dt> <dd>la ba'e .djordj. klama le zarci

<i>*George* </i>goes to the store.

It is George who goes to the store.

#### </dl><lx "BE, selma'o catalog"><cx "tanru unit, filling in places of, selma'o catalog">selma'o BE (<a href=chap5.html>Chapter 5</a>)

<p>

Attaches sumti which fill the place structure of a single unit making up a tanru. Unless otherwise indicated, the sumti fill the x2, x3, and successive places in that order. BE is most useful in descriptions formed with LE. See BEI, BEhO.

<p>

<dl compact><dt> <dd>mi klama be ta troci

I am-a-(goer to-that) type-of-trier.

I try to go to that place.

#### </dl><cx "tanru unit, filling in places of, selma'o catalog"><lx "BEI, selma'o catalog">selma'o BEI (<a href=chap5.html>Chapter 5</a>)

<p>

Separates multiple sumti attached by BE to a tanru unit.

<p>

<dl compact><dt> <dd>mi klama be le zarci bei le zdani be'o troci

I am-a-(goer to-the store from-the home) type-of-trier.

I try to go from the home to the market.

#### </dl><lx "BEhO, selma'o catalog"><cx "BE, terminator for, selma'o catalog">selma'o BEhO (<a href=chap5.html>Chapter 5</a>)

<p>

Elidable terminator for BE. Terminates sumti that are attached to a tanru unit.

<p>

<dl compact><dt> <dd>mi klama be le zarci be'o troci

I am-a-(goer to-the market) type-of-trier.

I try to go to the market.

#### </dl><lx "BIhE, selma'o catalog"><cx "operator priority, selma'o catalog">selma'o BIhE (<a href=chap18.html>Chapter 18</a>)

<p>

Prefixed to a mathematical operator to mark it as higher priority than other mathematical operators, binding its operands more closely.

<p>

<dl compact><dt> <dd>li ci bi'e pi'u vo su'i mu du li paze

The-number 3 [priority] times 4 plus 5 equals the-number 17.

3 × 4 + 5 = 17

#### </dl><lx "BIhI, selma'o catalog"><cx "intervals, forming, selma'o catalog">selma'o BIhI (<a href=chap14.html>Chapter 14</a>)

<p>

Joins sumti or tanru units (as well as some other things) to form intervals. See GAhO.

<p>

<dl compact><dt> <dd>mi ca sanli la drezdn. bi'i la frankfurt.

I [present] stand-on-surface Dresden [interval] Frankfurt.

I am standing between Dresden and Frankfurt.

#### </dl><lx "BO, selma'o catalog"><cx "close-binding, selma'o catalog">selma'o BO (<a href=chap5.html>Chapter 5</a>, <a href=chap15.html>Chapter 15</a>, <a href=chap18.html>Chapter 18</a>)

<p>

Joins tanru units, binding them together closely. Also used to bind logically or non-logi­cally connected phrases, sentences, etc. BO is always high precedence and right-group­ing.

<p>

<dl compact><dt> <dd>ta cmalu nixli bo ckule

That is-a-small type-of (girl type-of school).

That is a small school for girls.

#### </dl><lx "BOI, selma'o catalog"><cx "PA, terminator for, selma'o catalog"><cx "BY, terminator for, selma'o catalog">selma'o BOI (<a href=chap18.html>Chapter 18</a>)

<p>

Elidable terminator for PA or BY. Used to terminate a number (string of numeric cmavo) or lerfu string (string of letter words) when another string immediately follows.

<p>

<dl compact><dt> <dd>li re du li vu'u voboi re

The-number two equals the-number the-difference-of four-and two.

#### </dl><lx "BU, selma'o catalog"><cx "letter, making a word into, selma'o catalog">selma'o BU (<a href=chap17.html>Chapter 17</a>)

<p>

A suffix which can be attached to any word, typically a word representing a letter of the alphabet or else a name, to make a word for a symbol or a different letter of the alpha­bet. In particular, attached to single-vowel cmavo to make words for vowel letters.

<p>

<dl compact><dt> <dd>.abu .ebu .ibu .obu .ubu .ybu

a, e, i, o, u, y.

#### </dl><lx "BY, selma'o catalog"><cx "letters, selma'o catalog">selma'o BY (<a href=chap17.html>Chapter 17</a>)

<p>

Words representing the letters of the Lojban alphabet, plus various shift words which al­ter the interpretation of other letter words. Terminated by BOI.

<p>

<dl compact><dt> <dd>.abu tavla .by le la .ibymym. skami

A talks-to B about-the of-IBM computers.

A talks to B about IBM computers.

#### </dl><lx "CAI, selma'o catalog"><cx "emotion, marking intensity of, selma'o catalog">selma'o CAI (<a href=chap13.html>Chapter 13</a>)

<p>

Indicates the intensity of an emotion: maximum, strong, weak, or not at all. Typically follows another particle which specifies the emotion.

<p>

<dl compact><dt> <dd>.ei cai mi klama le zarci

[Obligation!] [Intense!] I go-to the market.

I must go to the market.

#### </dl><lx "CAhA, selma'o catalog"><cx "actuality, marking, selma'o catalog">selma'o CAhA (<a href=chap10.html>Chapter 10</a>)

<p>

Specifies whether a bridi refers to an actual fact, a potential (achieved or not), or merely an innate capability.

<p>

<dl compact><dt> <dd>ro datka ka'e flulimna

all ducks [capability] are-float-swimmers

All ducks have the capability of swimming by floating.

#### </dl><lx "CEI, selma'o catalog"><cx "selbri assignment, selma'o catalog">selma'o CEI (<a href=chap7.html>Chapter 7</a>)

<p>

Assigns a selbri definition to one of the five pro-bridi gismu: “broda”, “brode”, “brodi”, “brodo”, or “brodu”, for later use.

<p>

<dl compact><dt> <dd>ti slasi je mlatu bo cidja lante gacri cei broda

.i le crino broda cu barda .i le xunre broda cu cmalu

This is a plastic cat-food can cover, or thingy.

The green thingy is large. The red thingy is small.

#### </dl><lx "CEhE, selma'o catalog"><cx "termsets, selma'o catalog">selma'o CEhE (<a href=chap14.html>Chapter 14</a>, <a href=chap16.html>Chapter 16</a>)

<p>

Joins multiple terms into a termset. Termsets are used to associate several terms for logi­cal connectives, for equal quantifier scope, or for special constructs in tenses.

<p>

<dl compact><dt> <dd>mi ce'e do pe'e je la djan. ce'e la djeimyz. cu pendo

I [,] you [joint] and John [,] James are-friends-of.

I am a friend of you, and John are a friend of James.

#### </dl><lx "CO, selma'o catalog"><cx "inverting a tanru, selma'o catalog">selma'o CO (<a href=chap5.html>Chapter 5</a>)

<p>

When inserted between the components of a tanru, inverts it, so that the following tanru unit modifies the previous one.

<p>

<dl compact><dt> <dd>mi troci co klama le zarci le zdani

I am-a-trier of-type (goer to-the market from-the house).

I try to go to the market from the house.

#### </dl><lx "COI, selma'o catalog"><cx "vocative, selma'o catalog">selma'o COI (<a href=chap6.html>Chapter 6</a>, <a href=chap13.html>Chapter 13</a>)

<p>

When prefixed to a name, description, or sumti, produces a vocative: a phrase which indi­cates who is being spoken to (or who is speaking). Vocatives are used in conversa­tional protocols, including greeting, farewell, and radio communication. Terminated by DOhU. See DOI.

<p>

<dl compact><dt> <dd>coi .djan.

Greetings, John.

#### </dl><lx "CU, selma'o catalog"><cx "selbri separator, selma'o catalog">selma'o CU (<a href=chap9.html>Chapter 9</a>)

<p>

Separates the selbri of a bridi from any sumti which precede it. Never strictly necessary, but often useful to eliminate various elidable terminators.

<p>

<dl compact><dt> <dd>le gerku cu klama le zarci

The dog goes to-the store.

#### </dl><lx "CUhE, selma'o catalog"><cx "question, modal, selma'o catalog">selma'o CUhE (<a href=chap10.html>Chapter 10</a>)

<p>

Forms a question which asks when, where, or in what mode the rest of the bridi is true. See PU, CAhA, TAhE, and BAI.

<p>

<dl compact><dt> <dd>do cu'e klama le zarci

You [When/Where?] go to-the store?

When are you going to the store?

#### </dl><lx "DAhO, selma'o catalog"><cx "cancellation of sumti assignment, selma'o catalog"><cx "sumti assignment, cancellation of, selma'o catalog">selma'o DAhO (<a href=chap7.html>Chapter 7</a>)

<p>

Cancels the assigned significance of all sumti cmavo (of selma'o KOhA) and bridi cmavo (of selma'o GOhA).

<p>

#### <lx "DOI, selma'o catalog"><cx "vocative indicator, selma'o catalog">selma'o DOI (<a href=chap13.html>Chapter 13</a>)

<p>

The non-specific vocative indicator. May be used with or without COI. No pause is re­quired between “doi” and a following name. See DOhU.

<p>

<dl compact><dt> <dd>doi frank. mi tavla do

O Frank, I speak-to you.

Frank, I'm talking to you.

#### </dl><lx "DOhU, selma'o catalog"><cx "COI, terminator for, selma'o catalog"><cx "DOI, terminator for, selma'o catalog">selma'o DOhU (<a href=chap13.html>Chapter 13</a>)

<p>

Elidable terminator for COI or DOI. Signals the end of a vocative.

<p>

<dl compact><dt> <dd>coi do'u

Greetings [terminator]

Greetings, O unspecified one!

#### </dl><lx "FA, selma'o catalog"><cx "place number, specifying, selma'o catalog">selma'o FA (<a href=chap9.html>Chapter 9</a>)

<p>

Prefix for a sumti, indicating which numbered place in the place structure the sumti be­longs in; overrides word order.

<p>

<dl compact><dt> <dd>fa mi cu klama fi la .atlantas. fe la bastn. fo le dargu fu le karce

x1= I go x3= Atlanta x2= Boston x4= the road x5= the car.

I go from Atlanta to Boston via the road using the car.

#### </dl><lx "FAhA, selma'o catalog"><cx "direction, spatial, selma'o catalog">selma'o FAhA (<a href=chap10.html>Chapter 10</a>)

<p>

Specifies the direction in which, or toward which (when marked with MOhI) or along which (when prefixed by VEhA or VIhA) the action of the bridi takes place.

<p>

<dl compact><dt> <dd>le nanmu zu'a batci le gerku

The man [left] bites the dog.

To my left, the man bites the dog.

#### </dl><lx "FAhO, selma'o catalog"><cx "end of text indicator, selma'o catalog">selma'o FAhO (<a href=chap19.html>Chapter 19</a>)

<p>

A mechanical signal, outside the grammar, indicating that there is no more text. Useful in talking to computers.

<p>

#### <lx "FEhE, selma'o catalog"><cx "space indicator for interval modifiers, selma'o catalog">selma'o FEhE (<a href=chap10.html>Chapter 10</a>)

<p>

Indicates that the following interval modifier (using TAhE, ROI, or ZAhO) refers to space rather than time.

<p>

<dl compact><dt> <dd>ko vi'i fe'e di'i sombo le gurni

You-imperative [1-dimensional] [space] [regularly] sow the grain.

Sow the grain in a line and evenly!

#### </dl><lx "FEhU, selma'o catalog"><cx "FIhO, terminator for, selma'o catalog">selma'o FEhU (<a href=chap9.html>Chapter 9</a>)

<p>

Elidable terminator for FIhO. Indicates the end of an ad hoc modal tag: the tagged sumti immediately follows.

<p>

<dl compact><dt> <dd>mi viska do fi'o kanla [fe'u] le zunle

I see you [modal] eye: the left-thing

I see you with my left eye.

#### </dl><lx "FIhO, selma'o catalog"><cx "selbri to modal converter, selma'o catalog"><cx "conversion, selbri to modal, selma'o catalog">selma'o FIhO (<a href=chap9.html>Chapter 9</a>)

<p>

When placed before a selbri, transforms the selbri into a modal tag, grammatically and semantically equivalent to a member of selma'o BAI. Terminated by FEhU.

#### <p>

<dl compact><dt> <dd>mi viska do fi'o kanla le zunle

I see you with eye the left-thing.

I see you with my left eye.

#### </dl><lx "FOI, selma'o catalog"><cx "TEI, terminator for, selma'o catalog">selma'o FOI (<a href=chap17.html>Chapter 17</a>)

<p>

Signals the end of a compound alphabet letter word that begins with TEI. Not an eli­dable terminator.

<p>

<dl compact><dt> <dd>tei .ebu .akut. bu foi

(“e” “acute” )

the letter “e” with an acute accent

#### </dl><lx "FUhA, selma'o catalog"><cx "reverse Polish indicator, selma'o catalog">selma'o FUhA (<a href=chap18.html>Chapter 18</a>)

<p>

Indicates that the following mathematical expression is to be interpreted as reverse Polish (RP), a mode in which mathematical operators follow their operands.

<p>

<dl compact><dt> <dd>li fu'a reboi re[boi] su'i du li vo

The-number [RP!] two, two, plus equals the-number four.

2 + 2 = 4

#### </dl><lx "FUhE, selma'o catalog"><cx "UI, extending the scope of, selma'o catalog">selma'o FUhE (<a href=chap19.html>Chapter 19</a>)

<p>

Indicates that the following indicator(s) of selma'o UI affect not the preceding word, as usual, but rather all following words until a FUhO.

#### <p>

<dl compact><dt> <dd>mi viska le fu'e .ia blanu zdani fu'o ponse

I see the [start] [belief] blue house [end] possessor.

I see the owner of a blue house, or what I believe to be one.

#### </dl><lx "FUhO, selma'o catalog"><cx "cancellation of indicators, selma'o catalog"><cx "indicators, cancellation of, selma'o catalog">selma'o FUhO (<a href=chap19.html>Chapter 19</a>)

<p>

Cancels all indicators of selma'o UI which are in effect.

#### <p>

<dl compact><dt> <dd>mi viska le fu'e .ia blanu zdani fu'o ponse

I see the [start] [belief] blue house [end] possessor.

I see the owner of what I believe to be a blue house.

#### </dl><lx "GA, selma'o catalog"><cx "connection, forethought, selma'o catalog">selma'o GA (<a href=chap14.html>Chapter 14</a>)

<p>

Indicates the beginning of two logically connected sumti, bridi-tails, or various other things. Logical connections include “both <dots>…</dots>and”, “either <dots>…</dots>or”, “if <dots>…</dots>then”, and so on. See GI.

<p>

<dl compact><dt> <dd>ga la djan. nanmu gi la djeimyz. ninmu

Either John is a man or James is a woman (or both).

#### </dl><lx "GAhO, selma'o catalog"><cx "interval, open/closed specification, selma'o catalog">selma'o GAhO (<a href=chap14.html>Chapter 14</a>)

<p>

Specifies whether an interval specified by BIhI includes or excludes its endpoints. Used in pairs before and after the BIhI cmavo, to specify the nature of both the left- and the right-hand endpoints.

<p>

<dl compact><dt> <dd>mi ca sanli la drezdn. ga'o bi'i ga'o la frankfurt.

I [present] stand Dresden [inclusive] [interval] [inclusive] Frankfurt.

I am standing between Dresden and Frankfurt, inclusive of both.

#### </dl><lx "GEhU, selma'o catalog"><cx "GOI, terminator for, selma'o catalog">selma'o GEhU (<a href=chap8.html>Chapter 8</a>)

<p>

Elidable terminator for GOI. Marks the end of a relative phrase. See KUhO.

<p>

<dl compact><dt> <dd>la djan. goi ko'a ge'u blanu

John (referred to as it-1) is-blue.

#### </dl><lx "GI, selma'o catalog"><cx "connection, forethought separator, selma'o catalog">selma'o GI (<a href=chap14.html>Chapter 14</a>)

<p>

Separates two logically or non-logically connected sumti, tanru units, bridi-tails, or other things, when the prefix is a forethought connective involving GA, GUhA, or JOI.

<p>

<dl compact><dt> <dd>ge la djan. nanmu gi la djeimyz. ninmu

(It is true that) both John is a man and James is a woman.

#### </dl><lx "GIhA, selma'o catalog"><cx "connection, of bridi-tails, selma'o catalog"><cx "bridi-tail, definition, selma'o catalog">selma'o GIhA (<a href=chap14.html>Chapter 14</a>)

<p>

Specifies a logical connective (e.g. “and”, “or”, “if”) between two bridi-tails: a bridi-tail is a selbri with any associated following sumti, but not including any preceding sumti.

<p>

<dl compact><dt> <dd>mi klama le zarci gi'e nelci la djan.

I go-to the market and like John.

#### </dl><lx "GOI, selma'o catalog"><cx "relative phrase marker, selma'o catalog">selma'o GOI (<a href=chap8.html>Chapter 8</a>)

<p>

Specifies the beginning of a relative phrase, which associates a subordinate sumti (following) to another sumti (preceding). Terminated by GEhU. See NOI.

<p>

<dl compact><dt> <dd>la djan. goi ko'a cu blanu

John (referred to as #1) is blue.

#### </dl><lx "GOhA, selma'o catalog"><cx "cmavo as brivla, selma'o catalog">selma'o GOhA (<a href=chap7.html>Chapter 7</a>)

<p>

A general selma'o for all cmavo which can take the place of brivla. There are several groups of these.

#### <p>

<dl compact><dt> <dd>A: mi klama le zarci

B: mi go'i

A: I'm going to the market.

B: Me, too.

#### </dl><lx "GUhA, selma'o catalog"><cx "connection, of tanru units, selma'o catalog">selma'o GUhA (<a href=chap14.html>Chapter 14</a>)

<p>

Indicates the beginning of two logically connected tanru units. Takes the place of GA when forming logically-connected tanru. See GI.

<p>

<dl compact><dt> <dd>la .alis. gu'e ricfu gi blanu

Alice is both rich and blue.

#### </dl><lx "I, selma'o catalog"><cx "sentence separator, selma'o catalog">selma'o I (<a href=chap19.html>Chapter 19</a>)

<p>

Separates two sentences from each other.

<p>

<dl compact><dt> <dd>mi klama le zarci .i mi klama le zdani

I go-to the market. I go-to the office.

#### </dl><lx "JA, selma'o catalog"><cx "connection, of tanru units, selma'o catalog">selma'o JA (<a href=chap14.html>Chapter 14</a>)

<p>

Specifies a logical connection (e.g. “and”, “or”, “if”) between two tanru units, mathe­matical operands, tenses, or abstractions.

<p>

<dl compact><dt> <dd>ti blanu je zdani

This is-blue and a-house.

#### </dl><lx "JAI, selma'o catalog"><cx "conversion, modal, selma'o catalog">selma'o JAI (<a href=chap9.html>Chapter 9</a>)

<p>

When followed by a tense or modal, creates a conversion operator attachable to a selbri which exchanges the modal place with the x1 place of the selbri. When alone, is a con­version operator exchanging the x1 place of the selbri (which should be an abstract sumti) with one of the places of the abstracted-over bridi.

<p>

<dl compact><dt> <dd>mi jai gau galfi le bitmu skari

I am-the-actor-in modifying the wall color.

I act so as to modify the wall color.

I change the color of the wall.

#### </dl><lx "JOI, selma'o catalog"><cx "connection, of sumti, selma'o catalog">selma'o JOI (<a href=chap14.html>Chapter 14</a>)

<p>

Specifies a non-logical connection (e.g. together-with-as-mass, -set, or -sequence) be­tween two sumti, tanru units, or various other things. When immediately followed by GI, provides forethought non-logical connection analogous to GA.

<p>

<dl compact><dt> <dd>la djan. joi la .alis. cu bevri le pipno

John massed-with Alice carry the piano.

#### </dl><lx "JOhI, selma'o catalog"><cx "vector, forming, selma'o catalog">selma'o JOhI (<a href=chap18.html>Chapter 18</a>)

<p>

Indicates that the following mathematical operands (a list terminated by TEhU) form a mathematical vector (one-dimensional array).

<p>

<dl compact><dt> <dd>li jo'i paboi reboi te'u su'i jo'i ciboi voboi du

li jo'i voboi xaboi

The-number array (one, two) plus array (three, four) equals

the-number array (four, six).

(1,2) + (3,4) = (4,6)

#### </dl><lx "KE, selma'o catalog"><cx "grouping, indicator for, selma'o catalog">selma'o KE (<a href=chap5.html>Chapter 5</a>)

<p>

Groups everything between itself and a following KEhE for purposes of logical con­nec­tion, tanru construction, or other purposes. KE and KEhE are not used for mathe­matical (see VEI and VEhO) or discursive (see TO and TOI) purposes.

<p>

<dl compact><dt> <dd>ta ke melbi cmalu ke'e nixli ckule

That is-a-( pretty little ) girl school.

That is a school for girls who are pretty in their littleness.

#### </dl><lx "KEI, selma'o catalog"><cx "NU, terminator for, selma'o catalog">selma'o KEI (<a href=chap11.html>Chapter 11</a>)

<p>

Elidable terminator for NU. Marks the end of an abstraction bridi.

<p>

<dl compact><dt> <dd>la djan. cu nu sonci kei djica

John is-an-(event-of being-a-soldier) type-of desirer.

John wants to be a soldier.

#### </dl><lx "KEhE, selma'o catalog"><cx "KE, terminator for, selma'o catalog">selma'o KEhE (<a href=chap5.html>Chapter 5</a>)

<p>

Elidable terminator for KE. Marks the end of a grouping.

<p>

<dl compact><dt> <dd>ta ke melbi cmalu ke'e nixli ckule

That is-a-( pretty little ) girl school.

That is a school for girls who are pretty in their littleness.

#### </dl><lx "KI, selma'o catalog"><cx "tense, making sticky, selma'o catalog">selma'o KI (<a href=chap10.html>Chapter 10</a>)

<p>

When preceded by a tense or modal, makes it “sticky”, so that it applies to all further bridi until reset by another appearance of KI. When alone, eliminates all sticky tenses.

<p>

#### <lx "KOhA, selma'o catalog"><cx "cmavo as sumti, selma'o catalog">selma'o KOhA (<a href=chap7.html>Chapter 7</a>)

<p>

A general selma'o which contains all cmavo which can substitute for sumti. These cmavo are divided into several groups.

#### <p>

<dl compact><dt> <dd>le blanu zdani goi ko'a cu barda .i ko'a na cmamau ti

The blue house (referred to as #1) is big. #1 is-not smaller-than this-thing.

#### </dl><lx "KU, selma'o catalog"><cx "LE, terminator for, selma'o catalog"><cx "LA, terminator for, selma'o catalog"><cx "tense with no sumti, indicator for, selma'o catalog"><cx "modal with no sumti, indicator for, selma'o catalog"><cx "negation boundary, forming, selma'o catalog">selma'o KU (<a href=chap6.html>Chapter 6</a>, <a href=chap10.html>Chapter 10</a>)

<p>

Elidable terminator for LE and some uses of LA. Indicates the end of a description sumti. Also used after a tense or modal to indicate that no sumti follows, and in the compound NA+KU to indicate natural language-style negation.

<p>

<dl compact><dt> <dd>le prenu ku le zdani ku klama

The person, to-the house, goes.

The person goes to the house.

#### </dl><lx "KUhE, selma'o catalog"><cx "PEhO, terminator for, selma'o catalog">selma'o KUhE (<a href=chap18.html>Chapter 18</a>)

<p>

Elidable terminator for PEhO: indicates the end of a forethought mathematical expres­sion (one in which the operator precedes the operands).

<dl compact><dt> <dd>li pe'o su'i reboi reboi re[boi] ku'e du

li xa

The number [forethought] the-sum-of two two two [end] equals

the-number six.

#### </dl><lx "KUhO, selma'o catalog"><cx "NOI, terminator for, selma'o catalog">selma'o KUhO (<a href=chap8.html>Chapter 8</a>)

<p>

Elidable terminator for NOI. Indicates the end of a relative clause.

