One-to-many relations in morphology, syntax, and semantics

Edited by

Berthold Crysmann

Manfred Sailer

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Chapter 1

Introduction

Berthold Crysmann
Université de Paris, Laboratoire de linguistique formelle, CNRS

Manfred Sailer
Goethe-Universität Frankfurt a.M.

The standard view of the form-meaning interfaces, as embraced by the great majority of contemporary grammatical frameworks, consists in the assumption that meaning can be associated with grammatical form in a one-to-one correspondence. Under this view, composition is quite straightforward, involving concatenation of form, paired with functional application in meaning. In this book, we shall discuss linguistic phenomena across several grammatical sub-modules (morphology, syntax, semantics) that apparently pose a problem to the standard view, mapping out the potential for deviation from the ideal of one-to-one correspondences, and develop formal accounts of the range of phenomena. We shall argue that a constraint-based perspective is particularly apt to accommodate deviations from one-to-many correspondences, as it allows us to impose constraints on full structures (such as a complete word or the interpretation of a full sentence) instead of always deriving such structures step by step.

The book consists of a general introduction and seven topical contributions, ranging from morphology to syntax and semantics. In the introductory chapter, we shall give a general overview and typology of one-to-many correspondences. A number of papers in this volume are formulated in a particular constraint-based grammar framework, Head-driven Phrase Structure Grammar (Pollard & Sag 1994). These contributions investigate how the lexical and constructional aspects of this specific theory can be combined to provide an answer to the issue of one-to-many relations across different linguistic sub-theories.

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1 One-to-many relations across modules

1.1 Many-to-many nature of morphology

Possibly the first module of grammar where the ideal of one-to-one correspondence has been challenged is **morphology**: classical challenges (Matthews 1972) include (i) cumulation, where several morphosyntactic properties are jointly expressed by a single exponent, (ii) extended (or multiple) exponence, where a morphosyntactic property is jointly expressed by several exponents, and (iii) overlapping exponence, i.e. the combination of cumulation and extended exponence. These deviations from the canon of a one-to-one correspondence pertain to the relation between form and function.

Cumulation, or fusion, is indeed a highly common property of inflectional systems, where one form $n = 1$ corresponds to $m > 1$ functions. In fact, fusion is considered as the property that distinguishes the broad typological class of inflectional languages from the agglutinative type. However, cumulation can even be attested in agglutinative languages, such as Swahili (Stump 1993) or Finnish (Spencer 2003). Taking German nominal inflection as an example, marking of number and case is often fused, illustrated by the paradigm of *Rechner* in Table 1.1.

Table 1.1: German nominal paradigms

(a) *Rechner* 'computer'

	SINGULAR	PLURAL
NOM	Rechner	Rechner
GEN	Rechner-s	Rechner
DAT	Rechner	Rechner-n
ACC	Rechner	Rechner

(b) *Mensch* 'human'

	SINGULAR	PLURAL
NOM	Mensch	Mensch-en
GEN	Mensch-en	Mensch-en
DAT	Mensch-en	Mensch-en
ACC	Mensch-en	Mensch-en

(c) *Hals* 'neck'

	SINGULAR	PLURAL
NOM	Hals	Häls-e
GEN	Hals-es	Häls-e
DAT	Hals	Häls-en
ACC	Hals	Häls-e

(d) *Arm* 'arm'

	SINGULAR	PLURAL
NOM	Arm	Arm-e
GEN	Arm-s	Arm-e
DAT	Arm	Arm-en
ACC	Arm	Arm-e

The mirror image of cumulation is *extended* or *multiple exponence*, where a single function $m = 1$ is expressed multiple times by $n > 1$ exponents (see Caballero & Harris 2012; Harris 2017 for a typological overview). In German nominal plurals, this is attested e.g. by the combination of affixation and *umlaut*, an instance of morphologically conditioned vowel fronting. In this volume, the chapter by **Crysmann** explores a particularly compelling case of extended exponence in Batsbi (Harris 2009), where identical class agreement markers may show up multiple times within a verb.

What is probably even more common than pure extended exponence is *overlapping exponence*, which can be pictured as a combination of extended exponence and cumulation: e.g. in the dative plural *Arm-e-n*, plural is jointly expressed by the suffixes *-e* and *-n* ($1 : n > 1$), while at the same time *-n* cumulates plural and dative marking ($m > 1 : 1$).

Perhaps the most common deviation from one-to-one correspondence is *zero exponence*, with $m > 0$ functions being expressed by $n = 0$ forms: e.g. in the paradigm of German *Rechner*, a substantial number of case and number combinations are expressed by the absence of any inflectional marker. What is peculiar about the zero-marked forms is that they do not form any natural class here, neither in terms of case, nor in terms of number, nor any combination of these two dimensions. Rather, they are interpreted in terms of paradigmatic opposition to overtly marked cells. A common way to capture this is in terms of Pāṇini's principle or the Elsewhere Condition (Kiparsky 1985), a notion embraced by almost every theory of inflection (cf. Halle & Marantz 1993; Prince & Smolensky 1993; Anderson 1992; Stump 2001; Crysmann & Bonami 2016). While zero exponence represents the default more often than not, zero exponence may sometimes exceptionally constitute an override in an otherwise overtly marked paradigm. Consider the German paradigm of *Mensch* 'human': here the only way to give a uniform interpretation for the overt marker *-en* is in terms of opposition to the zero-marked nominative singular cell. Thus, within this inflectional class, zero exponence constitutes the special case, contrasting with non-zero default marking (*-en*).

While inflectional morphology also witnesses one-to-one correspondences between form and function, almost all possible deviations are well attested: one-to-many (cumulation), many-to-one (extended exponence), many-to-many (overlapping exponence), and zero-to-one. The fact that these deviations from a one-to-one ideal can be found in practically every inflectional system makes them qualify as an indispensable property of this grammatical module.

One-to-many relations are not only pervasive in the correspondence between morphosyntactic properties and the exponents that express them, but they are

also characteristic of paradigm structure: a frequently attested phenomenon is *syncretism*, the systematic identity of forms in different cells of the paradigm. In a sense, syncretism constitutes an instance of (local) ambiguity. The nominal paradigms of German we cited above provide different patterns of syncretism, illustrating identity of forms for different cells in the paradigm of a single word, as well as identity of patterns of exponence across different inflectional paradigms (cf. e.g. the singular of *Rechner* and *Arm* in Table 1.1).

Heteroclisis constitutes a particular case of cross-paradigm syncretism, where different parts of a lexeme's paradigm adhere to different inflection classes (Stump 2006). Table 1.2 illustrates the phenomenon with data from Czech: in the neuter, we find two basic declension classes (hard and soft), where corresponding cells are marked with different exponents. Mixed declension neuter nouns like *kuře* 'chicken', on the other hand, inflect like soft declension nouns in the singular, but, in the plural, the case/number exponents are identical to those found in the hard declension.

Table 1.2: Overabundance and heteroclisis in Czech declension (Bonami & Crysmann 2018)

		MASCULINE			NEUTER		
		hard	mixed	soft	hard	mixed	soft
SG	NOM	most	pramen	pokoj	měst-o	kuř-e	moř-e
	GEN	most-u	pramen-u~pramen-e	pokoj-e	měst-a	kuř-et-e	moř-e
	DAT	most-u	pramen-u~pramen-i	pokoj-i	měst-u	kuř-et-i	moř-i
	ACC	most	pramen	pokoj	měst-o	kuř-e	moř-e
	VOC	most-e	pramen-e~pramen-i	pokoj-i	měst-o	kuř-e	moř-e
	LOC	most-ě	pramen-u~pramen-i	pokoj-i	měst-ě	kuř-et-i	moř-i
	INS	most-em	pramen-em	pokoj-em	měst-em	kuř-et-em	moř-em
PL	NOM	most-y	pramen-y	pokoj-e	měst-a	kuř-at-a	moř-e
	GEN	most-ů	pramen-ů	pokoj-ů	měst	kuř-at	moř-í
	DAT	most-ům	pramen-ům	pokoj-ům	měst-ům	kuř-at-ům	moř-ím
	ACC	most-y	pramen-y	pokoj-e	měst-a	kuř-at-a	moř-e
	VOC	most-y	pramen-y	pokoj-e	měst-a	kuř-at-a	moř-e
	LOC	most-ech	pramen-ech	pokoj-ích	měst-ech	kuř-at-ech	moř-ích
	INS	most-y	pramen-y	pokoji	měst-y	kuř-at-y	moř-i
		'bridge'	'spring'	'room'	'town'	'chicken'	'sea'

Syncretism, however, differs from most other cases of lexical ambiguity in being systematic, rather than accidental. While systematic attachment ambiguities in syntax are rooted in the geometrical properties of tree structure (Catalan numbers), the systematicity of syncretism patterns is of a different nature, combining

underspecification in the case of natural splits with a specific type of default logic, in the case of Pāṇinian splits. By studying patterns of syncretism, morphologists try to understand inter alia how a small number of exponents are deployed to distinguish a much greater number of cells.

The opposite of syncretism is *overabundance* (Thornton 2011; 2012; 2019), which has been accepted only fairly recently in morphology. Overabundance is the inflectional equivalent of paraphrase, so its very existence should not come as too much of a surprise. However, with Pāṇinian competition as an organising principle of lexical and morphological knowledge, we should expect overabundance to be the exception rather than the rule in inflectional systems.

While heteroclisis, i.e. multiple inflection class membership can just give rise to mixed paradigms, where one set of cells adheres to one class and another set to a different class, multiple membership may even give rise to overabundance (Thornton 2011), as witnessed e.g. by English *dreamed/dreamt* where a function has more than one possible realisation.

The way in which heteroclisis and overabundance can interact is illustrated by the Czech masculine mixed declension given in Table 1.2: in the plural, *pramen* 'spring' uses the case/number exponents of the hard declension, entirely parallel to what we saw in the neuter mixed declension, whereas in the singular, we find the exponents of both hard and soft declensions. In essence, heteroclisis appears to be one of the contributing factors to overabundance.

Syncretism and overabundance can be thought of as the inflectional manifestations of two very general properties of language, namely ambiguity and paraphrases. However, within morphological theory, the situation where one form is identical across different functions is recognised to the extent that formal theories are optimised to describe syncretic patterns with minimal description length, typically using preemptive devices such as extrinsic rule ordering (Anderson 1992) or Pāṇinian competition (Kiparsky 2005; Stump 2001; Prince & Smolensky 1993; Embick & Noyer 2007). The resulting functional, as opposed to relational, perspective on the correspondence between inflectional meaning and form poses some challenge towards the integration of overabundance.

In his contribution to this volume, **Beniamine** presents an approach to computational induction of inflection classes and suggests that heteroclisis and overabundance are actually far more wide-spread than commonly assumed and that monotonic inheritance hierarchies, as used in HPSG lend themselves naturally towards modelling inflectional macro- and microclasses.

1.2 One-to-many phenomena beyond morphology

As shown in the previous section, one-to-many relations are well established in morphology. In this section, we list some example cases to which the morphological terminology can be applied, at least on a pretheoretical, descriptive level.

A key insight at the basis of modern formal semantics is the *Principle of Compositionality*, which we show in one of its standard versions in (1).

(1) Principle of Compositionality:
The meaning of a complex expression is a function of the meaning of its component parts and the way in which they are combined.

This principle captures the insight that speakers of a language can understand utterances they have never heard if they understand the words and the structure of these utterances. Typical formulations of the Principle of Compositionality such as (1) make a number of implicit assumptions that point towards a one-to-one relation between form and meaning. We shall review two aspects and some problems with them: First, a function has a unique value for a given input, second, there is a single relevant level of "meaning," or what Bach 1999 calls the dictum of *one sentence, one proposition*.

Turning to the first aspect, the very notion of a *function* suggests that there is a *unique* interpretation for any given word-structure combination. This is not immediately obvious once we look at ambiguities others than lexical and structural ambiguities. For example scope ambiguity, see (2a), or collective-distributive ambiguity, see (2b), are not straightforwardly related to different lexical items or syntactic structures.

(2) a. Most linguists speak at least two languages. (scope ambiguity)
Reading 1: For most linguists, there are at least two languages that they speak.
Reading 2: There are at least two languages such that most linguistics speak them.

b. Two students lifted the box. (collective-distributive ambiguity)
Reading 1: Two students jointly lifted the box.
Reading 2: Two students lifted the box separately.

There have been numerous attempts to make the analysis of such data compatible with the Principle of Compositionality. There are three standard solution strategies. First, more syntactic structure can be postulated to subsume these cases under structural ambiguity, as done in *Montague Grammar*, Montague

(1974) or through *quantifier raising*, starting from May (1977). Second, semantic shifting operations can be introduced in order to treat the problem as a (systematic) lexical ambiguity. Prominent examples of this include Link (1983), Partee & Rooth (1983) and *Flexible Montague Grammar* (Hendriks 1993). Third, attempts could be made to argue that there is no real ambiguity but rather a vagueness, i.e., that the apparent readings are just different scenarios that are compatible with the one, very general, interpretation of the clauses. This could be done in *underspecified semantics*, see Pinkal (1999) and Egg (2011) for an overview.

Let us turn to the second implicit one-to-one aspect of the Principle of Compositionality. It is usually interpreted as expressing the idea of *one sentence, one proposition*. Bach (1999) is widely quoted as explicitly challenging this assumption, in that whatever is "said" should be considered the relevant meaning in the sense of the Principle of Compositionality – in contrast to what is being communicated implicitly by a conversational implicature. The prime examples of sentences with more than one proposition involve *conventional implicatures* as in the classical example from Grice (1975) in (3).[1,2]

(3) He is an Englishman; he is, therefore, brave. (Grice 1975: 44)
   a. Proposition 1: 'He is brave.'
   b. Proposition 2: 'His being brave is a consequence of his being an Englishman.'

We indicate the two propositions expressed in (3) below the example. Often, only the proposition in (3a) is considered what is being "said," or asserted. The proposition in (3b) is considered non-asserted. Under the heading of *projective meaning*, it has been argued that the difference between asserted content, presupposition, conventional implicature, and, possibly other types, is not categorical (Tonhauser et al. 2013; AnderBois et al. 2015).

Formal approaches such as Potts (2005) and Liu (2012) show that the non-asserted meaning can be computed in parallel to and with the same techniques as the asserted content. Gutzmann (2013) provides examples of lexical items and constructions that contribute to the non-asserted content only (such as attributive *damn*) and to both asserted and non-asserted content – such as slurs like *kraut* with the asserted meaning 'German' and the non-asserted meaning of a

[1]Grice's example in (3) violates many of the LSA guidelines of linguistic examples, see https://www.linguisticsociety.org/resource/lsa-guidelines-nonsexist-usage, accessed 2020-03-04.

[2]Bach (1999) questions the notion of conventional implicature and rather intends to replace it by allowing more than one proposition.

speaker's negative attitude towards Germans. This shows that meaning computation itself is a one-to-many challenge, i.e., that not only a single, asserted, content needs to be computed, but potentially several, projective meaning contributions need to be computed in parallel.

There are, however, other constellations that are problematic for the one-to-one aspects of the Principle of Compositionality, some of which are also addressed in the contributions of **Sailer & Richter** and **Bargmann, Gehrke & Richter** of this volume.

When we reconsider the list of one-to-many phenomena in morphology, it is easy to find analogous cases for each of them at the morphology-syntax interface, in syntax, and at the syntax-semantics interface.

One obvious case is *periphrasis*, i.e., the marking of a morphosyntactic category (such as tense, number, or case) by means of several words. A simple example of this is past tense marking in Afrikaans: while a few verbs have a past tense form – such as *kan* 'can' with the form *kon* 'could' – most verbs form their past tense with the auxiliary *het* 'have' and a past participle, as in *ge-werk het* 'worked have'. Neither the verb *het* nor the past participle *ge-werk* express past tense when used on their own.

We find similar periphrastic behaviour at the syntax-semantics interface. Light verb constructions, complex predicates, particle verbs, or idiomatic expressions are all cases in which a single meaning is expressed through the use of more than one word, where none of the words may carry this meaning outside the combination. While there is a continuum of transparency in these cases, we find extreme examples such as the German particle verb *an-geben* 'brag' (lit.: on-give) or the English idiomatic expression *kick the bucket* 'die.'

There are many cases of *redundancy*, i.e., the same morphosyntactic or semantic property is marked on more than one word. This can be understood as the syntacto-semantic equivalent of extended exponence. A common pattern is to find the same category being marked on a substantive word and also by some function word. In some varieties of English, for example, we find both a morphological and a periphrastic marking of the comparative, as in (4).

(4) But I found that in all area of my life where I live the most according my own rules, I feel more stronger. (GloWbE, South Africa)

This constellation also occurs in the second stage in the *Jespersen Cycle* (Jespersen 1917), illustrated with a Frecnh example in (5). There, an original negation marker (*ne*) is strengthened through the occurrence of a further negative item (*pas*).

(5) Je ne dis pas. 'I don't say' (Jespersen 1917: 7)
I NE say not

The Jespersen Cycle has been applied to a number of grammaticalisation processes, see van Gelderen (2011; 2013) for an overview. Since the redundant step belongs to many of the grammaticalisation cycles, this particular one-to-many stage constitutes a standard case in the syntactic marking of grammatical categories.

Redundant marking outside morphology is also found in so-called *concord phenomena*. The most widely studied is negative concord, where more than one negative indefinite is used in a clause without expressing more than one negation (Jespersen 1917; Besten 1986; Zeijlstra 2004). There is also modal concord as in (6), where we find two modal expressions, here a modal auxiliary and a modal adverb, expressing the same modality (Zeijlstra 2007; Huitink 2012). We expect that there may potentially be other concord phenomena at the syntax-semantics interface.

(6) My eyes must certainly be deceiving me. (Huitink 2012: 404)
= My eyes must be deceiving me.
= Certainly, my eyes are deceiving me.

Cases of redundancy also involve pronouns, as witnessed, inter alia, by resumption. In many languages, the extraction site in an unbounded dependency, such as *wh*-fronting or relativisation can or must be marked by a pronominal in situ. For instance in Hausa, questioning the object of a preposition requires either pied-piping of the preposition, or else presence of a pronoun in situ, as illustrated by the example in (7).

(7) a. dà mèe kikà zoo?
with what you.F.SG come
'With what did you come?' (Jaggar 2001: 521)

b. mèe kikà zoo dà shii?
what you.F.SG come with him/it
'What did you come with?' (Jaggar 2001: 521)

In the case of pied-piping in (7a), we have a one-to-one correspondence between participants and their realisations. With resumption in (7b), hwoever, one participant is actually realised twice, namely by the fronted *wh* expression *mèe* 'what' and by the in situ resumptive pronoun *shii* 'him/it'. Unless one assumes

ambiguity between semantically potent ordinary pronouns and semantically vacuous resumptives, one is confronted with the problem that a single semantic role is simultaneously filled by two syntactic complements. However, as pointed out by McCloskey (2002), resumptive pronouns are non-distinct in shape from the ordinary pronouns of the language, casting doubts on an ambiguity approach.

We also find cases of doubling of *wh*-words. In Afrikaans long-distance extraction, there can be a copy of the extracted *wh*-phrase at the beginning of any intermediate clause. This is shown in (8). The construction is not restricted to Afrikaans. Höhle (2019) discusses analogous data in German, and Bruening (2006) in Passamaquoddy.

(8) Waarvoor denk julle waarvoor werk ons?
wherefore think you wherefore work we
'What do you think we are working for?' (Plessis 1977: 725)

We would like to mention a final group of redundancy phenomena that does not involve functional elements: predicate fronting and cognate objects. For many languages, we find a duplication of a fronted predicate, as in the Yiddish example in (9) from Källgren & Prince (1989). In this case, a non-finite form of the predicate occurs in the fronted position, and the same verb, though in a potentially different inflected form, occurs in the rest of the clause.

(9) leyenen leyent er dos bukh yetst.
read.INF reads he the book now
'As for reading, he's reading the book now.' (Källgren & Prince 1989: 48)

This phenomenon has been documented at least for Hebrew, Hungarian, Brazilian Portuguese, Russian, Spanish, Yiddish (Vicente 2009).

The cognate object construction is a further phenomenon showing redundancy. In the prototypical case of this construction, a usually intransitive verb combines with an NP complement that can be considered a nominalisation of the verb, see (10). As the example shows, the NP complement seems to be redundant. This is, again, a cross-linguistically very common construction (Jones 1988; Massam 1990; Mittwoch 1998).

(10) Harry lived an uneventful life.
= Harry lived uneventfully. (Jones 1988: 89)

We can turn to a different type of one-to-many relations. In the following cases, several quantificational elements occur in a sentence but need to be interpreted as a single unit, a *polyadic quantifier*. This is illustrated in (11), from

Keenan (1992), with a paraphrase of the relevant reading. Keenan (1992) shows that certain uses of *different* cannot be accounted for with a combination of "ordinary", i.e. monadic, quantifiers. This result presents an important challenge to systems of semantic combinatorics that assume compositionality.

(11) Different people like different things.
'There are at least two people and for all distinct people x, y the things that x likes are not exactly the same as those that y likes.'

Various approaches have been proposed to solve this problem: Moltmann (1995) and Beck (2006) generate more general readings in a compositional way and assume context-sensitive mechanisms that will filter out undesired readings. Barker (2007) proposes an unusual syntactic structure that will guide the interpretation. Lahm (2016) uses data on *different* as additional motivation for the use of choice functions. Finally, Richter (2016) employs a non-standard mechanism of semantic combinatorics to arrive at an explicitly polyadic semantic representation. If one accepts a polyadic analysis, the configuration is similar to the one we found in complex predicates: several expressions form an inseparable unit together.

The last one-to-many relation that we would like to mention are elliptical phenomena. These include *gapping*, see (12a), and *argument cluster coordination*, as in (12b), both examples are taken from Kubota & Levine (2016).

(12) a. Leslie bought a CD, and Robin a book.
b. I told the same joke to Robin on Friday and to Leslie on Sunday. (Kubota & Levine 2016)

Gapping is a one-to-many phenomenon in the sense that the verb is mentioned only in the first conjunct but present for interpretation in both conjuncts. There are numerous approaches to these phenomena. They can, basically, be divided into three groups: (i) phonological deletion approaches (Merchant 2001; Fox & Lasnik 2003); (ii) approaches assuming a copy at the level of Logical Form (Lobeck 1995; Chung et al. 1995); (iii) direct interpretation approaches (Ginzburg & Sag 2000; Culicover & Jackendoff 2005; Kubota & Levine 2016).

We hope to have shown in this section that we find one-to-many phenomena of various types in all modules of grammar and at their interfaces. It is common in formal linguistics to try to reduce these phenomena to one-to-one relations. The papers in this volume take a different approach, taking the one-to-many nature of the phenomena at face value.

2 Overview of the individual chapters

The chapters in this volume are grouped together according to the major linguistic sub-disciplines, starting with morphology, via the morphology-syntax interface towards syntax and semantics.

In the second chapter of the volume, **Beniamine** investigates the system of inflectional classes across a number of language, using a data-driven computational approach, which permits to assess the complexity of morphological systems without any bias from the analysing linguist.

Beniamine starts off with a comparison of different conceptualisations of inflection classes, going from simple, flat partitions, as characteristic of pedagogical grammars, via trees, as advocated in the theoretical literature, to lattices, i.e. multiple inheritance. In the discussion of tree-based approaches, he already notices deviations that would suggest a more general data structure.

The main theoretical question addressed in Beniamine's chapter is the extent to which inflection class systems can be regarded as trees or rather multiple inheritance hierarchies. Or, put in more linguistic terms, to what extent inflectional class systems are characterised by heteroclisis.

Beniamine's method takes as a starting point an ideally complete lexicon of morphological word forms, paired with the morphosyntactic features that are expressed. From these, he automatically extracts morphophonological alternation patterns that relate a lexeme's word form in one cell to that in another. These patterns then represent a lexeme's paradigm as the set of alternations. Full (or partial) identity of these alternations across lexemes provides the basis for an empirical notion of inflection class.

Using Concept Analysis, Beniamine automatically constructs more general superclasses corresponding to the sharing of patterns across lexemes. If a number of lexemes share all patterns, they form a microclass, which corresponds to a tree. More abstract classes are built from microclasses on the basis of partial identity.

Beniamine evaluates the complexity of the concept hierarchies of six different languages (Arabic, English, French, Russian, Portuguese, Chatino) using three metrics: (i) the number of concepts, (ii) the depth of the hierarchy, and (iii) the number of immediately dominating nodes for each concept, which is an indicator of multiple inheritance.

The results are highly interesting: in all six languages, the number of concepts clearly surpasses the number of microclasses, disconfirming the idea of a flat partitioning. The most spectacular finding, though, is that all systems witness an elevated degree of multiple inheritance, an average of almost two dominating nodes for English, and higher for all other languages. Beniamine concludes that

heteroclisis permeates the system and should be considered the norm rather than the exception. Thus, it seems that inflection class systems observe a many-to-many organisation that can be captured by multiple inheritance hierarchies, but neither partitions nor trees.

The contribution by **Crysmann** addresses a classical challenge in inflectional morphology, namely an extreme case of extended (or multiple) exponence in Batsbi (Tsova-Tush), called exuberant exponence (Harris 2009). In this language, the same set of class (=gender/number) markers can appear multiple times within a word, as shown in example (13).

(13) **y**-ox-**y**-∅-o-**y**-anǒ
CM-rip-CM-TR-PRS-CM-EVID1
'Evidently she ripped it.' (Harris 2009: 277)

What distinguishes exuberant exponence as found in Batsbi from more common cases of multiple exponence is not just a matter of quantity, or the fact that multiple marking is alliterative. These are important properties, yet the most central observation relates to its variable nature: because only certain stems take the marker, and only certain affixes (e.g. transitive/intransitive and evidential), we may find anything between zero and four identical exponents.

The formal analysis Crysmann proposes is carried out in the framework of Information-based Morphology (=IbM; Crysmann & Bonami 2016) and exploits the fact that this theory incorporates $m : n$ relations at the most basic level of organisation, namely realisational rules, extracting partial generalisations over rules by means of inheritance in typed feature structures. The analysis capitalises on the dependent nature of exuberant exponence in Batsbi and shows how IbM permits to improve over the holistic word-based baseline proposed in Harris (2009). There is an interesting twist as to how the one-to-many relation between the morphosyntactic property of class agreement and its zero to many exponents is captured in the formal analysis: because both the number and the position of markers depend on the presence of a particular stem or some other suffixal marker, multiple exponence is indirect, and so is the locus of the one-to-many relation: in essence, exponence rules for class markers compose with those for the stems and markers they depend on, forming many-to-many rules of exponence that introduce more than one marker corresponding to more than one function. Technically, this is done by systematic cross-classification of agreement marking rules for stems and exponents they depend on. This cross-classification in turn constitutes another instance of a one-to-many relation, namely at the level of the formalism (cf. the semi-lattices in Beniamine's chapter).

Thus, the availability of one-to-many relationships at the level of the underlying logic, as is the case with multiple inheritance hierarchies, appears to provide a solid foundation to approach one-to-many relations at the level of descriptions.

The chapter by **Bonami & Webelhuth** crosses the boundary between morphology and syntax by investigating periphrastic tenses in Czech. Periphrastic realisation describes the situation where syntactically independent words analytically fill cells in a paradigm for which there is typically no synthetic realisation. Periphrasis in itself already constitutes a one-to-many relationship, where more than one lexeme is involved in the inflectional realisation of a morphological word.

The particular phenomenon under investigation concerns the past and conditional, both of which are realised analytically by a participial form combined with the (clitic) copula in the present or past, respectively. While the copula is always overtly realised in predicative constructions, both in its present and past forms, and it is equally present in all cells of the periphrastic conditional, third person cells of the past paradigm are characterised by the significant absence of the ancillary element, an instance of what the authors call *zero periphrasis*, in analogy with the well-known phenomenon of zero exponence.

Bonami & Webelhuth argue that these particular non-periphrastic cells in otherwise periphrastic paradigms need to be accounted for in morphological terms, rather than in terms of a covert copula. Extending their previous theory of periphrasis (Bonami 2015; Bonami et al. 2016; Bonami & Webelhuth 2013), they propose that zero periphrasis should be captured at the morphology-syntax interface, treating third person past as exceptionally non-periphrastic cells. This mirrors quite neatly the case of non-default zero-exponence, as found in synthetic inflectional morphology.

Complex predicates provide one of the classical challenges for the view that the interface between syntax and the lexicon constitutes a straightforward one-to-one correspondence. In their chapter, **Faghiri & Samvelian** investigate the syntactic separability of complex predicates in Persian and explore to what extent complex predicate status correlates with linearisation properties. The authors report the results of two acceptability judgement studies that test word-order variation. In (14), the complex predicate *vāks zadan* 'to polish' (lit: polish hit) is used.[3] As can be seen, the nominal and the verbal part of the complex predicate are adjacent in (14a), but can be separated by a prepositional phrase, see (14b).

[3]See **Faghiri & Samvelian**'s contribution for an explanation of the abbreviations used in the glosses.

(14) a. ali be kafš-hā vāks zad
Ali to shoe-PL polish hit.PST.3SG
'Ali polished the shoes.'

b. ali behtarin vāks=rā be kafš-hā zad
Ali best polish=RA to shoe-PL polish hit.PST.3SG
'Ali polished the shoes with the best polish.'

The paper investigates the conditions under which such a separation is possible and contrasts this with the word order preferences of syntactic combinations that are not complex predicates. The studies show that complex predicates behave largely as one would expect given their syntactically complex form, not given their semantic or lexicographic unit-like nature. A certain preference for non-separate occurrence is, however, attested.

In the second chapter on syntax, **Pozniak**, **Abeillé & Hemforth** explore the use of inverted vs. non-inverted subjects with object relatives in French, as illustrated by the examples in (15). They start off by observing that inversion is standardly considered optional and possibly dispreferred and note that current competence and performance models alike make conflicting predictions regarding a preference for or against subject inversion in this context.

(15) a. Le médecin [que l'avocat connait] aime courir.
the physician that the lawyer knows likes run
'The physician [that the lawyer knows] likes running.'

b. Le médecin [que connait l'avocat] aime courir.
the physician that knows the lawyer likes run
'The physician [that the lawyer knows] likes running.'

The main aim of their contribution is to assess not only the relative acceptability of inversion with object relatives, but also what the specific use conditions for each of the two variants are that favour one realisation over the other. They report on three empirical studies they have conducted to shed light on this issue: a corpus study, an acceptability judgement task, and a self-paced reading experiment.

In the corpus study they annotated object relatives from the French Treebank with properties pertaining to the subject, the verb, and the relativised object, as well as global properties, such as length of the subject or the relative clause. The data were analysed using logistic regression. Among the significant factors favouring inversion they found two subject-related properties, namely intentionality and length. These were tested in two subsequent experiments: while the

acceptability judgement task confirmed the basic corpus findings regarding the equal acceptability of inverted and non-inverted subjects in this construction, the self-paced reading experiments revealed improved performance with combined factors (length and intentionality), from which the authors conclude that a proper understanding needs to acknowledge both distance-oriented processing constraints and semantic factors, which can be seen as an instance of one-to-many relations at the level of performance.

The final two chapters of this volume explore one-to-many aspects of semantics. **Sailer & Richter** look at the syntax-semantics interface and **Bargmann, Gehrke & Richter** study the simultaneous availability of different levels of interpretation.

Sailer & Richter combine two constellations that give rise to one-to-many correspondences: negative concord (NC) and coordination. In NC languages, two negative indefinites may co-occur in the same clause while a single negation is expressed semantically. Thus, we observe a one-to-many correspondence in the sense of a double marking of negation in syntax and a single negation in the interpretation. In coordination, we can find the opposite situation: what appears to be a constituent negation in syntax can, and sometimes must, be interpreted as a coordination of two clauses, i.e., the part of the sentence outside the coordinated constituent occurs only once, but is interpreted several times, once for each conjunct.

Sailer & Richter study cases in which two negative indefinite noun phrases are coordinated in a non-NC language, Standard German, as in example (16).

(16) Alex hat keine Milch und keinen Zucker verrührt.
Alex has no milk and no sugar stirred
Bi-propositional reading: 'Alex didn't stir milk and Alex didn't stir sugar.'
Mono-propositional readings: 'Alex didn't stir milk and sugar together.'

They show that there are, in principle, two readings of such sentences: a bi-propositional reading and a mono-propositional reading, i.e., the sentence can be logically characterised by a conjunction of two negated sentences or by a single negated sentence that contains the union of the two conjuncts in the scope of negation. In the mono-propositional reading, we find the first type of one-to-many correspondence, in the bi-propositional reading, we find the second type.

In the last chapter of this volume, **Bargmann, Gehrke & Richter** consider a case of a one-to-many correspondence that relates a single syntactic form to various

levels of interpretation at the same time. They discuss data with idioms expressing the idea of dying in English and German in which the idiom occurs with a modifier that seems to be interpreted literally rather than idiomatically. One of their examples is (17). Here, the idiom *kick the bucket* 'die' is used, but the noun phrase *the bucket* contains a modifier, *golden*, which is incompatible with the idiomatic meaning of the expression.

(17) Venezuela's Friend of the Working Class, Hugo Chávez, kicked the golden bucket with an estimated net worth of 2 billion dollars.

The authors argue that the sentence receives two types of interpretation simultaneously: an idiomatic interpretation (*Hugo Chávez died*) and a literal interpretation of part of the idiom (*Hugo Chávez had a golden bucket*). To make the two parts of interpretation fit together, the literal interpretation of the idiom part gives rise to an inference Hugo Chávez was rich. Taken together, sentence (17) expresses the idea that Hugo Chávez died and was very rich. **Bargmann et al.** provide a detailed discussion of naturally occurring examples of this type of intricate uses of idioms, in which an expression is used in its idiomatic meaning and, at the same time, part of the idiom is interpreted literally, like *the bucket* in (17).

It is the central aim of this book to make a strong case for accepting one-to-many correspondences as an essential property of the interfaces of natural language grammar. The individual chapters provide detailed studies of exemplary phenomena to see whether the analytic tools developed for handling them in one module of grammar are transferable to other modules, and to work on an integrated approach within a constraint-based grammar framework.

Abbreviations

Examples in this chapter follow the Leipzig glossing rules. We use the following additional abbreviations, in order of appearance: NE (French negative particle *ne*), CM (class marker), EVID1 (evidential 1), and RA (Persian particle *ra*).

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Chapter 2

One lexeme, many classes: inflection class systems as lattices

Sacha Beniamine
Department of Linguistic and Cultural Evolution, Max Planck Institute EVA

This paper discusses the nature of inflection classes (ICs) and provides a fully implemented methodology to conduct typological investigations into their structure.

ICs (conjugations or declensions) are sets of lexemes which inflect similarly. They are often described as partitioning the set of lexemes, but similarities across classes lead some authors to favor hierarchical descriptions. While some formalisms allow for multiple inheritance, where one class takes after two or more others, it is usually taken as an exceptional situation.

I submit that the structure of ICs is a typological property of inflectional systems. As a result, ICs are best modelled as semi-lattices, which by design capture non-canonical phenomena. I show how these monotonous multiple inheritance hierarchies can be inferred automatically from raw paradigms using alternation patterns and Formal concept analysis. Using quantitative measures of canonicity, I compare six inflectional systems and show that multiple inheritance is in fact pervasive across inflectional systems.

1 Introduction

In some inflectional systems, the same morphosyntactic properties can be expressed differently across lexemes. Descriptions of the resulting inflection classes (declensions or conjugations) can take several forms. The simplest possibility is to use a partition of the set of lexemes into classes, as in Figure 2.1a. Possible partitions will differ in their granularities. Pedagogical grammars are often content with giving a broad classification in major classes. At the other end of the

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spectrum, various studies (e.g. Stump & Finkel 2013) presuppose a classification into numerous fine-grained classes.

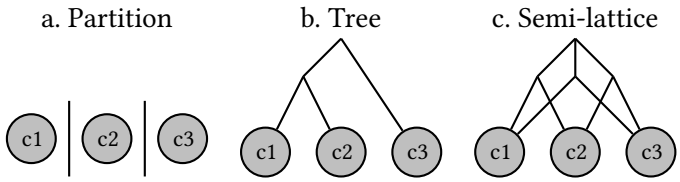


Figure 2.1: Three types of classification structures

Broad and fine-grained classifications can be linked by assuming a hierarchically-organized system of classes (Corbett & Fraser 1993; Dressler & Thornton 1996). In recent years, various efforts have been made towards inferring inflection class hierarchies automatically from paradigms (Brown & Hippisley 2012; Lee & Goldsmith 2013; Bonami 2014). While they use very different methodologies, most of these approaches converge on the use of tree-shaped hierarchies (Figure 2.1b.). Network Morphology (Corbett & Fraser 1993; Brown & Hippisley 2012) uses richer structure through default inheritance and multiple inheritance of orthogonal properties, but does not allow for multiple inheritance in a single dimension (e.g. affixes).

In this paper, I argue that while "inflection classes" (IC) usually refers to either partitions (Figure 2.1a.) or trees (Figure 2.1b.), these make simplifications which overlook numerous relations between lexemes and hide structural properties that are in fact pervasive.[1] I show that semi-lattices (Figure 2.1c.), where one subclass may belong to more than one superclass, are more faithful models of inflectional systems. I use Formal concept analysis (Ganter & Wille 1998: hereafter FCA) to automatically infer semi-lattices of inflection classes for the verbal systems of French, English, Modern Standard Arabic, European Portuguese and Zenzontepec Chatino; as well as for the nominal system of Russian.[2]

[1]I use the following abbreviations for paradigm cells throughout this paper. For Russian declensions, six cases are distinguished: nominative (NOM), accusative (ACC), genitive (GEN), dative (DAT), instrumental (INS), locative (LOC). Cases combine with number values: singular (SG) and plural (PL). Zenzontepec Chatino verbs inflect for four aspect-mood values: completive (COMP), progressive (PROG), potential (POT), habitual aspect (HAB). For English verbs, I discuss forms for the past (PST), past participe (PST.PART) and present (PRS). I abbreviate "inflection class" as IC and Formal concept analysis as FCA.

[2]The methodology described in this paper is fully implemented as part of the Qumín toolkit (Beniamine 2018) which can be accessed at: https://github.com/XachaB/Qumin. Qumín is distributed under GPLv.3.

I compare these systems using canonical typology. To do so, I provide formal definitions of inflectional structure and precise quantitative measures of inflectional canonicity, which can be computed automatically from a large inflected lexicon.

Inflection classes are usually taken as classes of lexemes or stems related by common affixes (Carstairs 1987; Carstairs-McCarthy 1991; Stump & Finkel 2013). However, alternations between stems also contribute to the expression of inflectional information. Segmentation in stems and affixes is useful to produce systems in constructive approaches (in the sense of Blevins 2006), where the goal is to generate the forms from a minimal grammar. Instead, I adopt here the abstractive approach (Blevins 2006) and attempt to account for all interesting generalizations. As a consequence, I take INFLECTIONAL BEHAVIOR to be relations between word-forms, or ALTERNATION PATTERNS, rather than affixes (Bonami & Luís 2014; Bonami & Beniamine 2016).

In the first section, I present partition- and tree-based accounts of ICs. Next, I motivate the need for multiple inheritance hierarchies and show that simpler models make problematic predictions. In Section 3, I present FCA, which can be used to infer a semi-lattice of classes. The last section discusses the properties of the IC lattices.

2 The structure of inflection class systems

IC systems are often described as a partition of a few broad classes of lexemes which share some of their inflectional behavior. Partitions of ICs are used both in pedagogical grammars and in many descriptive accounts. They usually count only a few classes. They are, as Matthews (1991: 129) puts it, "classes of lexemes that go together in respect of some inflection". This definition relies on the inflectional similarity between lexemes.

Corbett (1982) counts six nominal ICs (declensions) in Russian, which Table 2.1 illustrates by showing the full paradigm of one exemplar lexeme per class. I indicate frequencies based on counts in a lexicon of 1,239 nouns (Beniamine & Brown 2019) described in more detail in the appendix and in Beniamine 2018.

While it is usually thought that there is only one correct inventory of ICs in a given system, the number of classes is in fact often disputed, even in very well-documented languages. Corbett (1982: 202) highlights such disagreements in the case of Russian nouns: "The reader not familiar with the literature will quite reasonably expect a straightforward account of the paradigms in Russian. Tradition answers three, some writers claim four, and more recently it has been

Table 2.1: Six broad inflection classes of Russian in Roman transliteration, according to Corbett (1982: 203)

lexeme	ZAKON	VINO	ŠKOLA	KOST'	PUT'	VREMJA
gloss	'law'	'wine'	'school'	'bone'	'way'	'time'
frequency	874	96	428	112	1	6
NOM.SG	*zakon*	*vino*	*škola*	*kost'*	*put'*	*vremja*
ACC.SG	*zakon*	*vino*	*školu*	*kost'*	*put'*	*vremja*
GEN.SG	*zakona*	*vina*	*školy*	*kosti*	*puti*	*vremeni*
DAT.SG	*zakonu*	*vinu*	*škole*	*kosti*	*puti*	*vremeni*
INS.SG	*zakonom*	*vinom*	*školoj*	*kost'ju*	*putem*	*vremenem*
LOC.SG	*zakone*	*vine*	*škole*	*kosti*	*puti*	*vremeni*
NOM.PL	*zakony*	*vina*	*školy*	*kosti*	*puti*	*vremena*
ACC.PL	*zakony*	*vina*	*školy*	*kosti*	*puti*	*vremena*
GEN.PL	*zakonov*	*vin*	*škol*	*kostej*	*putej*	*vremen*
DAT.PL	*zakonam*	*vinam*	*školam*	*kostjam*	*putjam*	*vremenam*
INS.PL	*zakonami*	*vinami*	*školami*	*kostjami*	*putjami*	*vremenami*
LOC.PL	*zakonax*	*vinax*	*školax*	*kostjax*	*putjax*	*vremenax*

suggested that only two paradigms are required". The situation of Russian nouns is far from exceptional. One reason is that constructive and pedagogical analyses both usually strive for the shortest possible description. This leads to the merging of classes wherever possible, for example where distinct surface realizations can be abstracted away as allomorphy or predicted using semantic or grammatical properties of the lexemes. For example, Corbett shows that most descriptions of the ICs of Russian nouns merge together the classes ZAKON and VINO. The classes KOST' and PUT' are also usually merged, sometimes with the class VREMJA. In a similar fashion, Plénat (1987) provides a two-class analysis of the French verbal inflectional system, which is usually described as having three conjugations. To do so, he merges the second and third conjugation using abstract phonological representations. Blevins (2004) reports that the nominal system of Estonian has been described as having between 26 and 400 "paradigms", which can be merged in 6 to 12 ICs.

Going back to the data presented in Table 2.1, two shades of gray indicate some similarities across classes in each cell. All the classes share realizations for the dative, instrumental and locative plural. The class ZAKON shares the same endings as the class VINO for the genitive, instrumental and locative singular. The

locative singular is also identical to that of ŠKOLA. ZAKON and ŠKOLA also share the same endings in the nominative and accusative plural, while VINO and ŠKOLA both present no affixes in the genitive plural. The nominative and accusative singular of ZAKON, like those of KOST' and PUT', show no affixes on the stem, etc. To these similarities in terms of endings or affixes, one could add similarities in terms of alternations, such as syncretisms: for example, the classes ZAKON, VINO, KOST', PUT' and VREMJA (but not ŠKOLA) all present a syncretism between nominative and accusative singular. All these lexemes share a syncretism between the nominative and accusative plural.

A look at the Russian lexicon described in the appendix shows that the behavior of lexemes inside each class is less homogeneous than suggested by the table of exemplars. While all the exemplars shown above are inanimate and present the accusative-nominative syncretism, I found several lexemes with an accusative-genitive syncretism (typical of animates): 163 in the class ZAKON, 8 in the class VINO, 47 in the class ŠKOLA and 6 in the class KOST' (see Corbett & Fraser 1993: 129). Moreover, 76 lexemes of the class ZAKON, 3 of the class VINO and 6 of the class ŠKOLA have genitives in *-ej* rather than *-ov* or the bare stem.

Since similarity is gradient, it is difficult to determine how similar lexemes need to be to belong to the same class. Recent works in computational linguistics have attempted to decide on the best partition using minimal description length, either by comparing hand-written analysis (Walther & Sagot 2011) or by generating the analysis automatically from the data (Beniamine et al. 2017). But even when selected very rigorously, the resulting partitions are simplifications. They can be useful as pedagogical tools, or as compact constructive descriptions, but they do not account for all similarities between classes, nor for the internal variation in each class.

At the other end of the descriptive spectrum, various studies take ICs as very fine-grained partitions, where each distinction in inflectional behavior warrants a separate class. IC membership is then defined in terms of identity. Aronoff (1994: 64) defines an IC as "a set of lexemes whose members each select the same set of inflectional realizations". Carstairs-McCarthy (1994: 739) provides two definitions of a paradigm:

> (1) PARADIGM$_1$: the set of combinations of morphosyntactic properties or features (or the set of "cells") realized by inflected forms of words (or lexemes) in a given word-class (or major category or lexeme-class) in a given language.
> (2) PARADIGM$_2$: the set of inflectional realizations expressing a paradigm$_1$

for a given word (or lexeme) in a given language.

Based on these definitions, he offers a very similar definition of ICs: "a set of words (lexemes) displaying the same paradigm$_2$ in a given language". Applied to realistic datasets, these definitions yield a high number of classes, many of which are often very small. Stump & Finkel (2013) report 72 ICs for French verbs, while Bonami (2014), Beniamine et al. (2017) and Beniamine (2018) find up to 97 classes.[3] For Russian nouns, Beniamine (2018) identifies 159 ICs based on identity of surface segmental inflectional behavior (not counting stress patterns). While, by definition, these classes do not show any internal heterogeneity, enumerating them does not account for any similarities across classes.

Descriptive grammars often make use of explicit or implicit tree-shaped hierarchies when they provide several granularity levels. For example, the French pedagogical grammar Bescherelle (Arrivé 2012) describes three ICs, each exemplified by numerous verbal exemplars (one per page) and finer variations in footnotes. These can be interpreted as a three-level hierarchy. Campbell (2011) describes the ICs in Zenzontepec Chatino, an Oto-Manguean language spoken in Oaxaca, by a three-level hierarchy presented in Figure 2.2. Zenzontepec Chatino expresses inflection through prefixes and has only four paradigm cells: potential, habitual, progressive and completive. Figure 2.2 shows common prefixes for each node of the hierarchy. The notation "[lam]" marks the laminalization of initial [t] in class Bt. Campbell (2011) shows identical underlying prefixes for classes Au and Ac, but they differ on the surface. Class Bc presents a stem-initial alternation between *y-* and *ch-*. Since class C2 presents several distinct affixes, it could be further divided in two distinct classes. The first level of Campbell's (2011) classification is not based on similarity alone, but inherits from Kaufman's (1989) description of Zapotec ICs.

Dressler & Thornton (1996), Kilani-Schoch & Dressler (2005) and Dressler et al. (2008) use the term "macroclass" for the broad ICs based on similarity and "microclass" for the fine-grained ICs based on identity of inflectional behavior. They link both in tree-shaped hierarchies, in which any node can be seen as an IC. Microclasses form the leaves of the hierarchy, while macroclasses form the first level below the root. Any number of intermediate classes is possible. In Kilani-Schoch & Dressler's (2005) approach to French, the macroclasses are not based on similarity alone, but instead they constitute a bipartition between productive

[3] While they all base their computations on the Flexique lexicon (Bonami et al. 2014), differences across accounts are due both to different methodologies and to corrections that have been made in the lexicon since its publication.

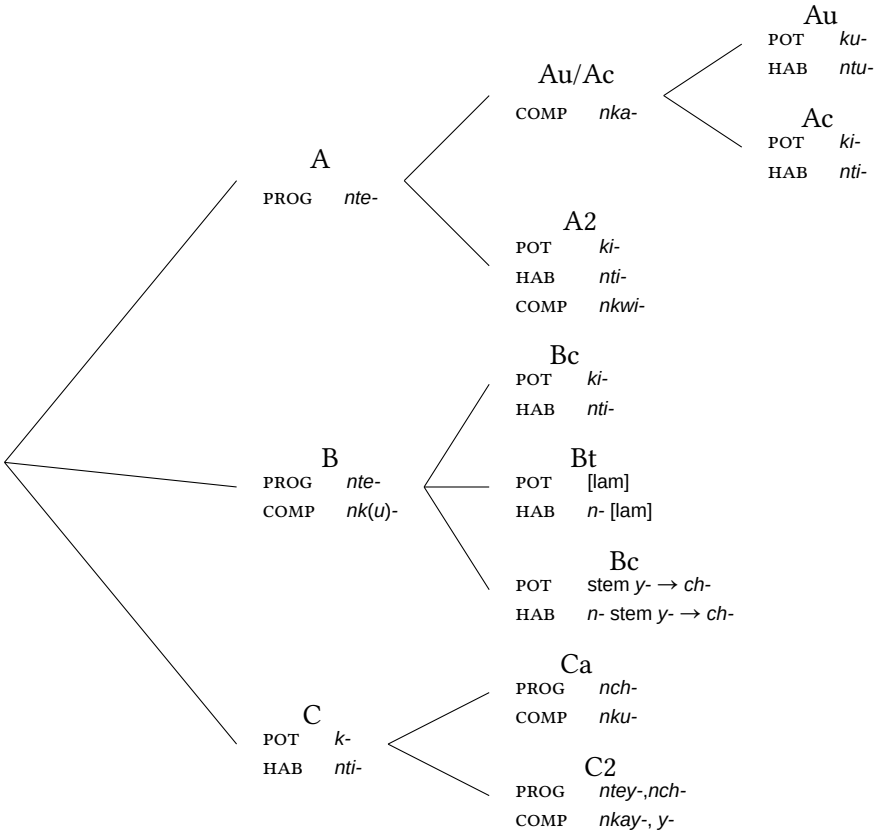


Figure 2.2: Inflection class tree in Zenzontepec Chatino verbs according to Campbell (2011: 229)

and unproductive patterns. Each IC is motivated by common inflectional patterns, written as implicative statements which the authors call "paradigm structure conditions". These conditions are inherited by default.

In Network Morphology (Corbett & Fraser 1993; Brown & Hippisley 2012), ICs are also represented by a tree-shaped default inheritance hierarchy. The analyses are constructive: couched in the DATR formalism, each node specifies affixal rules. The grammar is designed to generate surface forms. Default inheritance has two main advantages. First, it allows for more compact representations by limiting repetitions and the overall number of nodes in the hierarchy. Second, it gives the notion of regularity a natural status: a node which rewrites a default is exceptional relative to the ancestor which stipulated the default rule.

Going back to Russian nouns, Brown (1998) count four main ICs which correspond to the first four declensions described by Corbett (1982): ZAKON (I), ŠKOLA (II), KOST' (III) and VINO (IV). Brown (1998) argues in favor of the hierarchical structure summarized in Figure 2.3. In the inflectional tree, the leaves N_I to N_-IV stand for each of the four ICs. The root is the node MOR_NOMINAL, which also spans adjectives (which I will ignore for the purpose of this paper). It defines common properties between nouns and adjectives, as well as two default values: a zero affix in the nominative singular and an *-i* ending in the nominative plural. The term EVALUATION denotes the usage of a realization function which takes as input morphological properties of a lexeme and can assign distinct values to lexemes belonging to the same class. The node MOR_NOM specifies a thematic vowel characteristic of all nouns, a default affixal value for the locative singular and a default syncretism between dative and locative singular. There is only one intermediate node, N_O. It manifests properties shared between classes I and IV.

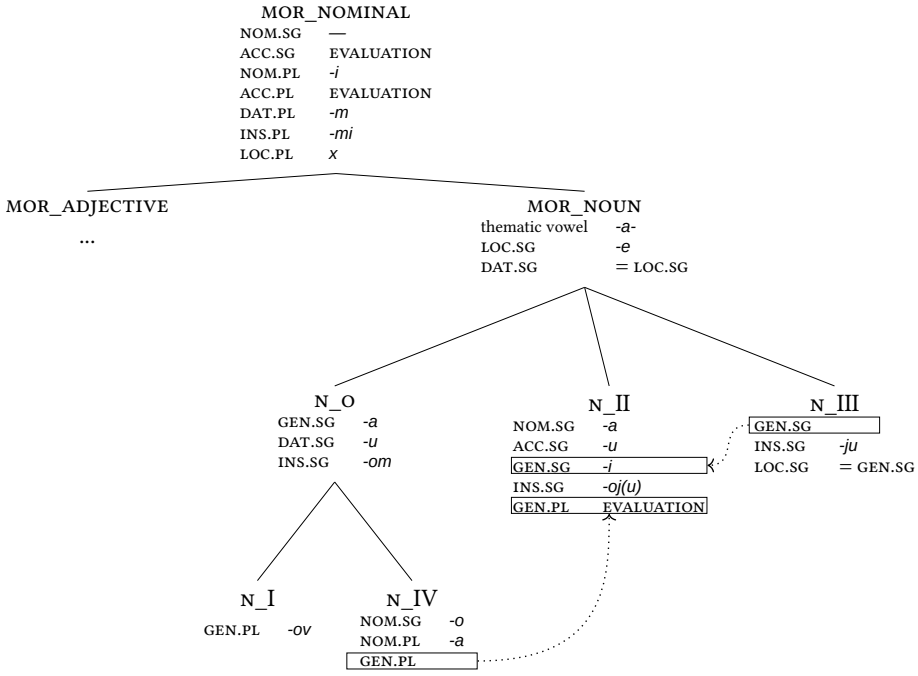


Figure 2.3: DATR hierarchy for Russian nouns according to Brown (1998: Theory B, 128 et seq.)

In Brown's (1998) account, some commonalities between classes are not modeled through the tree structure itself but by direct references across classes for

specific cells. These references are indicated in Figure 2.3 by dotted arcs between framed cells. For example, the genitive plural of class IV is formed by using the evaluation functions of the genitive plural in class II. The need for this second mechanism highlights the inadequacy of a tree structure to express all similarities between ICs. In addition, while default inheritance is useful for producing a compact hierarchy, it hides the exact span of the default rules. In the following section, I show how a richer hierarchy can account more naturally for IC structure in an abstractive approach.

3 Noncanonical systems as inflection class lattices

In the previous section, I showed that partitions and tree structures have been used to describe inflectional systems even when their similarity structure is more complex than these descriptive devices can account for. It is, however, conceivable that some inflectional systems do conform to the structure of either a partition or a tree.

Corbett (2009) chooses this particular ideal structure as a canonical point of comparison for typological investigation. He defines canonical IC systems as following the principle of distinctiveness (Corbett 2009: 3), which can be evaluated using four criteria:

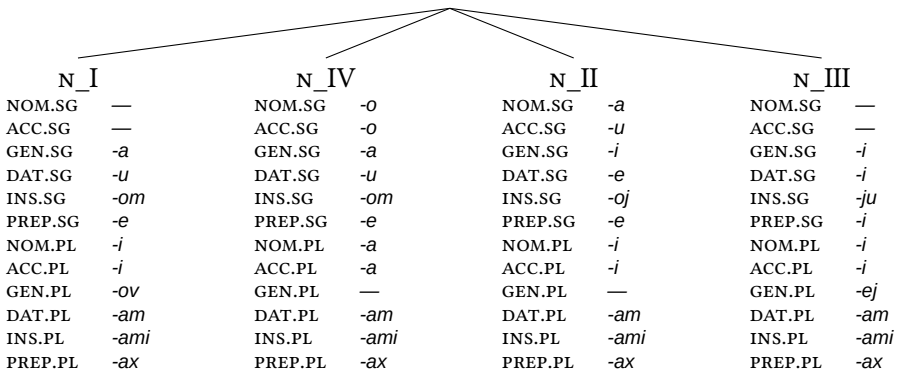
> PRINCIPLE I (distinctiveness): Canonical inflection classes are fully comparable and are distinguished as clearly as is possible. [...]
>
> *criterion 1* In the canonical situation, forms differ as consistently as possible across inflectional classes, cell by cell.
>
> *criterion 2* Canonical inflectional classes realize the same morphosyntactic or morphosemantic distinctions (they are of the same structure).
>
> *criterion 3* Within a canonical inflectional class each member behaves identically.
>
> *criterion 4* Within a canonical inflectional class each paradigm cell is of equal status.

From these criteria, it follows that in a canonical system, there are no similarities between classes. If two classes were to have a common exponent or alternation pattern, they would violate criterion 1. Moreover, the cells affected by common patterns would then be less predictive of the ICs than other cells, which violates criterion 4. According to criterion 2, a canonical system of ICs can have

only one form per paradigm cell and lexeme. Defective lexemes, which lack forms for certain cells and overabundant lexemes, which have more than one possible form for certain cells, violate criterion 2. Finally, criterion 3 means that all classes are microclasses: they are based on identity. In a canonical system, micro- and macroclasses coincide. The system then truly has the shape of a partition (or a one-level tree, with classes as leaves and the whole system as root).

If real systems mostly conformed to the canonical ideal – which is not usually expected – then it would be adequate to model them using partitions. If, however, noncanonicity is the norm, then more expressive models are required. Since partitions and trees make the assumption of a certain degree of canonicity, these models are not suited to evaluating a system's position in the canonical space.

Figure 2.4 shows the same four ICs of Russian nouns as in Figure 2.3, now arranged as a partition, with each class characterized by affixes. While the shape of this classification is that of a partition, it is obvious from the numerous repetitions that it is not the structure of the data. The use of a partition masks the system's noncanonicity.



N_I		N_IV		N_II		N_III	
NOM.SG	—	NOM.SG	*-o*	NOM.SG	*-a*	NOM.SG	—
ACC.SG	—	ACC.SG	*-o*	ACC.SG	*-u*	ACC.SG	—
GEN.SG	*-a*	GEN.SG	*-a*	GEN.SG	*-i*	GEN.SG	*-i*
DAT.SG	*-u*	DAT.SG	*-u*	DAT.SG	*-e*	DAT.SG	*-i*
INS.SG	*-om*	INS.SG	*-om*	INS.SG	*-oj*	INS.SG	*-ju*
PREP.SG	*-e*	PREP.SG	*-e*	PREP.SG	*-e*	PREP.SG	*-i*
NOM.PL	*-i*	NOM.PL	*-a*	NOM.PL	*-i*	NOM.PL	*-i*
ACC.PL	*-i*	ACC.PL	*-a*	ACC.PL	*-i*	ACC.PL	*-i*
GEN.PL	*-ov*	GEN.PL	—	GEN.PL	—	GEN.PL	*-ej*
DAT.PL	*-am*	DAT.PL	*-am*	DAT.PL	*-am*	DAT.PL	*-am*
INS.PL	*-ami*	INS.PL	*-ami*	INS.PL	*-ami*	INS.PL	*-ami*
PREP.PL	*-ax*	PREP.PL	*-ax*	PREP.PL	*-ax*	PREP.PL	*-ax*

Figure 2.4: Partition of four Russian inflection classes

The tree structure in Figure 2.3 assumes an intermediate level of canonicity and is also insufficient to express all the similarities between these ICs. The analysis in Figure 2.5 accounts for each point of similarity between the four classes in Figure 2.4. This analysis does not allow any other inheritance mechanism than the hierarchy itself: as a consequence, it does not contain defaults, rules of referral, or evaluation functions.[4]

[4]For this small example, in the interest of legibility, I take classes I to IV to be microclasses,

In contrast to a tree, the hierarchy in Figure 2.5 displays multiple inheritance. For example, class I has two parents. From one parent, it inherits the absence of affix in the nominative and accusative singular, and from the other parent, it inherits values for its genitive, dative and instrumental singular affixes. This structure is a lattice. Lattices have been used to model linguistic structures, for example in the type hierarchy of HPSG (Flickinger 1987; Pollard & Sag 1994; Ginzburg & Sag 2000) or in phonological feature hierarchies (Chomsky & Halle 1968; Frisch 1997). Since ICs can be seen as "classes of lexemes that share similar morphological contrasts" (Brown & Hippisley 2012: 4), I call any node of this hierarchy an inflection class, not only its leaves. In consequence, one lexeme can belong to many inflection classes.

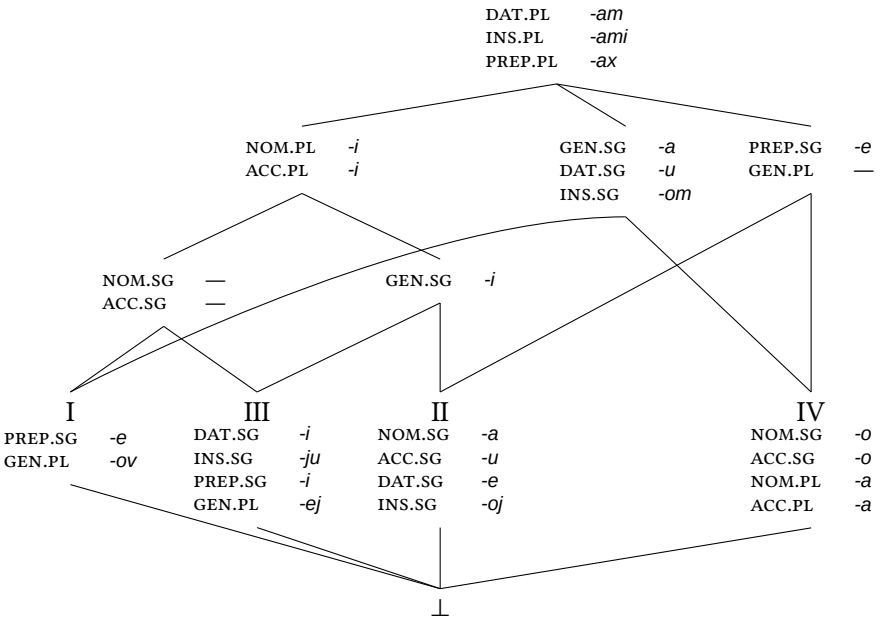


Figure 2.5: Lattice of four Russian inflection classes

In the hierarchy in Figure 2.5, each intermediate node represents a similarity point between lower nodes. All the similarities are represented.

In this hierarchy, classes are ordered by increasing generality. Higher nodes hold more general information than lower nodes: their value is less specified and

and I exclude some lexemes which Brown (1998) accounts for using evaluation functions. The hierarchy can, however, be extended to account for all microclasses of a system. For the same reason, I ignore adjectives in this example.

they encompass more classes. Information specified on the leaves, labeled here with Roman numerals, is entirely distinctive: it is specific to each microclass.

All the information relating to a class can be read by going through each of its ancestors. The common information shared by any two classes can be found by searching for their least upper bound, also called JOIN. If any values are common to all ICs, they are specified at the highest node, which is called the SUPREMUM.

Symmetrically, one can find the common subclass of two nodes by searching their greatest lower bound, also called MEET. There is only one such child. For example, the node {NOM.PL *-i*, ACC.PL *-i*} and the node {PREP.SG *-e*, GEN.PL -} have the class II for greatest lower bound. The lowest node in the hierarchy, or INFIMUM, noted $\bot$, is the MEET between any pair of the leaves, because no lexeme can belong to more than one of these microclasses. Since the infimum is always present and never brings any relevant information, I will sometimes omit it.

This hierarchy displays precisely what distinguishes this system from the canonical situation. While canonical ICs have only microclasses and a supremum (root) as is the case in Figure 2.4, the structure in Figure 2.5 has five more intermediate classes. A hierarchy of canonical ICs has a depth of 1, but the lattice from Figure 2.5 has a depth of 3 (the longest path from the root to a microclass follows three edges). Finally, while the canonical situation shows only simple inheritance, classes in this hierarchy have on average 1.4 direct parents.

This section showed that a partition model makes the prediction that the classes are canonical, which isn't the case of the partial systems previously discussed. A tree structure allows some sharing across microclasses, but still makes a prediction on their canonicity. It assumes that while classes can share some properties, there is no heteroclite sharing. HETEROCLISIS is usually taken to occur when the paradigm of a small IC is split in such a way that it follows two or more separate distinct ICs (Corbett 2009). The term can be extended in order to describe any class which displays multiple inheritance. Modeling IC systems as lattices will allow us to observe the amount of heteroclite sharing and quantify IC canonicity.

4 Inferring inflection class lattices with Formal concept analysis

To automatically produce an inflectional lattice, I use Formal concept analysis (Ganter & Wille 1998). This mathematical formalism allows us to study all interesting relationships between sets of objects (in this case lexemes, or microclasses) and their properties by ordering them in a CONCEPTUAL HIERARCHY. This section

describes the basics of FCA, illustrated on a few sub-paradigms of English verbs shown in Table 2.2.

Table 2.2: Some sub-paradigms of English verbs

lexeme	PST	PST.PART	PRS
DRIVE	/drəˑʊv/	/drɪvn̩/	/draˑɪv/
RIDE	/rəʊd/	/rɪdn̩/	/raˑɪd/
BITE	/bɪt/	/bɪtn̩/	/baˑɪt/
FORGET	/fəgɒt/	/fəgɒtn̩/	/fəgɛt/

In the previous sections, I took inflectional attributes to be affixes. However, using affixes to automatically assess similarity of inflectional behavior is problematic (Beniamine 2018): first, they do not account for all similarities between paradigms (Beniamine et al. 2017), second, ignoring stem alternations excludes a large number of relevant inflectional properties (Bonami & Beniamine 2016). Last but not least, there is no consensual method for segmenting wordforms into affixes (Spencer 2012). For these reasons, I prefer to rely on alternation patterns (Bonami & Luís 2014; Bonami & Beniamine 2016). Using the Qumín software (Beniamine 2018; 2017), they can be automatically inferred from raw forms in a language-agnostic way. Qumín takes as its input a fully inflected lexicon structured as a paradigm table (as in Table 2.2). Forms are transcribed in phonemic notation, and the lexicon is accompanied by a decomposition of each phoneme into minimal features (see the appendix). Both the structure of the paradigm table and the transcription constitute idealizations.

Table 2.3 shows the alternation patterns deduced from pairwise alternations from Table 2.2. For example, the alternation between /fəgɛt/ (PRS) and /fəgɒt/ (PST) follows the bidirectional alternation pattern _ɛ_ ⇌_ɒ_, where "_" indicates the presence of constant material in the form.[5] The empty string is written ϵ .

Table 2.3 defines a relationship between lexemes and alternation patterns. It can be written as an incidence matrix, that is, a cross table where objects are indicated in rows and attributes in columns. A cross in a cell indicates that the object in this row instantiates the property in this column. Such a table is called a FORMAL CONTEXT. Table 2.4 shows the context for the subparadigms of English verbs

[5] I report here a simplified view of alternation patterns, specifying only the alternating material as well as its position in the word. Qumín (Beniamine 2017; 2018) also extracts a detailed set of phonotactic constraints on the context of the changes. I omit it here in all examples for simplicity.

Table 2.3: Alternation patterns for the subparadigms from Table 2.2

lexeme	PST.PART ⇌PRS	PST.PART ⇌PST	PRS ⇌PST
RIDE	_ɪ_n̩ ⇌_aˑɪ_	_ɪ_n̩ ⇌_əˑʊ_	_aˑɪ_ ⇌_əˑʊ_
DRIVE	_ɪ_n̩ ⇌_aˑɪ_	_ɪ_n̩ ⇌_əˑʊ_	_aˑɪ_ ⇌_əˑʊ_
BITE	_ɪ_n̩ ⇌_aˑɪ_	_n̩ ⇌_ϵ	_aˑɪ_ ⇌_ɪ_
FORGET	_ɒ_n̩ ⇌_ɛ_ϵ	_n̩ ⇌_ϵ	_ɛ_ ⇌_ɒ_

from Table 2.2. I take objects to be lexemes and attributes to be combinations of a pair of cell and an alternation pattern.

Table 2.4: Formal context for Table 2.3.

	PST.PART⇌PRS		PST ⇌ PRS			PST.PART ⇌ PST	
	_ɪ_n̩ ⇌_aˑɪ_	_ɒ_n̩ ⇌_ɛ_ϵ	_aˑɪ_ ⇌_əˑʊ_	_aˑɪ_ ⇌_ɪ_	_ɛ_ ⇌_ɒ_	_ɪ_n̩ ⇌_əˑʊ_	_n̩ ⇌_ϵ
DRIVE	×		×			×	
RIDE	×		×			×	
BITE	×			×			×
FORGET		×			×		×

A FORMAL CONTEXT is a triplet $\langle X, Y, I\rangle$, where X and Y are non-empty sets and I is a binary incidence relation between X (objects, in row) and Y (attributes, in column): $I \subseteq X \times Y$. For all objects $x \in X$ and all attributes $y \in Y$:

- $\langle x, y\rangle \in I$ indicates that the object x has the attribute y,
- $\langle x, y\rangle \notin I$ indicates that x does not have y.

In the context table $\langle X, Y, I\rangle$, there is a cross at coordinates i, j if and only if $\langle x_i, y_i\rangle \in I$. Ganter & Wille (1998) write $\langle x, y\rangle \in I$ as xIy.

For any subset of objects $A \subset X$, we are interested in the attributes they have in common. For any subset of attributes $B \subset Y$, we are interested in the objects

which instantiate them. Let us define two operators, "↑" and "↓" (Bělohlávek 2009: 6-7), such that:[6]

- The operator ↑ maps objects (subsets of X) to attributes (subsets of Y). $A\uparrow$ is defined as the subset of all attributes shared by the objects in A:

$$\uparrow: 2^X \rightarrow 2^Y \text{ and } A\uparrow = \{y \in Y | \text{ for each } x \in A : xIy\}$$

- The operator ↓ maps attributes (subsets of Y) to objects (subsets of X). $B\downarrow$ is defined as the subset of all objects which share all attributes in B:

$$\downarrow: 2^Y \rightarrow 2^X \text{ and } B\downarrow = \{x \in X | \text{ for each } y \in B : xIy\}$$

If the objects in A have no common attribute, then $A\uparrow = \emptyset$. Similarly, if no object shares all the attributes from B, then $B\downarrow = \emptyset$. Consequently, $\emptyset\uparrow = Y$ and $\emptyset\downarrow = X$.

For example, the following equalities can be deduced from Table 2.4:[7]

(1) {RIDE, DRIVE}↑ = {_ɪ_n̩ ⇌ _aˑɪ_ , _aˑɪ_ ⇌ _əˑʊ_, _ɪ_n̩ ⇌ _əˑʊ_}

(2) {_ɪ_n̩ ⇌ _aˑɪ_, _aˑɪ_ ⇌ _əˑʊ_, _ɪ_n̩ ⇌ _əˑʊ_}↓ = {DRIVE, RIDE}

(3) {_ɪ_n̩ ⇌ _aˑɪ_}↓ = {DRIVE, RIDE}

(4) {_aˑɪ_ ⇌ _ɪ_, ɛ ⇌ ɒ}↓ = ∅

These equalities can be read directly in Table 2.4. The lexemes DRIVE and RIDE share all of their attributes (1). The three patterns they share are only shared by them (2). The pattern _ɪ_n̩ ⇌ _aˑɪ_ is also shared by only DRIVE and RIDE (3). Finally, the operator ↓, applied to the concurrent contradictory pattern for PST ⇌ PRS, produces the empty set (4) unless there are overabundant lexemes instantiating these patterns.

Using these operators, we can define a FORMAL CONCEPT. A formal concept in the context $\langle X, Y, I\rangle$ is a pair $\langle A, B\rangle$ of a set of objects $A \subseteq X$ called the EXTENSION of the concept and a set of attributes $B \subseteq Y$ called the INTENSION of the concept,

[6] This notation is that of Bělohlávek (2009). Ganter & Wille (1998) represents both operators by $'$, writing the sets $A\uparrow$ and $B\downarrow$ as A' and B', respectively. I prefer Bělohlávek's (2009) more explicit convention.