<dl compact><dt> <dd>le zdani poi blanu ku'o barda

The house which is-blue is-big.

#### </dl><lx "LA, selma'o catalog"><cx "name descriptor, selma'o catalog">selma'o LA (<a href=chap5.html>Chapter 5</a>)

<p>

Descriptors which change name words (or selbri) into sumti which identify people or things by name. Similar to LE. May be terminated with KU if followed by a description selbri.

<p>

<dl compact><dt> <dd>la kikeros. du la tulis.

Cicero is Tully.

#### </dl><lx "LAU, selma'o catalog"><cx "letter shift, selma'o catalog">selma'o LAU (<a href=chap17.html>Chapter 17</a>)

<p>

Combines with the following alphabetic letter to represent a single marker: change from lower to upper case, change of font, punctuation, etc.)

<p>

<dl compact><dt> <dd>tau sy. .ibu

[single-shift] “s” “i”

Si (chemical symbol for silicon)

#### </dl><lx "LAhE, selma'o catalog"><cx "converting sumti to related meaning, selma'o catalog">selma'o LAhE (<a href=chap6.html>Chapter 6</a>)

<p>

Qualifiers which, when prefixed to a sumti, change it into another sumti with related meaning. Qualifiers can also consist of a cmavo from selma'o NAhE plus BO. Termi­nated by LUhU.

#### <p>

<dl compact><dt> <dd>mi viska la'e zoi kuot. A Tale of Two Cities .kuot

I see that-represented-by the-text “A Tale of Two Cities”.

I see the book “A Tale of Two Cities”.

#### </dl><lx "LE, selma'o catalog"><cx "descriptor, selma'o catalog"><cx "article, selma'o catalog">selma'o LE (<a href=chap6.html>Chapter 6</a>)

<p>

Descriptors which make selbri into sumti which describe or specify things that fit into the x1 place of the selbri. Termionated by KU. See LA.

<p>

<dl compact><dt> <dd>le gerku klama le zdani

The dog goes-to the house.

#### </dl><lx "LEhU, selma'o catalog"><cx "LOhU, terminator for, selma'o catalog">selma'o LEhU (<a href=chap19.html>Chapter 19</a>)

<p>

Indicates the end of a quotation begun with LOhU. Not an elidable terminator.

<p>

<dl compact><dt> <dd>lo'u mi du do du mi le'u cu na lojbo drani

[quote] mi du do du mi [unquote] is-not Lojbanically correct.

“mi du do du mi” is not correct Lojban.

#### </dl><lx "LI, selma'o catalog"><cx "number, descriptor for, selma'o catalog"><cx "descriptor for numbers, selma'o catalog">selma'o LI (<a href=chap18.html>Chapter 18</a>)

<p>

Descriptors which change numbers or other mathematical expressions into sumti which specify numbers or numerical expressions. Terminated by LOhO.

<p>

<dl compact><dt> <dd>li re su'u re na du li vo su'i vo

The-number 2 minus 2 not equals the-number 4 plus 4.

$2 - 2<>≠ ≠ 4 + 4$

#### </dl><lx "LIhU, selma'o catalog"><cx "LU, terminator for, selma'o catalog">selma'o LIhU (<a href=chap19.html>Chapter 19</a>)

<p>

Elidable terminator for LU. Indicates the end of a text quotation.

<p>

<dl compact><dt> <dd>mi cusku lu mi klama le zarci li'u

I express [quote] I go-to the market [end quote].

#### </dl><lx "LOhO, selma'o catalog"><cx "LI, terminator for, selma'o catalog">selma'o LOhO (<a href=chap18.html>Chapter 18</a>)

<p>

Elidable terminator for LI. Indicates the end of a mathematical expression used in a LI description.

<p>

<dl compact><dt> <dd>li vo lo'o li ci lo'o cu zmadu

The-number 4 [end number], the number 3 [end number], is greater.

$4 > 3$

#### </dl><lx "LOhU, selma'o catalog"><cx "quotation, of Lojban words, selma'o catalog">selma'o LOhU (<a href=chap19.html>Chapter 19</a>)

<p>

Indicates the beginning of a quotation (a sumti) which is grammatical as long as the quoted material consists of Lojban words, whether they form a text or not. Terminated by LEhU.

<p>

<dl compact><dt> <dd>do cusku lo'u mi du do du ko'a le'u

You express [quote] mi du do du ko'a [end quote].

You said, “mi du do du ko'a”.

#### </dl><lx "LU, selma'o catalog"><cx "quotation, grammatical, selma'o catalog">selma'o LU (<a href=chap19.html>Chapter 19</a>)

<p>

Indicates the beginning of a quotation (a sumti) which is grammatical only if the quoted material also forms a grammatical Lojban text. Terminated by LIhU.

<p>

<dl compact><dt> <dd>mi cusku lu mi klama le zarci li'u

I express [quote] I go-to the market [end quote].

#### </dl><lx "LUhU, selma'o catalog"><cx "LAhE, terminator for, selma'o catalog"><cx "NAhE+BO, terminator for, selma'o catalog">selma'o LUhU (<a href=chap6.html>Chapter 6</a>)

<p>

Elidable terminator for LAhE and NAhE+BO. Indicates the end of a qualified sumti.

<p>

<dl compact><dt> <dd>mi viska la'e lu barda gerku li'u lu'u

I see the-referent-of [quote] big dog [end quote] [end ref]

I saw “Big Dog” [not the words, but a book or movie].

#### </dl><lx "MAI, selma'o catalog"><cx "index numbering, selma'o catalog">selma'o MAI (<a href=chap18.html>Chapter 18</a>, <a href=chap19.html>Chapter 19</a>)

<p>

When suffixed to a number or string of letter words, produces a free modifier which serves as an index number within a text.

<p>

<dl compact><dt> <dd>pamai mi pu klama le zarci

1-thly, I [past] go to-the market.

First, I went to the market.

#### </dl><lx "MAhO, selma'o catalog"><cx "converting, operand to operator, selma'o catalog">selma'o MAhO (<a href=chap18.html>Chapter 18</a>)

<p>

Produces a mathematical operator from a letter or other operand. Terminated by TEhU. See VUhU.

<p>

<dl compact><dt> <dd>ma'o fy. boi xy.

[operator] f x

*f(x)*

#### </dl><lx "ME, selma'o catalog"><cx "converting, sumti to tanru unit, selma'o catalog">selma'o ME (<a href=chap5.html>Chapter 5</a>, <a href=chap18.html>Chapter 18</a>)

<p>

Produces a tanru unit from a sumti, which is applicable to the things referenced by the sumti. Terminated by MEhU.

<p>

<dl compact><dt> <dd>ta me la ford. karce

That is-a-Ford-type car.

That's a Ford car.

#### </dl><lx "MEhU, selma'o catalog"><cx "ME, terminator for, selma'o catalog">selma'o MEhU (<a href=chap5.html>Chapter 5</a>)

<p>

The elidable terminator for ME. Indicates the end of a sumti converted to a tanru unit.

<p>

<dl compact><dt> <dd>ta me mi me'u zdani

That's a me type of house.

#### </dl><lx "MOI, selma'o catalog"><cx "converting, quantifier to selbri, selma'o catalog">selma'o MOI (<a href=chap5.html>Chapter 5, Chapter 18</a>)

<p>

Suffixes added to numbers or other quantifiers to make various numerically-based sel­bri.

<p>

<dl compact><dt> <dd>la djan. joi la frank. cu bruna remei

John in-a-mass-with Frank are-a-brother-type-of twosome.

John and Frank are two brothers.

#### </dl><lx "MOhE, selma'o catalog"><cx "converting, sumti to operand, selma'o catalog">selma'o MOhE (<a href=chap18.html>Chapter 18</a>)

<p>

Produces a mathematical operand from a sumti; used to make dimensioned units. Ter­mi­nated by TEhU.

<p>

<dl compact><dt> <dd>li mo'e re ratcu su'i mo'e re ractu du li mo'e vo danlu

The-number two rats plus two rabbits equals the-number four animals.

2 rats + 2 rabbits = 4 animals.

#### </dl><lx "MOhI, selma'o catalog"><cx "space movement indicator, selma'o catalog">selma'o MOhI (<a href=chap10.html>Chapter 10</a>)

<p>

A tense flag indicating movement in space, in a direction specified by a following FAhA cmavo.

<p>

<dl compact><dt> <dd>le verba mo'i ri'u cadzu le bisli

The child [movement] [right] walks-on the ice.

The child walks toward my right on the ice.

#### </dl><lx "NA, selma'o catalog"><cx "negator, contradictory, selma'o catalog">selma'o NA (<a href=chap14.html>Chapter 14</a>, <a href=chap15.html>Chapter 15</a>)

<p>

Contradictory negators, asserting that a whole bridi is false (or true).

<p>

<dl compact><dt> <dd>mi na klama le zarci

It is not true that I go to the market.

</dl><p>Also used to construct logical connective compound cmavo.

<p>

#### <lx "NAI, selma'o catalog"><cx "negator, single-word, selma'o catalog">selma'o NAI (<a href=chap14.html>Chapter 14</a>, <a href=chap15.html>Chapter 15</a>)

<p>

Negates the previous word, but can only be used with certain selma'o as specified by the grammar.

#### <p>

#### <lx "NAhE, selma'o catalog"><cx "negator, scalar, selma'o catalog">selma'o NAhE (<a href=chap15.html>Chapter 15</a>)

<p>

Scalar negators, modifying a selbri or a sumti to a value other than the one stated, the opposite of the one stated, etc. Also used with following BO to construct a sumti quali­fier; see LAhE.

<p>

<dl compact><dt> <dd>ta na'e blanu zdani

That is-a-non- blue house.

That is a house which is other than blue.

#### </dl><lx "NAhU, selma'o catalog"><cx "converting, selbri to operator, selma'o catalog">selma'o NAhU (<a href=chap18.html>Chapter 18</a>)

<p>

Creates a mathematical operator from a selbri. Terminated by TEhU. See VUhU.

<p>

<dl compact><dt> <dd>li na'u tanjo te'u vei pai fe'i re [ve'o] du li ci'i

The-number the-operator tangent (πpi / 2 ) = the-number infinity.

tan(πpi/2) = infinity∞

#### </dl><lx "NIhE, selma'o catalog"><cx "converting, selbri to operand, selma'o catalog">selma'o NIhE (<a href=chap18.html>Chapter 18</a>)

<p>

Creates a mathematical operand from a selbri, usually a “ni” abstraction. Terminated by TEhU.

<p>

<dl compact><dt> <dd>li ni'e ni clani [te'u] pi'i ni'e ni ganra [te'u] pi'i

ni'e ni condi te'u du li ni'e ni canlu

The-number quantity-of length times quantity-of width times

quantity-of depth equals the-number quantity-of volume.

Length × Width × Depth = Volume

#### </dl><lx "NIhO, selma'o catalog"><cx "paragraph marker, selma'o catalog">selma'o NIhO (<a href=chap19.html>Chapter 19</a>)

<p>

Marks the beginning of a new paragraph, and indicates whether it contains old or new subject matter.

<p>

#### <lx "NOI, selma'o catalog"><cx "relative clause marker, selma'o catalog">selma'o NOI (<a href=chap8.html>Chapter 8</a>)

Introduces r<p>

elative clauses. The following bridi modifies the preceding sumti. Termi­nated by KUhO. See GOI.

<dl compact><dt> <dd>le zdani poi blanu cu cmalu

The house which is blue is small.

#### </dl><lx "NU, selma'o catalog"><cx "abstractors, selma'o catalog">selma'o NU (<a href=chap11.html>Chapter 11</a>)

<p>

Abstractors which, when prefixed to a bridi, create abstraction selbri. Terminated by KEI.

<p>

<dl compact><dt> <dd>la djan. cu djica le nu sonci [kei]

John desires the event-of being-a-soldier.

#### </dl><lx "NUhA, selma'o catalog"><cx "converting, operator to selbri, selma'o catalog">selma'o NUhA (<a href=chap18.html>Chapter 18</a>)

<p>

Creates a selbri from a mathematical operator. See VUhU.

<p>

<dl compact><dt> <dd>li ni'umu cu nu'a va'a li ma'umu

The-number -5 is-the-negation-of the-number +5.

#### </dl><lx "NUhI, selma'o catalog"><cx "termset marker, selma'o catalog">selma'o NUhI (<a href=chap14.html>Chapter 14</a>, <a href=chap16.html>Chapter 16</a>)

<p>

Marks the beginning of a termset, which is used to make simultaneous claims involving two or more different places of a selbri. Terminated by NUhU.

<p>

<dl compact><dt> <dd>mi klama nu'i ge le zarci le briju nu’u gi le zdani

le ckule [nu'u]

I go [start] to-the market from-the office [joint] and to-the house

from-the school.

#### </dl><lx "NUhU, selma'o catalog"><cx "NUhU, terminator for, selma'o catalog">selma'o NUhU (<a href=chap14.html>Chapter 14</a>)

<p>

Elidable terminator for NUhI. Marks the end of a termset.

<p>

<dl compact><dt> <dd> mi klama nu'i ge le zarci le briju nu’u gi le zdani

le ckule [nu'u]

I go [start] to-the market from-the office [joint] and to-the house

from-the school.

#### </dl><lx "PA, selma'o catalog"><cx "quantifiers, selma'o catalog"><cx "digits, selma'o catalog">selma'o PA (<a href=chap18.html>Chapter 18</a>)

<p>

Digits and related quantifiers (some, all, many, etc.). Terminated by BOI.

<p>

<dl compact><dt> <dd>mi speni re ninmu

I am-married-to two women.

#### </dl><lx "PEhE, selma'o catalog"><cx "termset connectives, selma'o catalog">selma'o PEhE (<a href=chap14.html>Chapter 14</a>)

<p>

Precedes a logical or non-logical connective that joins two termsets. Termsets (see CEhE) are used to associate several terms for logical connectives, for equal quantifier scope, or for special constructs in tenses.

<p>

<dl compact><dt> <dd>mi ce'e do pe'e je la djan. ce'e la djeimyz. cu pendo

I [,] you [joint] and John [,] James are-friends-of.

I am a friend of you, and John is a friend of James.

#### </dl><lx "PEhO, selma'o catalog"><cx "operator, forethought marker, selma'o catalog">selma'o PEhO (<a href=chap18.html>Chapter 18</a>)

<p>

An optional signal of forethought mathematical operators, which precede their oper­ands. Terminated by KUhE.

<p>

<dl compact><dt> <dd>li vo du li pe'o su'i reboi re

The-number four equals the-number [forethought] sum-of two two.

#### </dl><lx "PU, selma'o catalog"><cx "direction, time, selma'o catalog">selma'o PU (<a href=chap10.html>Chapter 10</a>)

<p>

Specifies simple time directions (future, past, or neither).

<p>

<dl compact><dt> <dd>mi pu klama le zarci

I [past] go-to the market.

I went to the market.

#### </dl><lx "RAhO, selma'o catalog"><cx "pro-bridi update, flag for, selma'o catalog"><cx "re-evaluation of referents, flag for, selma'o catalog">selma'o RAhO (<a href=chap7.html>Chapter 7</a>)

<p>

The pro-bridi update flag: changes the meaning of sumti implicitly attached to a pro-bridi (see GOhA) to fit the current context rather than the original context.

<p>

<dl compact><dt> <dd>A: mi ba lumci le mi karce

B: mi go'i

A: I [future] wash my car.

B: I do-the-same-thing (i.e. wash A's car).

A: mi ba lumci le mi karce

B: mi go'i ra'o

A: I [future] wash my car.

B: I do-the-corresponding-thing (i.e. wash B's car).

#### </dl><lx "ROI, selma'o catalog"><cx "tense, extensional, selma'o catalog">selma'o ROI (<a href=chap10.html>Chapter 10</a>)

<p>

When suffixed to a number, makes an extensional tense (e.g. once, twice, many times).

<p>

<dl compact><dt> <dd>mi reroi klama le zarci

I twice go-to the market.

#### </dl><lx "SA, selma'o catalog"><cx "erasing phrase, selma'o catalog"><cx "erasing sentence, selma'o catalog">selma'o SA (<a href=chap19.html>Chapter 19</a>)

<p>

Erases the previous phrase or sentence.

<p>

<dl compact><dt> <dd>mi klama sa do klama le zarci

I go, er, you go-to the market.

#### </dl><lx "SE, selma'o catalog"><cx "conversion, of selbri, selma'o catalog"><cx "selbri places, re-ordering, selma'o catalog">selma'o SE (<a href=chap5.html>Chapter 5</a>)

<p>

Converts a selbri, rearranging the order of places by exchanging the x1 place with a specified numbered place.

<p>

<dl compact><dt> <dd>le zarci se klama mi

The market is-gone-to by me.

</dl><p>Also used in constructing connective and modal compound cmavo.

<p>

#### <lx "SEI, selma'o catalog"><cx "metalinguistic insertions, marker for, selma'o catalog">selma'o SEI (<a href=chap19.html>Chapter 19</a>)

<p>

Marks the beginning of metalinguistic insertions which comment on the main bridi. Ter­minated by SEhU.

<p>

<dl compact><dt> <dd>la frank. prami sei gleki [se'u] la djein.

Frank loves (he is happy) Jane.

#### </dl><lx "SEhU, selma'o catalog"><cx "SEI, terminator for, selma'o catalog"><cx "SOI, terminator for, selma'o catalog">selma'o SEhU (<a href=chap19.html>Chapter 19</a>)

<p>

Elidable terminator for SEI and SOI. Ends metalinguistic insertions.

<p>

<dl compact><dt> <dd>la frank. prami sei gleki se'u la djein.

Frank loves (he is happy) Jane.

#### </dl><lx "SI, selma'o catalog"><cx "erasing, word, selma'o catalog">selma'o SI (<a href=chap19.html>Chapter 19</a>)

<p>

Erases the previous single word.

<p>

<dl compact><dt> <dd>mi si do klama le zarci

I, er, you go to-the market.

#### </dl><lx "SOI, selma'o catalog"><cx "reciprocity, marking, selma'o catalog">selma'o SOI (<a href=chap7.html>Chapter 7</a>)

<p>

Marks reciprocity between two sumti (like “vice versa” in English).

<p>

<dl compact><dt> <dd>mi prami do soi mi

I love you [reciprocally] me.

I love you and vice versa.

#### </dl><lx "SU, selma'o catalog"><cx "erasing, discourse, selma'o catalog">selma'o SU (<a href=chap19.html>Chapter 19</a>)

<p>

Closes and erases the entire previous discourse.

<p>

#### <lx "TAhE, selma'o catalog"><cx "frequency within interval, specifying, selma'o catalog">selma'o TAhE (<a href=chap10.html>Chapter 10</a>)

<p>

A tense modifier specifying frequencies within an interval of time or space (regularly, habitually, etc.).

<p>

<dl compact><dt> <dd>le verba ta'e klama le ckule

The child habitually goes to-the school.

#### </dl><lx "TEI, selma'o catalog"><cx "compound letter marker, selma'o catalog">selma'o TEI (<a href=chap17.html>Chapter 17</a>)

<p>

Signals the beginning of a compound letter word, which acts grammatically like a sin­gle letter. Compound letter words end with the non-elidable selma'o FOI.

#### <p>

<dl compact><dt> <dd>tei .ebu .akut. bu foi

(“e” “acute” )

the letter “e” with an acute accent

#### </dl><lx "TEhU, selma'o catalog"><cx "JOhI, terminator for, selma'o catalog"><cx "MAhO, terminator for, selma'o catalog"><cx "MOhE, terminator for, selma'o catalog"><cx "NAhU, terminator for, selma'o catalog"><cx "NIhE, terminator for, selma'o catalog">selma'o TEhU (<a href=chap18.html>Chapter 18</a>)

<p>

Elidable terminator for JOhI, MAhO, MOhE, NAhU, or NIhE. Marks the end of a mathematical conversion construct.

<p>

<dl compact><dt> <dd>li jo'i paboi reboi te'u su'i jo'i ciboi voboi du

li jo'i voboi xaboi

The-number array (one, two) plus array (three, four) equals

the-number array (four, six).

(1,2) + (3,4) = (4,6)

#### </dl><lx "TO, selma'o catalog"><cx "parenthesis, discourse, selma'o catalog">selma'o TO (<a href=chap19.html>Chapter 19</a>)

<p>

Left discursive parenthesis: allows inserting a digression. Terminated by TOI.

<p>

<dl compact><dt> <dd>doi lisas. mi djica le nu to doi frank. ko sisti toi do viska le mlatu

O Lisa, I desire the event-of ( O Frank, [imperative] stop! ) you see the cat.

Lisa, I want you to (Frank! Stop!) see the cat.

#### </dl><lx "TOI, selma'o catalog"><cx "TO, terminator for, selma'o catalog">selma'o TOI (<a href=chap19.html>Chapter 19</a>)

<p>

Elidable terminator for TO. The right discursive parenthesis.

<dl compact><dt> <dd>doi lisas. mi djica le nu to doi frank. ko sisti toi do viska le mlatu

O Lisa, I desire the event-of ( O Frank, [imperative] stop! ) you see the cat.

Lisa, I want you to (Frank! Stop!) see the cat.

#### </dl><lx "TUhE, selma'o catalog"><cx "sentence grouping, selma'o catalog">selma'o TUhE (<a href=chap19.html>Chapter 19</a>)

<p>

Groups multiple sentences or paragraphs into a logical unit. Terminated by TUhU.

<p>

<dl compact><dt> <dd>xagmau zo'u tu'e ganai cidja gi cnino .i ganai vanju gi tolci'o [tu'u]

Is-best : [start] If food, then new. If wine, then old.

As for what is best: if food, then new [is best]; if wine, then old [is best].

#### </dl><lx "TUhU, selma'o catalog"><cx "TUhE, terminator for, selma'o catalog">selma'o TUhU (<a href=chap19.html>Chapter 19</a>)

<p>

Elidable terminator for TUhE. Marks the end of a multiple sentence group.

<p>

#### <lx "UI, selma'o catalog"><cx "emotion, marking, selma'o catalog">selma'o UI (<a href=chap13.html>Chapter 13</a>)

<p>

Indicates the speaker's emotional state or source of knowledge, or the present stage of discourse.

<p>

<dl compact><dt> <dd>.ui la djan. klama

[Happiness!] John is-coming.

Hurrah! John is coming!

#### </dl><lx "VA, selma'o catalog"><cx "distance, spatial, selma'o catalog">selma'o VA (<a href=chap10.html>Chapter 10</a>)

<p>

A tense indicating distance in space (near, far, or neither).

<p>

<dl compact><dt> <dd>le nanmu va batci le gerku

The man [medium distance] bites the dog.

Over there the man is biting the dog.

#### </dl><lx "VAU, selma'o catalog"><cx "simple bridi, terminator for, selma'o catalog"><cx "GIhA, terminator for, selma'o catalog">selma'o VAU (<a href=chap14.html>Chapter 14</a>)

<p>

Elidable terminator for a simple bridi, or for each bridi-tail of a GIhA logical connec­tion.

<p>

<dl compact><dt> <dd>mi dunda le cukta [vau] gi'e lebna lo rupnu vau do [vau]

I (give the book) and (take some currency-units) to/from you.

#### </dl><lx "VEI, selma'o catalog"><cx "mathematical parenthesis, left, selma'o catalog">selma'o VEI (<a href=chap18.html>Chapter 18</a>)

<p>

Left mathematical parenthesis: groups mathematical operations. Terminated by VEhO.

<p>

<dl compact><dt> <dd>li vei ny. su'i pa ve'o pi'i vei ny. su'i pa [ve'o] du

li ny. [bo] te'a re su'i re bo pi'i ny. su'i pa

The-number (“n” plus one ) times (“n” plus one ) equals

the-number n-power-two plus two-times-“n” plus 1.

(n + 1)(n + 1) = n<sup>2</sup>+ 2n + 1

#### </dl><lx "VEhA, selma'o catalog"><cx "interval size, spatial, selma'o catalog">selma'o VEhA (<a href=chap10.html>Chapter 10</a>)

<p>

A tense indicating the size of an interval in space (long, medium, or short).

<p>

#### <lx "VEhO, selma'o catalog"><cx "VEI, terminator for, selma'o catalog">selma'o VEhO (<a href=chap19.html>Chapter 19</a>)

<p>

Elidable terminator for VEI: right mathematical parenthesis.

<p>

<dl compact><dt> <dd><dl compact><dt><dd>li vei ny. su'i pa ve'o pi'i vei ny. su'i pa [ve'o] du

li ny. [bo] te'a re su'i re bo pi'i ny. su'i pa

The-number (“n” plus one ) times (“n” plus one ) equals

the-number n-power-two plus two-times-“n” plus 1.

(n + 1)(n + 1) = n<sup>2</sup>+ 2n + 1

#### </dl><lx "VIhA, selma'o catalog"><cx "dimensionality, spatial, selma'o catalog">selma'o VIhA (<a href=chap10.html>Chapter 10</a>)

<p>

A tense indicating dimensionality in space (line, plane, volume, or space-time interval).

<dl compact><dt> <dd>le verba ve'a vi'a cadzu le bisli

The child [medium space interval] [2-dimensional] walks-on the ice.

In a medium-sized area, the child walks on the ice.

#### </dl><lx "VUhO, selma'o catalog"><cx "relative clauses, connecting to whole sumti, selma'o catalog">selma'o VUhO (<a href=chap8.html>Chapter 8</a>)

<p>

Attaches relative clauses or phrases to a whole (possibly connected) sumti, rather than simply to the leftmost portion of the sumti.

<p>

<dl compact><dt> <dd>la frank. ce la djordj. vu'o noi gidva cu zvati le kumfa

Frank [in-set-with] George, which are-guides, are-in the room.

Frank and George, who are guides, are in the room.

#### </dl><lx "VUhU, selma'o catalog"><cx "operators, mathematical, selma'o catalog">selma'o VUhU (<a href=chap18.html>Chapter 18</a>)

<p>

Mathematical operators (e.g. +, −). See MAhO.

<p>

<dl compact><dt> <dd>li mu vu'u re du li ci

The-number 5 minus 2 equals the-number 3.

5 − 2 = 3

#### </dl><lx "XI, selma'o catalog"><cx "subscript marker, selma'o catalog">selma'o XI (<a href=chap18.html>Chapter 18</a>)

<p>

The subscript marker: the following number or lerfu string is a subscript for whatever precedes it.

<p>

<dl compact><dt> <dd>xy. xi re

x sub 2

x<sub>*2*</sub>

#### </dl><lx "Y, selma'o catalog"><cx "hesitation, selma'o catalog">selma'o Y (<a href=chap19.html>Chapter 19</a>)

<p>

Hesitation noise: content-free, but holds the floor or continues the conversation. It is dif­ferent from silence in that silence may be interpreted as having nothing more to say.

<p>

<dl compact><dt> <dd>doi .y. .y. .djan

O, uh, uh, John!

#### </dl><lx "ZAhO, selma'o catalog"><cx "tense aspect, selma'o catalog">selma'o ZAhO (<a href=chap10.html>Chapter 10</a>)

<p>

A tense modifier specifying the contour of an event (e.g. beginning, ending, continu­ing).

<p>

<dl compact><dt> <dd>mi pu'o damba

I [inchoative] fight.

I'm on the verge of fighting.

#### </dl><lx "ZEI, selma'o catalog"><cx "morphological glue, selma'o catalog"><cx "combining words into one, selma'o catalog">selma'o ZEI (<a href=chap4.html>Chapter 4</a>)

<p>

A morphological glue word, which joins the two words it stands between into the equivalent of a lujvo.

<p>

<dl compact><dt> <dd>ta xy. zei kantu kacma

That is-an-(X - ray) camera

That is an X-ray camera.

#### </dl><lx "ZEhA, selma'o catalog"><cx "interval size, time, selma'o catalog">selma'o ZEhA (<a href=chap10.html>Chapter 10</a>)

<p>

A tense indicating the size of an interval in time (long, medium, or short).

<p>

<dl compact><dt> <dd>mi puze'a citka

I [past] [short interval] eat.

I ate for a little while.

#### </dl><lx "ZI, selma'o catalog"><cx "distance, time, selma'o catalog">selma'o ZI (<a href=chap10.html>Chapter 10</a>)

<p>

A tense indicating distance in time (a long, medium or short time ago or in the future).

<p>

<dl compact><dt> <dd>mi puzi citka

I [past] [short distance] eat.

I ate a little while ago.

#### </dl><lx "ZIhE, selma'o catalog"><cx "connector, for relative clauses, selma'o catalog">selma'o ZIhE (<a href=chap8.html>Chapter 8</a>)

<p>

Joins multiple relative phrases or clauses which apply to the same sumti. Although gener­ally translated with “and”, it is not considered a logical connective.

<p>

<dl compact><dt> <dd>mi ponse pa gerku ku poi blabi zi'e noi mi prami ke'a

I own one dog such-that it-is-white and such-that-incidentally I love it.

I own a dog that is white and which, incidentally, I love.

I own a white dog, which I love.

#### </dl><lx "ZO, selma'o catalog"><cx "quotation, single-word, selma'o catalog">selma'o ZO (<a href=chap19.html>Chapter 19</a>)

<p>

Single-word quotation: quotes the following single Lojban word.

<p>

<dl compact><dt> <dd>zo si cu lojbo valsi

The-word “si” is-a-Lojbanic word.

#### </dl><lx "ZOI, selma'o catalog"><cx "quotation, delimited, selma'o catalog"><cx "quotation, any text, selma'o catalog">selma'o ZOI (<a href=chap19.html>Chapter 19</a>)

<p>

Non-Lojban quotation: quotes any text using a delimiting word (which can be any sin­gle Lojban word) placed before and after the text. The delimiting word must not appear in the text, and must be separated from the text by pauses.

<p>

<dl compact><dt> <dd>zoi kuot. Socrates is mortal .kuot. cu glico jufra

The-text “ Socrates is mortal ” is-an-English sentence.

#### </dl><lx "ZOhU, selma'o catalog"><cx "prenex marker, selma'o catalog">selma'o ZOhU (<a href=chap16.html>Chapter 16</a>, <a href=chap19.html>Chapter 19</a>)

<p>

Separates a logical prenex from a bridi or group of sentences to which it applies. Also separates a topic from a comment in topic/comment sentences.

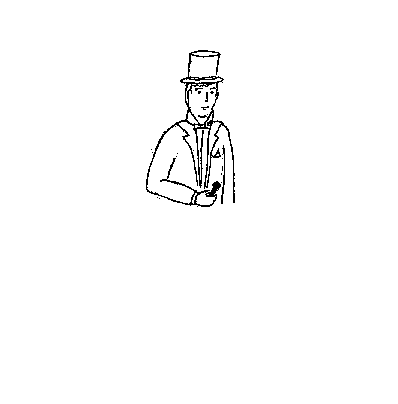
<p>

<dl compact><dt> <dd>su'o da poi remna ro da poi finpe zo'u da prami de

For-at-least-one X which is-a-man, for-all Ys which are-fish : X loves Y

There is a man who loves all fish.

<img src=chap21.gif alt=[Cartoon] align=center width=405 height=405>



## <h2>Chapter 21

## <br>

## Formal Grammars</h2>

###### <h6>$Revision: 4.0 $</h6>

</p></center>

<p>

<cx "formal grammar"><cx "machine grammar">The following two listings constitute the formal grammar of Lojban. The first version is written in the YACC language, which is used to describe parsers, and has been used to create a parser for Lojban texts. This parser is available from the Logical Language Group. The second listing is in Extended Backus-Naur Form (EBNF) and represents the same grammar in a more human-readable form. (In case of discrepancies, the YACC ver­sion is official.) There is a cross-reference listing for each format that shows, for each selma'o and rule, which rules refer to it.

### YACC Grammar of Lojban</h3>

<landscape><cx "YACC grammar"><h3>

<p align=center><center>/\*Lojban Machine Grammar, Final Baseline

<br>The Lojban Machine Grammar document is explicitly dedicated to the public domain by its author, The Logical Language Group, Inc.<br>

</center></p>

grammar.300 \*/

<p>

/\* The Lojban machine parsing algorithm is a multi-step process. The YACC ma­chine grammar presented here is an amalgam of those steps, concatenated so as to allow YACC to verify the syntactic ambiguity of the grammar. YACC is used to gener­ate a parser for a portion of the grammar, which is LALR1 (the type of grammar that YACC is designed to identify and process successfully), but most of the rest of the grammar must be parsed using some language-coded processing.

<p>

#### <h4> Step 1 - Lexing</h4>

<p>

From phonemes, stress, and pause, it is possible to resolve Lojban unambigu­ously into a stream of words. Any machine processing of speech will have to have some way to deal with 'non-Lojban' failures of fluent speech, of course. The resolved words can be expressed as a text file using Lojban's phonetic spelling rules.

<p>

The following steps assume that there is the possibility of non-Lojban text within the Lojban text (delimited appropriately). Such non-Lojban text may not be re­ducible from speech phonetically. However, step 2 allows the filtering of a phonetically transcribed text stream, to recognize such portions of non-Lojban text where properly delimited, without interference with the parsing algorithm.

#### <p>

#### <p>

#### <h4> Step 2 - Filtering</h4>

<p>

From start to end, performing the following filtering and lexing tasks using the given order of precedence in case of conflict:

<p>

a. If the Lojban word “zoi” (selma'o ZOI) is identified, take the following Loj­ban word (which should be end delimited with a pause for separation from the follow­ing non-Lojban text) as an opening delimiter.

Treat all text following that delimiter, until that delimiter recurs *after a pause*, as grammatically a single token (labelled '<a href=#y699>anything\_699</a>' in this grammar). There is no need for processing within this text except as necessary to find the closing delimiter.

<p>

b. If the Lojban word “zo” (selma'o ZO) is identified, treat the following Loj­ban word as a token labelled '<a href=#y698>any\_word\_698</a>', instead of lexing it by its normal gram­matical function.

<p>

c. If the Lojban word “lo'u” (selma'o LOhU) is identified, search for the clos­ing de­limiter “le'u” (selma'o LEhU), ignoring any such closing delimiters absorbed by the pre­vious two steps. The text between the delimiters should be treated as the single token '<a href=#y697>any\_words\_697</a>'.

<p>

d. Categorize all remaining words into their Lojban selma'o category, includ­ing the various delimiters mentioned in the previous steps. In all steps after step 2, only the sel­ma'o token type is significant for each word.

<p>

e. If the word “si” (selma'o SI) is identified, erase it and the previous word (or token, if the previous text has been condensed into a single token by one of the above rules).

<p>

f. If the word “sa” (selma'o SA) is identified, erase it and all preceding text as far back as necessary to make what follows attach to what precedes. (This rule is hard to formalize and may receive further definition later.)

<p>

g. If the word 'su' (selma'o SU) is identified, erase it and all preceding text back to and including the first preceding token word which is in one of the selma'o: NIhO, LU, TUhE, and TO. However, if speaker identification is available, a SU shall only erase to the beginning of a speaker's discourse, unless it occurs at the beginning of a speaker's discourse. (Thus, if the speaker has said something, two “su”s are required to erase the entire conversation.

#### <p>

#### <p>

#### <h4> Step 3 - Termination</h4>

<p>

If the text contains a FAhO, treat that as the end-of-text and ignore everything that follows it.

#### <p>

#### <p>

#### <h4> Step 4 - Absorption of Grammar-Free Tokens</h4>

<p>

In a new pass, perform the following absorptions (absorption means that the token is removed from the grammar for processing in following steps, and optionally reinserted, grouped with the absorbing token after parsing is completed).

<p>

a. Token sequences of the form any - (ZEI - any) <dots>…</dots>, where there may be any number of ZEIs, are merged into a single token of selma'o BRIVLA.

<p>

b. Absorb all selma'o BAhE tokens into the following token. If they occur at the end of text, leave them alone (they are errors).

<p>

c. Absorb all selma'o BU tokens into the previous token. Relabel the previous token as selma'o BY.

<p>

d. If selma'o NAI occurs immediately following any of tokens UI or CAI, ab­sorb the NAI into the previous token.

<p>

e. Absorb all members of selma'o DAhO, FUhO, FUhE, UI, Y, and CAI into the pre­vious token. All of these null grammar tokens are permitted following any word of the grammar, without interfering with that word's grammatical function, or causing any effect on the grammatical interpretation of any other token in the text. Indicators at the begin­ning of text are explicitly handled by the grammar.

#### <p>

#### <p>

#### <h4> Step 5 - Insertion of Lexer Lexemes</h4>

<p>

Lojban is not in itself LALR1. There are words whose grammatical function is de­termined by following tokens. As a result, parsing of the YACC grammar must take place in two steps. In the first step, certain strings of tokens with defined grammars are identi­fied, and either

<p>

a. are replaced by a single specified 'lexer token' for step 6, or

<p>

b. the lexer token is inserted in front of the token string to identify it uniquely.

<p>

The YACC grammar included herein is written to make YACC generation of a step 6 parser easy regardless of whether a. or b. is used. The strings of tokens to be la­belled with lexer tokens are found in rule terminals labelled with numbers between 900 and 1099. These rules are defined with the lexer tokens inserted, with the result that it can be veri­fied that the language is LALR1 under option b. after steps 1 through 4 have been per­formed. Alternatively, if option a. is to be used, these rules are commented out, and the rule terminals labelled from 800 to 900 refer to the lexer tokens *without* the strings of defining tokens. Two sets of lexer tokens are defined in the token set so as to be compati­ble with either option.

<p>

In this step, the strings must be labelled with the appropriate lexer tokens. Or­der of inserting lexer tokens *IS* significant, since some shorter strings that would be marked with a lexer token may be found inside longer strings. If the tokens are inserted before or in place of the shorter strings, the longer strings cannot be identified.

<p>

If option a. is chosen, the following order of insertion works correctly (it is not the only possible order): A, C, D, B, U, E, H, I, J, K, M, N, G, O, V, W, F, P, R, T, S, Y, L, Q. This ensures that the longest rules will be processed first; a PA+MAI will not be seen as a PA with a dangling MAI at the end, for example.

#### <p>

#### <p>

#### <h4> Step 6 - YACC Parsing</h4>

<p>

YACC should now be able to parse the Lojban text in accordance with the rule ter­minals labelled from 1 to 899 under option 5a, or 1 to 1099 under option 5b. Com­ment out the rules beyond 900 if option 5a is used, and comment out the 700-series of lexer-tokens, while restoring the series of lexer tokens numbered from 900 up. <p>

\*/

<pre>%token <a name=y501>A\_501 </a> /\* eks; basic afterthought logical connectives \*/

%token <a name=y502>BAI\_502 </a> /\* modal operators \*/

%token <a name=y503>BAhE\_503 </a> /\* next word intensifier \*/

%token <a name=y504>BE\_504 </a> /\* sumti link to attach sumti to a selbri \*/

%token <a name=y505>BEI\_505 </a> /\* multiple sumti separator between BE, BEI \*/

%token <a name=y506>BEhO\_506 </a> /\* terminates BE/BEI specified descriptors \*/

%token <a name=y507>BIhI\_507 </a> /\* interval component of JOI \*/

%token <a name=y508>BO\_508 </a> /\* joins two units with shortest scope \*/

%token <a name=y509>BRIVLA\_509 </a> /\* any brivla \*/

%token <a name=y511>BU\_511 </a> /\* turns any word into a BY lerfu word \*/

%token <a name=y513>BY\_513 </a> /\* individual lerfu words \*/

%token <a name=y514>CAhA\_514 </a> /\* specifies actuality/potentiality of tense \*/

%token <a name=y515>CAI\_515 </a> /\* afterthought intensity marker \*/

%token <a name=y516>CEI\_516 </a> /\* pro‑bridi assignment operator \*/

%token <a name=y517>CEhE\_517 </a> /\* afterthought term list connective \*/

%token <a name=y518>CMENE\_518 </a> /\* names; require consonant end, then pause no LA or DOI sel­ma'o embedded, pause before if vowel initial and preceded by a vowel \*/

%token <a name=y519>CO\_519 </a> /\* tanru inversion \*/

%token <a name=y520>COI\_520 </a> /\* vocative marker permitted inside names; must always be fol­lowed by pause or DOI \*/

%token <a name=y521>CU\_521 </a> /\* separator between head sumti and selbri \*/

%token <a name=y522>CUhE\_522 </a> /\* tense/modal question \*/

%token <a name=y524>DAhO\_524 </a> /\* cancel anaphora/cataphora assignments \*/

%token <a name=y525>DOI\_525 </a> /\* vocative marker \*/

%token <a name=y526>DOhU\_526 </a> /\* terminator for DOI‑marked vocatives \*/

%token <a name=y527>FA\_527 </a> /\* modifier head generic case tag \*/

%token <a name=y528>FAhA\_528 </a> /\* superdirections in space \*/

%token <a name=y529>FAhO\_529 </a> /\* normally elided 'done pause' to indicate end of utterance string \*/

%token <a name=y530>FEhE\_530 </a> /\* space interval mod flag \*/

%token <a name=y531>FEhU\_531 </a> /\* ends bridi to modal conversion \*/

%token <a name=y532>FIhO\_532 </a> /\* marks bridi to modal conversion \*/

%token <a name=y533>FOI\_533 </a> /\* end compound lerfu \*/

%token <a name=y535>FUhE\_535 </a> /\* open long scope for indicator \*/

%token <a name=y536>FUhO\_536 </a> /\* close long scope for indicator \*/

%token <a name=y537>GA\_537 </a> /\* geks; forethought logical connectives \*/

%token <a name=y538>GEhU\_538 </a> /\* marker ending GOI relative clauses \*/

%token <a name=y539>GI\_539 </a> /\* forethought medial marker \*/

%token <a name=y541>GIhA\_541 </a> /\* logical connectives for bridi‑tails \*/

%token <a name=y542>GOI\_542 </a> /\* attaches a sumti modifier to a sumti \*/

%token <a name=y543>GOhA\_543 </a> /\* pro‑bridi \*/

%token <a name=y544>GUhA\_544 </a> /\* GEK for tanru units, corresponds to JEKs \*/

%token <a name=y545>I\_545 </a> /\* sentence link \*/

%token <a name=y546>JA\_546 </a> /\* jeks; logical connectives within tanru \*/

%token <a name=y547>JAI\_547 </a> /\* modal conversion flag \*/

%token <a name=y548>JOI\_548 </a> /\* non‑logical connectives \*/

%token <a name=y550>KEhE\_550 </a> /\* right terminator for KE groups \*/

%token <a name=y551>KE\_551 </a> /\* left long scope marker \*/

%token <a name=y552>KEI\_552 </a> /\* right terminator, NU abstractions \*/

%token <a name=y554>KI\_554 </a> /\* multiple utterance scope for tenses \*/

%token <a name=y555>KOhA\_555 </a> /\* sumti anaphora \*/

%token <a name=y556>KU\_556 </a> /\* right terminator for descriptions, etc. \*/

%token <a name=y557>KUhO\_557 </a> /\* right terminator, NOI relative clauses \*/

%token <a name=y558>LA\_558 </a> /\* name descriptors \*/

%token <a name=y559>LAU\_559 </a> /\* lerfu prefixes \*/

%token <a name=y561>LAhE\_561 </a> /\* sumti qualifiers \*/

%token <a name=y562>LE\_562 </a> /\* sumti descriptors \*/

%token <a name=y565>LEhU\_565 </a> /\* possibly ungrammatical text right quote \*/

%token <a name=y566>LI\_566 </a> /\* convert number to sumti \*/

%token <a name=y567>LIhU\_567 </a> /\* grammatical text right quote \*/

%token <a name=y568>LOhO\_568 </a> /\* elidable terminator for LI \*/

%token <a name=y569>LOhU\_569 </a> /\* possibly ungrammatical text left quote \*/

%token <a name=y571>LU\_571 </a> /\* grammatical text left quote \*/

%token <a name=y573>LUhU\_573 </a> /\* LAhE close delimiter \*/

%token <a name=y574>ME\_574 </a> /\* converts a sumti into a tanru\_unit \*/

%token <a name=y575>MEhU\_575 </a> /\* terminator for ME \*/

%token <a name=y577>MOhI\_577 </a> /\* motion tense marker \*/

%token <a name=y578>NA\_578 </a> /\* bridi negation \*/

%token <a name=y581>NAI\_581 </a> /\* attached to words to negate them \*/

%token <a name=y583>NAhE\_583 </a> /\* scalar negation \*/

%token <a name=y584>NIhO\_584 </a> /\* new paragraph; change of subject \*/

%token <a name=y585>NOI\_585 </a> /\* attaches a subordinate clause to a sumti \*/

%token <a name=y586>NU\_586 </a> /\* abstraction \*/

%token <a name=y587>NUhI\_587 </a> /\* marks the start of a termset \*/

%token <a name=y588>NUhU\_588 </a> /\* marks the middle and end of a termset \*/

%token <a name=y591>PEhE\_591 </a> /\* afterthought termset connective prefix \*/

%token <a name=y592>PU\_592 </a> /\* directions in time \*/

%token <a name=y593>RAhO\_593 </a> /\* flag for modified interpretation of GOhI \*/

%token <a name=y594>ROI\_594 </a> /\* converts number to extensional tense \*/

%token <a name=y595>SA\_595 </a> /\* metalinguistic eraser to the beginning of the current utterance \*/

%token <a name=y596>SE\_596 </a> /\* conversions \*/

%token <a name=y597>SEI\_597 </a> /\* metalinguistic bridi insert marker \*/

%token <a name=y598>SEhU\_598 </a> /\* metalinguistic bridi end marker \*/

%token <a name=y601>SI\_601 </a> /\* metalinguistic single word eraser \*/

%token <a name=y602>SOI\_602 </a> /\* reciprocal sumti marker \*/

%token <a name=y603>SU\_603 </a> /\* metalinguistic eraser of the entire text \*/

%token <a name=y604>TAhE\_604 </a> /\* tense interval properties \*/

%token <a name=y605>TEI\_605 </a> /\* start compound lerfu \*/

%token <a name=y606>TO\_606 </a> /\* left discursive parenthesis \*/

%token <a name=y607>TOI\_607 </a> /\* right discursive parenthesis \*/

%token <a name=y610>TUhE\_610 </a> /\* multiple utterance scope mark \*/

%token <a name=y611>TUhU\_611 </a> /\* multiple utterance end scope mark \*/

%token <a name=y612>UI\_612 </a> /\* attitudinals, observationals, discursives \*/

%token <a name=y613>VA\_613 </a> /\* distance in space‑time \*/

%token <a name=y614>VAU\_614 </a> /\* end simple bridi or bridi‑tail \*/

%token <a name=y615>VEhA\_615 </a> /\* space‑time interval size \*/

%token <a name=y616>VIhA\_616 </a> /\* space‑time dimensionality marker \*/

%token <a name=y617>VUhO\_617 </a> /\* glue between logically connected sumti and relative clauses \*/