[7] In all examples below and in Figures 2.6 and 2.7, morphosyntactic attributes for the alternation patterns are not repeated. This is a shortcut, as our attributes are actually combinations of a pair of cells and an alternation pattern. In our small example, where only seven patterns are considered, this omission does not lead to ambiguity. However, due to syncretism, this would not be the case for most real systems.

such that $A \uparrow = B$ and $B \downarrow = A$. In other words, the objects from A have in common exactly the attributes from B, no more, no less. Reciprocally, the attributes from B are common to all objects in A, no more, no less.

For example, $\langle$ {DRIVE,RIDE}, {_ɪ_n̩ ⇌ _aˑɪ_, _aˑɪ_ ⇌ _əˑʊ_, _ɪ_n̩ ⇌ _əˑʊ_ } $\rangle$ is a formal concept, because we have both (1) and (2). However, $\langle$ {DRIVE,RIDE}, {_ɪ_n̩ ⇌ _aˑɪ_ } $\rangle$ is not a formal concept, because despite (3), the opposite isn't true, as {_ɪ_n̩ ⇌ _aˑɪ_ } is only a subset of {RIDE, DRIVE}↑ (1).

From the incidence table, it is possible to produce a list of all the formal concepts. Examples (5) through (11) list all the concepts present in Table 2.4:

(5) $\langle$ ∅, {_ɒ_n̩ ⇌ _ɛ_ϵ, _ɪ_n̩ ⇌ _aˑɪ_, _n̩ ⇌ _ϵ, _ɪ_n̩ ⇌ _əˑʊ_, _aˑɪ_ ⇌ _əˑʊ_, _aˑɪ_ ⇌ _ɪ_, _ɛ_ ⇌ _ɒ_ } $\rangle$

(6) $\langle$ {BITE}, {_ɪ_n̩ ⇌ _aˑɪ_, _n̩ ⇌ _ϵ, _aˑɪ_ ⇌ _ɪ_} $\rangle$

(7) $\langle$ {FORGET}, {_ɒ_n̩ ⇌ _ɛ_ϵ, _n̩ ⇌ _ϵ, _ɛ_ ⇌ _ɒ_} $\rangle$

(8) $\langle$ {RIDE, DRIVE}, {_ɪ_n̩ ⇌ _aˑɪ_, _ɪ_n̩ ⇌ _əˑʊ_, _aˑɪ_ ⇌ _əˑʊ_} $\rangle$

(9) $\langle$ {BITE, FORGET}, {_n̩ ⇌ _ϵ} $\rangle$

(10) $\langle$ {RIDE, DRIVE, BITE}, {_ɪ_n̩ ⇌ _aˑɪ_} $\rangle$

(11) $\langle$ {RIDE, DRIVE, BITE, FORGET}, ∅ $\rangle$

I noted, when observing the lattice in Figure 2.5, that classes were ordered by specificity. Concepts can also be ordered according to their specificity. Given two concepts $\langle A_1, B_1\rangle$ and $\langle A_2, B_2\rangle$ in $\langle X, Y, I\rangle$, $\langle A_1, B_1\rangle$ is more specific than $\langle A_2, B_2\rangle$ if and only if A_1 is a subset of A_2, which entails that B_2 is a subset of B_1. Let us call $\langle A_1, B_1\rangle$ a subconcept of $\langle A_2, B_2\rangle$:

$$\begin{aligned}\langle A_1, B_1\rangle \leq \langle A_2, B_2\rangle &\iff A_1 \subseteq A_2\\ &\iff B_2 \subseteq B_1\end{aligned}$$

In other words, the subconcept contains only some of the objects (lexemes) from the more general concept, but more attributes (patterns). For example, the concept in example (8) is a subconcept of the concept in example 10. The subconcept has one fewer lexeme and two more patterns.

If $\langle A_1, B_1\rangle \leq \langle A_2, B_2\rangle$ and there are no concepts $\langle A_i, B_i\rangle$ in $\langle X, Y, I\rangle$ such that $\langle A_1, B_1\rangle \leq \langle A_i, B_i\rangle \leq \langle A_2, B_2\rangle$, then $\langle A_1, B_1\rangle$ is an immediate lower neighbor of $\langle A_2, B_2\rangle$, which is written: $\langle A_1, B_1\rangle \prec \langle A_2, B_2\rangle$.

The collection of all formal concepts of a context $\langle X, Y, I\rangle$, together with the order relation $\leq$, form the CONCEPT LATTICE of $\langle X, Y, I\rangle$, written $\mathcal{B}\langle X, Y, I\rangle$. A

finite ordered set can be represented by a Hasse diagram in which each element of the set is a node in a hierarchical structure. If an element is a subconcept of another, it is written lower in the diagram. Edges link immediate neighbors. For any pair of concepts c_1, c_2 in $\langle X, Y, I \rangle$, we have $c_1 \leq c_2$ if c_2 can be reached from c_1 by an ascending path.

Figure 2.6 shows the hierarchical representation of the context lattice from Table 2.4 as a Hasse diagram. Each node is annotated by its concept.

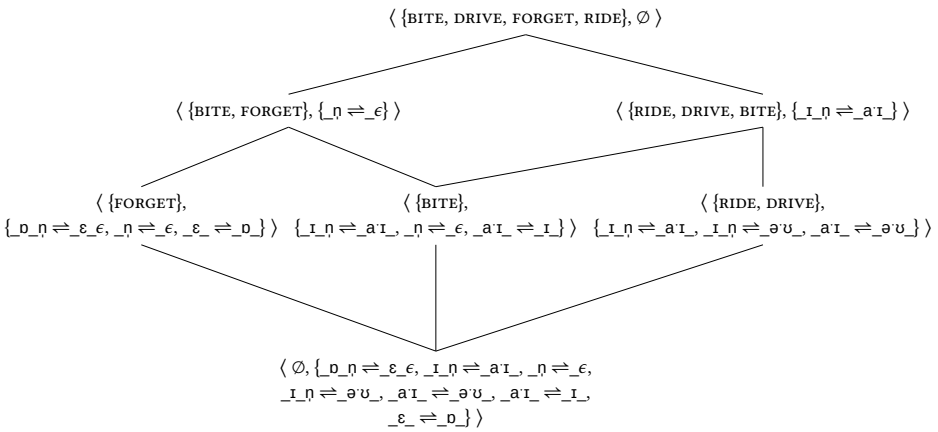


Figure 2.6: Concept lattice for the context in Figure 2.4

However, this notation is redundant. It is not necessary to repeat on higher nodes objects that have been defined by lower concepts, as they can be deduced from the hierarchical structure. Symmetrically, it is not necessary to repeat on lower nodes attributes that have been defined by higher concepts. The reduced notation only writes objects and attributes in the structure on those concepts which define them. Figure 2.7 shows the same lattice as 2.6, in reduced notation. Concept lattices written in reduced notation can be read as monotonous multiple inheritance hierarchies. The resulting hierarchy is unique. It is entirely deduced from the context table and there are no possible alternative structures which fit with the above definitions.

5 Properties of inflection class lattices

In this section, I apply the methodology described in the previous section to a few inflectional systems and investigate the similarity structure across their paradigms. I build IC lattices for the verbal systems of Modern Standard Arabic, English, French, European Portuguese and Zenzontepec Chatino, and for

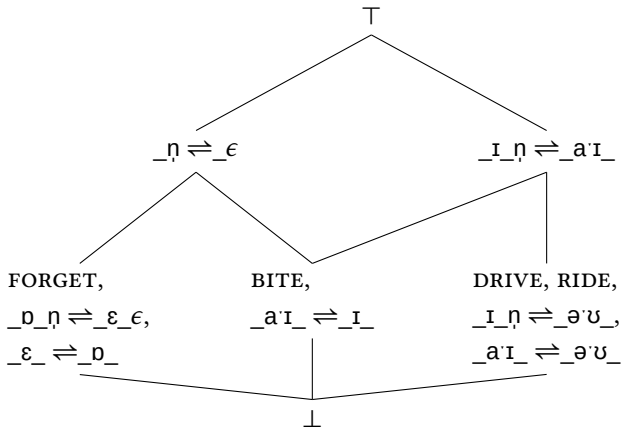


Figure 2.7: Concept lattice for the context in Figure 2.4, reduced notation

the nominal system of Russian. These languages are chosen for their variety and the availability of the computational resources needed for a quantitative investigation. The selection does not constitute a typologically representative sample, but it illustrates a variety of inflectional strategies.

For a description of the input datasets, see the appendix. As a first step before inferring IC lattices, I compute alternation patterns between all pairs of cells automatically from surface forms using the Qumín software (Beniamine 2017; 2018).

Russian declensions have been described as the conjunction of two separate systems: one affixal and one made of stress alternations (Brown & Hippisley 2012). Similarly, Campbell (2016) described Zenzontepec Chatino inflection as consisting of "two orthogonal layers, the prefixal system and the tone alternation system, simultaneously at play". Because alternation patterns describe change in a holistic way, inferring alternation patterns on whole forms in these datasets leads to a multitude of rare patterns which represent the many possible intersections of two more general phenomena, one on each dimension. As a solution, I divided the datasets into two parts, then joined the two resulting tables before inferring the classifications. For Russian, I created one table containing solely phonological segments and one containing solely stress information. For Zenzontepec Chatino, I created separate segmental and tonal tables. Ideally such decisions would be made automatically, but this enterprise is left to future work. For more discussion on the subject, see Beniamine (2018).

I define microclasses as the partition of lexemes which instantiate exactly the

same alternation patterns for all pairs of cells: these are identical rows in the alternation pattern table. I keep only one entry representative of each microclass, which I call the EXEMPLAR lexeme. The choice of the exemplar is arbitrary. To build inflectional context tables, I take objects to be microclass exemplars and attributes to be combinations of a pair of cell and alternation pattern. The resulting contexts are very large. I use the python library CONCEPTS (Bank 2016) to generate all concepts from the context table and order them by specificity.

I obtain very large lattices. As an example, Figure 2.8 shows the overall structure of French and English lattices. Objects are labelled on the structure next to the concept which defines them. For legibility purposes, alternation patterns are not labelled. These examples are typical of the situation for all observed languages: the structures are by far too large for manual exploration and multiple inheritance is pervasive.

This fact in itself invalidates the hypothesis according to which real inflectional systems could be appropriately described as either partitions or trees. Computing the whole similarity structure now allows us to quantify precisely how far from the canon these systems fall. I operationalize three measures described in section 3:

- **Number of concepts**: in the canonical situation, if a lattice has b leaves, there are exactly $b + 1$ concepts in the system (ignoring the infimum), the only other concept being the supremum. The higher the number of concepts, the more an inflectional system violates criterion 1 (distinctivity).

- **Depth of the hierarchy**: In the canonical situation, the longest path (and in fact, all paths) from the root to a leaf passes through only one edge. Evaluating the depth of the hierarchy gives us information regarding the type of sharing between classes. A deep hierarchy is organized in successive classes and subclasses. Because concepts imply their ancestors, a deep hierarchy has more implicative structure than a shallower one. The deeper the hierarchy, the more it violates criterion 4 (flat implicative structure).

- **Mean degree**: A canonical IC hierarchy is a one-level tree. A multi-level tree is a minor deviation from the canon. In a tree, the mean in-degree is 1 (ignoring the root, which has no incoming edges). Mean degree indicates the amount of multiple inheritance in the hierarchy. The higher the mean degree, the more the structure violates criterion 1 through heteroclite sharing.

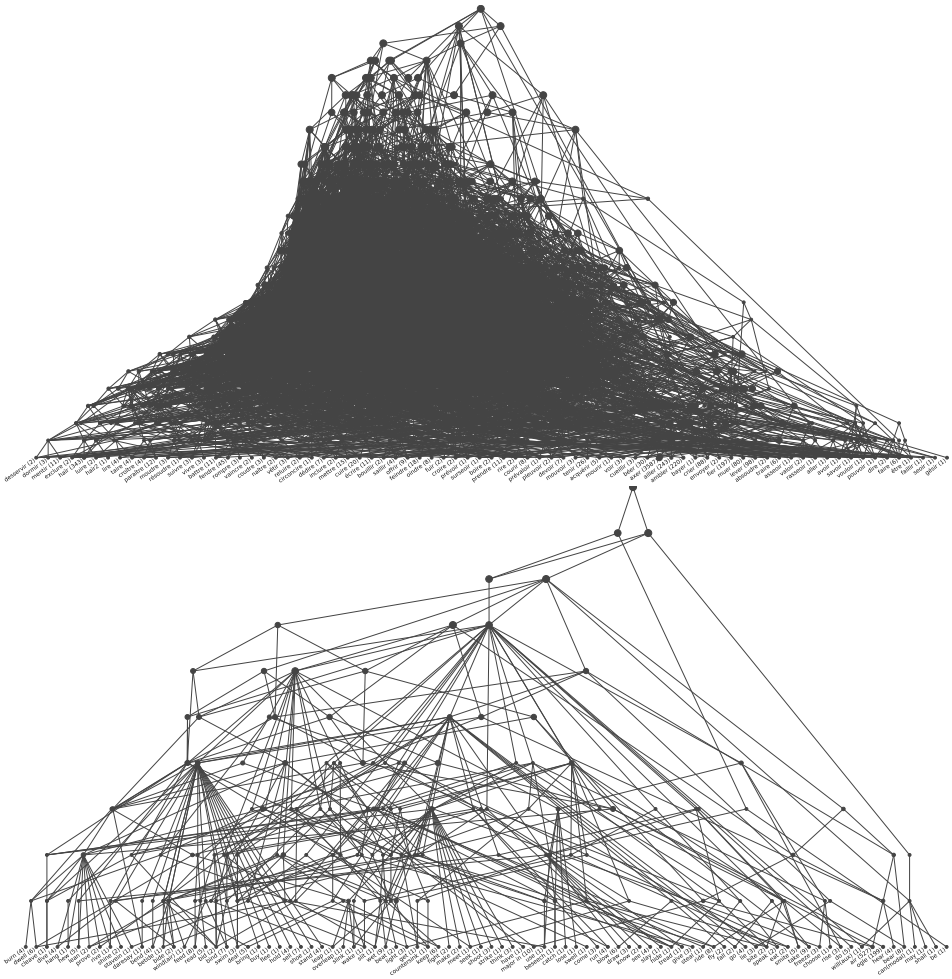


Figure 2.8: Inflection class lattices for French (top) and English (bottom) verbs.

Table 2.5 shows these measures for each system, as well as the number of lexemes in the dataset and the number of microclasses based on inflectional patterns. It is notable that the number of concepts found in each dataset is often comparable to the number of lexemes. In modern standard Arabic, there are 10 times more concepts than lexemes and in Russian, there are 35 times more concepts than lexemes. In French and Zenzontepec Chatino, the number of concepts and lexemes are of the same order. In English and European Portuguese, there are fewer concepts than lexemes, though the number of concepts is still high. This shows an important deviation from the conception according to which ICs provide a summary of inflectional behaviors.

Table 2.5: Canonicity measures of inflection class lattices based on alternation patterns

	Lexemes	Microclasses	Leaves	Depth	Degree	Concepts
Modern Standard Arabic	1018	367	302	33	3.65	10125
English	6064	118	88	11	1.91	244
French	5249	97	77	27	3.96	4845
Russian	1529	226	208	26	5.19	53858
European Portuguese	1996	60	60	21	2.79	677
Zenzontepec Chatino	324	99	98	8	2.65	524

The mean in-degree in all systems is close to or higher than 2, indicating that heteroclisis is the general case. Depth and number of concepts are always much higher than in the canonical situation, although it is difficult to compare these raw numbers from one dataset to another, given that the number of leaves varies.

To be able to compare these values across datasets, I calculate a relative depth and a relative number of concepts (or density). Given a lattice with b leaves and a depth of h, I normalize this depth by the maximal possible depth over b leaves, which is $b - 1$ (ignoring the infimum):

$$\text{relative depth}(\mathcal{B}\langle X, Y, I\rangle) = \frac{h}{b-1} \tag{2.12}$$

The maximal depth $b - 1$ corresponds to the least possible canonical situation, where the lattice is the power set over the b leaves. In that case, there are $n = 2^b - 1$ concepts. I thus normalize the number of concepts in the lattice by this maximal value, and I call the resulting measure DENSITY. If a lattice $\mathcal{B}\langle X, Y, I\rangle$ has n concepts over b leaves, then its density is:

$$\text{density}(\mathcal{B}\langle X, Y, I\rangle) = \frac{n}{2^b - 1} \tag{2.13}$$

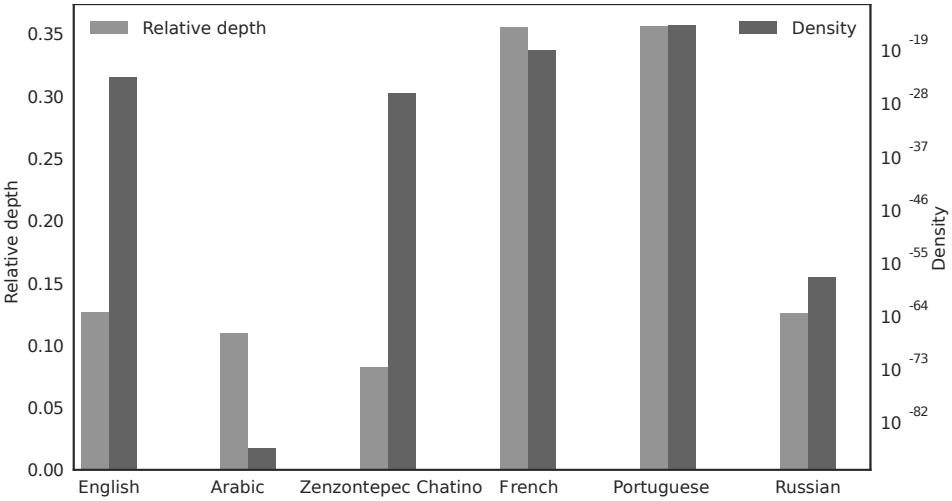


Figure 2.9: Relative canonicity measures on alternation pattern lattices

Figure 2.9 shows these values for each system. The growth of 2^b is such that compared to the maximum non-canonicity conceivable, our lattices have very few nodes, resulting in very low densities (all below 10^{-10}), even when the absolute number of nodes is high. The differences in density in Figure 2.9 are very small (they are shown on a log scale to make them perceptible) and depend mainly on the number of leaves. There is more variation in relative depth. In Zenzontepec Chatino, Modern Standard Arabic, Russian and English, relative depth is lower than 0.15, while European Portuguese and French verbal systems have densities around 0.35, indicative of a more hierarchical system. It is interesting to note that the absolute depth in Russian, French and European Portuguese is similar, but results in a higher density for Portuguese and French because they have fewer than 100 microclasses, while Russian counts over 200. It appears that the French and European Portuguese verbal systems, both Romance languages, would be especially poorly accounted for by a partition, despite a tradition of doing so in Romance linguistics.

Globally, these results show that the resulting classifications are visually very complex and far from the canon. This allows us to reject without hesitation the hypothesis according to which either partitions or tree structures would be appropriate models of ICs. However, these systems are also orders of magnitude less complex than the theoretical maximum.

6 Conclusion

In this chapter, I argued that while "inflection classes" usually refers to either partitions or trees, the similarity structure of inflectional systems is usually more complex and should rather be modeled as a lattice. Following the intuition according to which ICs are sets of lexemes distinguished by common inflectional properties, I put forward that any such maximal set is a relevant IC. FCA allows us to build automatically the ordered set of all these classes, or *concepts*, from paradigms of alternation patterns inferred over a large lexicon.

Using this methodology, I investigated the verbal systems of Modern Standard Arabic, English, French, European Portuguese and Zenzontepec Chatino, as well as the nominal system of Russian. I find that in all cases, the similarity structure between inflectional paradigms is undoubtedly hierarchical and that heteroclisis (multiple inheritance) is pervasive. These facts hold strongly even in systems like English which are usually seen as having a trivial inflectional structure.

The resulting classifications are much larger than what is suggested by traditional accounts and far too large for manual analysis. Usually, ICs are taken to be convenient summaries of an inflectional system. Our investigation shows that this is not the case when taking into account the entire IC structure: the number of concepts is often of the same order, if not higher, as the size of the lexicon. While one can always choose a small subset of classes for pedagogical or constructive purposes, there is no prominent such subset in the hierarchies. This can certainly explain why there are so many alternative analyses of known inflectional systems into partitions of ICs.

I defined precise quantitative measures of inflectional canonicity, taking partitions and trees as two degrees of inflectional canonicity. I showed that while the systems are much larger than they would be in the canonical situation, they are much closer to that ideal than they are to the theoretical maximum. This indicates that these systems are certainly not arbitrarily complex. This finding goes along with known observations that inflectional complexity, while surprisingly high in appearance, is usually bounded (Carstairs 1987; Carstairs-McCarthy 1991; Ackerman et al. 2009; Ackerman & Malouf 2015).

In conclusion, this study highlights the fact that the distribution of inflectional behaviors in a realistic lexicon is both highly structured and much more intricate than hand-crafted descriptions suggest.

Appendix

To compute IC lattices, I take as input paradigm tables of full, non segmented, raw forms in phonemic notation. The algorithm I use to infer alternation patterns (Beniamine 2018; 2017) also requires a decomposition of each phoneme into distinctive features. These serve as a basis to weight phoneme similarity in order to find linguistically sound alternations. They are also used to choose alternation patterns which lead to better generalizations over the whole lexicon. Unless specified otherwise, the definition of these features was based on Hayes (2012). The datasets and their constitution are described in more detail in Beniamine (2018).

Arabic is a Semitic language. Modern Standard Arabic is the standardized variety of Arabic used in writing in Arabic speaking countries. The lexicon was extracted and normalized from Wiktionary entries as part of the UNIMORPH project (Kirov et al. 2016). The UNIMORPH lexicon provides orthographic forms. I transcribed them phonemically in a semi-automatical way (for more details, see Beniamine 2018). The resulting lexicon counts 1,018 lexemes, inflected for 109 possible combinations of mode, tense, voice, gender, person and number.

English is a West Germanic language spoken primarily in the United Kingdom, the United States, Australia, Canada and globally as a *lingua franca*. Our lexicon is a subset of the CELEX2 database (Baayen et al. 1995). The original SAMPA notations were transcribed into IPA automatically (Beniamine 2018). The original lexicon often includes unlabelled regional variants, which leads to paradigms where overabundance (more than one form for a given lexeme and paradigm cell) is frequent. Most verbs are inflected for five paradigm cells: present third person, other present forms, past participle, present participle, past. However, because of the verb BE, which is overdifferentiated, I count eight paradigm cells: infinitive, present first person, present third person, present other persons, past participle, present participle, past first person, past third person, other past persons. The lexicon counts 6,064 verbal lexemes. Distinctive phonological features are based on Halle & Clements (1983) and Chomsky & Halle (1968).

French is a Romance language spoken primarily in France. French verbs are inflected for 51 paradigm cells, structured in seven finite tenses, each inflected for six persons, the imperative inflected for only two persons and six nonfinite cells. I use the verbal entries from the lexicon Flexique (Bonami et al. 2014), itself based on Lexique (New et al. 2001). Phonological features are based on Dell (1973). The lexicon counts 5,249 lexemes.

European Portuguese is a Romance language spoken in Portugal. Our lexicon is based on frequent verbs from Veiga et al.'s (2013) pronunciation dictionary. It

counts 1,996 lexemes inflected for 69 combinations of mood, tense and person. Phonological features originate from Bonami & Luís (2014).

Russian is an East Slavic language spoken in Russia and neighboring countries. Beniamine & Brown's (2019) lexicon was generated by a DATR fragment Brown & Hippisley 2012 as romanized forms. The forms were then transcribed phonemically semi-automatically (Beniamine 2018). The nominal paradigm of Russian counts six combinations of case and number. A small number of lexemes are also inflected for second singular locative (see Brown 2007). The lexicon counts 1,529 lexemes.

Zenzontepec Chatino is a Chatino language of the Zapotecan branch of Oto-Manguean, spoken in Oaxaca, Mexico. The dataset I use comes from Surrey's Oto-Manguean Inflectional Class Database (Feist & Palancar 2015) and is based on data provided by Eric Campbell. Explicit low tones were added automatically in the dataset (Beniamine 2018). Zenzontepec Chatino verbs are inflected for only four paradigm cells, with aspect/mood values: completive, potential, habitual and progressive. The dataset counts 324 lexemes.

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Chapter 3

Deconstructing exuberant exponence in Batsbi

Berthold Crysmann
Université de Paris, Laboratoire de linguistique formelle, CNRS

In this article, I shall discuss "exuberant exponence" in Batsbi (Harris 2009), an extreme case of extended exponence where identical gender-number markers can surface multiple times within the same word, subject to the presence of certain triggering stems or affixes. I shall also evaluate in some detail the challenge the Batsbi data pose for extant formal theories of inflection and show that these challenges cut across the divide between lexical and inferential theories. In the analysis, I shall highlight the dependent nature of the agreement exponents and propose a formal account that draws crucially on two central properties of Information-based Morphology, namely the recognition of many-to-many relations at the most fundamental level of description, and the possibility to extract (partial) generalisations over rules by means of cross-classifying inheritance hierarchies. As a result, cross-classification of agreement rule types with those for the triggering stems and affixes will capture the dependent nature directly, while at the same time ensuring the reuse of inflectional resources. Thus, the decomposition of Batsbi exuberant exponence improves considerably over a pure word-based approach and emphasises the need to afford both atomistic and holistic views within a theory of inflection.

1 Introduction

Ever since Matthews (1972), extended (or multiple) exponence has been one of the core phenomena highlighting the one-to-many nature of inflectional morphology (see Harris 2017 for a typological survey). In this chapter, I shall discuss exuberant exponence in Batsbi (Harris 2009), an extreme case of extended exponence, where one and the same morphosyntactic property may end up being

Berthold Crysmann. 2021. Deconstructing exuberant exponence in Batsbi. In Berthold Crysmann & Manfred Sailer (eds.), *One-to-many relations in morphology, syntax, and semantics*, 45–74. Berlin: Language Science Press. DOI: ??

marked over and over again within a word. Outside Batsbi, the phenomenon has been reported for a variety of languages, including Archi, Khinalug, Chamalal (see Harris 2009 for an extended list).

Exuberant exponence in Batsbi is manifest in gender/number agreement on verbs, giving rise to up to four realisations of agreement with the same argument, the absolutive. What is more, the shape of the exponents across multiple realisations stays the same.

(1) **y**-ox-**y**-∅-o-**y**-anǒ
CM-rip-CM-TR-PRES-CM-EVID1
'Evidently she ripped it.' (Harris 2009: 277)

What makes exuberant exponence particularly interesting from the viewpoint of formal grammar is that the phenomenon can serve as a stress-test for current theories of inflectional morphology. First, exuberant exponence will be less troublesome for theories that fully embrace extended exponence as a basic property of inflectional morphology, rather than providing limited workarounds on the basis of an essentially morphemic model. Second, the identity of exponents observed in Batsbi calls for inflectional models that provide a notion of resource reusability. Third, as I shall discuss below, the presence of agreement markers is dependent on adjacent triggering stems and suffixes, which suggests that agreement markers cannot be derived on their own, but rather compose with the affixes that license their occurrence into inflectional constructions. I shall argue more specifically that the dependent nature of Batsbi exuberant exponence calls for a model of morphology that addresses the many-to-many nature of inflection at the most basic level, a property characteristic of the framework adopted here.

The presentation of the empirical facts about Batsbi exuberant exponence is based on the original paper by Harris (2009). Thus, this paper aims at making contributions in two areas: first explore in more detail the implications of the data for different incarnations of inferential-realisational and inferential-lexical approaches, and second, provide a fully formalised treatment of this challenging case of dependent multiple exponence within the framework of Information-based Morphology (=IbM; Crysmann & Bonami 2016).

The chapter is organised as follows: in Section 2, I shall rehearse the basic empirical data concerning Batsbi exuberant exponence, starting with the inventory of (productive) gender markers, followed by a discussion of class marking on stems as well as affixal material. Section 3 will serve to evaluate extant theories of inflection with respect to their capability to address the phenomenon at hand, taking as a starting point the typology developed in Stump (2001): While

incremental theories prove to be inadequate, a somewhat striking observation is that exuberant exponence does not distinguish between lexical-realisational and incremental-realisational models as a class, but is rather sensitive to details of formal expressivity of the concrete theory.

Section 5 will finally provide an analysis within the framework of Information-based Morphology (henceforth: IbM), an inferential-realisational model of morphology cast entirely in terms of inheritance hierarchies of typed feature structures. I shall provide a brief sketch of IbM and then show how cross-classification in monotonic inheritance hierarchies is well-suited to capture reuse of form and the dependent nature of exuberant exponence at the same time.

2 Data

2.1 Properties of class marking in Batsbi

Batsbi has a rather elaborate gender system, distinguishing eight gender categories, each with singular and plural forms, out of which at least five are productive, while the following three are not, according to Corbett (1991) and Holisky & Gagua (1994): genders IV (2 nouns), VIII (4), and VII (15). Lexical counts are indicated in parentheses.

Exponence of gender/class agreement is detailed in Table 3.1. As can be seen, /d/ is quite prevalent as an exponent, which is why Harris occasionally uses it as a representative for the entire set of class markers.

Table 3.1: Gender agreement markers in Batsbi

	SINGULAR	PLURAL
I	v	b
II	y	d
III	y	y
(IV)	b	b
V	d	d
VI	b	d
(VII)	b	y
(VIII)	d	y

Gender/number agreement is controlled by the absolutive argument, i.e. the S argument of intransitives, as witnessed in (2), and the O argument of transitives, as shown by (3).

(2) xen-go-ħ potl-i **d**-ek'-ĩ
tree-ALL-LOC leaf(d/d)-PL.ABS CM-fall-AOR
'The leaves of the tree were falling.' (Harris 2009: 274)

(3) pst'uyn-čo-v bader **d**-iy-ẽ
married.woman(y/y)-OBL-ERG child(d/d).ABS CM-do-AOR
'The (married) woman bore a child.' (Harris 2009: 274)

2.2 Class marking on stems

As we have seen in example (1) above, Batsbi class marking can surface multiple times within a word, and when it does, we always find the same exponents. However, as pointed out by Harris (2009), presence of class markers in this language is contingent on the right-adjacent marker: just as we may find words with multiple class markers, as in (1), we may equally find words showing a single marker, as in (2), (3) or (4), or even no overt class making at all, as e.g. in (5).

(4) oqus mot: k'edl-e-guy tat:-**b**-iy-ẽ
3SG.ERG bed(b/d).ABS wall-OBL-towards push-CM-TR-AOR
'S/he pushed the bed towards the wall.' (Harris 2009: 275)

(5) qan simind lapsdan matx ot'-ŏ
tomorrow corn(d/d).ABS to.dry sun(b/d) spread-FUT
'Tomorrow [they] will spread the corn in the sun to dry.' (idem)

Stems are one of the elements that may require or disallow left adjacent class markers: according to Harris (2009: fn. 23), 468 (21.53%) out of 2178 verbs in the dictionary by Kadagiʒe & Kadagiʒe (1984) feature a pre-radical class marker. While none of the stems in (4) or (5) appears to take a class marker to its immediate left, the verbs *ek'* 'fall' and *iy* 'do' in fact do, as illustrated in (2) and (3) above.

Holisky & Gagua (1994) note that some verbs distinguish the perfective from the imperfective stem by means of an agreement marker, contrasting, e.g. ***d**-ek'-ar* 'fall.PFV' with *ak'-ar* 'fall.IPFV'. Harris (2009) provides a list of minimal pairs, where lexical meaning is solely distinguished by presence of a pre-radical marker, including e.g. *ot:-ar* 'stand, stay' vs. ***d**-ot:-ar* 'pour into'. Thus, it appears that the presence vs. absence of a pre-radical agreement marker is lexically determined, i.e. it is a property of individual stems, or else of the entire lexeme. Choice of the shape of the marker, by contrast, is clearly an inflectional property.

2.3 Class marking on suffixes

Similar to pre-stem class markers, post-stem gender/number markers appear left-adjacent to certain triggering suffixes. These comprise the transitivity markers *-al* (INTR) and *-iy* (TR), as well as the affirmative and negative evidentiality markers *-anŏ* (EVID1.AFF) and *-a* (EVID1.NEG). Pre-stem and pre-suffixal class markers are controlled by the same argument, the absolutive, and their shape is identical. However, their presence is conditioned independently.

Table 3.2: Patterns of dependent class marking in Batsbi (Harris 2009)

STEM	(IN)TRANS	EVID
stem	∅	∅/-inŏ
d-stem	∅	∅/-inŏ
stem	∅	**d**-anŏ
d-stem	∅	**d**-anŏ
stem	**d**-iy/al	∅/-inŏ
d-stem	**d**-iy/al	∅/-inŏ
stem	**d**-iy/al	**d**-anŏ
d-stem	**d**-iy/al	**d**-anŏ

2.3.1 Intransitive marker *-al*

The basic function of the intransitive marker *-al* is to derive intransitives from transitives, as illustrated in (6).[1]

(6) a. p'erang-mak-aħŏ xalat **y**-opx-ŏ
shirt-on-LOC house.coat(y/y).ABS CM-put.on-PRS
'[She] puts on a house coat over her shirt.' (Harris 2009: 275)

b. sẽ yoħ taguš **y**-opx-**y**-al-in=ĕ
me.GEN girl(y/d).ABS beautifully CM-put.on-CM-INTR-AOR=&
'My daughter dressed beautifully and ...' (Harris 2009: 275)

When this marker is present, it is obligatorily accompanied by the class marker to its left. Presence of the post-radical marker is triggered independently of the stem, as shown by the contrast between (6a,b) and (7).

[1]Note that the intransitive marker can also be found with some intransitive bases, e.g. *ak'-**d**-al-ar* 'light up, catch fire' vs. *ak'-ar* 'burn, be alight'.

(7) psare(ħ) oc'-**v**-al-in-es ...
yesterday weigh.PFV-CM-INTR-AOR-1SG.ERG
'I (masculine) weighed yesterday ...' (Harris 2009: 275)

2.3.2 Transitive marker *-iy*

While the intransitive marker *-al* derives intransitives from transitive bases, the transitive marker *-iy* signals the opposite, namely transitives derived from intransitive bases.[2] Again, this marker is immediately preceded by the class marker, as illustrated in the examples in (8).

(8) a. don-e-v taylz-i **d**-ek'-**d**-iy-ẽ
horse(b/d)-OBL-ERG saddlebags(/d)[3]-PL.ABS CM-fall-CM-TR-AOR
'The horse threw off the saddlebags.' (Harris 2009: 274)

b. kuyrc'l-e-x qečqečnayrẽ daq'r-i lal-**d**-iy-ẽ makaħŏ
wedding-OBL-CON various food(d/d)-PL.ABS go-CM-TR-AOR above
'At the wedding [they] passed around various foods.' (idem)

2.3.3 Present evidential

The third suffixal marker that takes the class marker, again to its immediate left, is the present evidential marker *-anŏ*. According to Harris (2009), this marker productively combines with any lexeme. Compare the examples in (9): adding the present evidential to an example like (9a), with already two class markers (one triggered by the stem and one triggered by the transitive marker), adds a third instance of class marking, yielding a total of three exponents, as shown in (9b).

(9) a. k'ab **y**-ox-**y**-iy-ẽ
dress(y/y).ABS CM-rip-CM-TR-AOR
'[She] ripped the dress.' (Harris 2009: 277)

b. **y**-ox-**y**-∅-o-**y**-anŏ
CM-rip-CM-TR-PRS-CM-EVID1
'Evidently she ripped it.' (Harris 2009: 277)

[2] This marker may occasionally serve to distinguish transitives.