%token <a name=y618>XI\_618 </a> /\* subscripting operator \*/

%token <a name=y619>Y\_619 </a> /\* hesitation \*/

%token <a name=y621>ZAhO\_621 </a> /\* event properties ‑ inchoative, etc. \*/

%token <a name=y622>ZEhA\_622 </a> /\* time interval size tense \*/

%token <a name=y623>ZEI\_623 </a> /\* lujvo glue \*/

%token <a name=y624>ZI\_624 </a> /\* time distance tense \*/

%token <a name=y625>ZIhE\_625 </a> /\* conjoins relative clauses \*/

%token <a name=y626>ZO\_626 </a> /\* single word metalinguistic quote marker \*/

%token <a name=y627>ZOI\_627 </a> /\* delimited quote marker \*/

%token <a name=y628>ZOhU\_628 </a> /\* prenex terminator (not elidable) \*/

%token <a name=y650>BIhE\_650 </a> /\* prefix for high‑priority MEX operator \*/

%token <a name=y651>BOI\_651 </a> /\* number or lerfu‑string terminator \*/

%token <a name=y655>FUhA\_655 </a> /\* reverse Polish flag \*/

%token <a name=y656>GAhO\_656 </a> /\* open/closed interval markers for BIhI \*/

%token <a name=y657>JOhI\_657 </a> /\* flags an array operand \*/

%token <a name=y658>KUhE\_658 </a> /\* MEX forethought delimiter \*/

%token <a name=y661>MAI\_661 </a> /\* change numbers to utterance ordinals \*/

%token <a name=y662>MAhO\_662 </a> /\* change MEX expressions to MEX operators \*/

%token <a name=y663>MOI\_663 </a> /\* change number to selbri \*/

%token <a name=y664>MOhE\_664 </a> /\* change sumti to operand, inverse of LI \*/

%token <a name=y665>NAhU\_665 </a> /\* change a selbri into an operator \*/

%token <a name=y666>NIhE\_666 </a> /\* change selbri to operand; inverse of MOI \*/

%token <a name=y667>NUhA\_667 </a> /\* change operator to selbri; inverse of MOhE \*/

%token <a name=y672>PA\_672 </a> /\* numbers and numeric punctuation \*/

%token <a name=y673>PEhO\_673 </a> /\* forethought (Polish) flag \*/

%token <a name=y675>TEhU\_675 </a> /\* closing gap for MEX constructs \*/

%token <a name=y677>VEI\_677 </a> /\* left MEX bracket \*/

%token <a name=y678>VEhO\_678 </a> /\* right MEX bracket \*/

%token <a name=y679>VUhU\_679 </a> /\* MEX operator \*/

%token any\_words\_697 </a> /\* a string of lexable Lojban words \*/

%token any\_word\_698 </a> /\* any single lexable Lojban words \*/

%token anything\_699 </a> /\* a possibly unlexable phoneme string \*/

/\* The following tokens are the actual lexer tokens. The \_900 series tokens are duplicates that allow limited testing of lexer rules in the context of the total grammar. They are used in the actual parser, where the 900 series rules are found in the lexer. \*/

%token lexer\_<a name=y701>A\_701 </a> /\* flags a MAI utterance ordinal \*/

%token lexer\_<a name=y702>B\_702 </a> /\* flags an EK unless EK\_BO, EK\_KE \*/

%token lexer\_<a name=y703>C\_703 </a> /\* flags an EK\_BO \*/

%token lexer\_<a name=y704>D\_704 </a> /\* flags an EK\_KE \*/

%token lexer\_<a name=y705>E\_705 </a> /\* flags a JEK \*/

%token lexer\_<a name=y706>F\_706 </a> /\* flags a JOIK \*/

%token lexer\_<a name=y707>G\_707 </a> /\* flags a GEK \*/

%token lexer\_<a name=y708>H\_708 </a> /\* flags a GUhEK \*/

%token lexer\_<a name=y709>I\_709 </a> /\* flags a NAhE\_BO \*/

%token lexer\_<a name=y710>J\_710 </a> /\* flags a NA\_KU \*/

%token lexer\_<a name=y711>K\_711 </a> /\* flags an I\_BO (option. JOIK/JEK lexer tags)\*/

%token lexer\_<a name=y712>L\_712 </a> /\* flags a PA, unless MAI (then lexer A) \*/

%token lexer\_<a name=y713>M\_713 </a> /\* flags a GIhEK\_BO \*/

%token lexer\_<a name=y714>N\_714 </a> /\* flags a GIhEK\_KE \*/

%token lexer\_<a name=y715>O\_715 </a> /\* flags a modal operator BAI or compound \*/

%token lexer\_<a name=y716>P\_716 </a> /\* flags a GIK \*/

%token lexer\_<a name=y717>Q\_717 </a> /\* flags a lerfu\_string unless MAI (then lexer\_A)\*/

%token lexer\_<a name=y718>R\_718 </a> /\* flags a GIhEK, not BO or KE \*/

%token lexer\_<a name=y719>S\_719 </a> /\* flags simple I \*/

%token lexer\_<a name=y720>T\_720 </a> /\* flags I\_JEK \*/

%token lexer\_<a name=y721>U\_721 </a> /\* flags a JEK\_BO \*/

%token lexer\_<a name=y722>V\_722 </a> /\* flags a JOIK\_BO \*/

%token lexer\_<a name=y723>W\_723 </a> /\* flags a JOIK\_KE \*/ /\*

%token lexer\_<a name=y724>X\_724 </a> /\* null \*/

%token lexer\_<a name=y725>Y\_725 </a> /\* flags a PA\_MOI \*/

/\*

%token lexer\_A\_905 /\* : lexer\_A\_701 utt\_ordinal\_root\_906 \*/ /\*

%token lexer\_B\_910 /\* : lexer\_B\_702 EK\_root\_911 \*/ /\*

%token lexer\_C\_915 /\* : lexer\_C\_703 EK\_root\_911 BO\_508 \*/ /\*

%token lexer\_D\_916 /\* : lexer\_D\_704 EK\_root\_911 KE\_551 \*/ /\*

%token lexer\_E\_925 /\* : lexer\_E\_705 JEK\_root\_926 \*/ /\*

%token lexer\_F\_930 /\* : lexer\_F\_706 JOIK\_root\_931 \*/ /\*

%token lexer\_G\_935 /\* : lexer\_G\_707 GA\_537 \*/ /\*

%token lexer\_H\_940 /\* : lexer\_H\_708 GUhA\_544 \*/ /\*

%token lexer\_I\_945 /\* : lexer\_I\_709 NAhE\_583 BO\_508 \*/ /\*

%token lexer\_J\_950 /\* : lexer\_J\_710 NA\_578 KU\_556 \*/ /\*

%token lexer\_K\_955 /\* : lexer\_K\_711 I\_432 BO\_508 \*/ /\*

%token lexer\_L\_960 /\* : lexer\_L\_712 number\_root\_961 \*/ /\*

%token lexer\_M\_965 /\* : lexer\_M\_713 GIhEK\_root\_991 BO\_508 \*/ /\*

%token lexer\_N\_966 /\* : lexer\_N\_714 GIhEK\_root\_991 KE\_551 \*/ /\*

%token lexer\_O\_970 /\* : lexer\_O\_715 simple\_tense\_modal\_972 \*/ /\*

%token lexer\_P\_980 /\* : lexer\_P\_716 GIK\_root\_981 \*/ /\*

%token lexer\_Q\_985 /\* : lexer\_Q\_717 lerfu\_string\_root\_986 \*/ /\*

%token lexer\_R\_990 /\* : lexer\_R\_718 GIhEK\_root\_991 \*/ /\*

%token lexer\_S\_995 /\* : lexer\_S\_719 I\_545 \*/ /\*

%token lexer\_T\_1000 /\* : lexer\_T\_720 I\_545 simple\_JOIK\_JEK\_957 \*/ /\*

%token lexer\_U\_1005 /\* : lexer\_U\_721 JEK\_root\_926 BO\_508 \*/ /\*

%token lexer\_V\_1010 /\* : lexer\_V\_722 JOIK\_root\_931 BO\_508 \*/ /\*

%token lexer\_W\_1015 /\* : lexer\_W\_723 JOIK\_root\_931 KE\_551 \*/ /\*

%token lexer\_X\_1020 /\* null \*/ /\*

%token lexer\_Y\_1025 /\* : lexer\_Y\_725 number\_root\_961 MOI\_663 \*/

%start <a href=#y0>text\_0 </a>

%%

<a name=y0>text\_0 </a> : <a href=#y1>text\_A\_1 </a>

| <a href=#y411>indicators\_411 </a><a href=#y1>text\_A\_1 </a>

| <a href=#y32>free\_modifier\_32 </a><a href=#y1>text\_A\_1 </a>

| <a href=#y404>cmene\_404 </a><a href=#y1>text\_A\_1 </a>

| <a href=#y411>indicators\_411 </a><a href=#y32>free\_modifier\_32 </a><a href=#y1>text\_A\_1 </a>

| <a href=#y581>NAI\_581 </a><a href=#y0>text\_0 </a>

;

<a name=y1>text\_A\_1 </a> : <a href=#y422>JOIK\_JEK\_422 </a><a href=#y2>text\_B\_2 </a>

/\* incomplete JOIK\_JEK without preceding I \*/

/\* compare note on <a href=#y10>paragraph\_10 </a>\*/

| <a href=#y2>text\_B\_2 </a>

;

<a name=y2>text\_B\_2 </a> : <a href=#y819>I\_819 </a><a href=#y2>text\_B\_2 </a>

| <a href=#y820>I\_JEK\_820 </a><a href=#y2>text\_B\_2 </a>

| <a href=#y811>I\_BO\_811 </a><a href=#y2>text\_B\_2 </a>

| <a href=#y410>para\_mark\_410 </a><a href=#y3>text\_C\_3 </a>

| <a href=#y3>text\_C\_3 </a>

;

<a name=y3>text\_C\_3 </a> : <a href=#y4>paragraphs\_4 </a>

/\* Only indicators which follow certain selma'o: cmene, <a href=#y607>TOI\_607 </a>, <a href=#y571>LU\_571 </a>, and the lexer\_K and lexer\_S I\_roots and compounds, and at the start of text(\_0), will survive the lexer; all other valid ones will be absorbed. The only strings for which indicators generate a potential ambiguity are those which contain NAI. An indicator cannot be inserted in between a token and its ne­gating NAI, else you can't tell whether it is the indicator or the original token being negated. \*/

| /\* empty \*/

/\* An empty text is legal; formerly this was handled by the explicit appear­ance of <a href=#y529>FAhO\_529 </a>, but this is now absorbed by the preparser. \*/

;

<a name=y4>paragraphs\_4 </a> : <a href=#y10>paragraph\_10 </a>

| <a href=#y10>paragraph\_10 </a><a href=#y410>para\_mark\_410 </a><a href=#y4>paragraphs\_4 </a>

;

<a name=y10>paragraph\_10 </a> : <a href=#y11>statement\_11 </a>

| <a href=#y20>fragment\_20 </a>

| <a href=#y10>paragraph\_10 </a><a href=#y819>I\_819 </a><a href=#y11>statement\_11 </a>

| <a href=#y10>paragraph\_10 </a><a href=#y819>I\_819 </a><a href=#y20>fragment\_20 </a>

| <a href=#y10>paragraph\_10 </a><a href=#y819>I\_819 </a>

/\* this last fixes an erroneous start to a sentence, and permits incomplete JOIK\_JEK after I, as well in answer to questions on those connectives \*/

;

<a name=y11>statement\_11 </a> : <a href=#y12>statement\_A\_12 </a>

| <a href=#y30>prenex\_30 </a><a href=#y11>statement\_11 </a>

;

<a name=y12>statement\_A\_12 </a> : <a href=#y13>statement\_B\_13 </a>

| <a href=#y12>statement\_A\_12 </a><a href=#y820>I\_JEK\_820 </a><a href=#y13>statement\_B\_13 </a>

| <a href=#y12>statement\_A\_12 </a><a href=#y820>I\_JEK\_820 </a>

;

<a name=y13>statement\_B\_13 </a> : <a href=#y14>statement\_C\_14 </a>

| <a href=#y14>statement\_C\_14 </a><a href=#y811>I\_BO\_811 </a><a href=#y13>statement\_B\_13 </a>

| <a href=#y14>statement\_C\_14 </a><a href=#y811>I\_BO\_811 </a>

;

<a name=y14>statement\_C\_14 </a> : <a href=#y40>sentence\_40 </a>

| <a href=#y447>TUhE\_447 </a><a href=#y2>text\_B\_2 </a><a href=#y454>TUhU\_gap\_454 </a>

| <a href=#y491>tag\_491 </a><a href=#y447>TUhE\_447 </a><a href=#y2>text\_B\_2 </a><a href=#y454>TUhU\_gap\_454 </a>

;

<a name=y20>fragment\_20 </a> : <a href=#y802>EK\_802 </a>

| <a href=#y445>NA\_445 </a>

| <a href=#y818>GIhEK\_818 </a>

| <a href=#y300>quantifier\_300 </a>

| <a href=#y80>terms\_80 </a><a href=#y456>VAU\_gap\_456 </a>/\* answer to ma \*/

/\* <a href=#y490>mod\_head\_490 </a>requires both <a href=#y450>gap\_450 </a>and <a href=#y456>VAU\_gap\_456 </a> but needs no extra rule to accomplish this \*/

| <a href=#y121>relative\_clauses\_121 </a>

| <a href=#y161>links\_161 </a>

| <a href=#y160>linkargs\_160 </a>

| <a href=#y30>prenex\_30 </a>

;

<a name=y30>prenex\_30 </a> : <a href=#y80>terms\_80 </a><a href=#y492>ZOhU\_492 </a>

;

<a name=y32>free\_modifier\_32 </a> : <a href=#y33>free\_modifier\_A\_33 </a>

| <a href=#y33>free\_modifier\_A\_33 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y33>free\_modifier\_A\_33 </a>: <a href=#y35>vocative\_35 </a>

| <a href=#y36>parenthetical\_36 </a>

| <a href=#y34>discursive\_bridi\_34 </a>

| <a href=#y486>subscript\_486 </a>

| <a href=#y801>utterance\_ordinal\_801 </a>

;

<a name=y34>discursive\_bridi\_34 </a>: <a href=#y440>SEI\_440 </a><a href=#y130>selbri\_130 </a><a href=#y459>SEhU\_gap\_459 </a>

| <a href=#y498>SOI\_498 </a><a href=#y90>sumti\_90 </a><a href=#y459>SEhU\_gap\_459 </a>

| <a href=#y498>SOI\_498 </a><a href=#y90>sumti\_90 </a><a href=#y90>sumti\_90 </a><a href=#y459>SEhU\_gap\_459 </a>

| <a href=#y440>SEI\_440 </a><a href=#y80>terms\_80 </a><a href=#y451>front\_gap\_451 </a><a href=#y130>selbri\_130 </a><a href=#y459>SEhU\_gap\_459 </a>

| <a href=#y440>SEI\_440 </a><a href=#y80>terms\_80 </a><a href=#y130>selbri\_130 </a><a href=#y459>SEhU\_gap\_459 </a>

;

<a name=y35>vocative\_35 </a> : <a href=#y415>DOI\_415 </a><a href=#y130>selbri\_130 </a><a href=#y457>DOhU\_gap\_457 </a>

| <a href=#y415>DOI\_415 </a><a href=#y130>selbri\_130 </a><a href=#y121>relative\_clauses\_121 </a><a href=#y457>DOhU\_gap\_457 </a>

| <a href=#y415>DOI\_415 </a><a href=#y121>relative\_clauses\_121 </a><a href=#y130>selbri\_130 </a><a href=#y457>DOhU\_gap\_457 </a>

| <a href=#y415>DOI\_415 </a><a href=#y121>relative\_clauses\_121 </a><a href=#y130>selbri\_130 </a><a href=#y121>relative\_clauses\_121 </a><a href=#y457>DOhU\_gap\_457 </a>

| <a href=#y415>DOI\_415 </a><a href=#y404>cmene\_404 </a><a href=#y457>DOhU\_gap\_457 </a>

| <a href=#y415>DOI\_415 </a><a href=#y404>cmene\_404 </a><a href=#y121>relative\_clauses\_121 </a><a href=#y457>DOhU\_gap\_457 </a>

| <a href=#y415>DOI\_415 </a><a href=#y121>relative\_clauses\_121 </a><a href=#y404>cmene\_404 </a><a href=#y457>DOhU\_gap\_457 </a>

| <a href=#y415>DOI\_415 </a><a href=#y121>relative\_clauses\_121 </a><a href=#y404>cmene\_404 </a><a href=#y121>relative\_clauses\_121 </a><a href=#y457>DOhU\_gap\_457 </a>

| <a href=#y415>DOI\_415 </a><a href=#y90>sumti\_90 </a><a href=#y457>DOhU\_gap\_457 </a>

| <a href=#y415>DOI\_415 </a><a href=#y457>DOhU\_gap\_457 </a>

;

<a name=y36>parenthetical\_36 </a> : <a href=#y606>TO\_606 </a><a href=#y0>text\_0 </a><a href=#y468>TOI\_gap\_468 </a>

;

<a name=y40>sentence\_40 </a> : <a href=#y50>bridi\_tail\_50 </a>/\* bare observative or mo answer \*/

| <a href=#y80>terms\_80 </a><a href=#y451>front\_gap\_451 </a><a href=#y50>bridi\_tail\_50 </a>

| <a href=#y80>terms\_80 </a><a href=#y50>bridi\_tail\_50 </a>

;

<a name=y41>subsentence\_41 </a> : <a href=#y40>sentence\_40 </a>

| <a href=#y30>prenex\_30 </a><a href=#y41>subsentence\_41 </a>

;

<a name=y50>bridi\_tail\_50 </a> : <a href=#y51>bridi\_tail\_A\_51 </a>

| <a href=#y51>bridi\_tail\_A\_51 </a><a href=#y814>GIhEK\_KE\_814 </a><a href=#y50>bridi\_tail\_50 </a><a href=#y466>KEhE\_gap\_466 </a><a href=#y71>tail\_terms\_71 </a>

;

<a name=y51>bridi\_tail\_A\_51 </a> : <a href=#y52>bridi\_tail\_B\_52 </a>

| <a href=#y51>bridi\_tail\_A\_51 </a><a href=#y818>GIhEK\_818 </a><a href=#y52>bridi\_tail\_B\_52 </a><a href=#y71>tail\_terms\_71 </a>

;

<a name=y52>bridi\_tail\_B\_52 </a> : <a href=#y53>bridi\_tail\_C\_53 </a>

| <a href=#y53>bridi\_tail\_C\_53 </a><a href=#y813>GIhEK\_BO\_813 </a><a href=#y52>bridi\_tail\_B\_52 </a><a href=#y71>tail\_terms\_71 </a>

;

<a name=y53>bridi\_tail\_C\_53 </a> : <a href=#y54>gek\_sentence\_54 </a>

| <a href=#y130>selbri\_130 </a><a href=#y71>tail\_terms\_71 </a>

;

<a name=y54>gek\_sentence\_54 </a> : <a href=#y807>GEK\_807 </a><a href=#y41>subsentence\_41 </a><a href=#y816>GIK\_816 </a><a href=#y41>subsentence\_41 </a><a href=#y71>tail\_terms\_71 </a>

| <a href=#y491>tag\_491 </a><a href=#y493>KE\_493 </a><a href=#y54>gek\_sentence\_54 </a><a href=#y466>KEhE\_gap\_466 </a>

| <a href=#y445>NA\_445 </a><a href=#y54>gek\_sentence\_54 </a>

;

<a name=y71>tail\_terms\_71 </a> : <a href=#y80>terms\_80 </a><a href=#y456>VAU\_gap\_456 </a>

| <a href=#y456>VAU\_gap\_456 </a>

;

<a name=y80>terms\_80 </a> : <a href=#y81>terms\_A\_81 </a>

| <a href=#y80>terms\_80 </a><a href=#y81>terms\_A\_81 </a>

;

<a name=y81>terms\_A\_81 </a> : <a href=#y82>terms\_B\_82 </a>

| <a href=#y81>terms\_A\_81 </a><a href=#y494>PEhE\_494 </a><a href=#y422>JOIK\_JEK\_422 </a><a href=#y82>terms\_B\_82 </a>

;

<a name=y82>terms\_B\_82 </a> : <a href=#y83>term\_83 </a>

| <a href=#y82>terms\_B\_82 </a><a href=#y495>CEhE\_495 </a><a href=#y83>term\_83 </a>

;

<a name=y83>term\_83 </a> : <a href=#y90>sumti\_90 </a>

| <a href=#y84>modifier\_84 </a>

| <a href=#y85>term\_set\_85 </a>

| <a href=#y810>NA\_KU\_810 </a>

;

<a name=y84>modifier\_84 </a> : <a href=#y490>mod\_head\_490 </a><a href=#y450>gap\_450 </a>

| <a href=#y490>mod\_head\_490 </a><a href=#y90>sumti\_90 </a>

;

<a name=y85>term\_set\_85 </a> : <a href=#y496>NUhI\_496 </a><a href=#y80>terms\_80 </a><a href=#y460>NUhU\_gap\_460 </a>

| <a href=#y496>NUhI\_496 </a><a href=#y807>GEK\_807 </a><a href=#y80>terms\_80 </a><a href=#y460>NUhU\_gap\_460 </a><a href=#y816>GIK\_816 </a><a href=#y80>terms\_80 </a><a href=#y460>NUhU\_gap\_460 </a>

;

<a name=y90>sumti\_90 </a> : <a href=#y91>sumti\_A\_91 </a>

| <a href=#y91>sumti\_A\_91 </a><a href=#y497>VUhO\_497 </a><a href=#y121>relative\_clauses\_121 </a>

;

<a name=y91>sumti\_A\_91 </a> : <a href=#y92>sumti\_B\_92 </a>

| <a href=#y92>sumti\_B\_92 </a><a href=#y804>EK\_KE\_804 </a><a href=#y90>sumti\_90 </a><a href=#y466>KEhE\_gap\_466 </a>

| <a href=#y92>sumti\_B\_92 </a><a href=#y823>JOIK\_KE\_823 </a><a href=#y90>sumti\_90 </a><a href=#y466>KEhE\_gap\_466 </a>

;

<a name=y92>sumti\_B\_92 </a> : <a href=#y93>sumti\_C\_93 </a>

| <a href=#y92>sumti\_B\_92 </a><a href=#y421>JOIK\_EK\_421 </a><a href=#y93>sumti\_C\_93 </a>

;

<a name=y93>sumti\_C\_93 </a> : <a href=#y94>sumti\_D\_94 </a>

| <a href=#y94>sumti\_D\_94 </a><a href=#y803>EK\_BO\_803 </a><a href=#y93>sumti\_C\_93 </a>

| <a href=#y94>sumti\_D\_94 </a><a href=#y822>JOIK\_BO\_822 </a><a href=#y93>sumti\_C\_93 </a>

;

<a name=y94>sumti\_D\_94 </a> : <a href=#y95>sumti\_E\_95 </a>

| <a href=#y807>GEK\_807 </a><a href=#y90>sumti\_90 </a><a href=#y816>GIK\_816 </a><a href=#y94>sumti\_D\_94 </a>

;

<a name=y95>sumti\_E\_95 </a> : <a href=#y96>sumti\_F\_96 </a>

| <a href=#y96>sumti\_F\_96 </a><a href=#y121>relative\_clauses\_121 </a>

/\* indefinite sumti \*/

| <a href=#y300>quantifier\_300 </a><a href=#y130>selbri\_130 </a><a href=#y450>gap\_450 </a>

| <a href=#y300>quantifier\_300 </a><a href=#y130>selbri\_130 </a><a href=#y450>gap\_450 </a><a href=#y121>relative\_clauses\_121 </a>

;

<a name=y96>sumti\_F\_96 </a> : <a href=#y97>sumti\_G\_97 </a>

/\* outer‑quantified sumti \*/

| <a href=#y300>quantifier\_300 </a><a href=#y97>sumti\_G\_97 </a>

;

<a name=y97>sumti\_G\_97 </a> : <a href=#y483>qualifier\_483 </a><a href=#y90>sumti\_90 </a><a href=#y463>LUhU\_gap\_463 </a>

| <a href=#y483>qualifier\_483 </a><a href=#y121>relative\_clauses\_121 </a><a href=#y90>sumti\_90 </a><a href=#y463>LUhU\_gap\_463 </a>