[3] 'Saddlebags' is a plurale tantum (Harris 2009: 274). Lacking an attested singular form, its gender could be any of II, V, or VI.

Again, class inflection of the evidential is independent of that of the stem, i.e. it is triggered by the present evidential, regardless of whether the stem is already marked with the gender marker, as in (9b), or not, as in (10).

(10) tet'-**d**-anŏ
cut-CM-EVID1
'Evidently s/he was cutting it.' (Holisky & Gagua 1994: 181)

The present evidential *-anŏ* (EVID1) contrasts with, e.g. the aorist evidential *-inŏ*, which never takes a gender/number marker.

2.4 Wordhood

The implications of exuberant exponence for morphological theory depend of course on the crucial question whether the relevant domain is morphology, i.e. whether we are dealing with complex words, or syntax. Harris (2009) provides extensive tests showing that we are indeed confronted with massive extended exponence within a single word, rather than agreement across several syntactically independent words. This is even more important given that most markers involved here used to be independent words diachronically, e.g. the evidential marker derives from the verb 'to be'.

Regarding the status of class markers, Harris (2009) provides five tests in total.[4] I shall give a brief description of the tests, and summarise the results, which uniformly point towards the affixal status of the class markers (see Table 3.3 for a summary of the results, and Harris 2009: sec. 5 for details).

Agreement controller: Establishes whether auxiliary or evidential markers share an argument structure with the verb: true auxiliaries behave like intransitives (regardless of main verb), evidentials reflect the main verb's transitivity, suggesting bound status.

Intervention: Two related tests based on the possibility for intervention of negative marker and clitic conjunction: the possibility for intervention is independently established for auxiliaries, yet all markers under discussion uniformly prohibit intervention.

[4]Harris (2009) presents a total of seven tests, two of which are confined to the status of person/number markers. These markers may incidentally be controlled by the same argument, which leads Harris to regard them as yet another instance of (partial) exuberant agreement. However, given that the controllers need not be the same (see Harris 2009: ex. (33))), I shall rather treat this as accidental, and thus ignore person/number marking for the purposes of this paper.

Table 3.3: Tests for word vs. affix status (Harris 2009)

Test	TR	INTR	EVID1	AUX
Agreement trigger			aff	wd
Intervention (neg)	aff	aff	aff	wd
Intervention (clitic)			aff	wd
Conjoining	aff	aff	aff	wd
Gapping	aff			wd

Coordination & Gapping: Two tests that assess whether or not markers can be suppressed in coordinate structures. While auxiliaries and main verbs can be elided in the second conjunct, transitive markers and evidentials cannot.

To summarise, the evidence Harris (2009) provides robustly points in the same direction, namely that transitivity markers and evidential markers are bound affixes. Therefore, the issue of exuberant exponence and the dependent nature of the class markers are to be addressed in the domain of morphology rather than relegating them to syntax.

3 Discussion

Exuberant exponence can probably be regarded as just another case of extended (or multiple) exponence, so we would expect theories that embrace the notion of many-to-many relations between function and form to outperform those which picture morphology in terms of (classical) morphemes. This is indeed the line of argumentation put forth by Harris (2009). In her article, she discusses the theoretical significance of extended exponence in general and exuberant exponence in particular and confronts the Batsbi facts with claims made by various theoretical frameworks. In particular, she observes that incremental theories are uniformly hard pressed to cover the empirical patterns, since these approaches assume that morphological operations must always add information, as in the lexical-incremental theory of Wunderlich & Fabri (1995), or must always express information not yet expressed, as in the inferential-incremental approach of Steele (1995).

3.1 Implications for lexical-realisational theories

Harris (2009) already discusses in some depth the implications of the Batsbi data for two instances of Distributed Morphology, a lexical-realisational theory in terms of the typology of morphological theories proposed by Stump (2001). She shows convincingly that the theory of primary and secondary exponence advanced by Noyer (1992) restricts extended exponence to maximally two occurrences, which makes it impossible to capture the Batsbi data, even though it may be adequate for Berber and Arabic, the languages Noyer based his theory on.

In a paper on extended exponence in German, Müller (2007) suggests to complement the theory of impoverishment (used in Distributed Morphology Halle & Marantz 1993 to account for syncretism) with a theory of enrichment, in order to facilitate the treatment of extended exponence. In the interest of limiting the formal complexity of a system that recognises both deletion and insertion rules, he suggests that enrichment may only redundantly add features already present. As shown by Harris (2009), enrichment rules indeed make it possible for a lexical-realisational theory such as DM to cover the Batsbi data. The criticism she raises against the theory of enrichment is more of a conceptual nature, essentially stating that lexical theories are not well-equipped to capture the relevant generalisations directly, but rather force the surface patterns into a morphemic mould.

While I concur with Harris's general assessment of the two DM approaches, it is still worth noting that the problems faced by Noyer (1992) and by Müller (2007), are of an entirely different nature: while Müller's approach can indeed be criticised for favouring a morphemic ideal and deriving exuberant exponence by means of a "workaround", as argued convincingly in Harris (2009), it is equally clear that the theory of enrichment meets at least the criterion of weak generative capacity, unlike Noyer (1992). One might even suggest that the division between a morphemic core and enrichment could be motivated by considerations of what is or could be considered typologically canonical or unmarked. Noyer's theory contrasts sharply with that of Müller: his theory fails on grounds of weak capacity, i.e. it cannot even describe the set of acceptable surface words. What is more, the reason for this failure is located not at the level of the theory, where one might just drop some universal claim in favour of a language-particular constraint, but rather it is implemented at the level of the underlying logic of feature discharge, meaning there is just no chance of repair. To summarise, exuberant exponence falsifies Noyer's theory of feature discharge, while Müller's theory appears to be flexible enough to describe the facts.

The observation that there is no clear alignment with general properties of

the approaches, but rather a strong dependence on the details of implementation suggests that a typology of morphological theories can only give a coarse indication of the analytical properties of a theory and therefore still needs to be complemented by careful investigation of the formal properties of the individual approaches.

3.2 Batsbi and inferential-realisational theories

In contrast to both morpheme-based (=lexical) and incremental theories, inferential-realisational theories generally embrace extended exponence as a recurrent property in inflectional systems. However, it seems that this very fact has led Harris (2009) to take for granted that every approach within this family of theories will be able to capture the empirical patterns. While there certainly is no general obstacle, we shall see in this section that not all Word-and-Paradigm theories are equally well-equipped to account for the Batsbi data in an insightful and maximally general fashion. To illustrate this point, I shall briefly discuss A-morphous Morphology (=AM; Anderson 1992) and Paradigm Function Morphology (=PFM; Stump 2001) and argue that it is important to submit to further scrutiny the architectural decisions and the formal devices offered by each theory.

A-morphous Morphology (AM) organises inflectional rules into a system of ordered rule blocks that is used to derive affix order. While there is preemption within rule blocks, by way of extrinsic rule ordering, preemption does not generally apply across different blocks, thereby making it possible in principle that a morphosyntactic property may get expressed more than once. However, AM does not provide any device permitting reuse of resources across different rule blocks. Thus, while extended exponence or even exuberant exponence per se is not a problem at all for Anderson's model, the absence of, e.g. rules of referral makes it difficult to capture the generalisation that exponents of gender marking are indeed identical across different surface positions in the word. Thus in addition to massive duplication of gender-marking rules across different rule blocks, surface identity is pictured as entirely accidental.

Paradigm Function Morphology also builds on a system of extrinsically ordered rule blocks and it equally limits rule competition to rules within the same block. In contrast to AM, however, PFM does provide rules of referral, either in terms of rules of referral to an ordered rule block (cf. Stump 1993), or by means of "conflation" (Stump 2017). A solution along these lines clearly improves on Anderson's theory, which addresses the question of weak but not strong generative capacity. However, having both ordered and unordered rule blocks, or rule blocks and conflation, provides for a rather baroque structure that appears

to work around what I consider a design flaw of a rule block approach: being amorphous, PFM may look like the simpler model as far as derived structure is concerned, but this comes at the expense of an overly elaborate derivation structure. Thus the absence of morphological structure at the top-level is more than compensated by having several layers of structure in the cascade of rules of exponence and conflation rules, with intermediate representations at every level. The morphous inferential-realisational analysis that I shall present in Section 5, by contrast, invokes no structure at all beyond the assumption that exponents are segmentable, an assumption which is by the way implicitly made by the PFM rule system.

While at first sight, the move from ordinary extended exponence to exuberant exponence appeared as a mere quantitative difference, exuberance is actually a game-changer, inducing a qualitative difference when confronted with concrete formal theories: while incremental theories can indeed be discarded *en bloc*, the ability to account for exuberant exponence does not align with the distinction between lexical-realisational and inferential-realisational theories. As we have seen there are approaches of either type that can successfully analyse the data, as well as approaches that fail to do so. That means that the ability to capture exuberant exponence does not depend so much on the broad affiliation within the typology of morphological theories but rather on the specifics of the formal implementation.

4 Harris's word-based approach

Harris (2009) herself proposes a word-based analysis of Batsbi class marking, inspired inter alios by Blevins (2006), see Blevins (2016) for a more recent reference. Under a word-based perspective, speakers are assumed to store paradigms of high frequency words and establish analogical relationships between the cells of the paradigm. Such analogical relations are abstracted from full or partial paradigms, their application enabling speakers to form new word forms from already memorised ones. For instance, given a stored paradigm, word-to-word relations between paradigm cells can be abstracted out, like the one in (11):

(11) [Gender n] ~ [CM_n-X] ↔ [Gender m] ~ [CM_m-X]

According to her, such abstract relations, or the concrete instantiations thereof, to gender/number features and their corresponding surface exponents, make it possible to infer new forms from known forms, e.g. *yet:ŏ* 's/he pours milk' from

det:ŏ 's/he pours tea' (recall that agreement is with the absolutive, which is the object of a transitive in this case).

For Batsbi, Harris (2009) assumes that lexical items and affixes each give rise to two basic schemata, one that features a class marker (**d**-LEX/**d**-AFF), and one that does not (LEX/AFF). Based on the lexical schemata, Harris suggests that basic verbs like ***d**-ek'-i*^{n} 'they fell' and *ot'-ŏ* 'they spread it' can be schematised as [**d**-LEX]$_V$ and [LEX]$_V$, respectively.

She then moves on to "first order" extensions, including transitive and intransitive markers and suggests two abstract schemata [V-**d**-AFF]$_V$ and [V-AFF]$_V$ the first of which is instantiated in the following sub-schemata (Table 3.4).

Table 3.4: Transitive/intransitive first order extensions

	Sub-schema	Example	Translation
a.	[[**d**-LEX]$_V$ -**d**-i-]$_V$	**d**-ek'-**d**-iy-en	'threw it off'
b.	[[**d**-LEX]$_V$ -**d**-al]$_V$	**y**-opx-**y**-al-in=e	'dressed and'
c.	[[LEX]$_V$ -**d**-i-]$_V$	tat:-**b**-iy-en	'pushed it'
d.	[[LEX]$_V$ -**d**-al-]$_V$	oc'-**v**-al-in-es	'I weighed'

In order to incorporate second order extensions such as the evidential I and the aorist evidential, Harris (2009) proposes even more complex sub-schemata, illustrated in Table 3.5:

Table 3.5: Second order schemata

	Sub-schema	Explanation
a.	[[**d**-LEX]$_V$ -**d**-anŏ]$_V$	evidential I of simple verb with preradical CM
b.	[[[**d**- LEX]$_V$ -**d**-i]$_V$ -**d**-anŏ]$_V$	evidential I of derived transitive with preradical CM
c.	[[**d**- LEX]$_V$ -inŏ]$_V$	aorist evidential of simple verb with preradical CM
d.	[[[**d**- LEX]$_V$ -**d**-i]$_V$ -inŏ]$_V$	aorist evidential of derived transitive with preradical CM

As indicated by Harris (2009), the sub-schemata in Table 3.5 are only a subset of the actual number of schemata. Factoring in only the stem and transi-

tive/intransitive schemata, the number grows to 16. Once we factor in TAM markers (e.g. present, imperfective or aorist), we end up with a considerably greater number. The word-based approach therefore does not appear to be a very economical way of capturing the dependency of a class marker on the marker that licenses it. What is more, such a view will hardly scale up to the description of morphologically even more complex languages. Finally, a word-based view misses the utterly local nature of licensing involved with class marking.

It is rather clear what the basic intuitions are that Harris intends to capture with her (informal) analysis: to account for the dependent nature of gender markers (via schemata) and their uniform pattern of alternation (via analogy). It is far less clear though how the different abstractions of intermediate structures that she offers are to be interpreted in a word-based model. As a result, there are two basic readings of her analysis that I shall assume as plausible for the rest of this chapter: a purely word-based view, where intermediate abstractions are just abbreviatory devices (Harris 2009: p. 298), or a constructional view where such abstractions are meant to have some theoretical status. Depending on which of the two readings is correct, the current paper will make a different contribution: if the latter, it will provide a formal interpretation of Harris (2009), leading to a clearer understanding of what the different variables (depicted in bold face or small caps) are and how they can be interpreted in a generative grammar that makes use of typed feature logic. If, however, the former, word-based interpretation is more faithful, it will show in addition how a schema-based approach of Batsbi can be formalised in a rigorous fashion, without necessitating a fully holistic, word-based view.

In the next section, I shall therefore present an alternative analysis of Batsbi exuberant exponence, one which completely avoids unfolding the entire morphotactics into primary and secondary sub-schemata, but relies instead on a typed feature logic to give a formal interpretation to the basic combination of class-markers and the exponents that license their occurrence.

5 Analysis

In this section, I shall present Information-based Morphology, an inferential-realisational theory of inflection and show how the two basic analytical devices, inheritance and cross-classification in typed feature structures, are sufficient to provide an analysis of Batsbi exuberant exponence that captures simultaneously the dependent nature of class markers and the uniformity of their exponence. Furthermore, this analysis will highlight how Harris' original proposal, when un-

derstood in constructional rather than word-based terms, can be given a straightforward formal interpretation using the IbM framework.

5.1 Information-based Morphology

In this section[5], I shall present the basic architecture of Information-based Morphology (=IbM Crysmann & Bonami 2016; Crysmann 2017), an inferential-realisational theory of inflection (cf. Stump 2001) that is couched entirely within typed feature logic, as assumed in HPSG (Pollard & Sag 1987; 1994). In IbM, realisation rules embody partial generalisations over words, where each rule may pair *m* morphosyntactic properties with *n* morphs that serve to express them. IbM is a morphous theory (Crysmann & Bonami 2016), i.e. exponents are described as structured morphs, combining descriptions of shape (=phonology) and position class. As a consequence, individual rules can introduce multiple morphs, in different, even discontinuous positions. By means of multiple inheritance hierarchies of rule types, commonalities between rules are abstracted out: in essence, every piece of information can be underspecified, including shape, position, number of exponents, morphosyntactic properties, etc.

In contrast to other realisational theories, such as Paradigm Function Morphology (Stump 2001) or A-morphous Morphology (Anderson 1992), IbM does away with procedural concepts such as ordered rule blocks. Moreover, rules in IbM are non-recursive, reflecting the fact that inflectional paradigms in general constitute finite domains. Owing to the absence of rule blocks, IbM embraces a strong notion of Pāṇini's Principle or the Elsewhere Condition (Kiparsky 1985) which is couched purely in terms of informational content (=subsumption) and therefore applies in a global fashion (Crysmann 2017), thereby including discontinuous bleeding (Noyer 1992).

5.1.1 Inflectional rules as partial abstraction over words

From the viewpoint of inflectional morphology, words can be regarded as associations between a phonological shape (PH) and a morphosyntactic property set (MS), the latter including, of course, information pertaining to lexeme identity. This correspondence can be described in a maximally holistic fashion, as

[5]This section has been largely reproduced from Crysmann & Bonami (2017). For an overview of alternative approaches to morphology within HPSG and constraint-based grammar, please see Bonami & Crysmann (2016).

One difference between the current version of IbM and previous ones is that we have now settled on considering MPH as a list rather than a set.

shown in Figure 3.1. Throughout this section, I shall use German (circumfixal) passive/past participle (*ppp*) formation, as witnessed by *ge-setz-t* 'put', for illustration.

$$\begin{bmatrix} \textsc{ph} & \text{gesetzt} \\ \textsc{ms} & \left\{\left[\textsc{lid} \;\; \textit{setzen}\right], \left[\textsc{tma} \;\; \textit{ppp}\right]\right\} \end{bmatrix}$$

Figure 3.1: Holistic word-level association between form (PH) and function (MS)

Since words in inflectional languages typically consist of multiple segmentable parts, realisational models provide means to index position within a word: while in AM and PFM ordered rule blocks perform this function, IbM uses a list of morphs (MPH) in order to explicitly represent exponence. Having morphosyntactic properties and exponents represented as sets and lists, standard issues in inflectional morphology are straightforwardly captured at the level of rules: cumulative exponence corresponds to the expression of *m* properties by 1 morph, whereas extended (or multiple) exponence corresponds to 1 property being expressed by *n* morphs. Overlapping exponence finally represents the general case of *m* properties being realised by *n* exponents. Figure 3.2 illustrates the word-level $m : n$ correspondence of lexemic and inflectional properties to the multiple morphs that realise it. By means of simple underspecification, i.e. partial descriptions, one can easily abstract out realisation of the past participle property, arriving at a direct representation of circumfixal realisation.

Word:

$$\begin{bmatrix} \textsc{ph} & \text{gesetzt} \\ \textsc{mph} & \left\langle \begin{bmatrix} \textsc{ph} & \text{ge} \\ \textsc{pc} & -1 \end{bmatrix}, \begin{bmatrix} \textsc{ph} & \text{setz} \\ \textsc{pc} & 0 \end{bmatrix}, \begin{bmatrix} \textsc{ph} & \text{t} \\ \textsc{pc} & 1 \end{bmatrix} \right\rangle \\ \textsc{ms} & \left\{\left[\textsc{lid} \;\; \textit{setzen}\right], \left[\textsc{tma} \;\; \textit{ppp}\right]\right\} \end{bmatrix}$$

Abstraction of circumfixation ($1 : n$):

$$\begin{bmatrix} \textsc{mph} & \left\langle \begin{bmatrix} \textsc{ph} & \text{ge} \\ \textsc{pc} & -1 \end{bmatrix}, \begin{bmatrix} \textsc{ph} & \text{t} \\ \textsc{pc} & 1 \end{bmatrix}, \ldots \right\rangle \\ \textsc{ms} & \left\{\left[\textsc{tma} \;\; \textit{ppp}\right], \ldots\right\} \end{bmatrix}$$

Figure 3.2: Structured association of form (MPH) and function (MS)

Yet, a direct word-based description does not easily capture situations where the same association between form and content is used more than once in the same word, as is arguably the case for Swahili (Stump 1993; Crysmann & Bonami 2016; 2017) or, even more importantly for Batsbi (Harris 2009). By way of introducing a level of R(EALISATION) R(ULES), reuse of resources becomes possible. Rather than expressing the relation between form and function directly at the word level, IbM assumes that a word's description includes a specification of which rules license the realisation between form and content, as shown in Figure 3.3.

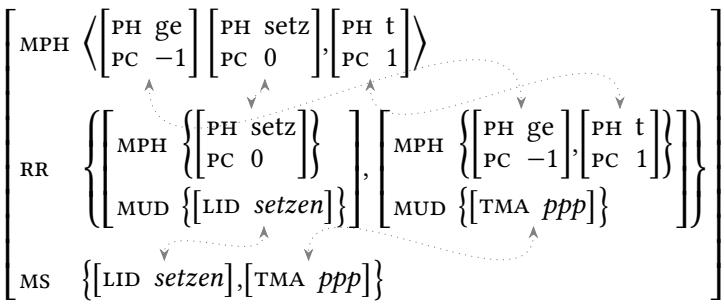

Figure 3.3: Association of form and function mediated by rule

Realisation rules (members of set RR) pair a set of morphological properties to be expressed, the morphology under discussion (MUD) with a list of morphs that realise them (MPH). In order to facilitate generalisations about shape and position in an independent fashion, IbM recognises each of them as first order properties of morphs, where PH represents a description of the phonological shape[6], whereas PC corresponds to position class information. A general principle of morphological well-formedness (Figure 3.4) ensures that the properties expressed by rules add up to the word's property set and that the rules' MPH list add up to that of the word, i.e. no contribution of a rule may ever be lost. [7] In essence, a word's sequence of morphs, and hence, its phonology will be obtained by shuffling (○) the rules' MPH lists in ascending order of position class (PC) indices (see Bonami & Crysmann 2013: for details). Similarly, a word's morphosyntactic property set (MS) will correspond to the non-trivial set union (⊎) of the rules' MUD values.[8] Finally, the entire morphosyntactic property set of the word (MS) is exposed on each realisation rule by way of structure sharing ($\boxed{0}$).

This latter aspect, i.e. the relationship between MUD and MS in rule descriptions, surely deserves some more clarification in the context of this chapter. IbM makes a deliberate distinction between expression of a property and conditioning on a property: while MUD represents expression of properties, constraints on the MS

[6]For ease of presentation, I shall use strings to represent phonological contributions. More generally, PH(ON) value should be considered descriptions of phonological events, as suggested e.g. by Bird & Klein (1994).

[7]The principle of general well-formedness in Figure 3.4 bears some resemblance to LFG's principles of completeness and coherence (Bresnan 1982), as well as to the notion of "Total Accountability" proposed by Hockett (1947). Since $m : n$ relations are recognised at the most basic level, i.e. morphological rules, mappings between the contributions of the rules and the properties of the word can and should be $1 : 1$.

[8]While standard set union (∪) allows for the situation that elements contributed by two sets may be collapsed, non-trivial set union (⊎) insists that the sets to be unioned must be disjoint.

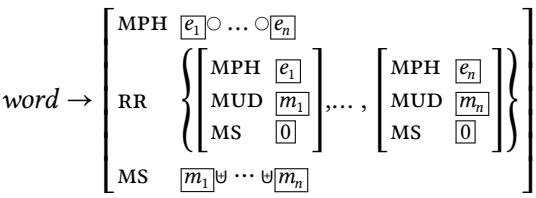

Figure 3.4: Morphological well-formedness

set serve to capture allomorphic conditioning, in the sense of Carstairs (1987). There are two important consequences of this distinction (Crysmann 2017): first, it becomes possible to make the application of inflectional rules a direct function of the information to be expressed, without having to postulate a system of (ordered) rule blocks. Second, it paves the way for a global notion of Pāṇinian competition, being able to distinguish between situations of discontinuous bleeding (Noyer 1992) and multiple or overlapping exponence. Thus, a rule with [MUD $\{\alpha, \beta\}$] would preempt a rule with [MUD $\{\beta\}$], since every morphosyntactic property is licensed (expressed) by exactly one rule. The rules [MUD $\{\alpha\}$, MS $\{\beta\}$] and [MUD $\{\beta\}$], by contrast, would give rise to overlapping exponence (provided exponents do not compete for position). Here, expression of α is merely conditioned on a property that is independently expressed: β. See Crysmann (2017) for extensive discussion of preemption and overlapping exponence in Swahili.

Realisation rules conceived like this essentially constitute partial abstractions over words, stating that some collection of morphs jointly expresses a collection of morphosyntactic properties. In the example in Figure 3.3, we find that realisation rules thus conceived implement the $m : n$ nature of inflectional morphology at the most basic level: while the representation of classical morphemes as $1 : 1$ correspondences is permitted, it is but one option. The circumfixal rule for past participial inflection directly captures the $1 : n$ nature of extended exponence.

5.1.2 Levels of abstraction

The fact that IbM, in contrast to PFM or AM, recognises $m : n$ relations between form and function at the most basic level of organisation, i.e. realisation rules, means that morphological generalisations can be expressed in a single place, namely simply as abstractions over rules. Rules in IbM are represented as typed feature structures organised in an inheritance hierarchy, such that properties common to leaf types can be abstracted out into more general supertypes. This vertical abstraction is illustrated in Figure 3.5. Using again German past participles as an example, the commonalities that regular circumfixal *ge-...-t* (as

in *gesetzt* 'put') shares with subregular *ge-...-en* (as in *geschrieben* 'written') can be generalised as the properties of a rule supertype from which the more specific leaves inherit. Note that essentially all information except choice of suffixal shape is associated with the supertype. This includes the shared morphotactics of the suffix.

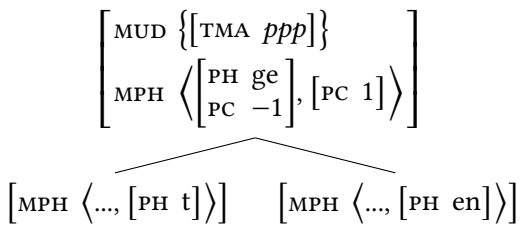

Figure 3.5: Vertical abstraction by inheritance

In addition to vertical abstraction by means of standard monotonic inheritance hierarchies, IbM draws on Online Type Construction (Koenig & Jurafsky 1994): using dynamic cross-classification, leaf types from one dimension can be distributed over the leaf types of another dimension. This type of horizontal abstraction permits modelling of systematic alternations, as illustrated once more with German past participle formation:

(12) a. **ge**-setz-**t** 'set/put'
b. über-setz-**t** 'translated'
c. **ge**-schrieb-**en** 'written'
d. über-schrieb-**en** 'overwritten'

In the more complete set of past participle formations shown in (12), we find alternation not only between choice of suffix shape (*-t* vs. *-en*), but also between presence vs. absence of the prefixal part (*ge-*).

Figure 3.6 shows how Online Type Construction enables us to generalise these patterns in a straightforward way: while the common supertype still captures properties true of all four different realisations, namely the property to be expressed and the fact that it involves at least a suffix, concrete prefixal and suffixal realisation patterns are segregated into dimensions of their own (indicated by PREF and SUFF). Systematic cross-classification (under unification) of types in PREF with those in SUFF yields the set of well-formed rule instances, e.g. distributing the left-hand rule type in PREF over the types in SUFF yields the rules for *ge-setz-t* and *ge-schrieb-en*, whereas distributing the right hand rule type in

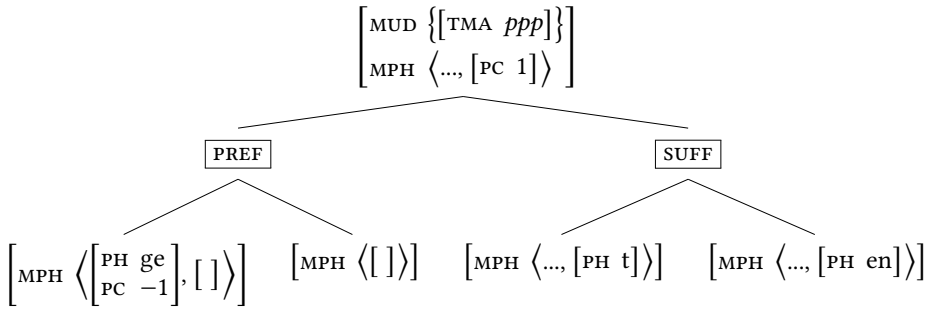

Figure 3.6: Horizontal abstraction by dynamic cross-classification

PREF gives us the rules for *über-setz-t* and *über-schrieb-en*, which are characterised by the absence of the participial prefix.

5.2 An information-based account of Batsbi exuberant exponence

Having introduced the basic workings of IbM, we are now in a position to approach the analysis of exuberant exponence in Batsbi. For the purposes of the following discussion, recall the two most central observations made in Section 2: first that the shape of class markers remains identical across all occurrences, and second, that the presence vs. absence of a class marker depends on their right-adjacent marker. Thus we saw both stems that trigger presence of an immediately preceding class marker, and stems that do not. Similarly, some classes of affixal exponents are obligatorily accompanied by a left-adjacent marker, whereas others do not license presence of such a marker. As a consequence, a word may surface with multiple identical class markers, a single pre-stem class marker or a single suffixal class marker, or even with no overt class marker at all.

The analysis I shall put forth in this section is that stems and affixes that trigger presence of overt agreement are actually allomorphically conditioned on gender marking properties, but that expression of gender marking can be zero, in the limiting case.

By way of illustration, let us start with a sample analysis of a word featuring exuberant exponence. As given in Figure 3.7, the word's MPH list features two occurrences of the gender V/VI plural marker *d*, each adjacent to a trigger, the stem *ek'* and the transitive marker *-iy*.

As indicated by coindexation, each instance of the agreement marker is introduced by the same realisation rule as its trigger, e.g. a single rule introduces both the stem *ek'* (b) and its dependent class marker (a). The same holds for

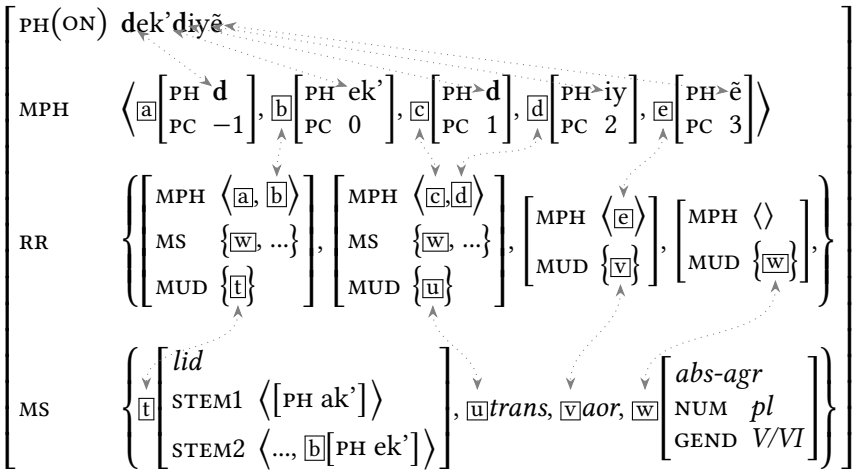

Figure 3.7: Sample analysis of Batsbi exuberant exponence

the transitivity marker *-iy* (d) and its accompanying class marker (c). Each of these complex rules expresses some property other than class agreement, as indicated by their MUD value, e.g. lexemic identity (t), or transitivity (u), but both are conditioned on the morphosyntactic property of gender/number agreement (w), specified as a constraint on the entire MS set. Since gender/number agreement has no expression independent of a trigger, and since in many words there is no overt exponent of class marking agreement, owing to the fact that only around 25% of stems and a select few suffixes license these dependent markers, I shall assume that class marking is expressed by default zero realisation, i.e. a rule that realises any property that has no more specific realisation rule by the empty set of morphs.[9] When class agreement does indeed surface, its dependent nature is best understood in terms of inflectional allomorphy.

[9]This rule is similar in spirit to the identity function default of Stump (2001). Note that in IbM, just like in PFM, this kind of default reasoning is part of the logic, based entirely on the notion of information. Furthermore, it only applies between rule instances, i.e. leaves of the hierarchy, leaving multiple inheritance in the type hierarchy entirely monotonic. This contrasts sharply with Network Morphology (=NM Brown & Hippisley 2012), where defaults are used at the description level and at any node in the hierarchy, necessitating strong assumptions about orthogonality of properties in order to keep resolution of defaults sound. In the remainder of this chapter, I shall make no further reference to NM, for the simple reason that, as far as I am aware, the two areas under discussion here, i.e. multiple exponence and morphotactics, have not been the focus of research in that framework, making it difficult to assess its predictions.

5.3 Rule types for gender/number marking

Having sketched the overall line of analysis, I shall now present a description of the actual rule system starting with the type hierarchy that associates gender/number agreement features with any particular shape of class marker.

At the top of the hierarchy in Figure 3.8, we find properties common to all class markers. First and foremost, the morphotactic description on MPH captures the fact that all class marking is dependent, consisting of two adjacent morphs. This basic property is expressed by means of requiring the list of morphs to be contributed by any class-marking rule to be bimorphic, i.e. a list of length 2. The phonology (PH) and position class (PC) of the morphs thus contributed are further constrained to have a consonantal morph immediately followed by a vowel-initial one, as dictated by the strictly consecutive position class indices. Second, the general rule type and its subtypes are restricted to have an *abs-agr* feature structure on the morphosyntactic property set.

Subtypes in the hierarchy in Figure 3.8 now further constrain the shape of the class marker. At the first level down in the hierarchy, the phonological shape of the initial consonantal marker is fixed. While *v-* is restricted to the singular of gender I and *d-* is treated as the default class marker, the two remaining markers *b-* and *j-* are both subject to unmotivated syncretism. This can be captured in a straightforward way by fixing their morphosyntactic constraints extensionally on the subtypes they dominate. This is possible since rule instances in IbM are only ever based on leaf types, following Koenig (1999).

As given in Figure 3.8, the rule type for default CM marking is fully underspecified. The version of Pāṇini's principle that IbM assumes will actually preempt application of any more general rule in the presence of a more specific one.

(13) Pāṇinian Competition (PAN) (Crysmann 2017)

1. For any leaf type $t_1[\textsc{mud}\ \mu_1,\textsc{ms}\ \sigma]$, $t_2[\textsc{mud}\ \mu_2,\textsc{ms}\ \sigma \wedge \tau]$ is a morphological competitor, iff $\mu_1 \subseteq \mu_2$.
2. For any leaf type t_1 with competitor t_2, expand t_1's MS σ with the negation of t_2's MS $\sigma \wedge \tau$: $\sigma \wedge \neg(\sigma \wedge \tau) \equiv \sigma \wedge \neg\tau$.

According to Pāṇinian competition, which is a closure operation on the type hierarchy, the MS set of the more general description for the default marker *d-* will end up being specialised to the description in Figure 3.9 below, which is essentially complementation with respect to the descriptions of its competitors.

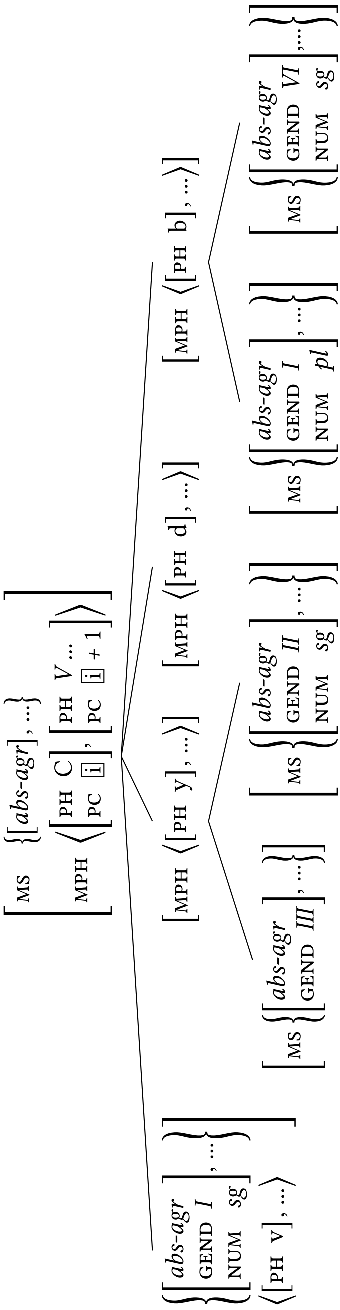

Figure 3.8: Subhierarchy of class marker rules

$$\left[\begin{array}{ll} \textsc{mph} & \left\langle \begin{bmatrix} \textsc{ph} & \text{d} \\ \textsc{pc} & \boxed{i} \end{bmatrix}, \begin{bmatrix} \textsc{ph} & \text{V...} \\ \textsc{pc} & \boxed{i}+1 \end{bmatrix} \right\rangle \\ \textsc{ms} & \{\textit{abs-agr},...\} \wedge \left(\begin{array}{l} \neg \left\{ \begin{bmatrix} \textit{abs-agr} \\ \textsc{gend} & \textit{I} \end{bmatrix}, ... \right\} \wedge \\ \neg \left(\left\{ \begin{bmatrix} \textit{abs-agr} \\ \textsc{gend} & \textit{II} \\ \textsc{num} & \textit{sg} \end{bmatrix}, ... \right\} \right) \wedge \\ \neg \left\{ \begin{bmatrix} \textit{abs-agr} \\ \textsc{gend} & \textit{III} \end{bmatrix}, ... \right\} \wedge \\ \neg \left(\left\{ \begin{bmatrix} \textit{abs-agr} \\ \textsc{gend} & \textit{VI} \\ \textsc{num} & \textit{sg} \end{bmatrix}, ... \right\} \right) \end{array} \right) \end{array}\right]$$

Figure 3.9: Pāṇinian competition applied to default CM marker *d-*

5.4 Deconstructing class marking (suffixes)

Having introduced the partial constraints on the shape and position of the class markers, we are now in a position to bring them together with the suffixal markers on which they depend. The essential analytic device we shall rely on is Online Type Construction (Koenig & Jurafsky 1994), which enables us to state constraints on class markers and their licensors in dimensions of their own, yet distribute rule types in one dimension over the types in the other. Thus, each individual ingredient can be described in the most general way, while at the same time we can ensure their systematic combination.