/\*sumti grouping, set/mass/individual conversion; also sumti scalar negation \*/

| <a href=#y400>anaphora\_400 </a>

| <a href=#y499>LA\_499 </a><a href=#y404>cmene\_404 </a>

| <a href=#y499>LA\_499 </a><a href=#y121>relative\_clauses\_121 </a><a href=#y404>cmene\_404 </a>

| <a href=#y489>LI\_489 </a><a href=#y310>MEX\_310 </a><a href=#y472>LOhO\_gap\_472 </a>

| <a href=#y110>description\_110 </a>

| <a href=#y432>quote\_arg\_432 </a>

;

<a name=y110>description\_110 </a> : <a href=#y499>LA\_499 </a><a href=#y111>sumti\_tail\_111 </a><a href=#y450>gap\_450 </a>

| <a href=#y488>LE\_488 </a><a href=#y111>sumti\_tail\_111 </a><a href=#y450>gap\_450 </a>

;

<a name=y111>sumti\_tail\_111 </a> : <a href=#y112>sumti\_tail\_A\_112 </a>

/\* inner‑quantified sumti relative clause \*/

| <a href=#y121>relative\_clauses\_121 </a><a href=#y112>sumti\_tail\_A\_112 </a>

/\* pseudo‑possessive (an abbreviated inner restriction); note that sumti cannot be quantified \*/

| <a href=#y97>sumti\_G\_97 </a><a href=#y112>sumti\_tail\_A\_112 </a>

/\* pseudo‑possessive with outer restriction \*/

| <a href=#y97>sumti\_G\_97 </a><a href=#y121>relative\_clauses\_121 </a><a href=#y112>sumti\_tail\_A\_112 </a>

;

<a name=y112>sumti\_tail\_A\_112 </a> : <a href=#y130>selbri\_130 </a>

| <a href=#y130>selbri\_130 </a><a href=#y121>relative\_clauses\_121 </a>

/\* explicit inner quantifier \*/

| <a href=#y300>quantifier\_300 </a><a href=#y130>selbri\_130 </a>

/\* quantifier both internal to a description, and external to a sumti thereby made specific \*/

| <a href=#y300>quantifier\_300 </a><a href=#y130>selbri\_130 </a><a href=#y121>relative\_clauses\_121 </a>

| <a href=#y300>quantifier\_300 </a><a href=#y90>sumti\_90 </a>

;

<a name=y121>relative\_clauses\_121 </a>: <a href=#y122>relative\_clause\_122 </a>

| <a href=#y121>relative\_clauses\_121 </a><a href=#y487>ZIhE\_487 </a><a href=#y122>relative\_clause\_122 </a>

;

<a name=y122>relative\_clause\_122 </a>: <a href=#y485>GOI\_485 </a><a href=#y83>term\_83 </a><a href=#y464>GEhU\_gap\_464 </a>

| <a href=#y484>NOI\_484 </a><a href=#y41>subsentence\_41 </a><a href=#y469>KUhO\_gap\_469 </a>

;

<a name=y130>selbri\_130 </a> : <a href=#y491>tag\_491 </a><a href=#y131>selbri\_A\_131 </a>

| <a href=#y131>selbri\_A\_131 </a>

;

<a name=y131>selbri\_A\_131 </a> : <a href=#y132>selbri\_B\_132 </a>

| <a href=#y445>NA\_445 </a><a href=#y130>selbri\_130 </a>

;

<a name=y132>selbri\_B\_132 </a> : <a href=#y133>selbri\_C\_133 </a>

| <a href=#y133>selbri\_C\_133 </a><a href=#y443>CO\_443 </a><a href=#y132>selbri\_B\_132 </a>

;

<a name=y133>selbri\_C\_133 </a> : <a href=#y134>selbri\_D\_134 </a>

| <a href=#y133>selbri\_C\_133 </a><a href=#y134>selbri\_D\_134 </a>

;

<a name=y134>selbri\_D\_134 </a> : <a href=#y135>selbri\_E\_135 </a>

| <a href=#y134>selbri\_D\_134 </a><a href=#y422>JOIK\_JEK\_422 </a><a href=#y135>selbri\_E\_135 </a>

| <a href=#y134>selbri\_D\_134 </a><a href=#y823>JOIK\_KE\_823 </a><a href=#y133>selbri\_C\_133 </a><a href=#y466>KEhE\_gap\_466 </a>

;

<a name=y135>selbri\_E\_135 </a> : <a href=#y136>selbri\_F\_136 </a>

| <a href=#y136>selbri\_F\_136 </a><a href=#y821>JEK\_BO\_821 </a><a href=#y135>selbri\_E\_135 </a>

| <a href=#y136>selbri\_F\_136 </a><a href=#y822>JOIK\_BO\_822 </a><a href=#y135>selbri\_E\_135 </a>

;

<a name=y136>selbri\_F\_136 </a> : <a href=#y150>tanru\_unit\_150 </a>

| <a href=#y150>tanru\_unit\_150 </a><a href=#y479>BO\_479 </a><a href=#y136>selbri\_F\_136 </a>

| <a href=#y137>GUhEK\_selbri\_137 </a>

| <a href=#y482>NAhE\_482 </a><a href=#y137>GUhEK\_selbri\_137 </a>

;

<a name=y137>GUhEK\_selbri\_137 </a> : <a href=#y808>GUhEK\_808 </a><a href=#y130>selbri\_130 </a><a href=#y816>GIK\_816 </a><a href=#y136>selbri\_F\_136 </a>

;

<a name=y150>tanru\_unit\_150 </a> : <a href=#y151>tanru\_unit\_A\_151 </a>

| <a href=#y150>tanru\_unit\_150 </a><a href=#y444>CEI\_444 </a><a href=#y151>tanru\_unit\_A\_151 </a>

;

<a name=y151>tanru\_unit\_A\_151 </a> : <a href=#y152>tanru\_unit\_B\_152 </a>

| <a href=#y152>tanru\_unit\_B\_152 </a><a href=#y160>linkargs\_160 </a>

;

<a name=y152>tanru\_unit\_B\_152 </a> : <a href=#y407>bridi\_valsi\_407 </a>

| <a href=#y493>KE\_493 </a><a href=#y133>selbri\_C\_133 </a><a href=#y466>KEhE\_gap\_466 </a>

| <a href=#y480>SE\_480 </a><a href=#y152>tanru\_unit\_B\_152 </a>

| <a href=#y478>JAI\_478 </a><a href=#y491>tag\_491 </a><a href=#y152>tanru\_unit\_B\_152 </a>

| <a href=#y478>JAI\_478 </a><a href=#y152>tanru\_unit\_B\_152 </a>

| <a href=#y477>ME\_477 </a><a href=#y90>sumti\_90 </a><a href=#y465>MEhU\_gap\_465 </a>

| <a href=#y477>ME\_477 </a><a href=#y90>sumti\_90 </a><a href=#y465>MEhU\_gap\_465 </a><a href=#y476>MOI\_476 </a>

| <a href=#y475>NUhA\_475 </a><a href=#y374>MEX\_operator\_374 </a>

| <a href=#y482>NAhE\_482 </a><a href=#y152>tanru\_unit\_B\_152 </a>

| <a href=#y425>NU\_425 </a><a href=#y41>subsentence\_41 </a><a href=#y453>KEI\_gap\_453 </a>

;

<a name=y160>linkargs\_160 </a> : <a href=#y446>BE\_446 </a><a href=#y83>term\_83 </a><a href=#y467>BEhO\_gap\_467 </a>

| <a href=#y446>BE\_446 </a><a href=#y83>term\_83 </a><a href=#y161>links\_161 </a><a href=#y467>BEhO\_gap\_467 </a>

;

<a name=y161>links\_161 </a> : <a href=#y442>BEI\_442 </a><a href=#y83>term\_83 </a>

| <a href=#y442>BEI\_442 </a><a href=#y83>term\_83 </a><a href=#y161>links\_161 </a>

;

/\* Main entry point for MEX; everything but a number must be in parens. \*/

<a name=y300>quantifier\_300 </a> : <a href=#y812>number\_812 </a><a href=#y461>BOI\_gap\_461 </a>

| <a href=#y470>left\_bracket\_470 </a><a href=#y310>MEX\_310 </a><a href=#y471>right\_bracket\_gap\_471 </a>

;

/\* Entry point for MEX used after LI; no parens needed, but LI now has an eli­dable terminator. (This allows us to express the difference between “the ex­pression a + b” and “the expression (a + b)” \_) \*/

/\* This rule supports left‑grouping infix expressions and reverse Polish ex­pres­sions. To handle infix monadic, use a null operand; to handle infix with more than two operands (whatever that means) use an extra operator or an ar­ray op­erand. \*/

<a name=y310>MEX\_310 </a> : <a href=#y311>MEX\_A\_311 </a>

| <a href=#y310>MEX\_310 </a><a href=#y370>operator\_370 </a><a href=#y311>MEX\_A\_311 </a>

| <a href=#y441>FUhA\_441 </a><a href=#y330>rp\_expression\_330 </a>

;

/\* Support for right‑grouping (short scope) infix expressions with BIhE. \*/

<a name=y311>MEX\_A\_311 </a> : <a href=#y312>MEX\_B\_312 </a>

| <a href=#y312>MEX\_B\_312 </a><a href=#y439>BIhE\_439 </a><a href=#y370>operator\_370 </a><a href=#y311>MEX\_A\_311 </a>

;

/\* Support for forethought (Polish) expressions. These begin with a fore­thought flag, then the operator and then the argument(s). \*/

<a name=y312>MEX\_B\_312 </a> : <a href=#y381>operand\_381 </a>

| <a href=#y370>operator\_370 </a><a href=#y313>MEX\_C\_313 </a><a href=#y452>MEX\_gap\_452 </a>

| <a href=#y438>PEhO\_438 </a><a href=#y370>operator\_370 </a><a href=#y313>MEX\_C\_313 </a><a href=#y452>MEX\_gap\_452 </a>

;

<a name=y313>MEX\_C\_313 </a> : <a href=#y312>MEX\_B\_312 </a>

| <a href=#y313>MEX\_C\_313 </a><a href=#y312>MEX\_B\_312 </a>

;

/\* Reverse Polish expressions always have exactly two operands. To handle one operand, use a null operand; to handle more than two operands, use a null operator. \*/

<a name=y330>rp\_expression\_330 </a>: <a href=#y332>rp\_operand\_332 </a><a href=#y332>rp\_operand\_332 </a><a href=#y370>operator\_370 </a>

;

<a name=y332>rp\_operand\_332 </a> : <a href=#y381>operand\_381 </a>

| <a href=#y330>rp\_expression\_330 </a>

;

/\* Operators may be joined by logical connectives. \*/

<a name=y370>operator\_370 </a> : <a href=#y371>operator\_A\_371 </a>

| <a href=#y370>operator\_370 </a><a href=#y422>JOIK\_JEK\_422 </a><a href=#y371>operator\_A\_371 </a>

| <a href=#y370>operator\_370 </a><a href=#y823>JOIK\_KE\_823 </a><a href=#y370>operator\_370 </a><a href=#y466>KEhE\_gap\_466 </a>

;

<a name=y371>operator\_A\_371 </a> : <a href=#y372>operator\_B\_372 </a>

| <a href=#y808>GUhEK\_808 </a><a href=#y371>operator\_A\_371 </a><a href=#y816>GIK\_816 </a><a href=#y372>operator\_B\_372 </a>

| <a href=#y372>operator\_B\_372 </a><a href=#y822>JOIK\_BO\_822 </a><a href=#y371>operator\_A\_371 </a>

| <a href=#y372>operator\_B\_372 </a><a href=#y821>JEK\_BO\_821 </a><a href=#y371>operator\_A\_371 </a>

;

<a name=y372>operator\_B\_372 </a> : <a href=#y374>MEX\_operator\_374 </a>

| <a href=#y493>KE\_493 </a><a href=#y370>operator\_370 </a><a href=#y466>KEhE\_gap\_466 </a>

;

<a name=y374>MEX\_operator\_374 </a> : <a href=#y679>VUhU\_679 </a>

| <a href=#y679>VUhU\_679 </a><a href=#y32>free\_modifier\_32 </a>

| <a href=#y480>SE\_480 </a><a href=#y374>MEX\_operator\_374 </a>

/\* changes argument order \*/

| <a href=#y482>NAhE\_482 </a><a href=#y374>MEX\_operator\_374 </a>

/\* scalar negation \*/

| <a href=#y430>MAhO\_430 </a><a href=#y310>MEX\_310 </a><a href=#y473>TEhU\_gap\_473 </a>

| <a href=#y429>NAhU\_429 </a><a href=#y130>selbri\_130 </a><a href=#y473>TEhU\_gap\_473 </a>

;

<a name=y381>operand\_381 </a> : <a href=#y382>operand\_A\_382 </a>

| <a href=#y382>operand\_A\_382 </a><a href=#y804>EK\_KE\_804 </a><a href=#y381>operand\_381 </a><a href=#y466>KEhE\_gap\_466 </a>

| <a href=#y382>operand\_A\_382 </a><a href=#y823>JOIK\_KE\_823 </a><a href=#y381>operand\_381 </a><a href=#y466>KEhE\_gap\_466 </a>

;

<a name=y382>operand\_A\_382 </a> : <a href=#y383>operand\_B\_383 </a>

| <a href=#y382>operand\_A\_382 </a><a href=#y421>JOIK\_EK\_421 </a><a href=#y383>operand\_B\_383 </a>

;

<a name=y383>operand\_B\_383 </a> : <a href=#y385>operand\_C\_385 </a>

| <a href=#y385>operand\_C\_385 </a><a href=#y803>EK\_BO\_803 </a><a href=#y383>operand\_B\_383 </a>

| <a href=#y385>operand\_C\_385 </a><a href=#y822>JOIK\_BO\_822 </a><a href=#y383>operand\_B\_383 </a>

;

<a name=y385>operand\_C\_385 </a> : <a href=#y300>quantifier\_300 </a>

| <a href=#y817>lerfu\_string\_817 </a><a href=#y461>BOI\_gap\_461 </a>

/\* lerfu string as operand ‑ classic math variable \*/

| <a href=#y428>NIhE\_428 </a><a href=#y130>selbri\_130 </a><a href=#y473>TEhU\_gap\_473 </a>

/\* quantifies a bridi ‑ inverse of ‑MOI \*/

| <a href=#y427>MOhE\_427 </a><a href=#y90>sumti\_90 </a><a href=#y473>TEhU\_gap\_473 </a>

/\* quantifies a sumti ‑ inverse of LI \*/

| <a href=#y431>JOhI\_431 </a><a href=#y313>MEX\_C\_313 </a><a href=#y473>TEhU\_gap\_473 </a>

| <a href=#y807>GEK\_807 </a><a href=#y381>operand\_381 </a><a href=#y816>GIK\_816 </a><a href=#y385>operand\_C\_385 </a>

| <a href=#y483>qualifier\_483 </a><a href=#y381>operand\_381 </a><a href=#y463>LUhU\_gap\_463 </a>

;

/\* \_400 series constructs are mostly specific strings, some of which may also be used by the lexer; the lexer should not use any reference to terminals num­bered less than \_400, as they have grammars composed on non‑deterministic strings of selma'o. Some above \_400 also are this way, so care should be taken; this is especially true for those that reference <a href=#y32>free\_modifier\_32</a>. \*/

<a name=y400>anaphora\_400 </a> : <a href=#y555>KOhA\_555 </a>

| <a href=#y555>KOhA\_555 </a><a href=#y32>free\_modifier\_32 </a>

| <a href=#y817>lerfu\_string\_817 </a><a href=#y461>BOI\_gap\_461 </a>

;

<a name=y404>cmene\_404 </a> : <a href=#y405>cmene\_A\_405 </a>

| <a href=#y405>cmene\_A\_405 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y405>cmene\_A\_405 </a> : <a href=#y518>CMENE\_518 </a>/\* pause \*/

| <a href=#y405>cmene\_A\_405 </a><a href=#y518>CMENE\_518 </a>/\* pause\*/

/\* multiple CMENE are identified morphologically (by the lexer) – separated by consonant & pause \*/

;

<a name=y407>bridi\_valsi\_407 </a> : <a href=#y408>bridi\_valsi\_A\_408 </a>

| <a href=#y408>bridi\_valsi\_A\_408 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y408>bridi\_valsi\_A\_408 </a>: <a href=#y509>BRIVLA\_509 </a>

| <a href=#y824>PA\_MOI\_824 </a>

| <a href=#y543>GOhA\_543 </a>

| <a href=#y543>GOhA\_543 </a><a href=#y593>RAhO\_593 </a>

;

<a name=y410>para\_mark\_410 </a> : <a href=#y584>NIhO\_584 </a>

| <a href=#y584>NIhO\_584 </a><a href=#y32>free\_modifier\_32 </a>

| <a href=#y584>NIhO\_584 </a><a href=#y410>para\_mark\_410 </a>

;

<a name=y411>indicators\_411 </a> : <a href=#y412>indicators\_A\_412 </a>

| <a href=#y535>FUhE\_535 </a><a href=#y412>indicators\_A\_412 </a>

;

<a name=y412>indicators\_A\_412 </a> : <a href=#y413>indicator\_413 </a>

| <a href=#y412>indicators\_A\_412 </a><a href=#y413>indicator\_413 </a>

;

<a name=y413>indicator\_413 </a> : <a href=#y612>UI\_612 </a>

| <a href=#y515>CAI\_515 </a>

| <a href=#y612>UI\_612 </a><a href=#y581>NAI\_581 </a>

| <a href=#y515>CAI\_515 </a><a href=#y581>NAI\_581 </a>

| <a href=#y619>Y\_619 </a>

| <a href=#y524>DAhO\_524 </a>

| <a href=#y536>FUhO\_536 </a>

;

<a name=y415>DOI\_415 </a> : <a href=#y525>DOI\_525 </a>

| <a href=#y416>COI\_416 </a>

| <a href=#y416>COI\_416 </a><a href=#y525>DOI\_525 </a>

;

<a name=y416>COI\_416 </a> : <a href=#y417>COI\_A\_417 </a>

| <a href=#y416>COI\_416 </a><a href=#y417>COI\_A\_417 </a>

;

<a name=y417>COI\_A\_417 </a> : <a href=#y520>COI\_520 </a>

| <a href=#y520>COI\_520 </a><a href=#y581>NAI\_581 </a>

;

<a name=y421>JOIK\_EK\_421 </a> : <a href=#y802>EK\_802 </a>

| <a href=#y806>JOIK\_806 </a>

| <a href=#y806>JOIK\_806 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y422>JOIK\_JEK\_422 </a> : <a href=#y806>JOIK\_806 </a>

| <a href=#y806>JOIK\_806 </a><a href=#y32>free\_modifier\_32 </a>

| <a href=#y805>JEK\_805 </a>

| <a href=#y805>JEK\_805 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y424>XI\_424 </a> : <a href=#y618>XI\_618 </a>

| <a href=#y618>XI\_618 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y425>NU\_425 </a> : <a href=#y426>NU\_A\_426 </a>

| <a href=#y425>NU\_425 </a><a href=#y422>JOIK\_JEK\_422 </a><a href=#y426>NU\_A\_426 </a>

;

<a name=y426>NU\_A\_426 </a> : <a href=#y586>NU\_586 </a>

| <a href=#y586>NU\_586 </a><a href=#y581>NAI\_581 </a>

| <a href=#y586>NU\_586 </a><a href=#y32>free\_modifier\_32 </a>

| <a href=#y586>NU\_586 </a><a href=#y581>NAI\_581 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y427>MOhE\_427 </a> : <a href=#y664>MOhE\_664 </a>

| <a href=#y664>MOhE\_664 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y428>NIhE\_428 </a> : <a href=#y666>NIhE\_666 </a>

| <a href=#y666>NIhE\_666 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y429>NAhU\_429 </a> : <a href=#y665>NAhU\_665 </a>

| <a href=#y665>NAhU\_665 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y430>MAhO\_430 </a> : <a href=#y662>MAhO\_662 </a>

| <a href=#y662>MAhO\_662 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y431>JOhI\_431 </a> : <a href=#y657>JOhI\_657 </a>

| <a href=#y657>JOhI\_657 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y432>quote\_arg\_432 </a> : <a href=#y433>quote\_arg\_A\_433 </a>

| <a href=#y433>quote\_arg\_A\_433 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y433>quote\_arg\_A\_433 </a> : <a href=#y434>ZOI\_quote\_434 </a>

| <a href=#y435>ZO\_quote\_435 </a>

| <a href=#y436>LOhU\_quote\_436 </a>

| <a href=#y571>LU\_571 </a><a href=#y0>text\_0 </a><a href=#y448>LIhU\_gap\_448 </a>

;

/\* The quoted material in the following three terminals must be identified by the lexer, but no additional lexer processing is needed. \*/

<a name=y434>ZOI\_quote\_434 </a> : <a href=#y627>ZOI\_627 </a><a href=#y698>any\_word\_698 </a>/\*pause\*/ <a href=#y699>anything\_699 </a>/\*pause\*/ <a href=#y698>any\_word\_698 </a>

;

/\* 'pause' is morphemic, represented by '.' The lexer assembles <a href=#y699>anything\_699 </a>\*/

<a name=y435>ZO\_quote\_435 </a> : <a href=#y626>ZO\_626 </a><a href=#y698>any\_word\_698 </a>

;

/\* 'word' may not be a compound; but it can be any valid Lojban selma'o value, including ZO, ZOI, SI, SA, SU. The preparser will not lex the word per its normal selma'o. \*/

<a name=y436>LOhU\_quote\_436 </a> : <a href=#y569>LOhU\_569 </a><a href=#y697>any\_words\_697 </a><a href=#y565>LEhU\_565 </a>

;

/\* 'words' may be any Lojban words, with no claim of grammaticality; the pre­parser will not lex the individual words per their normal selma'o; used to quote ungrammatical Lojban, equivalent to the \* or ? writing convention for such text.

The preparser needs one bit of sophistication for this rule. A quoted string should be able to contain other quoted strings ‑ this is only a problem for a LOhU quote itself, since the LEhU clossing this quote would otherwise close the outer quotes, which is incorrect. For this purpose, we will cheat on the use of ZO in such a quote (since this is ungrammatical text, it is a sign ig­nored by the parser). Use ZO to mark any nested quotation LOhU. The pre­parser then will absorb it by the ZO rule, before testing for LOhU. This is obviously not the standard usage for ZO, which would otherwise cause the result to be a sumti. But, since the result will be part of an unparsed string anyway, it doesn't matter.