The hierarchy of rule types in Figure 3.10 is organised into two dimensions, labelled ALLOMORPHY and EXPONENCE. In the former, one finds the type hierarchy of class marking from Figure 3.8, with class-marking leaf types abbreviated by the representative rule type for the *d*-marker. In the EXPONENCE dimension, we find realisation rule types for markers that show class-marking allomorphy, such as the present evidential or the intransitive, and some that do not. All realisation rules in this dimension specify a morphosyntactic property to be expressed via their non-empty MUD set, and all of them pair this property with a constraint on the exponent that serves to express this property, consisting of a phonological description and a position class index. The crucial difference between exponents that are accompanied by a class marker and those that are not is the constraint on the cardinality of the MPH set: while the latter specify a closed list (of length 1), those that do require a class marker are characterised by an open list.

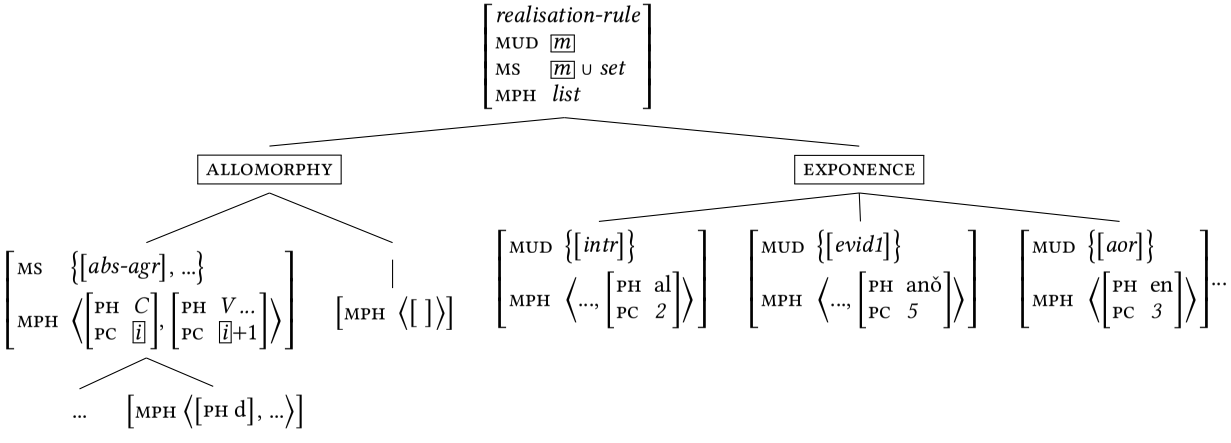

Figure 3.10: Hierarchy for suffix and class marking rule types

Building on Online Type Construction (Koenig & Jurafsky 1994), IbM obtains the set of rule instances by systematic intersection, under unification, of every leaf type from every dimension with every leaf type from every other dimension. The rule instances thus inferred from the type hierarchy are then subject to Pāṇinian competition.

Rule types that do not take a class marker specify a monomorphic MPH set and therefore fail to unify with any of the class marking constraints, which are constrained to have a bimorphic MPH set, as specified on their supertype. Thus, rule types such as the one for the aorist can only combine with the rightmost leaf type in the ALLOMORPHY dimension, which merely constrains the cardinality of the MPH set to 1. Rule types that do take class markers, by contrast, do unify with the class marking constraints, yielding all combinations of class markers with the triggering marker.[10] When unifying class-marking and triggering types, unification of the phonological descriptions will ensure that morphs introduced in the two dimensions will receive the correct position class indices, thereby enforcing left adjacency of the class-marker to the triggering marker.

$$\begin{bmatrix} \textsc{mud} & \{[]\} \\ \textsc{mph} & \langle\rangle \end{bmatrix}$$

Figure 3.11: Default zero realisation

Finally, since expression of agreement properties does not necessarily have to be overt, I shall propose that agreement in Batsbi is expressed by a default rule of zero realisation, as shown in Figure 3.11. So any single morphosyntactic property that does not have any more specific expression can be realised without introducing any morphs. This will capture the vast number of cases where indeed no overt marking of agreement is found: as stated above, only a quarter of stems in the Batsbi lexicon license class agreement markers and only a select few affixes. If we assume that class agreement in Batsbi does not necessarily have an overt expression, we can treat those cases where we do find agreement as allomorphic variations of certain stems and affixes, as sketched in the analysis in Figure 3.7. Thus, by taking the majority case of zero exponence as our point of departure and treat dependent overt exponence as inflectional allomorphy, we avoid making arbitrary or even conflicting decisions about which overt exponents are realisations of agreement and which ones are just allomorphs.

[10] To be exact, triggering markers will also combine with the underspecified monomorphic rule type. However, these rules will always be preempted by the more specific rules showing allomorphic gender/number variation.

5.5 Deconstructing class marking (stems)

As we have seen in Section 2.2, agreement marking of stems is ultimately decided in the lexicon: some stems take a class marker, some do not, and for some lexical entries we even find alternation where one stem in a lexeme's stem space comes with a class marker, but the other does not. To make sense of this lexically conditioned alternation, I shall build on the notion of stem spaces as proposed by Bonami & Boyé (2006). In IbM, stem spaces are provided by the lexeme and stem introduction rules, a subtype of realisation rules, serve to select an appropriate stem from the stem space and insert it into MPH (see Bonami & Crysmann (2018) for details on the interface between lexemes and the inflectional system).

As a first step to integrate inflecting and non-inflecting stems, I shall sketch a sample lexical entry for the alternating verb *ak'/ek'* and subsequently show how the general stem selection rules of the language will thread this lexemic information into the inflectional system, where it will take part in the allomorphic alternation we described above.

$$\left[\begin{array}{l}\textsc{synsem}\ \left[\textsc{loc}\ \left[\begin{array}{l}\textsc{cat}\ \left[\begin{array}{ll}\textsc{head} & \textit{verb}\\ \textsc{val} & \left[\begin{array}{ll}\textsc{subj} & \left\langle \mathrm{NP}\left[\textit{abs}\right]_{\boxed{1}}\right\rangle\\ \textsc{comps} & \langle\rangle\end{array}\right]\end{array}\right]\\ \textsc{cont}\ \left[\textsc{rels}\ \left\langle\left[\begin{array}{ll}\textsc{pred} & \textit{fall}\\ \textsc{arg1} & \boxed{1}\end{array}\right]\right\rangle\right]\end{array}\right]\right]\\ \textsc{morph}\ \left[\textsc{ms}\ \left\{\left[\begin{array}{ll}\textit{lid}\\ \textsc{stem1} & \left\langle\left[\textsc{ph}\ \text{ak'}\right]\right\rangle\\ \textsc{stem2} & \left\langle[],\left[\textsc{ph}\ \text{ek'}\right]\right\rangle\end{array}\right],\ldots\right\}\right]\end{array}\right]$$

Figure 3.12: Sample lexical entry of a Batsi verb

At the lexical level, all it takes is to differentiate in the stem space between inflecting and non-inflecting stems. A most straightforward way of doing this is to replicate in the specification of stems a distinction we have already drawn for affixal markers, namely between monomorphic and bimorphic. Thus, an alternating stem such as *ak'/ek'* will have a singleton list as the value of STEM1, but a two-elementary list as the value of STEM2, as shown in Figure 3.12.

Stem introduction rules are given in the rule type hierarchy in Figure 3.13: just like the realisation rules for the aorist, evidential, transitive etc. in Figure 3.10 above, the stem introduction rules are part of the EXPONENCE dimension, so they are available for cross-classification with the class marking rule types. The two stem selection rules given here identify their MPH value with that of a stem

value in MUD, STEM2 in the perfective, and STEM1 otherwise. Note that neither stem selection rule limits the arity of the stem values or of their MPH list. Thus, they both unify freely with any of the types in the ALLOMORPHY dimension, including all of the class-marking rule types, as well as the non-marking monomorphic type. Thus, cross-classification by online type construction will derive both bimorphic class-marking and monomorphic non-marking stem selection rules.

However, once any of the stem selection rules is applied to a concrete lexeme, bimorphic class marking rules will only be applicable to stem values of arity two, whereas monomorphic non-marking stem selection rules will exclusively apply to stem values of arity one.

To conclude, the present analysis of exuberant exponence in Batsbi exploits the fact that IbM recognises many-to-many relations between morphosyntactic properties at the most basic level of representation, namely realisation rules. Using online type construction in an inheritance hierarchy of rule types, the two most central generalisations regarding exuberant exponence in this language can be given a unified and straightforward account, by separating constraints on the shape of class markers from licensing their presence: Thus, while triggering affix rules and stems ultimately decide on whether they must (or may not) combine with a class marker, the constraints on class-marking are stated separately, distributing over rules of exponence.

5.6 Reflections on the dependent nature of exuberant exponence

The kind of exuberant exponence expounded in Batsbi witnesses two important properties: first, agreement marking is dependent on an adjacent triggering marker, a stem or some affix, and the number of class markers found then depends on the number of triggering stems or suffixes present in the word, yielding a variable degree of exuberant exponence. The formal analysis does justice to these two observations by treating the dependent class marker as morphologically conditioned allomorphy of the triggering stem or suffix. This raises the obvious question whether exuberant exponence must in general be of the dependent type.[11] Fully redundant multiple exponence involving more than two markers is rare, so I shall extrapolate from what we know about multiple exponence in general.

To answer this question, let us consider pre-prefixation in Nyanja (Stump 2001; Crysmann 2017): in this language a subclass of adjectives takes two agreement markers, one from the set of adjectival markers, the other from the set of verbal agreement markers.

[11]Thanks to Jean-Pierre Koenig for drawing my attention to this.

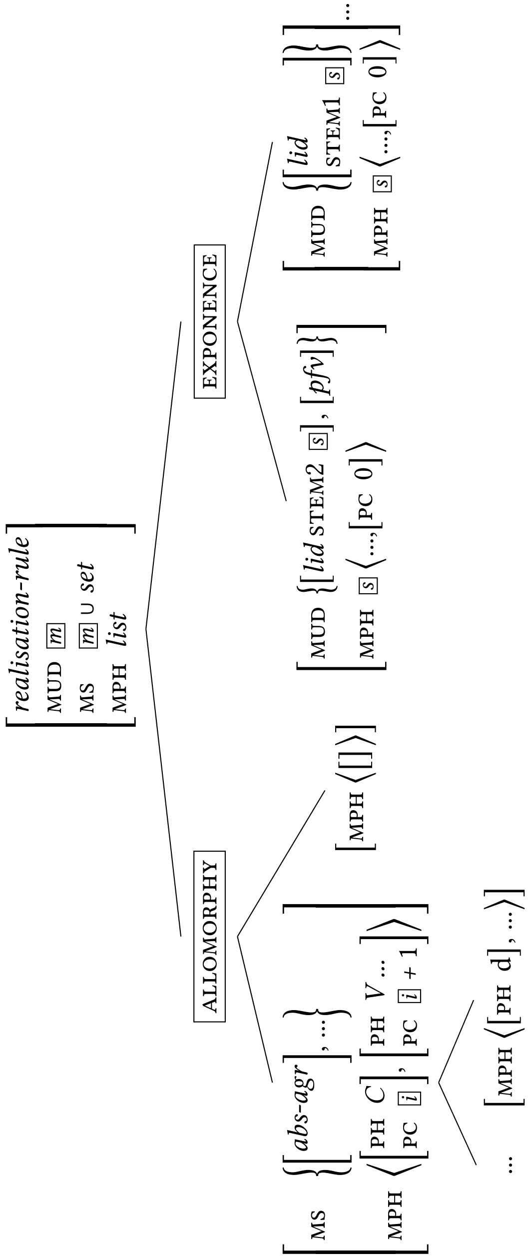

Figure 3.13: Stem selection and class-marking rule types

(14) a. ci-lombo ci-kula.
cl7-weed conc7-grow
'A weed grows.'

b. ci-manga ca-bwino
cl7-maize qual7-good
'good maize'

(15) ci-pewa ca-ci-kulu
cl7-hat(7/8) qual7-conc7-large
'a large hat'

Multiple exponence in Nyanja is solely determined by inflection class membership, and the two agreement markers surface adjacent to each other, without any additional triggering exponent. In IbM, this situation has been analysed by means of composing simple verbal and adjectival markers into a class-specific morphotactically complex marker (Crysmann 2017). However, what we find here is composition of similar yet non-identical markers, each of which is attested independently.

The crucial difference between Nyanja and Batsbi is that the number of exponents is fixed in the former for any given inflection class, but it is variable and dependent on the presence of concrete stems and suffixes in the latter. Whenever multiple exponence is morphotactically dependent, the formal approach sketched here, which composes each instance of multiple marking with a triggering exponent, is to be preferred. It so happens that this approach is also much more apt at handling variable degrees of exuberance, a property that is actually expected, if exponence is dependent on a triggering marker. Composition among the instances of multiple exponence, by contrast, is the way to go, if multiple exponence is morphotactically independent and fixed with respect to the degree of exuberance.

6 Conclusion

In this paper I have discussed exuberant exponence in Batsbi (Harris 2009). I have shown that the design property of IbM to recognise $m : n$ relations between form and function at the level of realisation rules lends itself naturally to accounting for the dependent nature of these markers. Thus, under the perspective offered here, exuberant class marking in Batsbi is just a case of allomorphy on the markers/stems they depend on, conditioned by number and gender properties. The uniformity of shape of these markers has been captured by a system

of cross-classifying type hierarchies along the dimensions of allomorphy and exponence, building on the formal notion of Online Type Construction (Koenig & Jurafsky 1994) standardly embraced by IbM. As a result, I have offered a theory of Batsbi exuberant exponence that is as holistic as necessary to capture dependence, and at the same time as atomistic as possible, thereby facilitating reuse. In other words, the current approach captures the constructional properties of the system within a formal generative model.

Finally, this paper provided some meta-theoretical result, showing that there is only limited a priori superiority of inferential-realisational approaches over lexical-realisational ones: just as much as the conceptual foundations, it is the formal expressivity of the specific framework that determines its adequacy in light of exuberant exponence.

Abbreviations

The glosses in this chapter follow the original description by Harris (2009), slightly adapted to adhere more fully to the Leipzig conventions. Here is a list of additional abbreviations being used: CM (class marker), PRES (present), AOR (aorist), EVID1 (evidential 1), CON (contact case). Furthermore, inherent noun class is indicated by means of the exponents of the singular and plural class markers.

Acknowledgements

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Chapter 4

Periphrasis and morphosyntatic mismatch in Czech

Olivier Bonami
Université de Paris, Laboratoire de linguistique formelle, CNRS

Gert Webelhuth
Goethe-Universität Frankfurt a.M.

This paper presents an HPSG analysis of the Czech periphrastic past and conditional at the morphology-syntax interface. After clarifying the status of Czech auxiliaries as words rather than affixes, we discuss the fact that the past tense exemplifies the phenomenon of *zero periphrasis*, where a form of the main verb normally combined with an auxiliary can stand on its own in some paradigm cells. We argue that this is the periphrastic equivalent of zero exponence, and show how the phenomenon can be accommodated within a general theory of periphrasis, where periphrasis is a particular instance of a mismatch between morphology and syntax.

1 Introduction

The term "inflectional periphrasis" denotes a situation where a construction involving two or more words stands in paradigmatic opposition with a single word in the expression of a morphosyntactic contrast. The two Czech examples in (1) illustrate this: where the present indicative of ČEKAT is expressed by the single word *čekáme* in (1a), its past indicative is expressed by the combination of the two words *jsme* and *čekali*, as shown in (1b).

(1) a. Čekáme na Jardu.
wait.PRS.1PL for Jarda.ACC.SG
'We are waiting for Jarda.'

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b. Čekali jsme na Jardu.
wait.LF.M.AN.PL be.PRS.1PL for Jarda.ACC.SG
'We were waiting for Jarda.'

Traditional grammars of European languages treat inflectional periphrases as part of the inflectional paradigm. While this is intuitively satisfactory, capturing that intuition within contemporary lexicalist formal grammar has proven particularly elusive, for reasons outlined with great clarity by Matthews (1991: 219–220): a periphrase is "clearly two words, which obey separate syntactic rules (for example, of agreement). Nevertheless they are taken together as a term in what are otherwise morphological oppositions." Meeting the challenges raised by that observation has been the focus of much attention since the seminal work of Vincent & Börjars (1996) and Ackerman & Webelhuth (1998), including publications such as Sadler & Spencer (2001); Ackerman & Stump (2004); Stump & Hippisley (2011); Brown et al. (2012); Bonami & Webelhuth (2013); Popova & Spencer (2013); Stump & Finkel (2013); Dalrymple (2015); Bonami (2015).

The Czech past indicative presents an additional conceptual challenge for theories of periphrasis. While the expression of the past tense is periphrastic in general, it is not in the third person, where the same form of the main verb is used on its own (2). Two things are remarkable here: the fact that periphrasis is the default while synthesis is the special case, and the apparent finiteness mismatch between what looks like a nonfinite form of the main verb and the finite clause it presumably heads.

(2) Čekali na Jardu.
wait.LF.M.AN.PL for Jarda.ACC.SG
'They were waiting for Jarda.'

The goal of this paper is to show that the approach to periphrasis developed in Bonami (2015) and Bonami et al. (2016) readily accounts for this situation, because it sees periphrasis as a special instance of a more general notion of morphosyntactic mismatch.

Section 2 presents the basic data. Section 3 shows that previous approaches to the Czech facts do not really address the challenges raised by the contrast between (1b) and (2). Section 4 presents the framework and shows how it can be deployed to account for the basic properties of the Czech past tense.

2 The data

2.1 The paradigmatics of the Czech present and past tenses

Table 4.1 shows the positive past subparadigm of a Czech verb.[1]

Table 4.1: Positive past subparadigm of ČEKAT 'wait'

	PST			
	MAS.ANIM	MAS.INAN	FEM	NEU
1SG	čekal jsem	čekal jsem	čekala jsem	čekalo jsem
2SG	čekal jsi	čekal jsi	čekala jsi	čekalo jsi
3SG	čekal	čekal	čekala	čekalo
1PL	čekali jsme	čekaly jsme	čekaly jsme	čekala jsme
2PL	čekali jste	čekaly jste	čekaly jste	čekala jste
3PL	čekali	čekaly	čekaly	čekala

As can be inferred from the table, all forms of the Czech past tense are based on a form we will call the *l*-form, ending in the suffix *-l*. While it is the historical descendant of a participle, the *l*-form is used only in the formation of the Czech past indicative, and present and past conditional. There are no nonfinite clauses headed by the *l*-participle; passive is also periphrastic, but relies on a different passive participle, as shown by the contrast in (3).

(3) a. Koupil jsem knihy.
buy.LF.M.SG be.PRS.1SG book.ACC.PL
'I bought books.'

b. Knihy byly koupeny.
book.NOM.PL be.LF.F.PL buy.PASS.F.PL
'Books were bought.'

Hence it is misleading to call that form a participle from a synchronic point of view. In addition, when used without an accompanying auxiliary, the *l*-form is the sole exponent of the past. This motivates the fact that traditional grammar calls it the "past form". This term is again a bit misleading, since the *l*-form is

[1]For simplicity we do not include polite plural forms such as *čekal jste*, which implement a number mismatch between the main verb and the participle. See https://www.czechency.org/slovnik/VYKÁNÍ (Karlík et al. 2016). These can be integrated straightforwardly in the analysis below by refining the mapping between HEAD and INFL values.

also used in the construction of the conditional periphrases, where it is clearly not an exponent of the past, as we will see below. We will keep on using the morphosyntactically opaque label "*l*-form" and gloss it as "LF".

The *l*-form systematically agrees in gender and number with the subject. Note that in the plural, differences between masculine animate on the one hand, and feminine and masculine inanimate on the other hand, is purely orthographic, as sequences ⟨ly⟩ and ⟨li⟩ note the same phonemic sequence /lɪ/.[2]

In the first and second person past, the *l*-form is obligatorily accompanied by an auxiliary, which we will call the past indicative auxiliary. That auxiliary is homophonous with a present indicative form of the copula BÝT, and exhibits agreement in person and number with the subject. In the third person, by contrast, the *l*-form obligatorily occurs on its own. Despite the existence in Czech of third person forms of the auxiliary, adding such a form to an example such as (2) leads to ungrammaticality.

(4) * Čekali jsou.
wait.LF.M.AN.PL be.3PL

It is worth stressing that, unlike some other Slavic languages, Czech requires the overt presence of a copula in copular constructions in all persons (5). Hence omission of the auxiliary in the past indicative is specific to that (periphrastic) construction.

(5) a. Děti jsou rády.
child.NOM.PL be.PRS.3PL happy.F.NOM.PL
'The kids are happy'

b. * Děti rády.
child.NOM.PL happy.F.PL

Finally, the *l*-form is the locus of expression of negation in the periphrastic past: while negation is expressed as a prefix on the only verb in synthetic forms such as the present or third person past, it is obligatorily expressed on the main verb, and cannot be expressed on the auxiliary, in the periphrastic first and second person.

(6) Nečekáme na Jardu.
NEG.wait.PRS.1PL for Jarda.ACC.SG
'We are not waiting for Jarda.'

[2] In Czech orthography, ⟨y⟩ and ⟨i⟩ note the same short vowel /ɪ/, while ⟨ý⟩ and ⟨í⟩ note the same long vowel /i:/. The ⟨i⟩ vs. ⟨y⟩ contrast indicates presence vs. absence of palatalization for the preceding consonant, for those consonants that are subject to palatalization, which /l/ is not.

(7) Nečekali na Jardu.
NEG.wait.LF.M.AN.PL for Jarda.ACC.SG
'They were not waiting for Jarda.'

(8) a. Nečekali jsme na Jardu.
NEG.wait.LF.M.AN.PL be.PRS.1PL for Jarda.ACC.SG
'We were not waiting for Jarda.'

b. * Čekali nejsme na Jardu.

c. * Nečekali nejsme na Jardu.

We now turn to a brief description of the conditional. As Table 4.2 illustrates, the present conditional is formed by combining a finite form of the conditional auxiliary BY[3] and the *l*-form. As in the past indicative, the auxiliary agrees in person and number, and the *l*-form in number and gender, with the subject. Also as in the past indicative, negation is expressed on the *l*-form.

(9) Nečekali bychom na Jardu.
NEG.wait.LF.M.AN.PL COND.1PL for Jarda.ACC.SG
'We would not wait for Jarda.'

Unlike what happens in the past indicative, a form of the auxiliary is obligatorily present in the third person. Hence an *l*-form not accompanied by an auxiliary is unambiguously a past indicative third person form.

Table 4.2: Present conditional subparadigm of ČEKAT 'wait'

	MAS.ANIM	MAS.INAN	FEM	NEU
1SG	čekal bych	čekal bych	čekala bych	čekalo bych
2SG	čekal bys	čekal bys	čekala bys	čekalo bys
3SG	čekal by	čekal by	čekala by	čekalo by
1PL	čekali bychom	čekaly bychom	čekaly bychom	čekala bychom
2PL	čekali byste	čekaly byste	čekaly byste	čekala byste
3PL	čekali by	čekaly by	čekaly by	čekala by

Two older periphrases further illustrate the contrast between the past and the conditional auxiliary.[4] Table 4.3 illustrates the past conditional. This combines

[3]The conditional auxiliary is historically a form of the copula BÝT, but is never used as an independent synthetic verb form in contemporary Czech.

[4]We are indebted to Alexandr Rosen for pointing out the relevance of the pluperfect here, and to Olga Nádvorníková for helping us clarify the synchronic status of these periphrases.

the conditional auxiliary with a form homophonous to the *l*-form of the copula, and the *l*-form of the main verb. As expected, the conditional auxiliary agrees in person and number, and both *l*-forms agree in number and gender, with the subject. By contrast, Table 4.4 illustrates the (indicative) pluperfect. In the first and second person, this combines the past auxiliary with a form homophonous to the *l*-form of the copula, and the *l*-form of the main verb. In the third person, just as in the simple past, there is no finite form of the auxiliary, and the apparent *l*-form of the copula is the only auxiliary element.

Table 4.3: Past conditional subparadigm of ČEKAT 'wait'

	MAS.ANIM	MAS.INAN	FEM	NEU
1SG	byl bych čekal	byl bych čekal	byla bych čekala	bylo bych čekalo
2SG	byl bys čekal	byl bys čekal	byla bys čekala	bylo bys čekalo
3SG	byl by čekal	byl by čekal	byla by čekala	bylo by čekalo
1PL	byli bychom čekali	byly bychom čekaly	byly bychom čekaly	byla bychom čekala
2PL	byli byste čekali	byly byste čekaly	byly byste čekaly	byla byste čekala
3PL	byli by čekali	byly by čekaly	byly by čekaly	byla by čekala

Table 4.4: Pluperfect subparadigm of ČEKAT 'wait'

	MAS.ANIM	MAS.INAN	FEM	NEU
1SG	byl jsem čekal	byl jsem čekal	byla jsem čekala	bylo jsem čekalo
2SG	byl jsi čekal	byl jsi čekal	byla jsi čekala	bylo jsi čekalo
3SG	byl čekal	byl čekal	byla čekala	bylo čekalo
1PL	byli jsme čekali	byly jsme čekaly	byly jsme čekaly	byla jsme čekala
2PL	byli jste čekali	byly jste čekaly	byly jste čekaly	byla jste čekala
3PL	byli čekali	byly čekaly	byly čekaly	byla čekala

A possible analysis of the constructions illustrated in Tables 4.3 and 4.4 posits the existence of a general past periphrase combining a finite or *l*-form past auxiliary with an *l*-form of the main verb. Under such an analysis, the past indicative (Table 4.1) relies solely on the general past periphrase with a finite auxiliary; the past conditional (Table 4.3) combines the conditional periphrase with the general past periphrase, using the *l*-form of the past auxiliary; and the pluperfect (Table 4.4) applies the general past periphrase recursively, with both a finite and an *l*-form auxiliary. Note that the *l*-form of the past auxiliary, unlike its finite forms, is not a clitic (see below), and is not dropped in the third person.

More work on earlier stages of the language would be needed to substantiate the feasibility of such compositional analyses of complex periphrases. For present purposes, corpus searches confirm that the forms in Tables 4.3 and 4.4 are clearly no longer in use, and we will not attempt to analyze them further.

To sum up this section, the past indicative contrasts with the present indicative in relying on an *l*-form for the main verb; it contrasts with conditional subparadigms in (i) the use of the past auxiliary in the first and second person, and (ii) the absence of an auxiliary in the third person. Such a distribution can be seen as the periphrastic equivalent of the familiar situation of "zero exponence". Consider the present subparadigm in Table 4.5. Here, the 3SG form contrasts with all other forms in the absence of a suffix following the vowel *-á-*. In the same way, in Table 4.1, the past indicative third person forms contrast with their first and second person equivalents in the absence of a past auxiliary; they likewise contrast with their conditional correspondents in the absence of one or two auxiliaries. By analogy with zero exponence, we will call this phenomenon 'zero periphrasis'.

Table 4.5: Present indicative subparadigm of ČEKAT 'wait'

	SG	PL
1	čekám	čekáme
2	čekáš	čekáte
3	čeká	čekají

One main goal of the present paper is to account for zero periphrasis in Czech. Before doing so, however, we need to discuss the morphosyntactic status of auxiliaries in this system.

2.2 The morphosyntactic status of the past auxiliary

The Czech past auxiliary is standardly described as a clitic, on the basis of the fact that it is systematically prosodically dependent on an adjacent word. In this context, within a lexicalist framework, it is crucial to establish whether this pretheoretical clitic status is to be analyzed by seeing the auxiliary as a prosodically deficient word, or "true clitic", or as some kind of phrasal affix, inserted by morphology on a word at the edge of some syntactically-defined constituent. In this section we review the evidence on the status of Czech clitics, and draw relevant consequences for the analysis of the past indicative periphrase. We rely mainly on the extensive discussion in Hana (2007), and ignore many complications.

Czech possesses a family of second position clitics. These form a rigidly ordered cluster that cannot be interrupted by any intervening material and consists of the following elements, in the indicated order:[5]

(10) a. Past or conditional auxiliary
b. Reflexive *se* (reflexivization of direct object) and *si* (reflexivization of indirect object)
c. Dative weak pronouns
d. Accusative weak pronouns
e. Genitive weak pronouns
f. Demonstrative *to*

There can be some amount of morphological fusion within the cluster. In particular, the sequence of a 2SG past auxiliary and a reflexive is fused to a portmanteau form, as indicated in (11). In addition to an organization in rigid position classes, this provides limited evidence for the view that the elements in the clitic cluster belong to a single syntactic word, and that the combination of the clitics is governed by morphology rather than syntax.

(11) a. jsi se > ses
PST.2SG REFL.ACC REFL.ACC.PST.2SG
b. jsi si > sis
PST.2SG REFL.DAT REFL.DAT.PST.2SG

In finite clauses, the clitic cluster linearizes after the first major constituent.[6] In most cases, the cluster attaches prosodically to that preceding constituent, as shown in example (12).

(12) Koupil =jsem =je pro Jardu.
buy.LF[M.SG] =be.PRS.1SG =ACC.PL for Jarda.ACC.SG
'I bought them for Jarda.'

However, as discussed by Toman (1996), the clitic cluster attaches to the following, rather than to the preceding constituent whenever a prosodic break needs to

[5]We leave aside adverbial clitics such as *už* 'already' and subtler aspects of the distribution of pronominal clitics. Note that *se* and *si* can also be used as part of so-called "inherent reflexive verbs", where they have no referential value and hence no true reflexive function.

[6]See Hana (2007: 98–114) for discussion of situations where the clitic follows what is pretheoretically a partial constituent or a sequence of constituents.

be present after the first constituent. This happens if a parenthetical, e.g. a non-restrictive relative clause modifies that first constituent, or if the first constituent is a clause. Toman's examples are given in (13–14); (15–16) provide parallel examples involving the past auxiliary.

(13) a. Knihy, které tady vidíte, se= dnes platí
book.NOM.PL which here see-2PL REFL= today pay.PRS.3PL
zlatem.
gold.INS.SG
'The books you can see here are paid for with gold today.'

b. * Knihy, které tady vidíte=se dnes platí zlatem.

(14) a. Poslouchat =ji, by= ji= asi nudilo.
listen =her would= her= probably bore.
'It would perhaps bore her$_i$ to listen to her$_j$.'

b. * Poslouchat =ji =by =ji asi nudilo.

c. * Poslouchat ji= by= ji= asi nudilo.

(15) Tu knihu, která se mi moc
DEM.ACC.SG.F book(F).ACC.SG which.NOM.F.SG REFL 1SG.DAT much
líbila, jsem= koupil v Praze.
like.PST.3SG.F be.PRS.1SG= buy.LF.M.SG in Prague.(F).LOC.SG
'This book, which I like very much, I bought in Prague.'

(16) Že tam bude, jsem= ne-věděl.
COMP there be.FUT.3SG be.PRS.1SG= NEG-know.LF.M.SG
'I did not know he would be there.'

Toman's observations provide a strong argument against a phrasal affixation analysis of Czech clitics: if clitics are affixes attached by morphology to the first constituent in the clause, it is predicted that they are always attached to that constituent, as morphology does not normally peer into syntax to decide where affixes should be attached; special mechanisms would need to be introduced to deal with examples (13–16), eliminating much of the appeal of a morphological analysis. On the other hand, this data is compatible with the view according to which clitics are just prosodically deficient words, occurring in a fixed syntactic position and attaching to the preceding or following constituent depending on prosodic properties of the context.

Pointing in the same direction is the observation by Rosen (2001: 210) that some lexical items, including the copula, can be clitic or nonclitic depending on

context. That the copula does not need to be clitic is evident from the fact that it can form a full utterance of its own, as a short answer to a question (second utterance in (17)), and can occur in first (first utterance in (17)) or third (18) position, unlike, e.g. the past auxiliary.[7] However, that it *can* be a clitic is evident from examples such as (19), cited by Rosen from the Czech National Corpus, where the copula occurs between the first constituent and a pronominal clitic. Since pronominal clitics obligatorily belong to the clitic cluster and the clitic cluster needs to be in second position, the copula has to also be part of the cluster in this and similar examples.

(17) A: Jsou děti takové?
be.PRS.3PL child.NOM.PL such.F.NOM.PL
'Are kids like that?'
B: Jsou. 'They are.'
be.PRS.3PL

(18) Děti takové jsou.
child.NOM.PL such.F.NOM.PL be.PRS.3PL
'Kids are like that.'

(19) Jedinou radostí =jsou mu dopisy z
only.INS.FEM.SG joy.INS.SG =be.3PL DAT.MAS.SG letter.NOM.PL from
domova, [...]
home.GEN.SG
'His only pleasure is the letters from home, [...]'

These facts strongly suggest that Czech clitics are words. If they were affixes, we would need two entirely separate mechanisms to generate the form *jsou*: a lexical entry in (17–18), a rule of morphology in (19). If on the other hand they are words, we just need to assume that clitichood is a property that can be underspecified: some words (e.g. most verbs, strong pronouns) are nonclitics, some (e.g. past and conditional auxiliaries, weak pronouns) are clitics, and some (e.g. finite forms of the copula) can be either.

We thus conclude that Czech clitics cannot be affixes. What remains unresolved at this point is whether each clitic should be considered a separate word, or whether the clitic cluster as a whole should be considered a word. We provided limited evidence for the latter view. However, because such a view raises

[7] The past auxiliary can occur clause-initially in questions in colloquial or "Common" Czech, but not in the more formal variety of "Standard" Czech (Hana 2007: 70). In this paper we ignore the complexities of Common Czech.

many issues for a lexicalist formal grammar, and because these issues are largely orthogonal to the analysis of periphrasis, we will not attempt to substantiate it. In the remainder of this paper we thus focus on cases where the only clitic in the clause is the auxiliary, in which case it has to constitute a word. We leave the proper treatment of the clitic cluster for future research.

3 Previous approaches

To the extent that previous approaches to the Czech past indicative within lexicalist formal grammars address the phenomenon of zero periphrasis, they rely on a reductionist approach based on zero auxiliaries.

The most explicit relevant analysis is that of Hana (2007), who assumes a phonologically empty auxiliary (p. 153). Hana takes the past auxiliary to raise all arguments of the *l*-form and combine in a flat structure. This leads to the parallel analyses in Figure 4.1, where sentences in the past indicative first and third person have exactly parallel structures.