It may be seen that any of the ZO/ZOI/LOhU trio of quotation markers may contain the powerful metalinguistic erasers. Since these quotations are not parsed internally, these operators are ignored within the quote. To erase a ZO, then, two SI's are needed after giving a quoted word of any type. ZOI takes four SI's, with the ENTIRE BODY OF THE QUOTE treated as a single 'word' since it is one selma'o. Thus one for the quote body, two for the single word delimiters, and one for the ZOI. In LOhU, the entire body is treated as a single word, so three SI's can erase it.\*/

/\*All rule terminator names with 'gap' in them are potentially elidable, where such elision does not cause an ambiguity. This is implemented through use of the YACC 'error' token, which effectively recovers from an elision. \*/

<a name=y437>FIhO\_437 </a> : <a href=#y532>FIhO\_532 </a>

| <a href=#y532>FIhO\_532 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y438>PEhO\_438 </a> : <a href=#y673>PEhO\_673 </a>

| <a href=#y673>PEhO\_673 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y439>BIhE\_439 </a> : <a href=#y650>BIhE\_650 </a>

| <a href=#y650>BIhE\_650 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y440>SEI\_440 </a> : <a href=#y597>SEI\_597 </a>

| <a href=#y597>SEI\_597 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y441>FUhA\_441 </a> : <a href=#y655>FUhA\_655 </a>

| <a href=#y655>FUhA\_655 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y442>BEI\_442 </a> : <a href=#y505>BEI\_505 </a>

| <a href=#y505>BEI\_505 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y443>CO\_443 </a> : <a href=#y519>CO\_519 </a>

| <a href=#y519>CO\_519 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y444>CEI\_444 </a> : <a href=#y516>CEI\_516 </a>

| <a href=#y516>CEI\_516 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y445>NA\_445 </a> : <a href=#y578>NA\_578 </a>

| <a href=#y578>NA\_578 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y446>BE\_446 </a> : <a href=#y504>BE\_504 </a>

| <a href=#y504>BE\_504 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y447>TUhE\_447 </a> : <a href=#y610>TUhE\_610 </a>

| <a href=#y610>TUhE\_610 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y448>LIhU\_gap\_448 </a> : <a href=#y567>LIhU\_567 </a>

| error

;

<a name=y450>gap\_450 </a> : <a href=#y556>KU\_556 </a>

| <a href=#y556>KU\_556 </a><a href=#y32>free\_modifier\_32 </a>

| error

;

<a name=y451>front\_gap\_451 </a> : <a href=#y521>CU\_521 </a>

| <a href=#y521>CU\_521 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y452>MEX\_gap\_452 </a> : <a href=#y658>KUhE\_658 </a>

| <a href=#y658>KUhE\_658 </a><a href=#y32>free\_modifier\_32 </a>

| error

;

<a name=y453>KEI\_gap\_453 </a> : <a href=#y552>KEI\_552 </a>

| <a href=#y552>KEI\_552 </a><a href=#y32>free\_modifier\_32 </a>

| error

;

<a name=y454>TUhU\_gap\_454 </a> : <a href=#y611>TUhU\_611 </a>

| <a href=#y611>TUhU\_611 </a><a href=#y32>free\_modifier\_32 </a>

| error

;

<a name=y456>VAU\_gap\_456 </a> : <a href=#y614>VAU\_614 </a>

| <a href=#y614>VAU\_614 </a><a href=#y32>free\_modifier\_32 </a>

| error

;

/\* redundant to attach a free modifier on the following \*/

<a name=y457>DOhU\_gap\_457 </a> : <a href=#y526>DOhU\_526 </a>

| error

;

<a name=y458>FEhU\_gap\_458 </a> : <a href=#y531>FEhU\_531 </a>

| <a href=#y531>FEhU\_531 </a><a href=#y32>free\_modifier\_32 </a>

| error

;

<a name=y459>SEhU\_gap\_459 </a> : <a href=#y598>SEhU\_598 </a>

| error

/\* a free modifier on a discursive should be somewhere within the discursive. See <a href=#y440>SEI\_440 </a>\*/

;

<a name=y460>NUhU\_gap\_460 </a> : <a href=#y588>NUhU\_588 </a>

| <a href=#y588>NUhU\_588 </a><a href=#y32>free\_modifier\_32 </a>

| error

;

<a name=y461>BOI\_gap\_461 </a> : <a href=#y651>BOI\_651 </a>

| <a href=#y651>BOI\_651 </a><a href=#y32>free\_modifier\_32 </a>

| error

;

<a name=y462>sub\_gap\_462 </a> : <a href=#y651>BOI\_651 </a>

| error

;

<a name=y463>LUhU\_gap\_463 </a> : <a href=#y573>LUhU\_573 </a>

| <a href=#y573>LUhU\_573 </a><a href=#y32>free\_modifier\_32 </a>

| error

;

<a name=y464>GEhU\_gap\_464 </a> : <a href=#y538>GEhU\_538 </a>

| <a href=#y538>GEhU\_538 </a><a href=#y32>free\_modifier\_32 </a>

| error

;

<a name=y465>MEhU\_gap\_465 </a> : <a href=#y575>MEhU\_575 </a>

| <a href=#y575>MEhU\_575 </a> <a href=#y32>free\_modifier\_32 </a>

| error

;

<a name=y466>KEhE\_gap\_466 </a> : <a href=#y550>KEhE\_550 </a>

| <a href=#y550>KEhE\_550 </a><a href=#y32>free\_modifier\_32 </a>

| error

;

<a name=y467>BEhO\_gap\_467 </a> : <a href=#y506>BEhO\_506 </a>

| <a href=#y506>BEhO\_506 </a><a href=#y32>free\_modifier\_32 </a>

| error

;

<a name=y468>TOI\_gap\_468 </a> : <a href=#y607>TOI\_607 </a>

| error

;

<a name=y469>KUhO\_gap\_469 </a> : <a href=#y557>KUhO\_557 </a>

| <a href=#y557>KUhO\_557 </a><a href=#y32>free\_modifier\_32 </a>

| error

;

<a name=y470>left\_bracket\_470 </a> : <a href=#y677>VEI\_677 </a>

| <a href=#y677>VEI\_677 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y471>right\_bracket\_gap\_471 </a>: <a href=#y678>VEhO\_678 </a>

| <a href=#y678>VEhO\_678 </a><a href=#y32>free\_modifier\_32 </a>

| error

;

<a name=y472>LOhO\_gap\_472 </a> : <a href=#y568>LOhO\_568 </a>

| <a href=#y568>LOhO\_568 </a><a href=#y32>free\_modifier\_32 </a>

| error

;

<a name=y473>TEhU\_gap\_473 </a> : <a href=#y675>TEhU\_675 </a>

| <a href=#y675>TEhU\_675 </a><a href=#y32>free\_modifier\_32 </a>

| error

;

<a name=y474>right\_br\_no\_free\_474 </a>: <a href=#y678>VEhO\_678 </a>

| error

;

<a name=y475>NUhA\_475 </a> : <a href=#y667>NUhA\_667 </a>

| <a href=#y667>NUhA\_667 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y476>MOI\_476 </a> : <a href=#y663>MOI\_663 </a>

| <a href=#y663>MOI\_663 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y477>ME\_477 </a> : <a href=#y574>ME\_574 </a>

| <a href=#y574>ME\_574 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y478>JAI\_478 </a> : <a href=#y547>JAI\_547 </a>

| <a href=#y547>JAI\_547 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y479>BO\_479 </a> : <a href=#y508>BO\_508 </a>

| <a href=#y508>BO\_508 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y480>SE\_480 </a> : <a href=#y596>SE\_596 </a>

| <a href=#y596>SE\_596 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y481>FA\_481 </a> : <a href=#y527>FA\_527 </a>

| <a href=#y527>FA\_527 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y482>NAhE\_482 </a> : <a href=#y583>NAhE\_583 </a>

| <a href=#y583>NAhE\_583 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y483>qualifier\_483 </a> : <a href=#y561>LAhE\_561 </a>

| <a href=#y561>LAhE\_561 </a><a href=#y32>free\_modifier\_32 </a>

| <a href=#y809>NAhE\_BO\_809 </a>

;

<a name=y484>NOI\_484 </a> : <a href=#y585>NOI\_585 </a>

| <a href=#y585>NOI\_585 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y485>GOI\_485 </a> : <a href=#y542>GOI\_542 </a>

| <a href=#y542>GOI\_542 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y486>subscript\_486 </a> : <a href=#y424>XI\_424 </a><a href=#y812>number\_812 </a><a href=#y462>sub\_gap\_462 </a>

| <a href=#y424>XI\_424 </a><a href=#y470>left\_bracket\_470 </a><a href=#y310>MEX\_310 </a><a href=#y474>right\_br\_no\_free\_474 </a>

| <a href=#y424>XI\_424 </a><a href=#y817>lerfu\_string\_817 </a><a href=#y462>sub\_gap\_462 </a>

;

<a name=y487>ZIhE\_487 </a> : <a href=#y625>ZIhE\_625 </a>

| <a href=#y625>ZIhE\_625 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y488>LE\_488 </a> : <a href=#y562>LE\_562 </a>

| <a href=#y562>LE\_562 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y489>LI\_489 </a> : <a href=#y566>LI\_566 </a>

| <a href=#y566>LI\_566 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y490>mod\_head\_490 </a> : <a href=#y491>tag\_491 </a>

| <a href=#y481>FA\_481 </a>

;

<a name=y491>tag\_491 </a> : <a href=#y815>tense\_modal\_815 </a>

| <a href=#y491>tag\_491 </a><a href=#y422>JOIK\_JEK\_422 </a><a href=#y815>tense\_modal\_815 </a>

;

<a name=y492>ZOhU\_492 </a> : <a href=#y628>ZOhU\_628 </a>

| <a href=#y628>ZOhU\_628 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y493>KE\_493 </a> : <a href=#y551>KE\_551 </a>

| <a href=#y551>KE\_551 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y494>PEhE\_494 </a> : <a href=#y591>PEhE\_591 </a>

| <a href=#y591>PEhE\_591 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y495>CEhE\_495 </a> : <a href=#y517>CEhE\_517 </a>

| <a href=#y517>CEhE\_517 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y496>NUhI\_496 </a> : <a href=#y587>NUhI\_587 </a>

| <a href=#y587>NUhI\_587 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y497>VUhO\_497 </a> : <a href=#y617>VUhO\_617 </a>

| <a href=#y617>VUhO\_617 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y498>SOI\_498 </a> : <a href=#y602>SOI\_602 </a>

| <a href=#y602>SOI\_602 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y499>LA\_499 </a> : <a href=#y558>LA\_558 </a>

| <a href=#y558>LA\_558 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y801>utterance\_ordinal\_801 </a>: <a href=#y905>lexer\_A\_905 </a>

;

<a name=y802>EK\_802 </a> : <a href=#y910>lexer\_B\_910 </a>

| <a href=#y910>lexer\_B\_910 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y803>EK\_BO\_803 </a> : <a href=#y915>lexer\_C\_915 </a>

| <a href=#y915>lexer\_C\_915 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y804>EK\_KE\_804 </a> : <a href=#y916>lexer\_D\_916 </a>

| <a href=#y916>lexer\_D\_916 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y805>JEK\_805 </a> : <a href=#y925>lexer\_E\_925 </a>

;

<a name=y806>JOIK\_806 </a> : <a href=#y930>lexer\_F\_930 </a>

;

<a name=y807>GEK\_807 </a> : <a href=#y935>lexer\_G\_935 </a>

| <a href=#y935>lexer\_G\_935 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y808>GUhEK\_808 </a> : <a href=#y940>lexer\_H\_940 </a>

| <a href=#y940>lexer\_H\_940 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y809>NAhE\_BO\_809 </a> : <a href=#y945>lexer\_I\_945 </a>

| <a href=#y945>lexer\_I\_945 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y810>NA\_KU\_810 </a> : <a href=#y950>lexer\_J\_950 </a>

| <a href=#y950>lexer\_J\_950 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y811>I\_BO\_811 </a> : <a href=#y955>lexer\_K\_955 </a>

| <a href=#y955>lexer\_K\_955 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y812>number\_812 </a> : <a href=#y960>lexer\_L\_960 </a>

;

<a name=y813>GIhEK\_BO\_813 </a> : <a href=#y965>lexer\_M\_965 </a>

| <a href=#y965>lexer\_M\_965 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y814>GIhEK\_KE\_814 </a> : <a href=#y966>lexer\_N\_966 </a>

| <a href=#y966>lexer\_N\_966 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y815>tense\_modal\_815 </a> : <a href=#y970>lexer\_O\_970 </a>

| <a href=#y970>lexer\_O\_970 </a><a href=#y32>free\_modifier\_32 </a>

| <a href=#y437>FIhO\_437 </a><a href=#y130>selbri\_130 </a><a href=#y458>FEhU\_gap\_458 </a>

;

<a name=y816>GIK\_816 </a> : <a href=#y980>lexer\_P\_980 </a>

| <a href=#y980>lexer\_P\_980 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y817>lerfu\_string\_817 </a> : <a href=#y985>lexer\_Q\_985 </a>

;

<a name=y818>GIhEK\_818 </a> : <a href=#y990>lexer\_R\_990 </a>

| <a href=#y990>lexer\_R\_990 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y819>I\_819 </a> : <a href=#y995>lexer\_S\_995 </a>

| <a href=#y995>lexer\_S\_995 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y820>I\_JEK\_820 </a> : <a href=#y1000>lexer\_T\_1000 </a>

| <a href=#y1000>lexer\_T\_1000 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y821>JEK\_BO\_821 </a> : <a href=#y1005>lexer\_U\_1005 </a>

| <a href=#y1005>lexer\_U\_1005 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y822>JOIK\_BO\_822 </a> : <a href=#y1010>lexer\_V\_1010 </a>

| <a href=#y1010>lexer\_V\_1010 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y823>JOIK\_KE\_823 </a> : <a href=#y1015>lexer\_W\_1015 </a>

| <a href=#y1015>lexer\_W\_1015 </a><a href=#y32>free\_modifier\_32 </a>

;

<a name=y824>PA\_MOI\_824 </a> : <a href=#y1025>lexer\_Y\_1025 </a>

;

/\* The following rules are used only in lexer processing. They have been tested for ambiguity at various levels in the YACC grammar, but are in the recursive descent lexer in the current parser. The lexer inserts the lexer to­kens before the processed strings, but leaves the original tokens. \*/

<a name=y905>lexer\_A\_905 </a> : <a href=#y701>lexer\_A\_701 </a><a href=#y906>utt\_ordinal\_root\_906 </a>

;

<a name=y906>utt\_ordinal\_root\_906 </a>: <a href=#y986>lerfu\_string\_root\_986 </a><a href=#y661>MAI\_661 </a>

| <a href=#y961>number\_root\_961 </a><a href=#y661>MAI\_661 </a>

;

<a name=y910>lexer\_B\_910 </a> : <a href=#y702>lexer\_B\_702 </a><a href=#y911>EK\_root\_911 </a>

;

<a name=y911>EK\_root\_911 </a> : <a href=#y501>A\_501 </a>

| <a href=#y596>SE\_596 </a><a href=#y501>A\_501 </a>

| <a href=#y578>NA\_578 </a><a href=#y501>A\_501 </a>

| <a href=#y501>A\_501 </a><a href=#y581>NAI\_581 </a>

| <a href=#y596>SE\_596 </a><a href=#y501>A\_501 </a><a href=#y581>NAI\_581 </a>

| <a href=#y578>NA\_578 </a><a href=#y501>A\_501 </a><a href=#y581>NAI\_581 </a>

| <a href=#y578>NA\_578 </a><a href=#y596>SE\_596 </a><a href=#y501>A\_501 </a>

| <a href=#y578>NA\_578 </a><a href=#y596>SE\_596 </a><a href=#y501>A\_501 </a><a href=#y581>NAI\_581 </a>

;

<a name=y915>lexer\_C\_915 </a> : <a href=#y703>lexer\_C\_703 </a><a href=#y911>EK\_root\_911 </a><a href=#y508>BO\_508 </a>

| <a href=#y703>lexer\_C\_703 </a><a href=#y911>EK\_root\_911 </a><a href=#y971>simple\_tag\_971 </a><a href=#y508>BO\_508 </a>

;

<a name=y916>lexer\_D\_916 </a> : <a href=#y704>lexer\_D\_704 </a><a href=#y911>EK\_root\_911 </a><a href=#y551>KE\_551 </a>

| <a href=#y704>lexer\_D\_704 </a><a href=#y911>EK\_root\_911 </a><a href=#y971>simple\_tag\_971 </a><a href=#y551>KE\_551 </a>

;

<a name=y925>lexer\_E\_925 </a> : <a href=#y705>lexer\_E\_705 </a><a href=#y926>JEK\_root\_926 </a>

;

<a name=y926>JEK\_root\_926 </a> : <a href=#y546>JA\_546 </a>

| <a href=#y546>JA\_546 </a><a href=#y581>NAI\_581 </a>

| <a href=#y578>NA\_578 </a><a href=#y546>JA\_546 </a>

| <a href=#y578>NA\_578 </a><a href=#y546>JA\_546 </a><a href=#y581>NAI\_581 </a>

| <a href=#y596>SE\_596 </a><a href=#y546>JA\_546 </a>

| <a href=#y596>SE\_596 </a><a href=#y546>JA\_546 </a><a href=#y581>NAI\_581 </a>

| <a href=#y578>NA\_578 </a><a href=#y596>SE\_596 </a><a href=#y546>JA\_546 </a>

| <a href=#y578>NA\_578 </a><a href=#y596>SE\_596 </a><a href=#y546>JA\_546 </a><a href=#y581>NAI\_581 </a>

;

<a name=y930>lexer\_F\_930 </a> : <a href=#y706>lexer\_F\_706 </a><a href=#y931>JOIK\_root\_931 </a>

;

<a name=y931>JOIK\_root\_931 </a> : <a href=#y548>JOI\_548 </a>

| <a href=#y548>JOI\_548 </a><a href=#y581>NAI\_581 </a>

| <a href=#y596>SE\_596 </a><a href=#y548>JOI\_548 </a>

| <a href=#y596>SE\_596 </a><a href=#y548>JOI\_548 </a><a href=#y581>NAI\_581 </a>

| <a href=#y932>interval\_932 </a>

| <a href=#y656>GAhO\_656 </a><a href=#y932>interval\_932 </a><a href=#y656>GAhO\_656 </a>

;

<a name=y932>interval\_932 </a> : <a href=#y507>BIhI\_507 </a>

| <a href=#y507>BIhI\_507 </a><a href=#y581>NAI\_581 </a>

| <a href=#y596>SE\_596 </a><a href=#y507>BIhI\_507 </a>

| <a href=#y596>SE\_596 </a><a href=#y507>BIhI\_507 </a><a href=#y581>NAI\_581 </a>

;

<a name=y935>lexer\_G\_935 </a> : <a href=#y707>lexer\_G\_707 </a><a href=#y537>GA\_537 </a>

| <a href=#y707>lexer\_G\_707 </a><a href=#y596>SE\_596 </a><a href=#y537>GA\_537 </a>

| <a href=#y707>lexer\_G\_707 </a><a href=#y537>GA\_537 </a><a href=#y581>NAI\_581 </a>

| <a href=#y707>lexer\_G\_707 </a><a href=#y596>SE\_596 </a><a href=#y537>GA\_537 </a><a href=#y581>NAI\_581 </a>

| <a href=#y707>lexer\_G\_707 </a><a href=#y971>simple\_tag\_971 </a><a href=#y981>GIK\_root\_981 </a>

| <a href=#y707>lexer\_G\_707 </a><a href=#y931>JOIK\_root\_931 </a><a href=#y539>GI\_539 </a>

;

<a name=y940>lexer\_H\_940 </a> : <a href=#y708>lexer\_H\_708 </a><a href=#y544>GUhA\_544 </a>

| <a href=#y708>lexer\_H\_708 </a><a href=#y596>SE\_596 </a><a href=#y544>GUhA\_544 </a>

| <a href=#y708>lexer\_H\_708 </a><a href=#y544>GUhA\_544 </a><a href=#y581>NAI\_581 </a>

| <a href=#y708>lexer\_H\_708 </a><a href=#y596>SE\_596 </a><a href=#y544>GUhA\_544 </a><a href=#y581>NAI\_581 </a>

;

<a name=y945>lexer\_I\_945 </a> : <a href=#y709>lexer\_I\_709 </a><a href=#y583>NAhE\_583 </a><a href=#y508>BO\_508 </a>

;

<a name=y950>lexer\_J\_950 </a> : <a href=#y710>lexer\_J\_710 </a><a href=#y578>NA\_578 </a><a href=#y556>KU\_556 </a>

;

<a name=y955>lexer\_K\_955 </a> : <a href=#y711>lexer\_K\_711 </a><a href=#y956>I\_root\_956 </a><a href=#y508>BO\_508 </a>

| <a href=#y711>lexer\_K\_711 </a><a href=#y956>I\_root\_956 </a><a href=#y971>simple\_tag\_971 </a><a href=#y508>BO\_508 </a>

;

<a name=y956>I\_root\_956 </a> : <a href=#y545>I\_545 </a>

| <a href=#y545>I\_545 </a><a href=#y957>simple\_JOIK\_JEK\_957 </a>

;

<a name=y957>simple\_JOIK\_JEK\_957 </a>: <a href=#y806>JOIK\_806 </a>

| <a href=#y805>JEK\_805 </a>

;

/\* no freemod in this version; cf. <a href=#y422>JOIK\_JEK\_422 </a>\*/

/\* this reference to a version of JOIK and JEK which already have the lexer to­kens attached prevents shift/reduce errors. The problem is resolved in a hard‑coded parser implementation which builds lexer\_K, before lexer\_S, be­fore lexer\_E and lexer\_F. \*/

<a name=y960>lexer\_L\_960 </a> : <a href=#y712>lexer\_L\_712 </a><a href=#y961>number\_root\_961 </a>

;

<a name=y961>number\_root\_961 </a> : <a href=#y672>PA\_672 </a>

| <a href=#y961>number\_root\_961 </a><a href=#y672>PA\_672 </a>

| <a href=#y961>number\_root\_961 </a><a href=#y987>lerfu\_word\_987 </a>

;

<a name=y965>lexer\_M\_965 </a> : <a href=#y713>lexer\_M\_713 </a><a href=#y991>GIhEK\_root\_991 </a><a href=#y508>BO\_508 </a>

| <a href=#y713>lexer\_M\_713 </a><a href=#y991>GIhEK\_root\_991 </a><a href=#y971>simple\_tag\_971 </a><a href=#y508>BO\_508 </a>

;

<a name=y966>lexer\_N\_966 </a> : <a href=#y714>lexer\_N\_714 </a><a href=#y991>GIhEK\_root\_991 </a><a href=#y551>KE\_551 </a>

| <a href=#y714>lexer\_N\_714 </a><a href=#y991>GIhEK\_root\_991 </a><a href=#y971>simple\_tag\_971 </a><a href=#y551>KE\_551 </a>

;

<a name=y970>lexer\_O\_970 </a> : <a href=#y715>lexer\_O\_715 </a><a href=#y972>simple\_tense\_modal\_972 </a>

;

/\* the following rule is a lexer version of non‑terminal\_815 for compounding PU/modals; it disallows the lexer picking out FIhO clauses, which would re­quire it to have knowledge of the main parser grammar \*/

<a name=y971>simple\_tag\_971 </a> : <a href=#y972>simple\_tense\_modal\_972 </a>

| <a href=#y971>simple\_tag\_971 </a><a href=#y957>simple\_JOIK\_JEK\_957 </a><a href=#y972>simple\_tense\_modal\_972 </a>

;

<a name=y972>simple\_tense\_modal\_972 </a>: <a href=#y973>simple\_tense\_modal\_A\_973 </a>

| <a href=#y583>NAhE\_583 </a><a href=#y973>simple\_tense\_modal\_A\_973 </a>

| <a href=#y554>KI\_554 </a>

| <a href=#y522>CUhE\_522 </a>

;

<a name=y973>simple\_tense\_modal\_A\_973 </a>: </a><a href=#y974>modal\_974 </a>

| <a href=#y974>modal\_974 </a><a href=#y554>KI\_554 </a>

| <a href=#y977>tense\_A\_977 </a>

;

<a name=y974>modal\_974 </a> : <a href=#y975>modal\_A\_975 </a>

| <a href=#y975>modal\_A\_975 </a><a href=#y581>NAI\_581 </a>

;

<a name=y975>modal\_A\_975 </a> : <a href=#y502>BAI\_502 </a>

| <a href=#y596>SE\_596 </a><a href=#y502>BAI\_502 </a>

;

<a name=y977>tense\_A\_977 </a> : <a href=#y978>tense\_B\_978 </a>

| <a href=#y978>tense\_B\_978 </a><a href=#y554>KI\_554 </a>

;

<a name=y978>tense\_B\_978 </a> : <a href=#y979>tense\_C\_979 </a>

| <a href=#y514>CAhA\_514 </a>

| <a href=#y979>tense\_C\_979 </a><a href=#y514>CAhA\_514 </a>

;