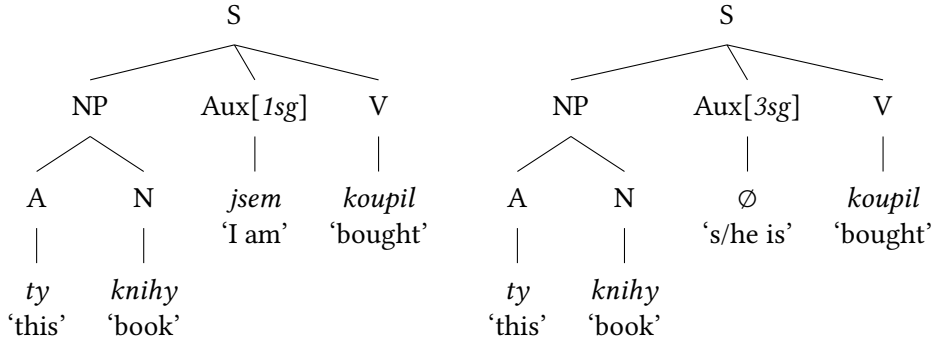

Figure 4.1: Czech auxiliaries according to Hana (2007)

While this is clearly a defendable analysis, it is subject to all the usual arguments against syntactic zero elements (Sag & Fodor 1994; Sag & Wasow 2011). In addition, from the point of view of inflectional morphology, it suffers from the same conceptual defect as all analyses relying on zero morphemes (Matthews 1991; Anderson 1992; Stump 2001; Blevins 2016): instead of modelling directly the fact that Czech grammar efficiently uses the contrast between presence and absence of an auxiliary to encode a morphosyntactic distinction, it treats that situation as a kind of defect of the system, which misleads the analyst (and, presumably, the speaker) into believing that there is nothing where in fact there is

something. Just as in synthetic morphology, it is conceptually more satisfactory to address the descriptive generalization directly.

A different take on the system is proposed by Tseng & Kupść (2007) in the context of a general discussion of Slavic past and conditional auxiliaries. In Polish, there is strong evidence that tense auxiliaries are phrasal affixes. To account for that situation, Kupść & Tseng (2005) propose an analysis along the lines shown in Figure 4.2.

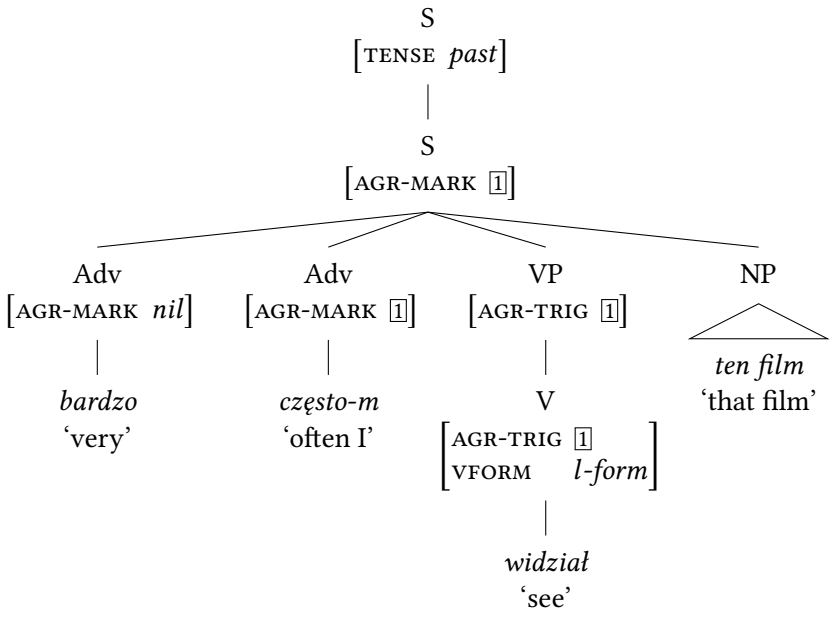

Figure 4.2: Polish auxiliaries as phrasal affixes (adapted from Tseng & Kupść 2007: 269).

The workings of the analysis rely on the two features AGR-TRIG and AGR-MARK. AGR-TRIG is a head feature which transmits the requirement for an agreement marker upwards from the main verb along the head path. At the clause level, the value of that feature is matched with that of the initial constituent's AGR-MARK feature. AGR-MARK itself is a (right) EDGE feature, which transmits information down to the right edge of the relevant subtree to the rightmost word in that tree. At the word level, the value of that feature is interpreted by inflectional morphology, and possibly realized as an affix.

In Polish as in Czech, no form of the auxiliary is used in the third person. Among other desirable features, the analysis in Kupść & Tseng (2005) reduces

this situation of zero periphrasis to a case of zero synthetic exponence: as suggested in Figure 4.3, the syntactic analysis is exactly the same in the third person; it just happens that inflectional morphology provides no exponent for the expression of [ARG-MARK *3sg*].

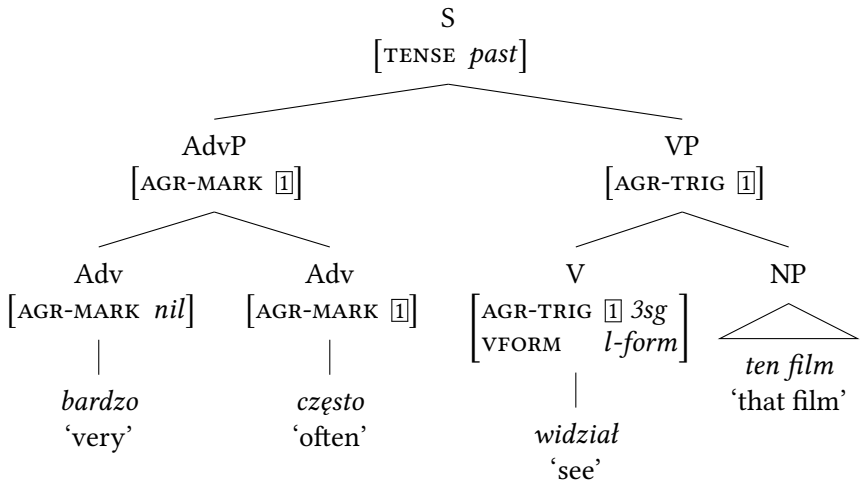

Figure 4.3: Zero periphrasis in Polish (adapted from Tseng & Kupść 2007: 269).

Tseng & Kupść (2007) suggest that the very same analysis proposed for Polish can be redeployed for Czech. Such an option is untenable, for the reasons we discuss in Section 2.2. Tseng (2009) is aware of this, and provides an extremely rough sketch of an analysis where the Czech copula is a clitic, in the form of the tree reproduced in Figure 4.4. While this tree gives a few hints as to what Tseng has in mind for the first and second person past indicative, with the auxiliary being an adjunct or marker attached to the initial constituent, it is entirely unclear how such an analysis will deal with zero periphrasis, unless a phonologically empty marker is postulated in the third person.

Finally, Petkevič et al. (2015) present a very careful HPSG approach to the formation of past and conditional periphrases in Czech, relying in particular on the idea that, in addition to their individual inflectional category, the auxiliary (called the *surface head*) and the main verb (called the *deep head*) jointly contribute to the construction of an analytic category. There are many similarities between this and Bonami's 2015 use of a distinction between HEAD and INFL features discussed below. However, Petkevič et al.'s approach says nothing on zero periphrasis: the principle regulating the distribution of tense and mood values

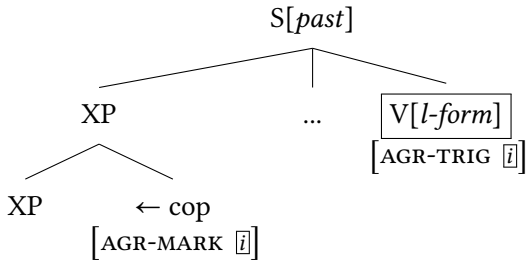

Figure 4.4: Tseng's 2009 sketch of an analysis of the Czech copula

in a periphrase is dependent on the presence of an auxiliary surface head in the syntax. According to Alexandr Rosen (p.c.), the treebank annotation scheme that the paper reports on resolves the issue by positing a third-person past tense form that is homophonous with the *l*-form, but not explicitly related to it. Hence such an approach implicitly treats the similarity between the forms in the first and second person on the one hand and third person on the other hand as synchronically accidental.

We thus conclude that previous literature on Czech and Slavic languages in HPSG and neighboring approaches provides no means of addressing the phenomenon of zero periphrasis.

4 Periphrasis as syntactic exponence

4.1 Main assumptions

In this subsection we outline the general approach to periphrasis that we will rely on in the remainder of this paper, building heavily on Bonami & Webelhuth (2013), Bonami (2015), and Bonami et al. (2016). This relies on three main ideas. First, we adopt an inferential-realizational approach to inflection (Matthews 1972; Zwicky 1985; Anderson 1992; Aronoff 1994; Stump 2001), where inflection and syntax are strictly separated, and the inflectional component deduces the phonological form of words jointly from the lexeme's lexical entry and the morphosyntactic description provided by syntax for that word in the context of a particular utterance. Crysmann & Bonami (2016) and Bonami & Crysmann (2016) present a detailed inferential-realizational approach to inflection within HPSG that is entirely compatible with the proposals discussed here. However, since we will not be discussing matters of synthetic exponence in detail, for present purposes we

can simply see inflection as a function f that deduces a phonological form from a SYNSEM object, as indicated in Figure 4.5.

$$word \rightarrow \begin{bmatrix} \textsc{phon} & f(\boxed{1}) \\ \textsc{synsem} & \boxed{1} \end{bmatrix}$$

Figure 4.5: Inflection as a function from syntax and semantics to phonology (preliminary version)

Second, we follow Ackerman & Webelhuth (1998); Sadler & Spencer (2001); Ackerman & Stump (2004) in assuming that periphrastic inflection can be seen as an alternative to ordinary (synthetic) inflection, where the combination of the main verb with an auxiliary serves as the exponent of a set of morphosyntactic properties, in the same way as the combination of a stem with an affix may serve as an exponent.

Third, our theory of periphrasis builds on the view that morphosyntactic mismatches in general require a distinction between paradigmatic oppositions as defined by syntax and semantics and their implementation in morphology: although in the canonical situation, the same distinctions made by syntax and semantics are used in morphology, there are various types of situations where morphology makes fewer (syncretism, neutralization), more (overabundance), or different (morphomic distributions, deponency) contrasts than syntax and semantics. This general idea is known under different names in the literature, with important technical differences that do not concern us here directly: Sadler & Spencer (2001) use two disjoint sets of *syntactic* and *morphological* features; Ackerman & Stump (2004) and Stump (2006; 2016) contrast *content paradigms* and *form paradigms*; Bonami & Samvelian (2015) oppose HPSG's SYNSEM attribute, collecting features relevant to syntax and semantics to the exclusion of phonology, to a distinct MORSYN attribute that collects those features that happen to be relevant to inflection. Finally, Bonami (2015); Bonami et al. (2016) make the simplifying assumption that syntactic and semantic contrasts relevant to inflection are coded as HPSG HEAD features, and hence contrast the value of the HEAD feature with that of the INFL feature, which is the direct input to inflection. In this paper we will adopt this final approach, which is sufficient for our purposes.

4.2 Modelling morphosyntactic mismatch

Under such an approach, the input to inflection is the INFL value, which will be identical to the HEAD value in the canonical situation, but may differ from it in grammatically specified ways in particular cases. This proposal is outlined in

Figure 4.6, where the dotted line represents the syntax-morphology interface: in simple cases, 1 and 2 will be equal, but the grammar will allow for (constrained) mismatches between the two values.

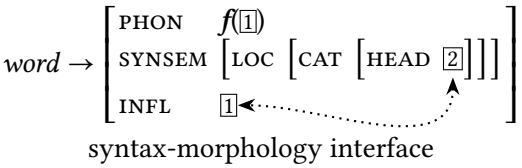

Figure 4.6: Inflection as a function from syntax and semantics to phonology (final version)

A crucial ingredient of such an approach, then, is a way of licensing limited deviations from identity between HEAD and INFL at the syntax-morphology interface. To this end, Bonami et al. (2016) propose that the grammar contain a set of dedicated interface implicational statements whose antecedent can mention any feature under WORD and whose consequent consists of specifications of feature values within INFL and/or reentrancies between HEAD and INFL. The statement in Figure 4.7 captures the default situation of an absence of mismatch: in the absence of any further specification, HEAD and INFL coincide.[8]

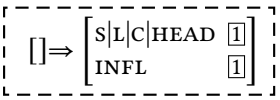

Figure 4.7: Interface statement: default identity between HEAD and INFL

This statement is sufficient to license the correct form in most situations. In particular it is the relevant statement for present forms of the verb in Czech, and contributes to licensing the analysis of the simple sentence in Figure 4.8.

Here we make some explicit assumptions about the feature geometry necessary to capture Czech inflection. As in Sag (2012) and related literature, the feature LID captures lexemic identity – all forms of a lexeme share the same LID value, and no two lexemes have identical LID values. For simplicity we first limit ourselves to the present and past indicative and the *l*-form, see Section 4.4 for an extension to the conditional. This simple subsystem can easily be captured using a single feature VFORM with possible values *l-form, prs, pst*. Our approach can trivially be generalized to the rest of the paradigm using a more elaborate feature geometry. The feature POL governs the inflectional realization of negation as

[8] We display interface statements in dashed boxes, in order to highlight their distinguished status in the grammar. S|L|C abbreviates SYNSEM|LOCAL|CAT.

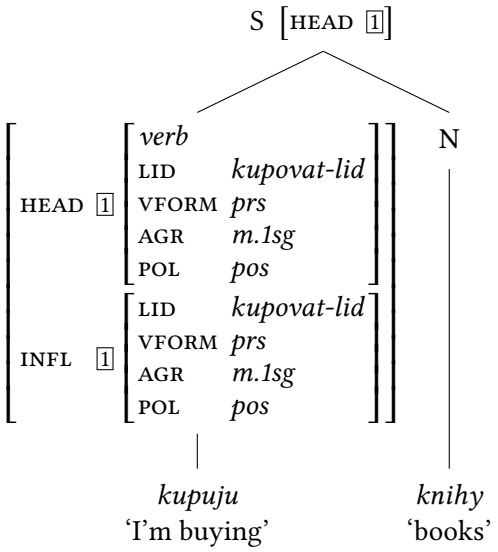

Figure 4.8: Analysis of a simple Czech clause in the present tense

the expression of its *neg* value. Finally, we assume that both finite and nonfinite forms of verbs have a full-fledged AGR value, with gender, number and person features. Implicit here is the hypothesis that rules of morphological exponence encapsulated in the function f relating INFL to HEAD will take care of the fact that *l*-forms neutralize person distinctions, while finite forms neutralize gender distinctions. Within an inferential-realizational view of inflection (Stump 2001), this simply amounts to having no rule realizing the neutralized category; see Zwicky (1986) for discussion and motivation. An obvious alternative would be to capture neutralizations in the feature system, by complicating the relationship between HEAD and INFL: under such a view, finite and nonfinite forms would have different features under INFL|AGR. Since the two solutions make the same empirical prediction, we adopt the simpler formulation based on morphology proper rather than the morphology-syntax interface.

While the interface statement in Figure 4.8 captures simple cases such as the present, extra statements are necessary to deal with situations of mismatch. For instance, we assume the statement in Figure 4.9 to account for the Czech third person past. What we want to capture here is the fact that the word *čekali* in a sentence such as (2) expresses the past third plural through a form that is not inherently a past form (e.g. it is used in the present conditional) nor a third person form (it is also part of the expression of first and second person plural past).

To this end, the statement contrasts the value of VFORM under HEAD with the value of VFORM under INFL: in essence, this states that, to express the past third person, one uses an *l*-form. All other feature values are constrained to be identical under HEAD and INFL. This ensures that the verb will be appropriately inflected for (positive or negative) polarity and for number and gender.

$$\left[\text{S|L|C|HEAD}\ \left[\begin{array}{ll}\textit{verb} & \\ \text{AGR} & [\text{PER}\ \textit{3}] \\ \text{VFORM} & \textit{pst}\end{array}\right]\right] \Rightarrow \left[\begin{array}{ll}\text{S|L|C|HEAD} & \left[\begin{array}{ll}\text{LID} & \boxed{2} \\ \text{AGR} & \boxed{3} \\ \text{POL} & \boxed{4}\end{array}\right] \\ \text{INFL} & \left[\begin{array}{ll}\text{LID} & \boxed{2} \\ \text{VFORM} & \textit{l-form} \\ \text{AGR} & \boxed{3} \\ \text{POL} & \boxed{4}\end{array}\right]\end{array}\right]$$

Figure 4.9: Interface statement: Third person past indicative

This statement thus licenses forms such as *koupil* in the sentence whose analysis is depicted in Figure 4.10.

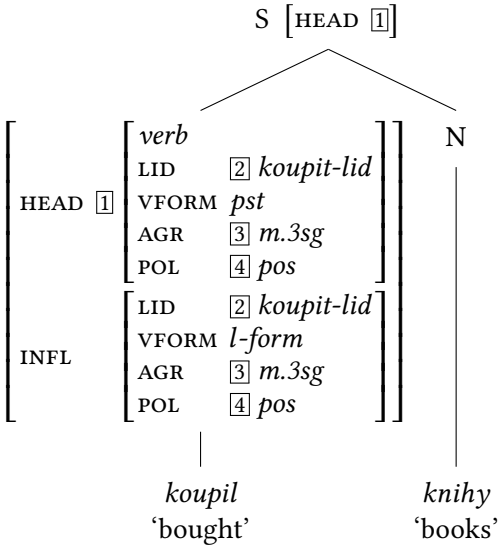

Figure 4.10: Analysis of a simple Czech clause in the third person past

We now have all the ingredients in place to turn to the analysis of periphrastic forms. Figure 4.11 exhibits the lexical entry of the Czech past auxiliary, which

embodies a number of assumptions. Following Hana (2007) and Petkevič et al. (2015), we assume that Czech auxiliaries are (surface) heads and raise the arguments of the main verb: both the subject [s] and the list of non-subject arguments [L] are raised from the main verb to the auxiliary's ARG-ST list. Following Bonami (2015), we assume that auxiliaries in general have unusual lexical identity. From the point of view of HEAD, they inherit the lexical identity of the main verb, which they project to phrase level, e.g. for purposes of selection. But from the point of view of inflection, they have their own properties that distinguish them from the main verb. This again can be captured by making use of the HEAD vs. INFL distinction, applied now to the LID feature: note the sharing of LID value [2] between the auxiliary's HEAD and that of its *l*-form complement. Finally, the lexical entry also enforces the sharing of HEAD|AGR and HEAD|POL values between auxiliary and main verb, ensuring appropriate inflection on the *l*-form.

$$\left[\begin{array}{ll}
\textsc{head} & \left[\begin{array}{ll} \textsc{lid} & \boxed{2} \\ \textsc{vform} & \textit{pst} \\ \textsc{agr} & \boxed{3} \\ \textsc{pol} & \boxed{4} \end{array}\right] \\
\textsc{infl} & \left[\textsc{lid}\ \textit{past-aux-lid}\right] \\
\textsc{arg-st} & \left\langle \boxed{s}, \left[\begin{array}{ll} \textsc{arg-st} & \langle \boxed{s} \rangle \oplus \boxed{L} \\ \textsc{head} & \left[\begin{array}{ll} \textsc{lid} & \boxed{2} \\ \textsc{vform} & \textit{l-form} \\ \textsc{agr} & \boxed{3} \\ \textsc{pol} & \boxed{4} \end{array}\right] \end{array}\right] \right\rangle \oplus \boxed{L}
\end{array}\right]$$

Figure 4.11: Lexical entry for the past auxiliary

It is important to note that neither of the previously stated syntax-morphology interface statements can apply to the auxiliary. The auxiliary is incompatible with both the default statement in Figure 4.7, and the more specific statement in Figure 4.9, since both enforce identity of HEAD|LID and INFL|LID. Thus a third statement, given in Figure 4.12, is necessary.

This states that, to inflect a verb in the past, one should use a word form that is the realization of the past auxiliary in the present tense, not inflected for polarity (whether the HEAD|POL value is positive or negative), and with appropriate person and number exponence. The fact that both the lexical entry in Figure 4.11 and the interface statement in Figure 4.12 refer to the INFL|LID value *pst-aux-lid* ensures that the use of the auxiliary is obligatory to express the past, and that the auxiliary can be used only in the expression of the past (as the only interface statement licensing the use of that auxiliary is restricted to the past).

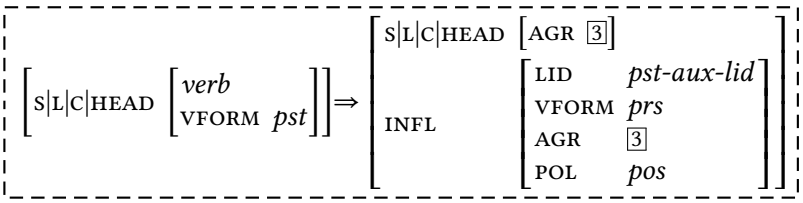

Figure 4.12: Interface statement: Third person past indicative

Figure 4.13 illustrates how the lexical entry for the auxiliary and the interface statement jointly license appropriate analyses for first or second person past indicative sentences. We purposefully choose a negative sentence to highlight the flow of information.

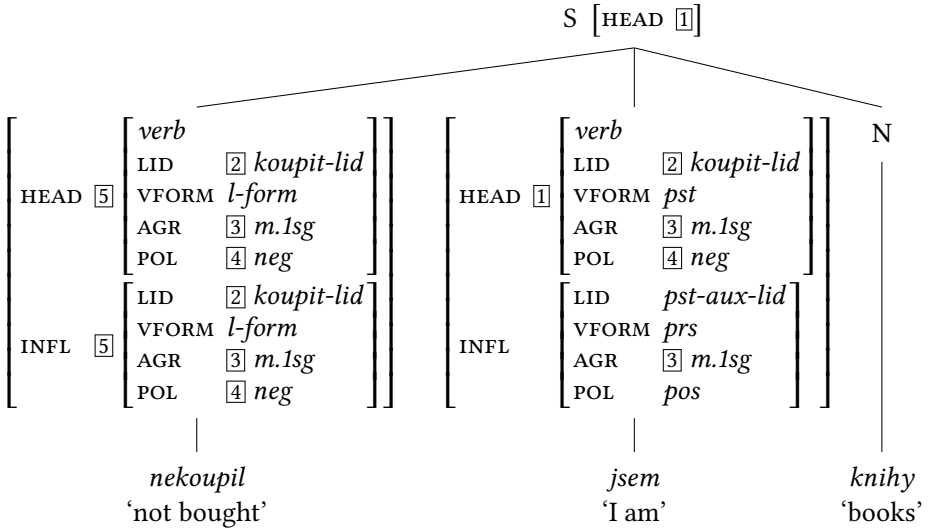

Figure 4.13: Analysis of a simple negative Czech clause in the non-third person past

It is useful to reflect on similarities and differences between the analyses of canonical synthetic inflection (Figure 4.8), mismatching synthetic inflection (Figure 4.10), and periphrastic inflection (Figure 4.13). In all three cases, the head word's HEAD specification is the locus of information relevant to syntax and semantics that gets projected to the phrasal level for purposes of selection and semantic composition. Synthetic and periphrastic past forms have in common a discrepancy between the head word's HEAD specification and its INFL specifica-

tion, with direct consequences for morphophonology. Thus they both instantiate morphosyntactic mismatch on the head word. What sets the first and second person past apart is the fact that exponence of the phrase's HEAD specification is distributed (Ackerman & Stump 2004) over two words: the main verb realizes polarity, gender and number, the auxiliary realizes person and number, and the combination of the two, as specified in the auxiliary's lexical entry, holistically realizes tense.

Note that, unlike the auxiliary, the main verb in this construction instantiates canonical morphosyntax: *nekoupil* is an *l*-form of the main verb, both from the point of view of HEAD (i.e., syntax) and INFL (i.e., morphology). This is in contrast with the use of the same word form in the third person past, where an [INFL|VFORM *l-form*] is used as the realization of [INFL|VFORM *pst*].

4.3 Paradigmatic competition

One remaining issue that has not been dealt with is paradigmatic competition between the three inflection strategies at hand: canonical synthetic inflection cannot be used in the past, periphrastic inflection in the past cannot be used in the third person. One way of dealing with this issue would be to add negative stipulations in various places so as to ensure that the three strategies are in complementary distribution. We contend that this is not a satisfactory approach, as it fails to capture the inherently paradigmatic competition between inflection strategies, and the fact that the same types of arbitration mechanisms regulating the choice of a synthetic exponent also regulate the choice between synthesis and periphrasis (Bonami 2015). In the case at hand, specificity seems to be at play: synthesis is the default, preempted by the more specific periphrastic past, which is itself preempted in the third person by the most specific third person past.

To capture this, we follow Stump (2006) in assuming that Pāṇini's Principle is active at the syntax-morphology interface, and regulates the use of the most specific inflection strategy wherever more than one strategy is available. Crysmann & Bonami (2016) present an HPSG-compatible formalization of Pāṇini's Principle for synthetic inflection defined as a closure operation on the descriptions of rules of exponence. In a nutshell, this assumes that each rule of exponence is a pairing of a description of a morphosyntactic context and an exponence strategy. The closure operation consists in identifying, for each rule R, the set of rules $S = R_1, \ldots, R_n$ whose morphosyntactic context is less specific than that of R, and to strengthen R's morphosyntactic context by the conjunction of the negations of the contexts of all rules in S. Bonami et al. (2016) propose to extend that

general modelling strategy to the syntax-morphology interface, through the use of interface statements such as those in Figures 4.7, 4.9, and 4.12. Specifically, they propose the following. The syntax-morphology interface takes the form of a set of conditional statements $S = \{A_1 \Rightarrow C_1, \ldots, A_n \Rightarrow C_n\}$. For each statement $A_i \Rightarrow C_i$, we first find the set of $S_i = \{A_i^1 \Rightarrow C_i^1, \ldots, A_i^k \Rightarrow C_i^k\} \subset S$ of statements whose antecedent is strictly more specific than A_i. Then each A_i is strengthened with the conjunction of the negations of all A_i^j. As a result, $A_i \Rightarrow C_i$ is replaced by $(A_i \wedge \neg A_i^1 \wedge \cdots \wedge \neg A_i^k) \Rightarrow C_i$, which is mutually exclusive with all the more specific statements in S.

$$\left(\begin{array}{l}[] \bigwedge \\ \neg \left[\textsc{head} \left[\textsc{vform} \ \textit{pst}\right]\right] \bigwedge \\ \neg \left[\textsc{head} \begin{bmatrix}\textsc{vform} & \textit{pst} \\ \textsc{agr} & \textit{3rd}\end{bmatrix}\right]\end{array}\right) \Rightarrow \begin{bmatrix}\textsc{head} & \boxed{1} \\ \textsc{infl} & \boxed{1}\end{bmatrix}$$

$$\left(\begin{array}{l}\left[\textsc{head} \left[\textsc{vform} \ \textit{pst}\right]\right] \bigwedge \\ \neg \left[\textsc{head} \begin{bmatrix}\textsc{vform} & \textit{pst} \\ \textsc{agr} & \textit{3rd}\end{bmatrix}\right]\end{array}\right) \Rightarrow \begin{bmatrix}\textsc{head} & \left[\textsc{agr} \ \boxed{3}\right] \\ \textsc{infl} & \begin{bmatrix}\textsc{lid} & \textit{past-aux-lid} \\ \textsc{vform} & \textit{prs} \\ \textsc{agr} & \boxed{3} \\ \textsc{pol} & \textit{pos}\end{bmatrix}\end{bmatrix}$$

$$\left[\textsc{head} \begin{bmatrix}\textsc{vform} & \textit{pst} \\ \textsc{agr} & \textit{3rd}\end{bmatrix}\right] \Rightarrow \begin{bmatrix}\textsc{head} & \begin{bmatrix}\textsc{lid} & \boxed{2} \\ \textsc{agr} & \boxed{3} \\ \textsc{pol} & \boxed{4}\end{bmatrix} \\ \textsc{infl} & \begin{bmatrix}\textsc{lid} & \boxed{2} \\ \textsc{vform} & \textit{l-form} \\ \textsc{agr} & \boxed{3} \\ \textsc{pol} & \boxed{4}\end{bmatrix}\end{bmatrix}$$

Figure 4.14: Literal effects of Pāṇinian strengthening

Figure 4.14 shows the literal effects of this process of Pāṇinian strengthening on the set of three interface statements presented respectively in Figures 4.7, 4.9 and 4.12. Figure 4.15 shows equivalent, more readable descriptions. As the reader can check, the net effect of the application of Pāṇini's principle is to end up with appropriately mutually exclusive statements in a principled, rather than stipulative, manner.

We have thus now presented a complete account of the interplay between synthesis and periphrasis in Czech indicative tenses. Crucially for our purposes, this account directly captures the phenomenon of zero periphrasis. First, synthetic and periphrastic past forms have much in common: both are instances of

$$\left[\textsc{head}\ \neg\left[\textsc{vform}\ \textit{pst}\right]\right] \Rightarrow \begin{bmatrix}\textsc{head} & \boxed{1}\\ \textsc{infl} & \boxed{1}\end{bmatrix}$$

$$\left[\textsc{head}\ \begin{bmatrix}\textsc{vform} & \textit{pst}\\ \textsc{agr} & \neg\textit{3rd}\end{bmatrix}\right] \Rightarrow \begin{bmatrix}\textsc{head} & \left[\textsc{agr}\ \boxed{3}\right]\\ \textsc{infl} & \begin{bmatrix}\textsc{lid} & \textit{past-aux-lid}\\ \textsc{vform} & \textit{prs}\\ \textsc{agr} & \boxed{3}\\ \textsc{pol} & \textit{pos}\end{bmatrix}\end{bmatrix}$$

$$\left[\textsc{head}\ \begin{bmatrix}\textsc{vform} & \textit{pst}\\ \textsc{agr} & \textit{3rd}\end{bmatrix}\right] \Rightarrow \begin{bmatrix}\textsc{head} & \begin{bmatrix}\textsc{lid} & \boxed{2}\\ \textsc{agr} & \boxed{3}\\ \textsc{pol} & \boxed{4}\end{bmatrix}\\ \textsc{infl} & \begin{bmatrix}\textsc{lid} & \boxed{2}\\ \textsc{vform} & \textit{l-form}\\ \textsc{agr} & \boxed{3}\\ \textsc{pol} & \boxed{4}\end{bmatrix}\end{bmatrix}$$

Figure 4.15: Simplified effects of Pāṇinian strengthening

noncanonical morphosyntax, and contrast in this with, e.g. present forms; both rely on an *l*-form of the lexeme being inflected to realize the past. Second, they contrast precisely in that an *l*-form on its own expresses third person, while in combination with an auxiliary it will express first or second person; the use of an auxiliary in the third person is blocked by the existence of a more specific strategy. There is no necessity to postulate that the auxiliary is defective, since its third person forms will never be required. This opens the door to capturing the common inflectional makeup between the past auxiliary and the copula by saying that they are distinct lexemes sharing the same PARADIGM IDENTIFIER (Bonami & Crysmann 2018).

4.4 Towards an analysis of the conditional

Having presented an analysis of the Czech past indicative at the morphology-syntax interface, in this final section we briefly present the challenges posed by the analysis of the conditional.

Remember from Section 2 that the Czech conditional comes in two tenses: the present (20a) relies on a finite auxiliary combined with the *l*-form of the main verb, while the past (20b) combines the finite conditional auxiliary also found in the present, a second element identical to the *l*-form of the copula, and the *l*-form of the main verb.

(20) a. Olga by koupila knihy.
Olga.NOM.SG cond[3SG] buy.LF.F.SG book.ACC.PL
'Olga would buy books.'

b. Olga by byla koupila knihy.
Olga.NOM.SG cond[3SG] be.LF.F.SG buy.LF.F.SG book.ACC.PL
'Olga would have bought books.'

Our analysis extends readily to the present conditional: just adding to the grammar the lexical entry for the conditional auxiliary in Figure 4.16 and the interface statement in Figure 4.17 will license analyses such as that shown in Figure 4.18.

Things are significantly more challenging, both conceptually and technically, for the past conditional. Looking at the examples in (20), it is very tempting to see the past conditional as the compositional combination of two periphrases, one for the expression of the conditional (shared with the present conditional) and one for the expression of the past (shared with the past indicative). Obviously, such an analysis would require modifying the geometry of inflection features to separate expression of tense from that of mood, but that poses no difficulty.

The two real challenges are the following. First, whereas in the indicative, there is no past auxiliary in the present, the past auxiliary is obligatorily realized in the past conditional. Here our general line of analysis provides an appropriate analytic tool: since the third person past indicative requires a dedicated interface statement anyway (see Figure 4.9), we can make that statement specific to indicative mood, while generalizing the statement licensing the past auxiliary (see Figure 4.12) to both moods.

Second, there is a complication with the expression of negation. Both in the past indicative and in the present conditional, negation can only be expressed on the *l*-form, as shown in (21–22). In the past conditional, however, expression of negation is variable, and can occur on either of the two *l*-forms (23), but not both.

(21) a. Nekoupil jsem knihy.
NEG.buy.LF[M.SG] be.PRS.1SG book.ACC.PL
'I didn't buy books.'

b. * Koupil nejsem knihy.

(22) a. Nekoupil bych knihy.
NEG.buy.LF[M.SG] cond.PRS.1SG book.ACC.PL
'I would not buy books.'

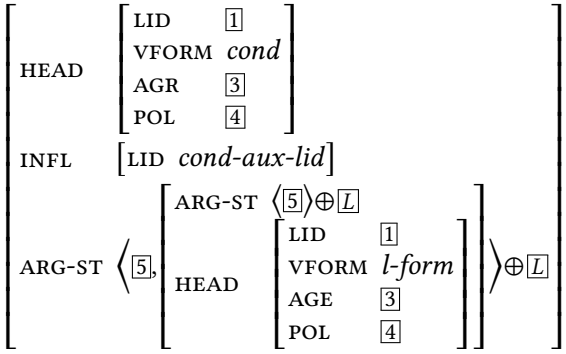

Figure 4.16: Lexical entry for the conditional auxiliary

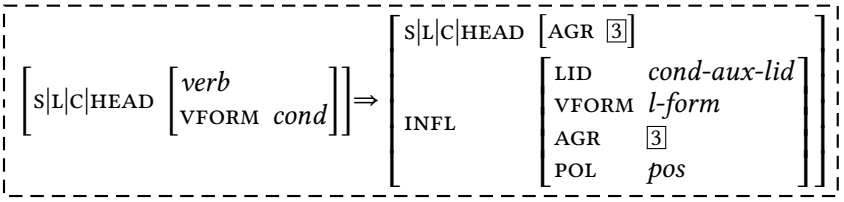

Figure 4.17: Interface statement for the present conditional

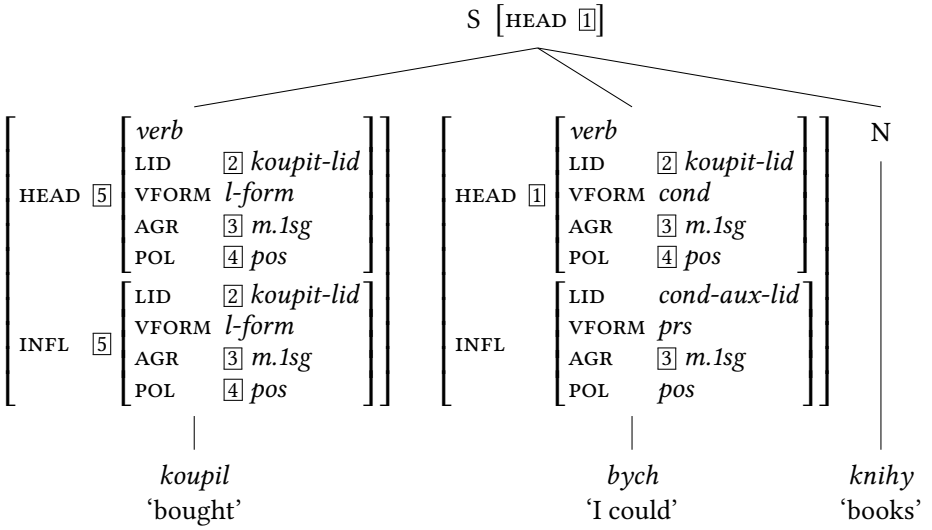

Figure 4.18: Analysis of a simple Czech clause in the present conditional

b. * Koupil nebych knihy.

(23) a. Byl bych nekoupil knihy.
be.LF[M.SG] cond.PRS.1SG NEG.buy.LF[M.SG] book.ACC.PL
'I would not have bought books.'

b. Nebyl bych koupil knihy.
NEG.be.LF[M.SG] cond.PRS.1SG NEG.buy.LF[M.SG] book.ACC.PL
'I would not have bought books.'

c. * nebyl bych nekoupil knihy.

Relevant evidence suggests that both variants in (23) are equally grammatical. Our informants have no consistent preference for one variant over the other, which is unsurprising, given that the past conditional is rarely used in contemporary usage, and felt as archaic. Searches in the Czech National Corpus reported in Table 4.6 suggest that expression of negation on the past auxiliary is preferred when it occurs before the (second position) conditional auxiliary, but that there is no such preference in the opposite order.

Table 4.6: Counts of occurrences of negative conditional forms consisting of three adjacent verbs in the SYN v6 Corpus (Hnátková et al. 2014)

	past > cond.	cond. > past
NEG on past auxiliary	433	372
NEG on main verb	32	307

The existence of such overabundance (Thornton 2012) in the expression of negation presents a significant challenge for the compositional analysis of the past conditional: given what we observe in the past indicative and present conditional, a compositional analysis predicts that negation should be expressible on the main verb only. Evidence from negation thus suggests a holistic analysis of the past conditional periphrase, whereby a single rule of periphrasis licenses a combination of three words, with a dedicated flow of morphosyntactic information. While this is technically feasible, given the vanishing use of this form in contemporary Czech, it might also be defendable that speakers do not have coherent usage, and that two separate competing analyses should be posited. Obviously, more empirical research on the past conditional, its usage in historical stages of the language where it was still frequent, and the conditions of its decay, is necessary to decide which line of analysis is more satisfactory.[9]

[9]In particular, one would want to know more about the historical development of current prop-

5 Conclusions

Our recent research on periphrasis has emphasized properties that periphrases share, on the one hand, with ordinary syntactic constructions, and on the other hand, with ordinary (synthetic) inflection. In connection with syntax, Bonami & Webelhuth (2013) and Bonami & Samvelian (2015) emphasize the fact that periphrasis builds on the constructional resources available in the language under consideration. In connection with inflection, Bonami (2015) showed that arbitration between synthetic and paradigmatic realization follows the same logic of paradigmatic opposition well documented for arbitration between synthetic strategies; Štichauer (2018) expanded this argument by exhibiting interesting cases of paradigmatic opposition among periphrastic strategies.

In this paper we expanded the set of parallels between synthetic and periphrastic inflection by attending to the phenomenon that we have called "zero periphrasis", by analogy with "zero exponence": this is the situation where the absence of an auxiliary combining with the main lexeme serves as the expression of some morphosyntactic feature. The Czech third person past tense provided a particularly clear example of a phenomenon that is also attested in other languages – see for example Stump & Hippisley (2011) on the past tense in Pamirian languages, or Stump (2013) on the future tense in Sanskrit. To model the phenomenon, we relied on the analytic devices deployed by Bonami et al. (2016) in the analysis of Welsh pseudo-finite constructions. Crucial to the analysis is the observation that ordinary periphrasis is a kind of morphosyntactic mismatch, but not the only possible kind of such a mismatch: another possibility, exemplified in Welsh by the verbs heading *bod* clauses, is that a morphologically nonfinite form of a verb heads a syntactically finite clause. Our analysis of zero periphrasis in Czech is essentially the same: the (finite) third person past is solely realized by a (nonfinite) *l*-form. What is different from the Welsh situation is the fact that the synthetic third person past contrasts with the periphrastic non-third person past. Our analysis states that the same form of the main verb (as expressed by having the same INFL value) can play double duty as the single expression of the past in the third person and as part of a periphrastic expression of the past in the first and second person; this directly captures the nature of zero periphrasis, without any need to postulate empty auxiliaries or other ontologically disputable entities.

erties of the past conditional. An appealing scenario would be that the past conditional started out as a more well-behaved combination of periphrases, and over time acquired autonomous properties, such as the unexpected realization of negation on the auxiliary. Future research will have to establish whether that is empirically accurate.

Abbreviations

ACC	accusative	M, MAS	masculine
AN, ANIM	animate	N, NEU	neuter
COMP	complementizer	NEG	negative
COND	conditional	NOM	nominative
DAT	dative	PASS	passive
DEM	demonstrative	PL	plural
F,FEM	feminine	POS	positive
GEN	genitive	PRS	present
INAN	inanimate	PST	past
INS	instrumental	REFL	reflexive
LF	*l*-form (or *l*-participle)	SG	singular
LOC	locative		

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Chapter 5

The issue of "separability" in Persian complex predicates

Pegah Faghiri
Universiteit van Amsterdam

Pollet Samvelian
Université Sorbonne Nouvelle

This paper addresses the issue of separability in Persian complex predicates (CPs). These are syntactic combinations formed by a verb and a preverbal element (noun, adjective, preposition) realizing a single conceptual unit. Although the separability of the components of a CP by morphological and grammaticalized elements (e.g. auxiliaries) is not a matter of controversy, the possibility for "real" syntactic constituents to interrupt a CP continues to be debated. Building on an experimental study, we show that real syntactic material can separate the components of a CP and suggest that this separability can be viewed as a word order variation phenomenon, comparable to the one observed for direct objects (DO) and indirect objects (IO) in the preverbal domain. The semantic bond nevertheless plays a role in granting CPs some hallmarks of "wordhood", favoring their adjacency, among other things.

1 Introduction

In this paper, we address the issue of separability in Persian complex predicates (CPs). Building on an experimental study, we show that real syntactic material can separate the components of a CP, a possibility generally underestimated or denied in most previous studies on Persian CPs. We also suggest that this separability can be viewed as a word order variation phenomenon, comparable to the one observed for direct objects (DO) and indirect objects (IO) in the preverbal

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domain. As such, it is best accounted for by soft constraints on word order, that is, (statistical) preferences, involving a set of functional factors, rather than by categoric syntactic, or phrase structure, rules (hard constraints). Likewise, we do not consider that the strong preference for the components of the CP to occur adjacent to each other is peculiar to CPs, hence requiring a specific syntactic treatment. This preference is also observed for bare objects in Persian, which tend to occur adjacent to the verb. The fact that it becomes even stronger in the case of CPs is completely expected, given that semantic relatedness favors adjacency. Thus, on the one hand, the fact that several words form a single conceptual unit favors their remaining together (one semantic unit), while on the other hand, the fact that the sequence is made up of multiple syntactic units still allows for the word order preference rules to apply.

It is a well-known fact that the verbal lexicon in Persian is overwhelmingly formed by complex predicates, that is, multiword expressions including a verb and a non-verbal element, mainly a noun, such as *bāzi kardan* 'to play' (play do) or *qadam zadan* 'to walk' (step hit), also known as "light verb constructions" (LVCs).[1]

Forming one semantic unit, the components of a CP tend to remain together and resist separation, except by morphological or grammaticalized material (verbal prefixes, clitic pronouns, auxiliaries). This has led many researchers to take a strong stance on this issue, claiming that "real" syntactic material can never intervene between the verb and the non-verbal unit of a CP. This claim has served as a key argument in favor of the "wordhood" (Goldberg 1996: 134–135) or a "lexical analysis" (Dabir-Moghaddam 1997; Karimi-Doostan 1997) of CPs, along with other properties, which are typical of words, or rather, lexemes in this case. Namely:

- The whole sequence generally has a conventional meaning that must be learned by the speakers. In other words, it is idiomatic, in that the meaning associated with the sequence cannot be fully derived from its components' meaning (Goldberg 1996; Karimi-Doostan 1997; Samvelian 2001; 2012; Samvelian & Faghiri 2013).

- It can serve as input to morphological word formation rules that derive new lexemes from existing ones (Goldberg 1996; Karimi-Doostan 1997; Megerdoomian 2002; Vahedi-Langrudi 1996).

[1]There are also CPs formed with an adjective, e.g. *bāz kardan* 'to open' (open do), a preposition or particle, e.g. *bar dāštan* 'to take' (PART have) or a prepositional phrase *be kār bordan* 'to use' (to work take). In this paper, we will focus on noun-verb CPs.

The supposed inseparability of the CP components has further been used to draw a clear-cut distinction between the latter on the one hand and ordinary verb-complement syntactic combinations on the other hand, and to support a specific syntactic analysis of CPs, which distinguishes them from ordinary syntactic combinations involving a verb and its object (with the notable exception of Müller 2010; Samvelian 2001; 2012; Samvelian & Faghiri 2014; 2016).

Although Samvelian (2012: 55–87) extensively discusses this issue and provides several attested examples showing that almost all CPs can undergo separation, the controversy seems to still persist since more recent studies (e.g. Safavi et al. 2016) take the inseparability of at least some classes of CPs as empirically uncontroversial.

In this paper, we will first present the basic empirical facts about Persian CPs and their syntactic properties as they have been discussed in the literature, with a special focus on the issue of separability. In particular, we will examine Karimi-Doostan's claim about the relationship between the separability and the predicative nature of the nominal element in noun-verb CPs. Contra Karimi-Doostan, we will provide experimental evidence showing that the nominal element of a CP, regardless of its type and its degree of determination, can be separated from the verb by syntactic material.

Comparing the results of our experiments with the findings of some recent studies on word order variations in the preverbal domain in Persian (Faghiri 2016; Faghiri & Samvelian 2014; Faghiri et al. 2018), which also resort to quantitative methods, we will argue that noun-verb CPs, on the whole, behave in the same way as DO-verb combinations with respect to word order preferences. Crucially, the latter involve preferences rather than strict syntactic constraints.

It has been shown that different (functional) factors (e.g. givenness, animacy, length) interact to determine the linear order of constituents, when the latter is not constrained by the grammar. Some of these factors (degree of determination, heaviness and animacy) have also been shown to intervene in ordering preferences regarding direct and indirect objects in Persian as well (Faghiri 2016). We will see that the same factors are at play in determining the ordering preferences of CPs components. Furthermore, semantic relatedness and collocational relation are two factors known to favor adjacency (see e.g. Hawkins 2001; Wasow 2002). Hence, the tendency for the components of a CP to appear adjacent is not surprising, since they convey one conceptual meaning.

2 Existing claims on the inseparability of CPs

Several studies on Persian CPs claim that the separability of the components of a CP is subject to significant restrictions. According to Goldberg (1996), only morphological and "grammatical" material may intervene between the non-verbal element and the verb, as illustrated in (1).

(1) a. omid goli=rā setāyeš ne-mi-konad
Omid Goli=RA praise NEG-IPFV-do.PRS-3SG
'Omid doesn't praise Goli.'

b. omid setāyeš=aš kard
Omid praise=CL.3SG did.PST
'Omid praised her/him.'

c. omid setāyeš=aš xāhad kard
Omid praise=CL.3SG AUX.FUT.3SG do.SINF
'Omid will praise her/him.'

In (1a), the nominal element of the CP *setāyeš kardan* 'to praise' (praise do), namely *setāyeš* 'praise', is separated from the verb by the negation prefix *na-* and the aspect-mode prefix *mi-*. In (1b), the clitic pronoun *=aš*, which refers to the direct object in the first example, attaches to the nominal element and thus separates it from the verb. Finally, in (1c), the intervening element is the tense auxiliary *xāstan* 'to want', which is an independent word.

Goldberg (1996) claims that "real" syntactic material, on the other hand, cannot occur between the components of the CP. This restriction is illustrated by the examples in (2), adapted from Goldberg (1996: 134–135):

(2) a. tond rānandegi kard-am
quickly driving do.PST-1SG
'I drove quickly.'

b. ?? rānandegi tond kard-am
driving quickly do.PST-1SG
(Intended) 'I drove quickly.'

(3) a. ali=rā setāyeš kard-am
Ali=RA praise do.PST-1SG
'I adored Ali.'

b. ?? setāyeš ali=rā kard-am
praise Ali=RA do.PST-1SG
(Intended) 'I adored Ali.' (Goldberg 1996, p. 135, e.g. 3)

According to Goldberg (1996), (2b) shows that the placement of a modifier adverb such as *tond* 'quickly' between the nominal element and the verb makes the sentence odd. The adverb must precede the whole CP, as in (2a), while, in ordinary object-verb combinations, a modifier adverb can intervene between the object and the verb, as shown by (4). Example (3b) shows that the direct object cannot interrupt the CP and must be placed before it, as in (3a).

(4) mašq=am=rā tond nevešt-am
homework=CL.1SG=RA quickly write.PST-1SG
'I did my homework quickly.'(Goldberg 1996, p. 134, e.g. 10)

These facts, Goldberg (1996) argues, imply that CPs are single syntactically integrated predicates, comparable to some extent to words (or lexical units). As such, they are subject to constraints which do not apply for ordinary syntactic combinations. These constraints may nevertheless be violated in some contexts, allowing for morphological (affixes and clitics) and grammatical elements (auxiliaries) to intervene between the components of a CP.

Contrary to Goldberg (1996), Karimi-Doostan (1997, 2011) admits that the components of a CP can be separated by syntactic elements depending on the type of the nominal element of the CP. The latter are classified into three categories: predicative nouns, e.g. *latme* 'damage', verbal nouns, e.g. *ersāl* 'sending', and non-predicative nouns, e.g. *guš* 'ear'. It is claimed that only CPs formed by predicative nouns are separable. The rationale is that for the nominal element to be separable from the verb, it needs to meet the following two conditions (in the context of a given CP):

1. It must have an argument structure.
2. It must be able to project a DP/NP, that is, be determined or quantified.

Only predicative nouns, it is claimed, can fit these conditions, as illustrated by examples (5)–(7).

(5) a. latme=ye tagarg be bāq=e man
damage=EZ hail to garden=EZ 1.SG
'hail damage to my garden'

b. tagarg be bāq=e man latme zad
hail to garden=EZ 1.SG damage hit.PST.3SG
'The hail damaged my garden.'

c. tagarg latme=ye bad=i be bāq=e man zad
hail damage=EZ bad=INDF to garden=EZ 1.SG hit.PST.3SG
'The hail damaged my garden badly.'

(6) a. anjām-e kār tavassot=e ali
performing=EZ work by=EZ Ali
'Ali's doing the work'

b. ali kār=rā anjām dād
Ali work=RA performing give.PST.3SG
'Ali did the work.'

c. * ali anjām-e xub=i be kār dād
Ali performing=EZ good=INDF to work give.PST.3SG
(Intended) 'Ali did the work well.'

(7) a. * guš=e ali be rādyo
ear=EZ Ali to radio
(Intended) 'Ali's listening to the radio'

b. ali be rādyo guš dād
Ali to radio ear give.PST.3SG
'Ali listened to the radio.'

c. * ali guš-e xub=i be rādyo dād
Ali ear=EZ good=INDF to radio give.PST.3SG
(Intended) 'Ali listened to the radio well.'

Latme 'damage', e.g. (5), is a predicative noun. It has an argument structure, as shown by its ability to realize its arguments within an DP/NP, e.g. (5a). As the nominal element of the CP *latme zadan* 'to damage', *latme* must be adjacent to the verb when it is realized as a bare noun, e.g. (5b). When determined, the nominal element of the CP functions as the nominal argument of the verb. It becomes autonomous and can be separated from the verb by various syntactic constituents. This is illustrated by (5c), where *latme* 'damage' carries the indefinite determiner, the enclitic *=i*, and consequently can precede the prepositional argument.

Like predicative nouns, verbal nouns, e.g. *ersāl* 'sending' and *anjām* 'doing, accomplishment', also carry an argument structure, e.g. (6a). However, unlike the former, they cannot project a DP/NP, since they have limited nominal behavior: they cannot be pluralized, modified, quantified and determined. These nouns are broadly assumed to form prototypical light verb constructions, e.g. *ersāl kardan* 'to send', *anjām dādan* 'to accomplish, to do'. In this case, they always occur in

their bare form and hence adjacent to the verb, e.g. (6b). These properties of verbal nouns explain the ungrammaticality of (6c).

Finally, non-predicative nouns, e.g. *guš* 'ear', do not carry argument structure, as illustrated by (7a). When used outside a CP, these nouns can develop into DP/NPs, e.g. *in guš* 'this ear'. However, when used as the nominal element of a CP, e.g. *guš kardan* 'to listen', they can only appear in their bare form, e.g. (7b), and therefore must remain adjacent to the verb, hence the ungrammaticality of (7c).

3 Severing separability from DP/NP projection

Before investigating the separability of the components of a CP, it should be made clear that Karimi-Doostan's claims involve two different, though perhaps interrelated, issues:

1. The first issue concerns the possibility for the bare nominal element of the CP to be separated from the verb by syntactic material.

2. The second issue is the possibility for the nominal element of the CP to project a DP/NP and thus to behave as an autonomous syntactic constituent with respect to the verb.

Under Karimi-Doostan's view, these two issues are entangled since separation is possible only for DP/NPs. However, several studies on Persian CPs provide examples of bare nominal elements of CPs which are not adjacent to the verb:

(8) a. ... va sili be surat=am zad
and slap to face=CL.1SG hit.PST.3SG
'...and (s)he slapped me (on the face).'[2] (Samvelian 2012: p. 40, ex. 29)

b. guš be man ne-mi-kon-e
ear to 1.SG NEG-IPFV-do-3SG
'(S)he doesn't listen to me.' (Mohammad & Karimi 1992: p. 197, ex. 7)

c. kimiā in otāq=rā extesās be mehmān dād
Kimea this room=RA allocation to guest give.PST.3SG
'Kimea allocated this room to the guest.' (Mohammad & Karimi 1992: p. 199, ex. 16)

[2]This is an attested example taken from the novel *Souvašun* by S. Danešvar (Samvelian 2012).

In (8a), the predicative noun *sili* 'slap', which occurs as a bare noun, is nevertheless separated from the verb by the PP argument of the CP. In (8b), the PP argument intervenes between the non-predictive noun *guš* 'ear', again in its bare form, and the verb. (8c) illustrates the possibility for a verbal noun to precede the PP argument.[3]

These examples show that the possibility for bare nominal elements of CPs to be separated from the verb is a matter of controversy. Contra Goldberg (1996) and Karimi-Doostan (1997; 2011), Samvelian (2012) claims that the adjacency of the bare nominal element and the verb in a CP is a matter of strong preference and not a strict constraint. She further draws a parallel between these bare nominal elements and bare objects of lexical verbs, which also tend to occur adjacent to the verb, as it has been noted in all studies on the syntax of Persian (Dabir-Moghaddam 1997; Givi Ahmadi & Anvari 1995; Ghomeshi 1996; Lazard 1982; Mahootian 1997; Samvelian 2001; Karimi 2003: among many others). Like bare objects, bare nominal elements of CPs can nevertheless be separated from the verb by syntactic material. Their greater reluctance to separation, compared to bare objects of lexical verbs, is due to the idiomatic relation between the components of a CP and their closer semantic relatedness, which favors even more adjacency.

To sum up, one issue to be addressed when talking about the separability of CP components is whether the bare nominal element can be separated from the verb by real syntactic material, and, if so, what are the parameters that favor this possibility.

Another issue is the possibility for the nominal element of the CP to project a DP/NP, regardless of its being adjacent to the verb. Recall that according to Karimi-Doostan, only predicative nouns display this property. In particular, concrete nouns like *guš* 'ear' are claimed to always occur in their bare form when part of a CP.

Here again, several counterexamples can be found in the literature, where a concrete noun participating in a CP is nevertheless determined, quantified or modified:

(9) tā čāy xonak šav-ad u sar=i be mahhal=e serqat
until tea cool become.SBJ-3SG he head=INDF to place=EZ burglary
zad
hit.PST.3S
'Until his tea cools, he went to visit the place the burglary had taken

[3]Samvelian (2012) provides numerous similar examples attested in contemporary Persian literature and websites. For more attested examples see also the PersPred Database http://www.perspred.cnrs.fr.

place.'[4] (Samvelian 2012: p. 85, ex. 68)

In this attested example from a contemporary Persian novel, the nominal element of the CP *sar zadan* 'to visit' (lit. 'head hit') projects a DP/NP *sar=i* 'a head', since it is determined by the indefinite determiner *=i*. This example and many others mentioned in Samvelian (2012) show that not all concrete nouns are incapable of projecting a DP/NP in the context of a CP. The question, as for the previous case, is whether the possibility for a noun to project a DP/NP in the context of a given CP can be correlated with some of its properties.

In this paper, we will focus on the first issue, that is, the separability of the nominal element of the CP. Since the nominal element of the CP is to some extent comparable to a bare direct object, we will compare the possibility for these two elements to be non-adjacent to the verb. Our purpose is to check to what extent the constraint or the preference for the bare nominal element to be adjacent to the verb parallels the tendency for bare DOs to precede the verb immediately. To put it differently, up to now, the issue of separability of the components of a CP has generally been investigated without considering the wider issue of ordering preferences in Persian, especially those involving direct and indirect objects. This is surprising since the literature on Differential Object Marking (DOM) in Persian has extensively discussed the tendency for bare direct objects to be adjacent to the verb, contrary to marked objects, which undergo scrambling.

In the next section, we will present basic word order properties of sentences involving a direct and an indirect object in Persian, with a special focus on recent findings from a series of corpus and experimental studies (Faghiri 2016; Faghiri & Samvelian 2014; Faghiri et al. 2014; 2018).

4 Bare objects and their position in Persian

The unmarked (neutral or canonical) word order in Persian is SOV. In ditransitive constructions, the ordering of the direct and the indirect object has been claimed to be dependent on the markedness of the direct object: unmarked DOs follow the IO and occur adjacent to the verb, (10a), while marked DOs precede the IO, (10b), and consequently, are separated from the verb (Browning & Karimi 1994; Mahootian 1997; Karimi 2003: among many others). Persian displays DOM. As illustrated in (10b), definite and/or specific DOs are marked by the enclitic *=rā*, which attaches to the last word of the DO. Note also that in formal Persian, there is no overt marker for definiteness, as shown by the fact that *gol* 'flower' has

[4] Attested example from *Zan-e ziādi* by J. Al Ahmad (short stories).

the same form in (10a) and (10b), albeit two different readings with respect to determination.[5]

It should also be noted that in Persian, bare nouns,[6] that is, nouns without any determination or quantification like *gol* in (10a), are not specified for number and therefore can yield a mass reading. Bare objects have either an existential, as in (10a), or a kind-level/generic reading, as in (11).

(10) a. maryam be sārā gol dād
Maryam to Sarah flower give.PST.3SG
'Maryam gave a flower/flowers to Sarah.'

b. maryam gol=rā be sārā dād
Maryam flower=RA to Sarah give.PST.3SG
'Maryam gave the flower to Sarah.'

(11) maryam gol dust dār-ad
Maryam flower friend have.PRS.3SG
'Maryam likes flowers.'

Indefiniteness, on the other hand, is overtly marked in Persian. It can be realized by the enclitic *=i*, as in (12a), by the cardinal *ye*(*k*), as in (12b), or by the combination of these two. Indefinite NPs can have either a specific or a nonspecific existential reading. In the latter case, they are generally *rā*-marked. Unlike bare nouns, they are always specified for number.

(12) a. maryam gol=i be sārā dād
Maryam flower=INDF to Sarah give.PST.3SG
'Maryam gave a flower to Sarah.'

b. maryam yek gol be sārā dād
Maryam one flower to Sarah give.PST.3SG
'Maryam gave a flower to Sarah.'

More recently, a series of corpus-based and experimental studies (Faghiri 2016; Faghiri & Samvelian 2014; Faghiri et al. 2014; 2018) have allowed for more fine-grained and accurate generalizations on the ordering of complements, which

[5]For DOs, the ambiguity is resolved due to the presence of *=rā*. Bare subjects, by contrast, are ambiguous between an existential or a kind-level generic reading and a definite/specific reading. Thus, in a sentence like *gol ru-ye miz bud*, two readings are available for *gol*: 'A flower/flowers were on the table' or 'The flower was on the table'.

[6]Note that we use the label "bare" here to refer to nouns that not only appear in their bare form, but also have a non-determined and non-quantified reading. This means that in (10b), *gol* 'flower' is not considered as a bare noun since it receives a definite reading.

partly go against the previous dichotomous view. In a nutshell, these studies show that the relative order between the DO and the IO: 1) depends on a set of cross-linguistically valid (functional) factors such as degree of determination (or definiteness), phrasal length and animacy; and 2) displays much more variation than previously assumed, implying that it is not empirically justified to posit a canonical order, similar to SOV, for ditransitive sentences. The main conclusions of these studies are:

a. As unanimously claimed in the literature, *rā*-marked DOs strongly prefer to precede the IO, that is, the DO-IO-V word order, and are thus separated from the verb.

b. Bare DOs, by contrast, display a strong preference for the IO-DO-V word order, that is, they follow the IO and appear adjacent to the verb. Importantly, bare modified DOs display more variation and show a relatively less strong preference for being adjacent to the verb.

c. Indefinite (non-*rā*-marked) DOs, however, contrary to what is generally claimed in the literature, are more likely to appear in the DO-IO-V order, that is, they tend to precede the IO. This means that indefinite DOs group with *rā*-marked DOs with respect to their word order preferences rather than with bare objects. Nevertheless, they display more variation and show a relatively less strong preference for the DO-IO-V order.

To sum up, according to these studies, the primary factor that determines the relative position of the DO with respect to IO is the degree of determination (i.e. zero, indefinite, =*rā*-marked or definite) as a cline. This view can capture the fact that DOs located in the middle of the continuum (*i.e.* bare-modified and indefinite DOs) show more ordering variability than the ones located on the two extremities, that is, bare DOs and definite DOs. In other words, the more determined the DO, the more it is likely to be separated from the verb. See Figure 5.1, adopted from Faghiri (2016: 196).

Other important findings of these studies are:

d. Phrasal length (or heaviness) also plays a role in ordering preferences. The "long-before-short" preference is also observed in the preverbal domain in Persian, as in some other SOV languages such as Japanese (Hawkins 1994; Yamashita & Chang 2001). Accordingly, "heavy" bare DOs, that is, bare-modified DOs, are less likely to appear adjacent to the verb than their "light" (single word) counterparts.

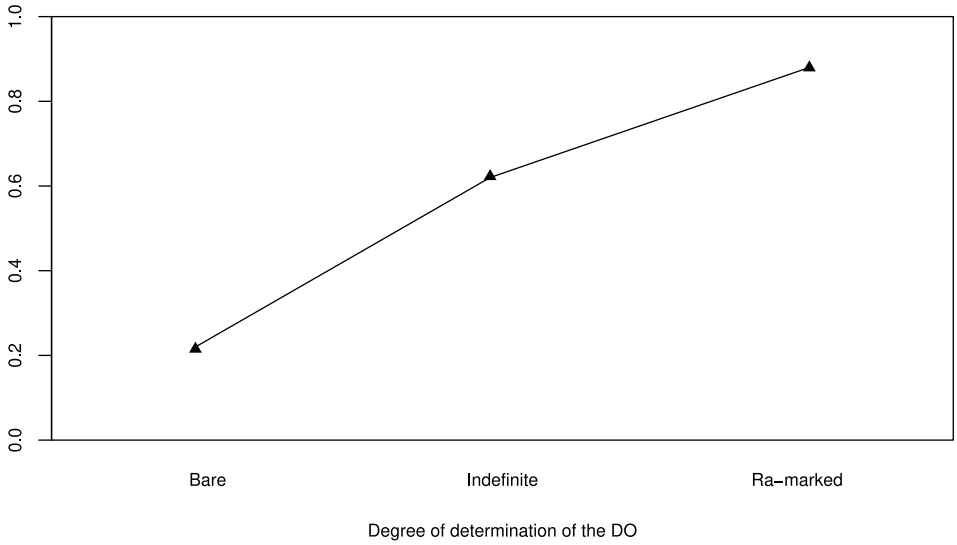

Figure 5.1: Probability of the DO-IO-V order by the degree of determination of the DO

e. The humanness of the IO favors the IO-DO-V order, which is in line with the general "animate-before-inanimate" preference (Bresnan et al. 2007; Branigan & Feleki 1999; Collins 1995; Hoberg 1981; Kempen & Harbusch 2004; Rosenbach 2002).

5 Empirical study

The review of the literature and the data discussed in previous sections show that in order to obtain an adequate account of the (in)separability of CP components we first need to get the empirical facts right. Most of the data provided in theoretical studies rely on "informal" anecdotal grammaticality judgements elicited without taking necessary methodological precautions and without any control for conflating factors. This undermines the empirical generalizations outlined in these studies, as shown by the abundance of counterexamples, some of which were given previously.

Our aim is to achieve a better understanding of the issue at stake by adopting a quantitative approach that provides us with more reliable data and enables us to investigate and identify different factors that favor (non-)adjacency. The question under study is to what extent the nominal element of a CP, which is formally and syntactically comparable to the direct object (DO) of a lexical verb,

is separable from the verb by a prepositional phrase, comparable to the indirect object (IO) of the same verb.

In this section, we present the results of two acceptability judgement experiments carried out as online questionnaires and filled out on a voluntary basis by native speakers of Persian living in Iran.

In both experiments, to obtain comparable data on word order variations in the preverbal domain, the questionnaire included (among other fillers) two additional series of experimental items, besides those for noun-verb CPs. One series focused on the relative order between the (bare) DO and the IO in ditransitive sentences and the other on the relative order of the subject and the (*rā*-marked) DO in transitive sentences.[7] Given that our first experiment serves as a pilot and that our two experiments are similar in many respects, we present and discuss these two additional series of items for the second experiment only.

For noun-verb CPs, we compared sentences in which CP components appear in adjacent versus shifted orders, and manipulated the realization of the nominal element, comparing bare nouns with indefinite *i*-marked NPs.

We included a selection of CPs formed by concrete and predicative nouns[8] that take a prepositional argument:[9]

CPs with concrete nouns: *āb dādan* 'to water' (water give), *āhār zadan* 'to starch' (starch hit), *qazā dādan* 'to feed' (food give), *rang zadan* 'to paint' (paint hit), *rowqan zadan* 'to oil' (oil hit), *vāks zadan* 'to polish' (polish hit), *vāksan zadan* 'to vaccinate' (vaccination hit), *namak zadan* 'to salt' (salt hit).

CPs with predicative nouns: *fohš dādan* 'to insult' (insult give), *labxand zadan* 'to smile' (smile hit), *lagad zadan* 'to kick' (kick hit), *ešāre kardan* 'to point' (point do), *kešide zadan* 'to slap' (slap hit), *kalak zadan* 'to trick' (trick hit), *češmqorre raftan* 'to glare' (glare go), *pok zadan* 'to puff' (whiff hit).

All of these CPs display the syntactic pattern given in the canonical order in (13) and illustrated by (14).[10]

(13) N0(=Subj) Prep N1(=IO) N2(=DO) Verb

[7] For each participant, the items were ordered in such a way that experimental items of each series were separated by other fillers: items of these different experiments were never presented in a successive order.

[8] Note that our study did not include verbal nouns since, due to their limited nominal properties, they cannot develop into a DP/NP. However, their separability when they form a CP needs to be investigated in forthcoming studies.

[9] The above list includes all CPs used in our second experiment.

[10] We selected our CPs using the PersPred database (Samvelian & Faghiri 2013).

(14) ali be maryam labxand zad
Ali to Maryam smile hit.PST.3SG
'Ali smiled at Maryam.'

Recall that while we agree with Karimi-Doostan's judgements (see (7c) above) on the impossibility for *guš* 'ear' to project a DP/NP when part of the CP *guš dādan/kardan* 'to listen', we do not endorse his generalization to the whole class of concrete (non-predicative) nouns. There are indeed examples of concrete nouns that can develop into a DP/NP in the context of a CP, such as those included in our selection. *Vāks* 'polish', for instance, in the context of *vāks zadan* 'to polish' (lit. polish hit) (15a), can head a DP/NP and be separated from the verb by a PP (15b)?

(15) a. ali be kafš-hā vāks zad
ali to shoe-PL polish hit.PST.3SG
'Ali polished the shoes.'

b. ali behtarin vāks=rā be kafš-hā zad
Ali best polish=RA to shoe-PL hit.PST.3SG
'Ali polished the shoes with the best polish.'

Moreover, the animacy/humanness of the referent of the prepositional argument was included in our experiments as a control variable, so that we could check whether the humanness of the IO favors the IO-DO-V order, as is suggested to be the case in ordinary ditransitive constructions in Persian (see page 129).

Our hypothesis is that the CPs of our sample do not differ from ordinary complement-verb combinations concerning word order variations. Therefore, based on the conclusions of Faghiri (2016) presented in Section 4, we predicted that:

1. When the nominal element of the CP is realized as an indefinite NP, semantic relatedness favors the adjacent order, while the NP shift is licensed by the general tendency of indefinite DOs to precede the PP argument.
2. For bare nouns, both factors favor the adjacent order.
3. The phrasal length of the nominal element, that is, adding modification to the noun, favors separation.
4. The humanness of the PP argument favors the adjacent order.

5.1 Experiment 1 (pilot)

5.1.1 Method

In our first (exploratory) experiment, we manipulated the nominal element on three levels: (a) bare noun, (b) indefinite *i*-marked and (c) modified indefinite *i*-marked. We prepared our material in such a way as to have a relatively natural and acceptable sentence with all three forms of the nominal element in the condition of adjacent orders. To this end, we added a continuation to our target sentence, as in (16), specifically to improve the acceptability of sentences with indefinite *i*-marked nominal elements.

We prepared 24 experimental items in six conditions according to Table 5.1. In half of our stimuli, the PP argument was animate, as in (16) and (17), and in the other half, it was inanimate, as in (18). In 6 items, the nominal element was a concrete noun. The PP argument was animate only in one, *qazā dādan*, e.g. (17). For the sake of space, only one version of each example is given here, the version corresponding to condition 6 in Table 5.1, on the basis of which other versions can be constructed straightforwardly.

Table 5.1: Experiment 1: Conditions

			Order (adjacent vs. shifted)	
Type of the nominal element:			[PP][NP]	[NP][PP]
bare	*fohš*	'insult'	1	4
i-marked	*fohš=i*	'an insult'	2	5
modified *i*-marked	*fohš=e rakik=i*	'a vulgar insult'	3	6

(16) sahar [fohš=e rakik=i] [be sārā] dād va u=rā
Sahar insult=EZ vulgar=INDF to Sarah give.PST.3SG and him=DOM
asabāni kard
angry do.PST.3SG
'Sahar launched a vulgar insult to Sarah and made her angry.'

(17) ali [qazā=ye sabok=i] [be bačče-hā] dād va anhā=rā be pārk
Ali food=EZ light=INDF to child-PL give.PST.3SG and they=RA to park
bord
take.PST.3SG
'Ali gave the children some light food and took them to the park.'

(18) nima [vāks=e siāh=i] [be kafš-hā] zad va anhā=rā
Nima polish=EZ black=INDF to shoe-PL hit.PST.3SG and they=RA
pušid
wear.PST.3SG
'Nima applied some black polish to the shoes and put them on.'

The experiment was carried out as a web-based questionnaire (on *Ibex Farm* (Drummond 2013)) filled out by 37 native speakers. Participants were asked to rate each sentence on a Likert scale from 1 (absolutely unacceptable) to 7 (completely acceptable).

5.1.2 Results

Figure 5.2 shows the distribution of the ratings by order (adjacent versus shifted) for the three realizations of the nominal element (bare, *i*-marked and modified *i*-marked).