/\* specifies actuality/potentiality of the bridi \*/

/\* puca'a = actually was \*/

/\* baca'a = actually will be \*/

/\* bapu'i = can and will have \*/

/\* banu'o = can, but won't have yet \*/

/\* canu'ojebapu'i = can, hasn't yet, but will \*/

<a name=y979>tense\_C\_979 </a> : <a href=#y1030>time\_1030 </a>

/\* time‑only \*/

/\* space defaults to time‑space reference space \*/

| <a href=#y1040>space\_1040 </a>

/\* can include time if specified with VIhA; otherwise time defaults to the time‑space reference time \*/

| <a href=#y1030>time\_1030 </a><a href=#y1040>space\_1040 </a>

/\* time and space ‑ If <a href=#y1040>space\_1040 </a>is marked with VIhA for space‑time the tense may be self‑contradictory \*/

/\* interval prop before space\_time is for time distribution \*/

| <a href=#y1040>space\_1040 </a><a href=#y1030>time\_1030 </a>

;

<a name=y980>lexer\_P\_980 </a> : <a href=#y716>lexer\_P\_716 </a><a href=#y981>GIK\_root\_981 </a>

;

<a name=y981>GIK\_root\_981 </a> : <a href=#y539>GI\_539 </a>

| <a href=#y539>GI\_539 </a><a href=#y581>NAI\_581 </a>

;

<a name=y985>lexer\_Q\_985 </a> : <a href=#y717>lexer\_Q\_717 </a><a href=#y986>lerfu\_string\_root\_986 </a>

;

<a name=y986>lerfu\_string\_root\_986 </a>: <a href=#y987>lerfu\_word\_987 </a>

| <a href=#y986>lerfu\_string\_root\_986 </a><a href=#y987>lerfu\_word\_987 </a>

| <a href=#y986>lerfu\_string\_root\_986 </a><a href=#y672>PA\_672 </a>

;

<a name=y987>lerfu\_word\_987 </a> : <a href=#y513>BY\_513 </a>

| <a href=#y559>LAU\_559 </a><a href=#y987>lerfu\_word\_987 </a>

| <a href=#y605>TEI\_605 </a><a href=#y986>lerfu\_string\_root\_986 </a><a href=#y533>FOI\_533 </a>

;

<a name=y990>lexer\_R\_990 </a> : <a href=#y718>lexer\_R\_718 </a><a href=#y991>GIhEK\_root\_991 </a>

;

<a name=y991>GIhEK\_root\_991 </a> : <a href=#y541>GIhA\_541 </a>

| <a href=#y596>SE\_596 </a><a href=#y541>GIhA\_541 </a>

| <a href=#y578>NA\_578 </a><a href=#y541>GIhA\_541 </a>

| <a href=#y541>GIhA\_541 </a><a href=#y581>NAI\_581 </a>

| <a href=#y596>SE\_596 </a><a href=#y541>GIhA\_541 </a><a href=#y581>NAI\_581 </a>

| <a href=#y578>NA\_578 </a><a href=#y541>GIhA\_541 </a><a href=#y581>NAI\_581 </a>

| <a href=#y578>NA\_578 </a><a href=#y596>SE\_596 </a><a href=#y541>GIhA\_541 </a>

| <a href=#y578>NA\_578 </a><a href=#y596>SE\_596 </a><a href=#y541>GIhA\_541 </a><a href=#y581>NAI\_581 </a>

;

<a name=y995>lexer\_S\_995 </a> : <a href=#y719>lexer\_S\_719 </a><a href=#y545>I\_545 </a>

;

<a name=y1000>lexer\_T\_1000 </a> : <a href=#y720>lexer\_T\_720 </a><a href=#y545>I\_545 </a><a href=#y957>simple\_JOIK\_JEK\_957 </a>

;

<a name=y1005>lexer\_U\_1005 </a> : <a href=#y721>lexer\_U\_721 </a><a href=#y926>JEK\_root\_926 </a><a href=#y508>BO\_508 </a>

| <a href=#y721>lexer\_U\_721 </a><a href=#y926>JEK\_root\_926 </a><a href=#y971>simple\_tag\_971 </a><a href=#y508>BO\_508 </a>

;

<a name=y1010>lexer\_V\_1010 </a> : <a href=#y722>lexer\_V\_722 </a><a href=#y931>JOIK\_root\_931 </a><a href=#y508>BO\_508 </a>

| <a href=#y722>lexer\_V\_722 </a><a href=#y931>JOIK\_root\_931 </a><a href=#y971>simple\_tag\_971 </a><a href=#y508>BO\_508 </a>

;

<a name=y1015>lexer\_W\_1015 </a> : <a href=#y723>lexer\_W\_723 </a><a href=#y931>JOIK\_root\_931 </a><a href=#y551>KE\_551 </a>

| <a href=#y723>lexer\_W\_723 </a><a href=#y931>JOIK\_root\_931 </a><a href=#y971>simple\_tag\_971 </a><a href=#y551>KE\_551 </a>

;

<a name=y1025>lexer\_Y\_1025 </a> : <a href=#y725>lexer\_Y\_725 </a><a href=#y961>number\_root\_961 </a><a href=#y663>MOI\_663 </a>

| <a href=#y725>lexer\_Y\_725 </a><a href=#y986>lerfu\_string\_root\_986 </a><a href=#y663>MOI\_663 </a>

;

<a name=y1030>time\_1030 </a> : <a href=#y624>ZI\_624 </a>

| <a href=#y624>ZI\_624 </a><a href=#y1031>time\_A\_1031 </a>

| <a href=#y1031>time\_A\_1031 </a>

;

<a name=y1031>time\_A\_1031 </a> : <a href=#y1032>time\_B\_1032 </a>

| <a href=#y1034>time\_interval\_1034 </a>

| <a href=#y1032>time\_B\_1032 </a><a href=#y1034>time\_interval\_1034 </a>

;

<a name=y1032>time\_B\_1032 </a> : <a href=#y1033>time\_offset\_1033 </a>

| <a href=#y1032>time\_B\_1032 </a><a href=#y1033>time\_offset\_1033 </a>

;

<a name=y1033>time\_offset\_1033 </a> : <a href=#y1035>time\_direction\_1035 </a>

| <a href=#y1035>time\_direction\_1035 </a><a href=#y624>ZI\_624 </a>

;

<a name=y1034>time\_interval\_1034 </a>: <a href=#y622>ZEhA\_622 </a>

| <a href=#y622>ZEhA\_622 </a><a href=#y1035>time\_direction\_1035 </a>

| <a href=#y1036>time\_int\_props\_1036 </a>

| <a href=#y622>ZEhA\_622 </a><a href=#y1036>time\_int\_props\_1036 </a>

| <a href=#y622>ZEhA\_622 </a><a href=#y1035>time\_direction\_1035 </a><a href=#y1036>time\_int\_props\_1036 </a>

;

<a name=y1035>time\_direction\_1035 </a>: <a href=#y592>PU\_592 </a>

| <a href=#y592>PU\_592 </a><a href=#y581>NAI\_581 </a>

;

<a name=y1036>time\_int\_props\_1036 </a>: <a href=#y1051>interval\_property\_1051 </a>

| <a href=#y1036>time\_int\_props\_1036 </a><a href=#y1051>interval\_property\_1051 </a>

;

<a name=y1040>space\_1040 </a> : <a href=#y1042>space\_A\_1042 </a>

| <a href=#y1041>space\_motion\_1041 </a>

| <a href=#y1042>space\_A\_1042 </a><a href=#y1041>space\_motion\_1041 </a>

;

<a name=y1041>space\_motion\_1041 </a>: <a href=#y577>MOhI\_577 </a><a href=#y1045>space\_offset\_1045 </a>

;

<a name=y1042>space\_A\_1042 </a> : <a href=#y613>VA\_613 </a>

| <a href=#y613>VA\_613 </a><a href=#y1043>space\_B\_1043 </a>

| <a href=#y1043>space\_B\_1043 </a>

;

<a name=y1043>space\_B\_1043 </a> : <a href=#y1044>space\_C\_1044 </a>

| <a href=#y1046>space\_intval\_1046 </a>

| <a href=#y1044>space\_C\_1044 </a><a href=#y1046>space\_intval\_1046 </a>

;

<a name=y1044>space\_C\_1044 </a> : <a href=#y1045>space\_offset\_1045 </a>

| <a href=#y1044>space\_C\_1044 </a><a href=#y1045>space\_offset\_1045 </a>

;

<a name=y1045>space\_offset\_1045 </a>: <a href=#y1048>space\_direction\_1048 </a>

| <a href=#y1048>space\_direction\_1048 </a><a href=#y613>VA\_613 </a>

;

<a name=y1046>space\_intval\_1046 </a>: <a href=#y1047>space\_intval\_A\_1047 </a>

| <a href=#y1047>space\_intval\_A\_1047 </a><a href=#y1048>space\_direction\_1048 </a>

| <a href=#y1049>space\_int\_props\_1049 </a>

| <a href=#y1047>space\_intval\_A\_1047 </a><a href=#y1049>space\_int\_props\_1049 </a>

| <a href=#y1047>space\_intval\_A\_1047 </a><a href=#y1048>space\_direction\_1048 </a><a href=#y1049>space\_int\_props\_1049 </a>

;

<a name=y1047>space\_intval\_A\_1047 </a>: <a href=#y615>VEhA\_615 </a>

| <a href=#y616>VIhA\_616 </a>

| <a href=#y615>VEhA\_615 </a><a href=#y616>VIhA\_616 </a>

;

<a name=y1048>space\_direction\_1048 </a>: <a href=#y528>FAhA\_528 </a>

| <a href=#y528>FAhA\_528 </a><a href=#y581>NAI\_581 </a>

;

<a name=y1049>space\_int\_props\_1049 </a>: <a href=#y1050>space\_int\_props\_A\_1050 </a>

| <a href=#y1049>space\_int\_props\_1049 </a><a href=#y1050>space\_int\_props\_A\_1050 </a>

;

<a name=y1050>space\_int\_props\_A\_1050 </a>: <a href=#y530>FEhE\_530 </a><a href=#y1051>interval\_property\_1051 </a>

;

/\* This terminal gives an interval size in space‑time (VEhA), and possibly a dimensionality of the interval. The dimensionality may also be used with the interval size left unspecified. When this terminal is used for the spacetime ori­gin, then barring any overriding VIhA, a VIhA here defines the dimen­sionality of the space‑time being discussed. \*/

<a name=y1051>interval\_property\_1051 </a>: <a href=#y961>number\_root\_961 </a><a href=#y594>ROI\_594 </a>

| <a href=#y961>number\_root\_961 </a><a href=#y594>ROI\_594 </a><a href=#y581>NAI\_581 </a>

| <a href=#y604>TAhE\_604 </a>

| <a href=#y604>TAhE\_604 </a><a href=#y581>NAI\_581 </a>

| <a href=#y621>ZAhO\_621 </a>

| <a href=#y621>ZAhO\_621 </a><a href=#y581>NAI\_581 </a>

;

/\* extensional/intensional interval parameters \*/

/\* These may be appended to any defined interval, or may stand in place of ei­ther time or space tenses. If no other tense is present, this terminal stands for the time‑space interval parameter with an unspecified interval.\*/

/\* roroi = always and everywhere \*/

/\* roroiku'avi = always here (ku'a = intersection) \*/

/\* puroroi = always in the past

/\* paroi = once upon a time (somewhere) \*/

/\* paroiku'avi = once upon a time here \*/

/\* The following are “Lexer‑only rules”, covered by steps 1‑4 described at the beginning. The grammar of these constructs is nonexistent, except possi­bly in cases where they interact with each other. Even there, however, the ef­fects are semantic rather than grammatical. Where it is believed possible that conflicts could exist, the grammar of these constructs has been put in the above gram­mar, even though the lexer/Preparser will actually prevent these from being passed thru to the parse routine. (Otherwise we have to put unac­ceptably fancy code in the PreParser to determine just when these can be passed thru, and when they can't.)

Constructs in this category include quotes and indicators as defined above. (The above grammar handles utterance scope (free\_modifier) and clause scope (gap) applications of the latter, however, and indicators should be al­lowed to be absorbed into almost any word without changing its grammar.

<a href=#y601>SI\_601 </a>, <a href=#y595>SA\_595 </a>, and <a href=#y603>SU\_603 </a>are metalinguistic erasers.

<a name=y1100>token\_1100 </a> : <a href=#y698>any\_word\_698 </a>

| <a href=#y503>BAhE\_503 </a><a href=#y698>any\_word\_698 </a>

| <a href=#y699>anything\_699 </a>

| <a href=#y698>any\_word\_698 </a><a href=#y511>BU\_511 </a>

| <a href=#y698>any\_word\_698 </a><a href=#y524>DAhO\_524 </a>

| <a href=#y698>any\_word\_698 </a><a href=#y536>FUhO\_536 </a>

| <a href=#y698>any\_word\_698 </a><a href=#y535>FUhE\_535 </a>

| <a href=#y698>any\_word\_698 </a><a href=#y612>UI\_612 </a>

| <a href=#y698>any\_word\_698 </a><a href=#y612>UI\_612 </a><a href=#y581>NAI\_581 </a>

| <a href=#y698>any\_word\_698 </a><a href=#y619>Y\_619 </a>

| <a href=#y698>any\_word\_698 </a><a href=#y515>CAI\_515 </a>

| <a href=#y698>any\_word\_698 </a><a href=#y515>CAI\_515 </a><a href=#y581>NAI\_581 </a>

| <a href=#y612>UI\_612 </a><a href=#y581>NAI\_581 </a>

| <a href=#y515>CAI\_515 </a><a href=#y581>NAI\_581 </a>

;

<a name=y1101>null\_1101 </a> : <a href=#y698>any\_word\_698 </a><a href=#y601>SI\_601 </a>

| possibly\_unlexable\_word (PAUSE) <a href=#y601>SI\_601 </a>

| <a href=#y20>utterance\_20 </a><a href=#y595>SA\_595 </a>

| possibly unlexable string (PAUSE) <a href=#y595>SA\_595 </a>

erases back to the last individual token I or NIhO or start of text, ignoring the insides of ZOI, ZO, and LOhU/LEhU quotes. Start of text is defined for SU below.

| <a href=#y3>text\_C\_3 </a><a href=#y603>SU\_603 </a>

| possibly unparsable text (PAUSE) <a href=#y603>SU\_603 </a>

erases back to start of text which is the beginning of a speaker's statement, a parenthesis (TO/TOI), a LU/LIhU quote, or a TUhE/TUhU utterance string.

;

\*/ %%

### YACC Grammar Cross-Reference

A\_501 EK\_root\_911

anaphora\_400 sumti\_G\_97

anything\_699 token\_1100, ZOI\_quote\_434

any\_word\_698 null\_1101, token\_1100, ZOI\_quote\_434, ZO\_quote\_435

any\_words\_697 LOhU\_quote\_436

BAhE\_503 token\_1100

BAI\_502 modal\_A\_975

BE\_446 linkargs\_160

BE\_504 BE\_446

BEhO\_506 BEhO\_gap\_467

BEhO\_gap\_467 linkargs\_160

BEI\_442 links\_161

BEI\_505 BEI\_442

BIhE\_439 MEX\_A\_311

BIhE\_650 BIhE\_439

BIhI\_507 interval\_932

BO\_479 selbri\_F\_136

BO\_508 BO\_479, lexer\_C\_915, lexer\_I\_945, lexer\_K\_955, lexer\_M\_965, lexer\_U\_1005, lexer\_V\_1010

BOI\_651 BOI\_gap\_461, sub\_gap\_462

BOI\_gap\_461 anaphora\_400, operand\_C\_385, quantifier\_300

bridi\_tail\_50 bridi\_tail\_50, sentence\_40

bridi\_tail\_A\_51 bridi\_tail\_50, bridi\_tail\_A\_51

bridi\_tail\_B\_52 bridi\_tail\_A\_51, bridi\_tail\_B\_52

bridi\_tail\_C\_53 bridi\_tail\_B\_52

bridi\_valsi\_407 tanru\_unit\_B\_152

bridi\_valsi\_A\_408 bridi\_valsi\_407

BRIVLA\_509 bridi\_valsi\_A\_408

BU\_511 token\_1100

BY\_513 lerfu\_word\_987

CAhA\_514 tense\_B\_978

CAI\_515 indicator\_413, token\_1100

CEhE\_495 terms\_B\_82

CEhE\_517 CEhE\_495

CEI\_444 tanru\_unit\_150

CEI\_516 CEI\_444

cmene\_404 sumti\_G\_97, text\_0, vocative\_35

CMENE\_518 cmene\_A\_405

cmene\_A\_405 cmene\_404, cmene\_A\_405

CO\_443 selbri\_B\_132

CO\_519 CO\_443

COI\_416 COI\_416, DOI\_415

COI\_520 COI\_A\_417

COI\_A\_417 COI\_416

CU\_521 front\_gap\_451

CUhE\_522 simple\_tense\_modal\_972

DAhO\_524 indicator\_413, token\_1100

description\_110 sumti\_G\_97

discursive\_bridi\_34 free\_modifier\_A\_33

DOhU\_526 DOhU\_gap\_457

DOhU\_gap\_457 vocative\_35

DOI\_415 vocative\_35

DOI\_525 DOI\_415

EK\_802 fragment\_20, JOIK\_EK\_421

EK\_BO\_803 operand\_B\_383, sumti\_C\_93

EK\_KE\_804 operand\_381, sumti\_A\_91

EK\_root\_911 lexer\_B\_910, lexer\_C\_915, lexer\_D\_916

error BEhO\_gap\_467, BOI\_gap\_461, DOhU\_gap\_457, FEhU\_gap\_458, gap\_450, GEhU\_gap\_464, KEhE\_gap\_466, KEI\_gap\_453, KUhO\_gap\_469, LIhU\_gap\_448, LOhO\_gap\_472, LUhU\_gap\_463, MEhU\_gap\_465, MEX\_gap\_452, NUhU\_gap\_460, right\_bracket\_gap\_471, right\_br\_no\_free\_474, SEhU\_gap\_459, sub\_gap\_462, TEhU\_gap\_473, TOI\_gap\_468, TUhU\_gap\_454, VAU\_gap\_456

FA\_481 mod\_head\_490

FA\_527 FA\_481

FAhA\_528 space\_direction\_1048

FEhE\_530 space\_int\_props\_A\_1050

FEhU\_531 FEhU\_gap\_458

FEhU\_gap\_458 tense\_modal\_815

FIhO\_437 tense\_modal\_815

FIhO\_532 FIhO\_437

FOI\_533 lerfu\_word\_987

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GIK\_816 gek\_sentence\_54, GUhEK\_selbri\_137, operand\_C\_385, operator\_A\_371, sumti\_D\_94, term\_set\_85

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MAhO\_662 MAhO\_430

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NAhE\_482 MEX\_operator\_374, selbri\_F\_136, tanru\_unit\_B\_152

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rp\_operand\_332 rp\_expression\_330

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VUhO\_617 VUhO\_497

VUhU\_679 MEX\_operator\_374

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XI\_618 XI\_424

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ZEhA\_622 time\_interval\_1034

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ZIhE\_487 relative\_clauses\_121

ZIhE\_625 ZIhE\_487

ZO\_626 ZO\_quote\_435

ZOhU\_492 prenex\_30

ZOhU\_628 ZOhU\_492

ZOI\_627 ZOI\_quote\_434

ZOI\_quote\_434 quote\_arg\_A\_433

ZO\_quote\_435 quote\_arg\_A\_433

</pre></landscape>

### EBNF Grammar of Lojban

<cx "EBNF grammar"><h3></h3>Lojban Machine Grammar, EBNF Version, Final Baseline

<p>

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<p>

Explanation of notation: All rules have the form:

<p align=center><center>

name<sub>number</sub>= bnf‑expression

</center></p>which means that the grammatical construct “name” is defined by “bnf‑expression”. The number cross‑references this grammar with the rule numbers in the YACC gram­mar. The names are the same as those in the YACC grammar, except that subrules are labeled with A, B, C,<dots>… </dots>in the YACC grammar and with 1, 2, 3,<dots>… </dots>in this grammar. In addition, rule 971 is “simple\_tag” in the YACC grammar but “stag” in this grammar, because of its fre­quent appearance. <ol>

* <li>Names in lower case are grammatical constructs.
* <li>Names in UPPER CASE are selma'o (lexeme) names, and are terminals.
* <li>Concatenation is expressed by juxtaposition with no operator symbol.
* <li>| represents alternation (choice).
* <li>[] represents an optional element.
* <li>& represents and/or (“A & B” is the same as “A | B | A B”).
* <li><dots>… </dots>represents optional repetition of the construct to the left.

Left‑grouping is implied; right‑grouping is shown by explicit

self‑referential recursion with no “<dots>… </dots>”

* <li>() serves to indicate the grouping of the other operators.

Otherwise, “<dots>… </dots>” binds closer than &, which binds closer than |.

* <li># is shorthand for “[free<dots>…</dots>]”, a construct which appears in many places.
* <li>// encloses an elidable terminator, which may be omitted (without change

of meaning) if no grammatical ambiguity results.

</ol>

<dl compact>

<a name=b0></a><a href=#y0><dt>text</a><sub>0</sub>= <dd>[NAI<dots>…</dots>] [CMENE<dots>… </dots># **|** (indicators & free<dots>…</dots>)] [joik‑jek] text‑1

<a name=b2></a><a href=#y2><dt>text‑1</a><sub>2</sub>= <dd>[(I [jek **|** joik] [[stag] BO] #)<dots>…</dots> **|** NIhO<dots>… </dots>#] [paragraphs]

<a name=b4></a><a href=#y4><dt>paragraphs</a><sub>4</sub>= <dd>paragraph [NIhO<dots>… </dots># paragraphs]

<a name=b10></a><a href=#y10><dt>paragraph</a><sub>10</sub>= <dd>(statement **|** fragment) [I # [statement **|** fragment]]<dots>…</dots>

<a name=b11></a><a href=#y11><dt>statement</a><sub>11</sub>= <dd>statement‑1<br> **|** prenex statement

<a name=b12></a><a href=#y12><dt>statement‑1</a><sub>12</sub>= <dd>statement‑2 [I joik‑jek [statement‑2]]<dots>…</dots>

<a name=b13></a><a href=#y13><dt>statement‑2</a><sub>13</sub>= <dd>statement‑3 [I [jek **|** joik] [stag] BO # [statement‑2]]

<a name=b14></a><a href=#y14><dt>statement‑3</a><sub>14</sub>= <dd>sentence<br> **|** [tag] TUhE # text‑1 /TUhU#/

<a name=b20></a><a href=#y20><dt>fragment</a><sub>20</sub>= <dd>ek #<br> **|** gihek #<br> **|** quantifier<br> | NA #<br> **|** terms /VAU#/<br> **|** prenex<br> **|** relative‑clauses<br> **|** links<br> **|** linkargs

<a name=b30></a><a href=#y30><dt>prenex</a><sub>30</sub>= <dd>terms ZOhU #

<a name=b40></a><a href=#y40><dt>sentence</a><sub>40</sub>= <dd>[terms [CU #]] bridi‑tail

<a name=b41></a><a href=#y41><dt>subsentence</a><sub>41</sub>= <dd>sentence<br> **|** prenex subsentence

<a name=b50></a><a href=#y50><dt>bridi‑tail</a><sub>50</sub>= <dd>bridi‑tail‑1 [gihek [stag] KE # bridi‑tail /KEhE#/ tail‑terms]

<a name=b51></a><a href=#y51><dt>bridi‑tail‑1</a><sub>51</sub>= <dd>bridi‑tail‑2 [gihek # bridi‑tail‑2 tail‑terms]<dots>…</dots>

<a name=b52></a><a href=#y52><dt>bridi‑tail‑2</a><sub>52</sub>= <dd>bridi‑tail‑3 [gihek [stag] BO # bridi‑tail‑2 tail‑terms]

<a name=b53></a><a href=#y53><dt>bridi‑tail‑3</a><sub>53</sub>= <dd>selbri tail‑terms<br> **|** gek‑sentence

<a name=b54></a><a href=#y54><dt>gek‑sentence</a><sub>54</sub>= <dd>gek subsentence gik subsentence tail‑terms<br> **|** [tag] KE # gek‑sentence /KEhE#/<br> **|** NA # gek‑sentence

<a name=b71></a><a href=#y71><dt>tail‑terms</a><sub>71</sub>= <dd>[terms] /VAU#/

<a name=b80></a><a href=#y80><dt>terms</a><sub>80</sub>= <dd>terms‑1<dots>…</dots>

<a name=b81></a><a href=#y81><dt>terms‑1</a><sub>81</sub>= <dd>terms‑2 [PEhE # joik‑jek terms‑2]<dots>…</dots>

<a name=b82></a><a href=#y82><dt>terms‑2</a><sub>82</sub>= <dd>term [CEhE # term]<dots>…</dots>

<a name=b83></a><a href=#y83><dt>term</a><sub>83</sub>= <dd>sumti **|** (tag **|** FA #) (sumti<br> **|** /KU#/)<br> **|** termset<br> **|** NA KU #

<a name=b85></a><a href=#y85><dt>termset</a><sub>85</sub>= <dd>NUhI # gek terms /NUhU#/ gik terms /NUhU#/<br> **|** NUhI # terms /NUhU#/

<a name=b90></a><a href=#y90><dt>sumti</a><sub>90</sub>= <dd>sumti‑1 [VUhO # relative‑clauses]

<a name=b91></a><a href=#y91><dt>sumti‑1</a><sub>91</sub>= <dd>sumti‑2 [(ek **|** joik) [stag] KE # sumti /KEhE#/]

<a name=b92></a><a href=#y92><dt>sumti‑2</a><sub>92</sub>= <dd>sumti‑3 [joik‑ek sumti‑3]<dots>…</dots>

<a name=b93></a><a href=#y93><dt>sumti‑3</a><sub>93</sub>= <dd>sumti‑4 [(ek<br> **|** joik) [stag] BO # sumti‑3]

<a name=b94></a><a href=#y94><dt>sumti‑4</a><sub>94</sub>= <dd>sumti‑5<br> **|** gek sumti gik sumti‑4

<a name=b95></a><a href=#y95><dt>sumti‑5</a><sub>95</sub>= <dd>[quantifier] sumti‑6 [relative‑clauses]<br> **|** quantifier selbri /KU#/ [relative‑clauses]

<a name=b97></a><a href=#y97><dt>sumti‑6</a><sub>97</sub>= <dd>(LAhE # **|** NAhE BO #) [relative‑clauses] sumti /LUhU#/<br> **|** KOhA #<br> **|** lerfu‑string /BOI#/<br> **|**

LA # [relative‑clauses] CMENE<dots>… </dots>#<br> **|**

(LA **|** LE) # sumti‑tail /KU#/<br> **|** LI # mex /LOhO#/<br> **|** ZO any‑word #<br> **|** LU text /LIhU#/<br> **|**

LOhU any‑word<dots>… </dots>LEhU #<br> **|**

ZOI any‑word anything any‑word #

<a name=b111></a><a href=#y111><dt>sumti‑tail</a><sub>111</sub>= <dd>[sumti‑6 [relative‑clauses]] sumti‑tail‑1 <br> |relative‑clauses sumti‑tail‑1

<a name=b112></a><a href=#y112><dt>sumti‑tail‑1</a><sub>112</sub>= <dd>[quantifier] selbri [relative‑clauses]<br> **|** quantifier sumti

<a name=b121></a><a href=#y121><dt>relative‑clauses</a><sub>121</sub>= <dd>relative‑clause [ZIhE # relative‑clause]<dots>…</dots>

<a name=b122></a><a href=#y122><dt>relative‑clause</a><sub>122</sub>= <dd>GOI # term /GEhU#/<br> **|** NOI # subsentence /KUhO#/

<a name=b130></a><a href=#y130><dt>selbri</a><sub>130</sub>= <dd>[tag] selbri‑1

<a name=b131></a><a href=#y131><dt>selbri‑1</a><sub>131</sub>= <dd>selbri‑2<br> | NA # selbri

<a name=b132></a><a href=#y132><dt>selbri‑2</a><sub>132</sub>= <dd>selbri‑3 [CO # selbri‑2]

<a name=b133></a><a href=#y133><dt>selbri‑3</a><sub>133</sub>= <dd>selbri‑4<dots>…</dots>

<a name=b134></a><a href=#y134><dt>selbri‑4</a><sub>134</sub>= <dd>selbri‑5 [joik‑jek selbri‑5 **|** joik [stag] KE # selbri‑3 /KEhE#/]<dots>…</dots>

<a name=b135></a><a href=#y135><dt>selbri‑5</a><sub>135</sub>= <dd>selbri‑6 [(jek **|** joik) [stag] BO # selbri‑5]

<a name=b136></a><a href=#y136><dt>selbri‑6</a><sub>136</sub>= <dd>tanru‑unit [BO # selbri‑6]<br> **|** [NAhE #] guhek selbri gik selbri‑6

<a name=b150></a><a href=#y150><dt>tanru‑unit</a><sub>150</sub>= <dd>tanru‑unit‑1 [CEI # tanru‑unit‑1]<dots>…</dots>

<a name=b151></a><a href=#y151><dt>tanru‑unit‑1</a><sub>151</sub>= <dd>tanru‑unit‑2 [linkargs]

<a name=b152></a><a href=#y152><dt>tanru‑unit‑2</a><sub>152</sub>= <dd>BRIVLA #<br> **|** GOhA [RAhO] #<br> **|** KE # selbri‑3 /KEhE#/<br> **|** ME # sumti /MEhU#/ [MOI #] **|** (number<br> **|** lerfu‑string) MOI #<br> **|** NUhA # mex‑operator<br> **|**

SE # tanru‑unit‑2<br> | JAI # [tag] tanru‑unit‑2<br> **|** any‑word (ZEI any‑word)<dots>…</dots><br> **|** NAhE # tanru‑unit‑2<br> **|** | NU [NAI] # [joik‑jek NU [NAI] #]<dots>… </dots>subsentence /KEI#/

<a name=b160></a><a href=#y160><dt>linkargs</a><sub>160</sub>= <dd>BE # term [links] /BEhO#/

<a name=b161></a><a href=#y161><dt>links</a><sub>161</sub>= <dd>BEI # term [links]

<a name=b300></a><a href=#y300><dt>quantifier</a><sub>300</sub>= <dd>number /BOI#/<br> **|** VEI # mex /VEhO#/

<a name=b310></a><a href=#y310><dt>mex</a><sub>310</sub>= <dd>mex‑1 [operator mex‑1]<dots>…</dots><br> **|** FUhA # rp‑expression

<a name=b311></a><a href=#y311><dt>mex‑1</a><sub>311</sub>= <dd>mex‑2 [BIhE # operator mex‑1]

<a name=b312></a><a href=#y312><dt>mex‑2</a><sub>312</sub>= <dd>operand<br> **|** [PEhO #] operator mex‑2<dots>… </dots>/KUhE#/

<a name=b330></a><a href=#y330><dt>rp‑expression</a><sub>330</sub>= <dd>rp‑operand rp‑operand operator

<a name=b332></a><a href=#y332><dt>rp‑operand</a><sub>332</sub>= <dd>operand<br> **|** rp‑expression

<a name=b370></a><a href=#y370><dt>operator</a><sub>370</sub>= <dd>operator‑1 [joik‑jek operator‑1 **|**

joik [stag] KE # operator /KEhE#/]<dots>…</dots>

<a name=b371></a><a href=#y371><dt>operator‑1</a><sub>371</sub>= <dd>operator‑2 <br> | guhek operator‑1 gik operator‑2<br> | operator‑2 (jek **|** joik) [stag] BO # operator‑1

<a name=b372></a><a href=#y372><dt>operator‑2</a><sub>372</sub>= <dd>mex‑operator<br> **|** KE # operator /KEhE#/

<a name=b374></a><a href=#y374><dt>mex‑operator</a><sub>374</sub>= <dd>SE # mex‑operator<br> **|** NAhE # mex‑operator<br> | MAhO # mex /TEhU#/<br> **|** NAhU # selbri /TEhU#/<br> | VUhU #

<a name=b381></a><a href=#y381><dt>operand</a><sub>381</sub>= <dd>operand‑1 [(ek **|** joik) [stag] KE # operand /KEhE#/]

<a name=b382></a><a href=#y382><dt>operand‑1</a><sub>382</sub>= <dd>operand‑2 [joik‑ek operand‑2]<dots>…</dots>

<a name=b383></a><a href=#y383><dt>operand‑2</a><sub>383</sub>= <dd>operand‑3 [(ek **|** joik) [stag] BO # operand‑2]

<a name=b385></a><a href=#y385><dt>operand‑3</a><sub>385</sub>= <dd>quantifier<br> **|** lerfu‑string /BOI#/<br> | NIhE # selbri /TEhU#/<br> **|** MOhE # sumti /TEhU#/<br> **|** JOhI # mex‑2<dots>… </dots>/TEhU#/<br> **|** gek operand gik operand‑3<br> **|** (LAhE # **|** NAhE BO #) operand /LUhU#/

<a name=b812></a><a href=#y812><dt>number</a><sub>812</sub>= <dd>PA [PA **|** lerfu‑word]<dots>…</dots>

<a name=b817></a><a href=#y817><dt>lerfu‑string</a><sub>817</sub>= <dd>lerfu‑word [PA **|** lerfu‑word]<dots>…</dots>

<a name=b987></a><a href=#y987><dt>lerfu‑word</a><sub>987</sub>= <dd>BY<br> **|** any‑word BU<br> **|** LAU lerfu‑word<br> **|**

TEI lerfu‑string FOI

<a name=b802></a><a href=#y802><dt>ek</a><sub>802</sub>= <dd>[NA] [SE] A [NAI]

<a name=b818></a><a href=#y818><dt>gihek</a><sub>818</sub>= <dd>[NA] [SE] GIhA [NAI]

<a name=b805></a><a href=#y805><dt>jek</a><sub>805</sub>= <dd>[NA] [SE] JA [NAI]

<a name=b806></a><a href=#y806><dt>joik</a><sub>806</sub>= <dd>[SE] JOI [NAI]<br> **|** interval<br> **|** GAhO interval GAhO

<a name=b932></a><a href=#y932><dt>interval</a><sub>932</sub>= <dd>[SE] BIhI [NAI]

<a name=b421></a><a href=#y421><dt>joik‑ek</a><sub>421</sub>= <dd>joik #<br> **|** ek #

<a name=b422></a><a href=#y422><dt>joik‑jek</a><sub>422</sub>= <dd>joik #<br> **|** jek #

<a name=b807></a><a href=#y807><dt>gek</a><sub>807</sub>= <dd>[SE] GA [NAI] #<br> **|** joik GI #<br> **|** stag gik

<a name=b808></a><a href=#y808><dt>guhek</a><sub>808</sub>= <dd>[SE] GUhA [NAI] #

<a name=b816></a><a href=#y816><dt>gik</a><sub>816</sub>= <dd>GI [NAI] #

<a name=b491></a><a href=#y491><dt>tag</a><sub>491</sub>= <dd>tense‑modal [joik‑jek tense‑modal]<dots>…</dots>

<a name=b971></a><a href=#y971><dt>stag</a><sub>971</sub>= <dd>simple‑tense‑modal [(jek **|** joik) simple‑tense‑modal]<dots>…</dots>

<a name=b815></a><a href=#y815><dt>tense‑modal</a><sub>815</sub>= <dd>simple‑tense‑modal #<br> **|** FIhO # selbri /FEhU#/

<a name=b972></a><a href=#y972><dt>simple‑tense‑modal</a><sub>972</sub>= <dd>[NAhE] [SE] BAI [NAI] [KI]<br> **|** [NAhE] (time [space]<br> **|** space [time]) & CAhA [KI]<br> **|** KI<br> | CUhE

<a name=b1030></a><a href=#y1030><dt>time</a><sub>1030</sub>= <dd>ZI & time‑offset<dots>… </dots>& ZEhA [PU [NAI]] & interval‑property<dots>…</dots>

<a name=b1033></a><a href=#y1033><dt>time‑offset</a><sub>1033</sub>= <dd>PU [NAI] [ZI]

<a name=b1040></a><a href=#y1040><dt>space</a><sub>1040</sub>= <dd>VA & space‑offset<dots>… </dots>& space‑interval & (MOhI space‑offset)

<a name=b1045></a><a href=#y1045><dt>space‑offset</a><sub>1045</sub>= <dd>FAhA [NAI] [VA]

<a name=b1046></a><a href=#y1046><dt>space‑interval</a><sub>1046</sub>= <dd>((VEhA & VIhA) [FAhA [NAI]]) & space‑int‑props

<a name=b1049></a><a href=#y1049><dt>space‑int‑props</a><sub>1049</sub>= <dd>(FEhE interval‑property)<dots>…</dots>

<a name=b1051></a><a href=#y1051><dt>interval‑property</a><sub>1051</sub>= <dd>number ROI [NAI]<br> **|** TAhE [NAI]<br> **|** ZAhO [NAI]

<a name=b32></a><a href=#y32><dt>free</a><sub>32</sub>= <dd>SEI # [terms [CU #]] selbri /SEhU/<br> **|**

SOI # sumti [sumti] /SEhU/<br> **|** vocative [relative‑clauses] selbri [relative‑clauses] /DOhU/<br> **|** vocative [relative‑clauses] CMENE<dots>… </dots># [relative‑clauses] /DOhU/<br> **|** vocative [sumti] /DOhU/<br> **|** (number **|** lerfu‑string) MAI<br> **|** TO text /TOI/<br> **|**

XI # (number **|** lerfu‑string) /BOI/<br> **|**

XI # VEI # mex /VEhO/

<a name=b415></a><a href=#y415><dt>vocative</a><sub>415</sub>= <dd>(COI [NAI])<dots>…</dots>& DOI

<a name=b411></a><a href=#y411><dt>indicators</a><sub>411</sub>= <dd>[FUhE] indicator<dots>…</dots>

<a name=b413></a><a href=#y413><dt>indicator</a><sub>413</sub>= <dd>(UI **|** CAI) [NAI]<br> **|** Y<br> **|** DAhO<br> **|** FUhO

</dl>

<p>

The following rules are non‑formal: <dl>

<a name=b1100>

</a><a href=#y1100><dt>word</a><sub>1100</sub>= <dd>[BAhE] any‑word [indicators]

<dt>any‑word= <dd>“any single word (no compound cmavo)”

<dt>anything= <dd>“any text at all, whether Lojban or not”

<a name=b1101></a><a href=#y1101><dt>null</a><sub>1101</sub>= <dd>any‑word SI<br> **|** utterance SA<br> **|** text SU

</dl>FAhO is a universal terminator and signals the end of parsable input.

### <h3>EBNF Grammar Cross‑Reference</h3>

<dl>

<dt>A <dd><a href=#b802>ek</a><sub>802</sub>

<dt>BAI <dd><a href=#b972>simple‑tense‑modal</a><sub>972</sub>

<dt>BAhE <dd><a href=#b1100>word</a><sub>1100</sub>

<dt>BE <dd><a href=#b160>linkargs</a><sub>160</sub>

<dt>BEI <dd><a href=#b161>links</a><sub>161</sub>

<dt>BEhO <dd><a href=#b160>linkargs</a><sub>160</sub>

<dt>BIhE <dd><a href=#b311>mex‑1</a><sub>311</sub>

<dt>BIhI <dd><a href=#b932>interval</a><sub>932</sub>

<dt>BO <dd><a href=#b52>bridi‑tail‑2</a><sub>52</sub>, <a href=#b383>operand‑2</a><sub>383</sub>, <a href=#b385>operand‑3</a><sub>385</sub>, <a href=#b371>operator‑1</a><sub>371</sub>, <a href=#b135>selbri‑5</a><sub>135</sub>, <a href=#b136>selbri‑6</a><sub>136</sub>, <a href=#b13>statement‑2</a><sub>13</sub>, <a href=#b93>sumti‑3</a><sub>93</sub>, <a href=#b97>sumti‑6</a><sub>97</sub>, <a href=#b2>text‑1</a><sub>2</sub>

<dt>BOI <dd><a href=#b32>free</a><sub>32</sub>, <a href=#b385>operand‑3</a><sub>385</sub>, <a href=#b300>quantifier</a><sub>300</sub>, <a href=#b97>sumti‑6</a><sub>97</sub>

<dt>BRIVLA <dd><a href=#b152>tanru‑unit‑2</a><sub>152</sub>

<dt>BU <dd><a href=#b987>lerfu‑word</a><sub>987</sub>

<dt>BY <dd><a href=#b987>lerfu‑word</a><sub>987</sub>

<dt>CAI <dd><a href=#b413>indicator</a><sub>413</sub>

<dt>CAhA <dd><a href=#b972>simple‑tense‑modal</a><sub>972</sub>

<dt>CEI <dd><a href=#b150>tanru‑unit</a><sub>150</sub>

<dt>CEhE <dd><a href=#b82>terms‑2</a><sub>82</sub>

<dt>CMENE <dd><a href=#b32>free</a><sub>32</sub>, <a href=#b97>sumti‑6</a><sub>97</sub>, <a href=#b0>text</a><sub>0</sub>

<dt>CO <dd><a href=#b132>selbri‑2</a><sub>132</sub>

<dt>COI <dd><a href=#b415>vocative</a><sub>415</sub>

<dt>CU <dd><a href=#b32>free</a><sub>32</sub>, <a href=#b40>sentence</a><sub>40</sub>

<dt>CUhE <dd><a href=#b972>simple‑tense‑modal</a><sub>972</sub>

<dt>DAhO <dd><a href=#b413>indicator</a><sub>413</sub>

<dt>DOI <dd><a href=#b415>vocative</a><sub>415</sub>

<dt>DOhU <dd><a href=#b32>free</a><sub>32</sub>

<dt>FA <dd><a href=#b83>term</a><sub>83</sub>

<dt>FAhA <dd><a href=#b1046>space‑interval</a><sub>1046</sub>, <a href=#b1045>space‑offset</a><sub>1045</sub>

<dt>FEhE <dd><a href=#b1049>space‑int‑props</a><sub>1049</sub>

<dt>FEhU <dd><a href=#b815>tense‑modal</a><sub>815</sub>

<dt>FIhO <dd><a href=#b815>tense‑modal</a><sub>815</sub>

<dt>FOI <dd><a href=#b987>lerfu‑word</a><sub>987</sub>

<dt>FUhA <dd><a href=#b310>mex</a><sub>310</sub>

<dt>FUhE <dd><a href=#b411>indicators</a><sub>411</sub>

<dt>FUhO <dd><a href=#b413>indicator</a><sub>413</sub>

<dt>GA <dd><a href=#b807>gek</a><sub>807</sub>

<dt>GAhO <dd><a href=#b806>joik</a><sub>806</sub>

<dt>GEhU <dd><a href=#b122>relative‑clause</a><sub>122</sub>

<dt>GI <dd><a href=#b807>gek</a><sub>807</sub>, <a href=#b816>gik</a><sub>816</sub>

<dt>GIhA <dd><a href=#b818>gihek</a><sub>818</sub>

<dt>GOI <dd><a href=#b122>relative‑clause</a><sub>122</sub>

<dt>GOhA <dd><a href=#b152>tanru‑unit‑2</a><sub>152</sub>

<dt>GUhA <dd><a href=#b808>guhek</a><sub>808</sub>

<dt>I <dd><a href=#b10>paragraph</a><sub>10</sub>, <a href=#b12>statement‑1</a><sub>12</sub>, <a href=#b13>statement‑2</a><sub>13</sub>, <a href=#b2>text‑1</a><sub>2</sub>

<dt>JA <dd><a href=#b805>jek</a><sub>805</sub>

<dt>JAI <dd><a href=#b152>tanru‑unit‑2</a><sub>152</sub>

<dt>JOI <dd><a href=#b806>joik</a><sub>806</sub>

<dt>JOhI <dd><a href=#b385>operand‑3</a><sub>385</sub>

<dt>KE <dd><a href=#b50>bridi‑tail</a><sub>50</sub>, <a href=#b54>gek‑sentence</a><sub>54</sub>, <a href=#b381>operand</a><sub>381</sub>, <a href=#b372>operator‑2</a><sub>372</sub>, <a href=#b370>operator</a><sub>370</sub>, <a href=#b134>selbri‑4</a><sub>134</sub>, <a href=#b91>sumti‑1</a><sub>91</sub>, <a href=#b152>tanru‑unit‑2</a><sub>152</sub>

<dt>KEI <dd><a href=#b152>tanru‑unit‑2</a><sub>152</sub>

<dt>KEhE <dd><a href=#b50>bridi‑tail</a><sub>50</sub>, <a href=#b54>gek‑sentence</a><sub>54</sub>, <a href=#b381>operand</a><sub>381</sub>, <a href=#b372>operator‑2</a><sub>372</sub>, <a href=#b370>operator</a><sub>370</sub>, <a href=#b134>selbri‑4</a><sub>134</sub>, <a href=#b91>sumti‑1</a><sub>91</sub>, <a href=#b152>tanru‑unit‑2</a><sub>152</sub>

<dt>KI <dd><a href=#b972>simple‑tense‑modal</a><sub>972</sub>

<dt>KOhA <dd><a href=#b97>sumti‑6</a><sub>97</sub>

<dt>KU <dd><a href=#b95>sumti‑5</a><sub>95</sub>, <a href=#b97>sumti‑6</a><sub>97</sub>, <a href=#b83>term</a><sub>83</sub>

<dt>KUhE <dd><a href=#b312>mex‑2</a><sub>312</sub>

<dt>KUhO <dd><a href=#b122>relative‑clause</a><sub>122</sub>

<dt>LA <dd><a href=#b97>sumti‑6</a><sub>97</sub>

<dt>LAU <dd><a href=#b987>lerfu‑word</a><sub>987</sub>

<dt>LAhE <dd><a href=#b385>operand‑3</a><sub>385</sub>, <a href=#b97>sumti‑6</a><sub>97</sub>

<dt>LE <dd><a href=#b97>sumti‑6</a><sub>97</sub>

<dt>LEhU <dd><a href=#b97>sumti‑6</a><sub>97</sub>

<dt>LI <dd><a href=#b97>sumti‑6</a><sub>97</sub>

<dt>LIhU <dd><a href=#b97>sumti‑6</a><sub>97</sub>

<dt>LOhO <dd><a href=#b97>sumti‑6</a><sub>97</sub>

<dt>LOhU <dd><a href=#b97>sumti‑6</a><sub>97</sub>

<dt>LU <dd><a href=#b97>sumti‑6</a><sub>97</sub>

<dt>LUhU <dd><a href=#b385>operand‑3</a><sub>385</sub>, <a href=#b97>sumti‑6</a><sub>97</sub>

<dt>MAI <dd><a href=#b32>free</a><sub>32</sub>

<dt>MAhO <dd><a href=#b374>mex‑operator</a><sub>374</sub>

<dt>ME <dd><a href=#b152>tanru‑unit‑2</a><sub>152</sub>

<dt>MEhU <dd><a href=#b152>tanru‑unit‑2</a><sub>152</sub>

<dt>MOI <dd><a href=#b152>tanru‑unit‑2</a><sub>152</sub>

<dt>MOhE <dd><a href=#b385>operand‑3</a><sub>385</sub>

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<dt>NA <dd><a href=#b802>ek</a><sub>802</sub>, <a href=#b20>fragment</a><sub>20</sub>, <a href=#b54>gek‑sentence</a><sub>54</sub>, <a href=#b818>gihek</a><sub>818</sub>, <a href=#b805>jek</a><sub>805</sub>, <a href=#b131>selbri‑1</a><sub>131</sub>, <a href=#b83>term</a><sub>83</sub>

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