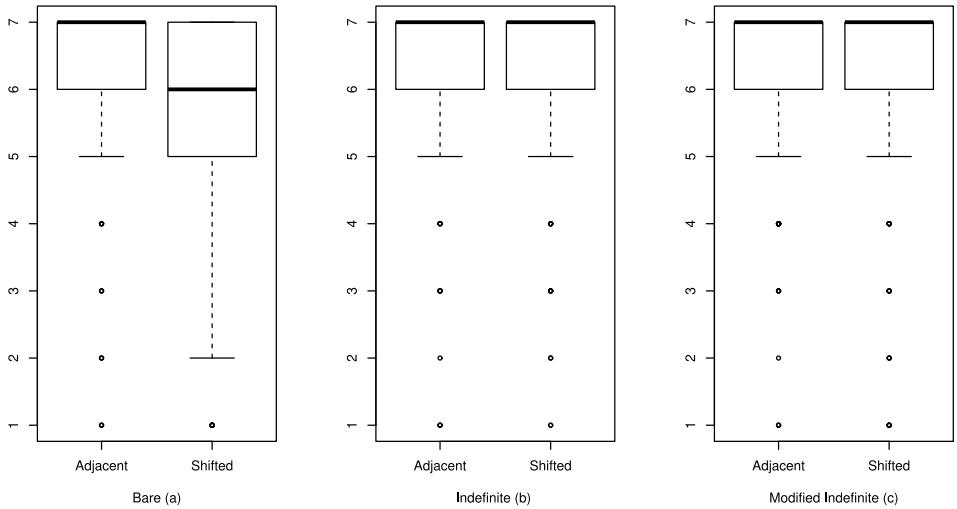

Figure 5.2: Experiment 1: Distribution of ratings by order and type of nominal element

The statistical analysis of the results showed a significant difference in the ratings between adjacent (mean = 6.32, SD = 1.36) and shifted orders (mean = 5.47, SD = 1.71) only for bare nouns; $t(36) = 5.05$, $p < 0.001$. The effect is, however, of medium size (Cohen's $d = 0.53$) and shifted orders were overall rated as acceptable, as we see in Figure 5.2. For *i*-marked (modified) NPs, both orders were

similarly rated as highly acceptable, with mean rates above 6 in all conditions, and we did not find any effect of phrasal length.

Concrete nouns of our sample display similar rating distributions. However, we will analyze this factor more thoroughly in the second experiment, in which the number of items is balanced for concrete and predicative nouns.

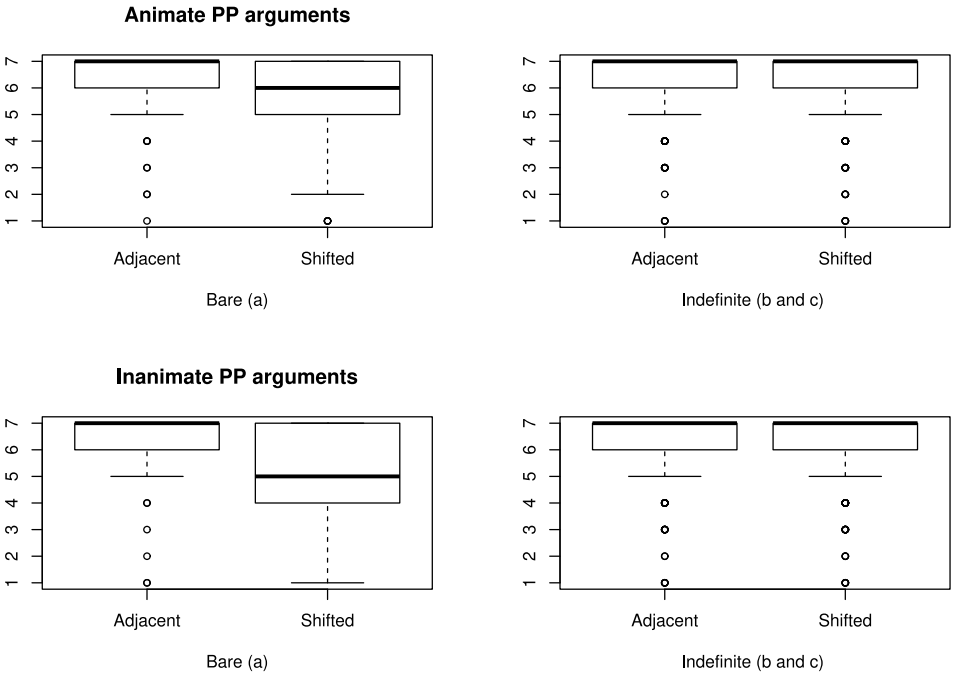

Figure 5.3: Experiment 1: Distribution of ratings for animate versus inanimate PP arguments

Interestingly, the humanness of the PP showed an impact on the ratings of sentences with bare nouns. As we can see in Figure 5.3, animate PPs disfavored the shift more than inanimate PPs do. The statistical analysis, using a linear mixed-effects regression model with order and animacy as fixed effects and items and participants as random effects, showed a small but significant interaction between the two factors (Est. $= 0.26, \text{SE} = 0.07, t = 3.44, p < 0.01$).

Overall, these results are in line with our predictions. However, ratings of "non-canonical" sentences were surprisingly high, that is, rates below 4 were infrequent. The fact that these sentences were not rated as unacceptable may follow from Faghiri (2016) and Faghiri et al.'s 2018 observations that the relative order between the NP and PP arguments is a matter of soft constraints rather

than a syntactic (phrase structure) rule. Hence, while there is a clear bias in production towards a given order, speakers do not consider the alternative order unacceptable (or ungrammatical), and may, in some cases, even consider them equally acceptable. Nevertheless, to make sure that these results are not due to an experimental confound, we replicated this experiment with a more careful protocol.

5.2 Experiment 2

5.2.1 Method

In this experiment, we chose to keep lexical differences between items to a minimum level:

1. Given that in Experiment 1 we did not find any differences between modified and single-word *i*-marked nominal elements, we removed the modified *i*-marked condition and manipulated the nominal element on two levels, bare versus indefinite *i*-marked.

2. Contrary to the previous experiment, we kept the sentence simple, that is, without any continuation.

We prepared 16 experimental items (15 from the previous experiment) in four conditions (see Table 5.2), as illustrated in examples (19) – (22). In half of the stimuli, CPs were built with concrete nominal elements, and in the other half, with predicative nouns (see the list on page 131). Two items with concrete nouns were built with animate PP arguments, e.g. (19), and six with inanimate PP arguments, e.g. (20). Two items with predicative nouns were built with inanimate PP arguments, e.g. (22), and six with animate PP arguments, e.g. (21). For the sake of space, only one version of each example is given here, the version corresponding to condition 4 in Table 5.1, on the basis of which other versions can be constructed straightforwardly.

(19) ali [qazā=i] [be bačče-hā] dād
Ali food=INDF to child-PL give.PST.3SG
'Ali gave some food to the children.'

(20) maryam [āb=i] [be bāqče] dād
Maryam water=INDF to garden give.PST.3SG
'Maryam (lit.) gave some water to the garden.'

Table 5.2: Experiment 2: Conditions

Type of the nominal element:			Order (adjacent vs. shifted)	
			[PP][NP]	[NP][PP]
bare	*qazā*	'food'	1	3
i-marked	*qazā=i*	'some food'	2	4

(21) sārā [labxand=i] [be mehmān-hā] zad
Sarah smile=INDF to guest-PL hit.PST.3SG
'Sarah (lit.) gave a smile to the guests.'

(22) omid [lagad=i] [be dar] zad
Omid kick=INDF to door hit.PST.3SG
'Omid gave a kick to the door.'

Beside these target sentences, our stimuli included four series of control items as fillers (two series of unacceptable control sentences and two series of experimental items on word order variation):

1. 8 sentences with clear grammaticality violations, such as (23).

   (23) * ... dišab bārān=rā ziād āmad
   last-night rain=RA very come.PST.3SG
   Intended:'... it rained a lot last night.'

2. 2 sentences similar to the example (7c) above by Karimi-Doostan:

   (24) ... amir [guš=e bā-deqqat=i] [be mo'alem] dād
   Amir ear=EZ careful=INDF to teacher give.PST.3SG
   Intended:'... Amir listened carefully to the teacher.'

   (25) ... neda [češm=e moztareb=i] [be čamedān] andāxt
   Neda eye=EZ worried=INDF to suitcase launch.PST.3SG
   Intended:'... Neda looked worriedly at the suitcase.'

3. 8 experimental items, similar to (26), focusing on the relative order between the subject and the *rā*-marked DO in prototypical transitive sentences.[11]

[11] These items are taken from Faghiri's (2016) sentence completion experiment on transitive sentences (see Experiment T1 (pp. 197–204)).

(26) a. ... omid maryam=rā nārāhat kard
... Omid Maryam=RA hurt do.PST.3SG
'... Omid hurt Maryam.'
b. ... maryam=rā omid nārāhat kard

4. 16 experimental items, similar to (27) and (28), focusing on the relative order between the IO and a bare DO[12] with control for the humanness of the IO.[13]

(27) a. ... sar=e miz gol be-gozār-and
on=EZ table flower SBJ-put.PRS-3PL
'... (they) put flowers on the table.'
b. ... gol sar=e miz be-gozār-and

(28) a. ... barā=ye soxanrān čāy bi-āvar-and
for=EZ speaker tea SBJ-bring.PRS-3PL
'... (they) bring tea for the speaker.'
b. ... čāy barā=ye soxanrān bi-āvar-and

The remaining 30 fillers covered a range from highly acceptable to less acceptable sentences.

The experiment was again carried out as a web-based questionnaire. However, unlike the previous experiment, we opted for an 11-point scale from 0 (absolutely unacceptable) to 10 (completely acceptable), which we consider to be more natural for our participants than a 7-point scale. Also, the rating task was followed by comprehension questions in 40 filler items.

116 monolingual speakers of Persian living in Iran filled out the questionnaire. We discarded answers from three participants who had more than 10% of wrong answers to comprehension questions and/or rated clearly ungrammatical sentences as acceptable. Our final dataset hence contained a total number of 1808 observations.

[12] In this experiment, we also manipulated the phrasal length of the DO, comparing bare and bare modified nouns. Here we only discuss the data for bare DOs.

[13] These items are taken from Faghiri's (2016) sentence completion experiments on ditransitive sentences (see Experiment D2 (pp. 178–193) and Experiment D4 (pp. 188–193)).

5.2.2 Results

The distribution of ratings by experimental condition in our target items is given in Figure 5.4. Figure 5.5 shows the distribution of ratings for our clearly unacceptable control items (1 and 2 on page 137).

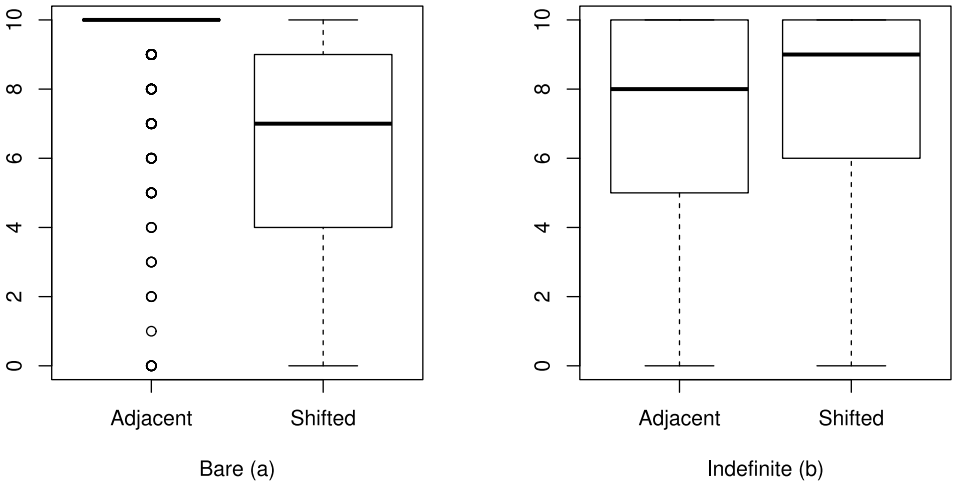

Figure 5.4: Experiment 2: Distribution of ratings by experimental condition

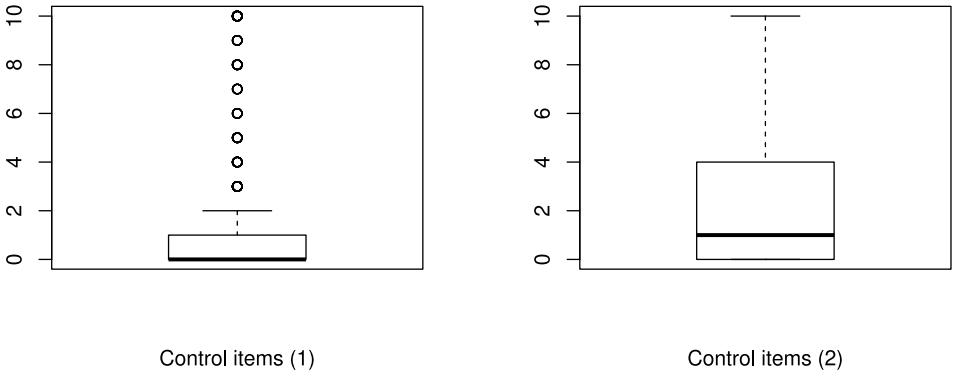

Figure 5.5: Experiment 2: Distribution of ratings for clearly unacceptable control items

We can see that the distribution of ratings in our new data is not substantially different from Experiment 1. Here again, the distribution of ratings is (al-

most)[14] identical for the two orders in the case of indefinite *i*-marked NPs and the analysis of the results shows a significant decrease for shifted orders (mean = 6.49, SD = 3.07) compared to adjacent orders (mean = 9.27, SD = 1.87) only for bare nouns; $t(112) = 13.43$, $p < 0.001$. The effect size is large (Cohen's $d = 0.96$) and much more important than what we had previously. Nevertheless, sentences in the shifted order were still not rated as unacceptable: the median is 7. Compare the distribution of ratings in target items with our clearly unacceptable controls where both mean and median are very low: respectively 2.4 and 1 for the first set of control items, and 1.2 and 0 for the second ones. It is also instructive to take a closer look at the frequency distribution of ratings for adjacent versus shifted orders, compared to our unacceptable controls (see Figure 5.6). In sharp contrast to the latter, high scores remained the most frequent ratings for shifted orders and the mode is still 10. Indeed, we do not have a bi-modal distribution, with some speakers rating these sentences as totally unacceptable and others as perfectly acceptable. Speakers mostly tended to rate these sentences as equally acceptable or slightly less acceptable than canonical sentences.

At this point, let us compare these data with our two other series of experimental items on word order variations, that is, 1) the relative order between the (bare) DO and the IO, and 2) the relative order between the subject and the DO in prototypical transitive sentences (see the box and whisker diagrams in Figure 5.7). In both cases, we find a significant decrease in the mean rating for "non-canonical" orders as well. However, the effect sizes are smaller and "non-canonical" orders were rated relatively better than what we observe for CPs (with bare nominal elements). In the case of the relative order in transitive sentences, the effect is of medium size (Cohen's $d = 0.73$), the difference between the mean rating for canonical (Subj-DO) and non-canonical (DO-Subj) orders is less than 2 points (9.19 vs. 7.34; $t(112) = 10.46$, $p < 0.001$), and the median rating for non-canonical orders is 8. Interestingly, for bare DOs, the effect size is small – half the size we had for bare nouns forming a CP (Cohen's $d = 0.48$). The difference between the mean rating for adjacent and shifted orders is almost 1 point (9.33 vs. 8.42; $t(112) = 7.48$, $p < 0.001$) and the median rating for shifted orders is 9.

Finally, let us consider the effect of our two control factors: 1) the type of the nominal element and 2) the humanness of the PP argument. Figures 5.8 and 5.9 provide the same box-and-whisker diagrams of the distribution of ratings, respectively, for concrete versus predicative nominal elements, and for animate versus inanimate PP arguments.

[14]Interestingly, the mean is slightly but significantly better for shifted orders: 7.59 (SD = 2.85) vs. 7.14 (SD = 3.05); $t(112) = 3.24$, $p < 0.01$.

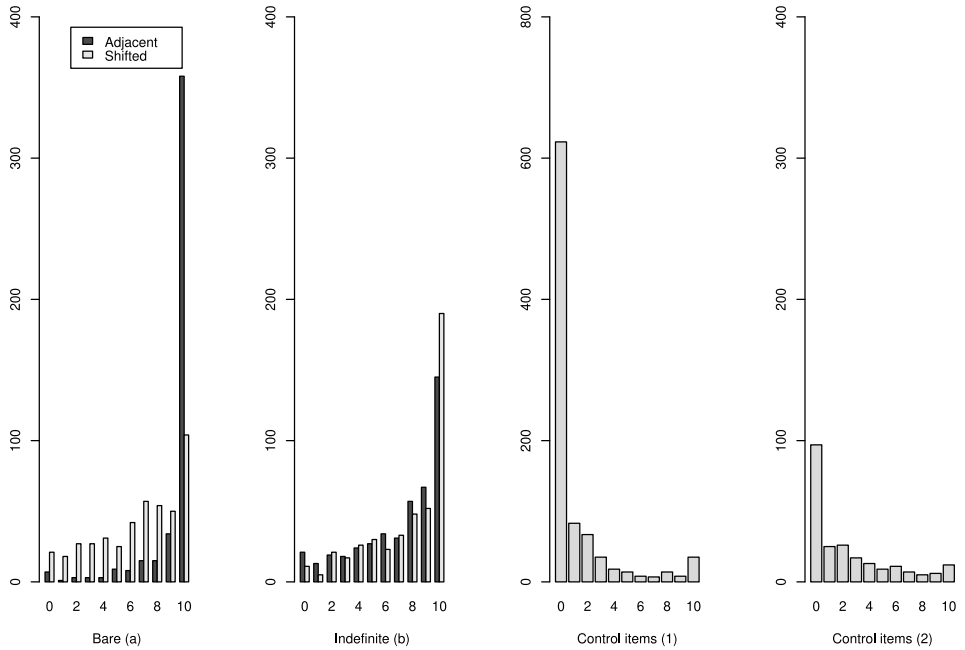

Figure 5.6: Experiment 2: Frequency distribution of ratings for target items versus unacceptable control items

Recall, however, that these two factors are correlated in our design. Hence, we need to look at the linear mixed-effects model (LMM) analyses of the data (Baayen et al. 2008) in order to be able to capture the effect of these two factors on acceptability judgements independently and in interaction with order. To this end, ratings were entered into a mixed-effect linear regression model using the lme4 package (Bates et al. 2015) of the R statistics software (R Core Team 2016). We ran two separate models, one including only bare nouns and the other indefinite *i*-marked NPs. In each model, the experimental factors are included as fixed effects, with sum-coded contrasts.[15] We fitted the full variance-covariance structure of random effects for both items and participants, justified by the design. Table 5.3 presents the summaries of both models for fixed effects. The results are as following:

1. The estimated mean (baseline) rating across all factors is above 7 in both cases (7.81 and 7.29, for bare nouns and indefinite NPs respectively).

[15]Order: Adjacent = 1, Shifted = −1; Animacy: Animate = 1, Inanimate = −1: Noun-Type: Predicative = 1, Concrete = −1.

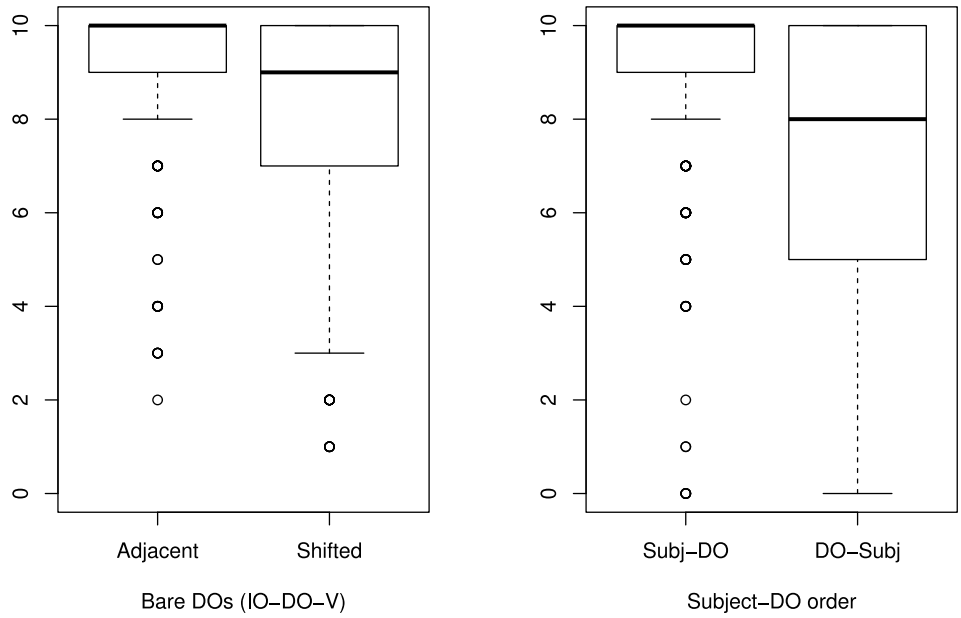

Figure 5.7: Experiment 2: Distribution of ratings for word order variation control items

2. As expected, there is a significant and relatively important main effect of order for bare nouns: the difference in the (estimated) mean rates between adjacent and shifted orders is about 3 points. However, in the case of indefinite NPs, the effect of order, while significant, is very small and, interestingly, goes in the opposite direction. The difference in the (estimated) mean scores between shifted and adjacent orders is only about 0.5 point.

3. There is a significant but rather small interaction between order and animacy for both bare nouns and indefinite NPs: with shifted orders, inanimate PPs yield slightly better scores than animate PPs.

4. There is no interaction between Order and Noun-Type, neither for bare nouns nor for *i*-marked NPs. For the latter, however, Noun-Type has a significant and relatively important main effect on the ratings: predicative nominal elements are rated better than concrete ones regardless of order. The difference in the (estimated) mean scores between the two noun types is about 2 points.

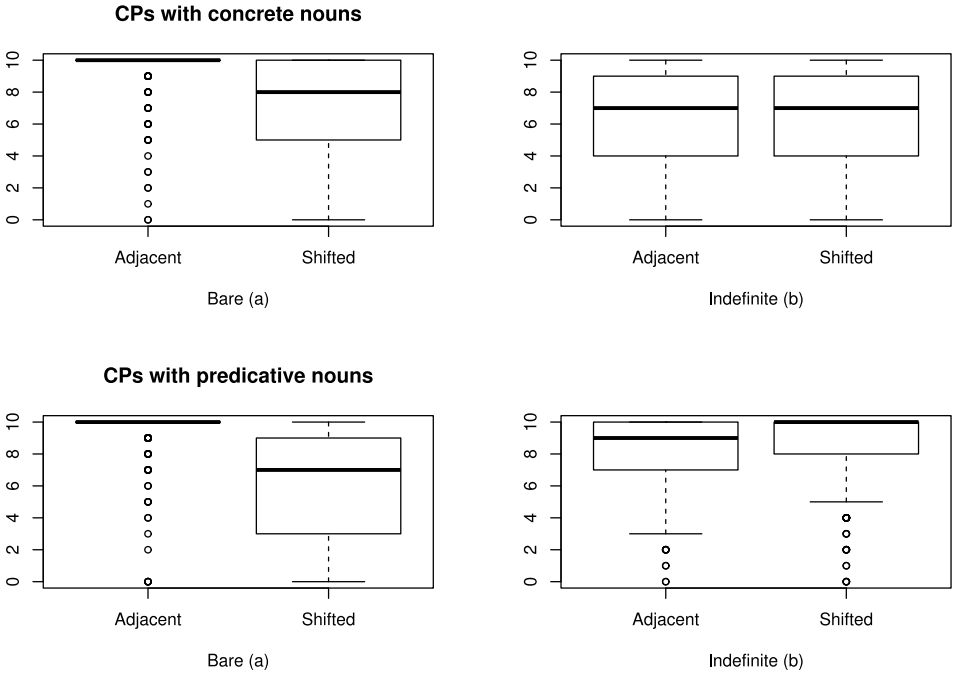

Figure 5.8: Experiment 2: Distribution of ratings by (semantic) type of the nominal element

5.3 Main findings

The main findings of our experimental study are:

1. Sentences in which bare nouns forming a CP appear separated from the verb by the PP argument are not considered to be ungrammatical by native speakers, but only less acceptable than sentences in which they appear adjacent to each other. However, in comparison, ordinary ditransitive sentences in which the bare noun is separated from the verb by the PP argument are rated better.

2. When the nominal element of a CP is realized as an indefinite *i*-marked NP, sentences in which the nominal element is separated from the verb by the PP argument are considered slightly more acceptable.

3. The predicative nature of the noun forming a CP has no effect on ordering preferences. In other words, speakers accept sentences in which concrete nouns are separated from the verb in the same manner as they accept those with predicative nouns. Meanwhile, as expected, the ability of

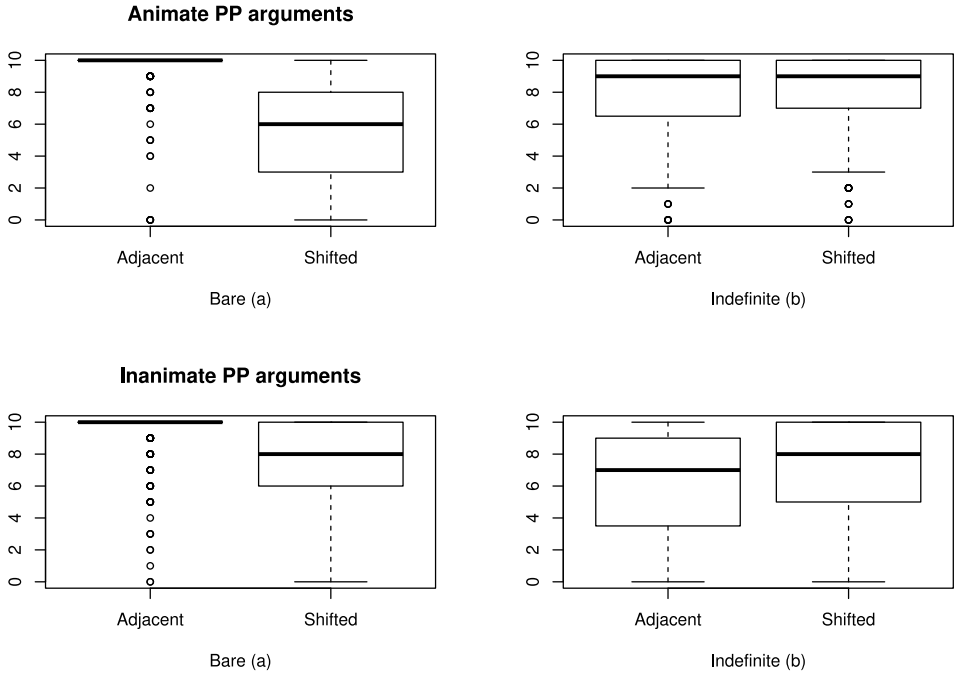

Figure 5.9: Experiment 2: Distribution of ratings by animacy (of the PP argument)

the nominal element of a CP to develop a DP projection is affected by its predicative nature: when the nominal element was *i*-marked, CPs of our sample formed by predicative nouns were rated better than those formed by concrete nouns.

4. The humanness of the intervening PP argument disfavors the separability of CP components: sentences in which the nominal element precedes the PP were rated slightly better when the PP argument was inanimate than when the PP argument was human.

In a nutshell, the findings of our study contradict all previous claims on the inseparability of CP components (e.g. Goldberg 1996; Karimi-Doostan 1997; 2011) and suggest not only that "real" syntactic material can interrupt a noun-verb CP but also that ordering preferences in CPs are comparable to those observed in ordinary complement-verb combinations, semantic relatedness and collocationality put aside.

Before closing this section, it is important to discuss a previous quantitative evaluation of Karimi-Doostan's claim on the (in)separability of CP components,

Table 5.3: Experiment 2: Results of LMM analyses

(a) Bare nouns

	Est.	SE	df	*t*	*p*	
Intercept	7.81	0.24	26.03	23.74	<0.001	***
ORDER [ADJACENT=1]	1.47	0.11	40.12	12.64	<0.001	***
ANIMACY [ANIMATE=1]	−0.21	0.24	14.25	−0.91	0.38	
NOUNTYPE [PREDICATIVE=1]	−0.10	0.23	13.48	−0.45	0.66	
ORDER:ANIMACY	0.40	0.10	14.73	3.85	<0.01	**
ORDER:NOUNTYPE	0.02	0.10	11.54	0.17	0.87	

(b) Indefinite *i*-marked NPs

	Est.	SE	df	*t*	*p*	
Intercept	7.29	0.26	46.16	28.16	<0.001	***
ORDER [ADJACENT=1]	−0.23	0.09	11.65	−2.61	<0.05	*
ANIMACY [ANIMATE=1]	0.04	0.22	14.79	0.21	0.84	
NOUNTYPE [PREDICATIVE=1]	1.07	0.22	16.97	4.78	<0.001	***
ORDER:ANIMACY	0.35	0.13	18.13	2.80	<0.05	*
ORDER:NOUNTYPE	−0.07	0.11	−0.59	0.17	0.57	

which arrives at a different conclusion, partially at odds with the conclusions of our study.

In a recent paper on language processing, Safavi et al. (2016) use separable Persian CPs to test the predictions of different accounts of locality effects and follow Karimi-Doostan's classification to select separable CPs. In order to make sure that the CPs included in their experimental material are separable for native speakers they carried out a preliminary norming acceptability rating experiment to test the relative acceptability of "separable" versus "inseparable" CPs (2016: 4). They had 50 native speakers rate three sets of 36 sentences with CPs from each class, following a between-items design with three conditions: (a) verbal nouns, (b) predicative nouns and (c) non-predicative nouns, and report the following mean rates on a 7-point Likert scale, respectively: 3.23 ($Q1 = 1, Q3 = 5$), 6.08 ($Q1 = 6, Q3 = 7$), and 3.12 ($Q1 = 1, Q3 = 5$), that suggest a clear-cut distinction between "separable" and "inseparable" CPs in support of Karimi-Doostan's classification.

Nevertheless, a closer look into their stimuli, provided on-line as supplementary material,[16] shows that they did not perform a systematic (minimally paired) comparison across the three conditions. An example of items in each condition is given in (29).[17]

(29) a. hamkār=am nāme=i *ersāl* [be man] kard
colleague=CL.3SG letter=INDF sending to me do.PAST.3SG
'My colleague sent me a letter.'

b. maryam *arezu=i* [barā=ye man] kard
Maryam wish=INDF for I do.PAST.3SG
'Maryam made a wish for me.'

c. golnaz *otu* [be lebās=aš] zad
Golnaz iron to dress=CL.3SG hit.PAST.3SG
'Golnaz ironed her dress.'

We notice that while the indefinite *i*-marked form is used in sentences with predicative nouns, as in (29b), the bare form is used for the other classes, as in (29a) and (29c). This is not surprising given that, as we have seen in Section 3, the issue of (in)separability is entangled with the realization of the NP (or the ability of the nouns to develop a DP/NP projection) in Karimi-Doostan's view. However, this design makes the comparison between the three conditions meaningless.

Putting aside verbal nouns that cannot develop a DP/NP projection, we have seen that in a number of CPs involving a non-predicative noun, the nominal element can develop a DP/NP projection and be separated from the verb. However, Safavi et al. did not control for this property in their design and in a number of their items involving a non-predicative noun, such as *otu zadan* 'to iron' (iron hit) in (29c), the nominal element can appear in the *i*-marked form, as illustrated in (30), while they also include CPs such as *guš dādan* 'to listen' (ear give).

(30) golnaz *otu=i* be lebās=aš zad
Golnaz iron=INDF to dress=CL.3SG hit.PAST.3SG
'Golnaz ironed her dress.'

Note that the stimuli include only one version of each item: a sentence in which the noun is separated from the verb by a prepositional phrase and there is no control on the function and semantics of the intervening PP. As a consequence,

[16] Accessible via the following link: http://journal.frontiersin.org/article/10.3389/fpsyg2016.00403
[17] Glossing and translations are ours.

while their data serve the initial purpose of their norming pretest, they do not provide evidence for the inseparability of CPs with non-predicative nouns (in opposition to CPs with predicative nouns).

6 Conclusions

The experimental data presented in the previous section 1) provide additional support, along with the attested counterexamples given in Section 3 and in Samvelian (2012), that the nominal element of a CP, whatever its form and its type, can be separated from the verb by syntactic material, and 2) suggest that the issue of separability in CPs cannot be studied separately from word order preferences involving the verb and its complements in ordinary transitive and ditransitive constructions.

Our study constitutes a first step in the study of the issue of separability with quantitative and experimental methods. Further studies are needed in order to investigate several points that we did not address in this paper:

Production data: Our study suggests that speakers have an important tolerance for sentences in which the bare nominal element is separated from the verb by the PP argument of the CP, since, as explained in the previous section, acceptability rates stay high, that is, clearly above the baseline. In order to have a more accurate picture, the acceptability judgement data must be completed by production data, including corpus studies.

Separation by constituents other than PP arguments: Our experiments were designed with sentences in which the intervening element was the PP argument of the CP since our purpose was to assess Karimi-Doostan's claim on separability. The possibility for other constituents, such as adverbials, to intervene between the nominal element and the verb must be investigated in forthcoming studies. However, we should emphasize that such an investigation must include an examination of the same possibilities in ordinary object-verb combinations, particularly in the case of bare objects. Recall from Section 4 that, as mentioned in several studies, a bare object of lexical verbs also displays a limited degree of autonomy with respect to the verb and tends to occur adjacent to the latter.

Separability and DP projection: All examples in our data were designed with nouns that can project NP/DPs, be they predicative or concrete, since the

purpose was not only to check the possibility for bare nouns to be separated from the verb but also to study the role of the degree of determination in ordering preferences. However, not all concrete nouns can project a DP/NP when forming a CP. Recall the example of *guš* 'ear' in *guš dādan/kardan* 'to listen' (ear give/do) given by Karimi-Doostan. Although we did not include these cases in our experiments, it seems safe to consider that their behavior (as bare nouns) should not be different from those that can project a DP/NP in the context of a given CP. Note that examples of separation for *guš dādan/kardan* abound in the literature. Here are a few of them:

(31) abbas nārāhat va pažmorde bud. guš be mādar=aš dād...
Abbas sad and unhappy was ear to mother=CL.3SG give.PST.3SG
'Abbas was sad and unhappy. He listened to his mother...' (Ali Ašraf Darvišian, *J̌ang be revāyat-e bačče hā*, p. 30)

(32) guš be harf=e man bo-kon ... va baqi=rā vel-kon...
ear to speech=EZ 1.SG IMP-do.2SG and rest=RA leave.IMP.2SG
'Listen to me (...) and let go of the rest...' (Širin Sami'i, *Bibi va touti*, p. 44)

Apart from non-projecting concrete nouns, we also excluded verbal nouns, e.g. *ersāl* 'sending', from our study. Recall that the latter display limited nominal properties and can never be determined, whether in the context of a CP or not. It seems that verbal nouns resist separation more than predicative and concrete nouns. Although this fact needs to be checked by further empirical studies, it would not be surprising a priori. Indeed, the problematic status of these "nouns" can account for the fact that they are not perceived as direct objects and consequently are not subject to the same ordering variations.

To conclude, Persian CPs, like other types of multiword expressions in various languages, illustrate a case of deviation from the one-to-one mapping of form and meaning. Even though they realize a single semantic unit, their components nevertheless enjoy the mobility granted to members of "ordinary" verb-complement syntactic constructions and are subject to the same constraints with respect to the linear order. The semantic bond nevertheless plays a role in granting CPs hallmarks of "wordhood", favoring their adjacency, among other things.

Abbreviations

Glosses follow the Leipzig Glossing Rules. The following non-standard abbreviations are used for clarity:

EZ Ezafe
RA differential object marker
SINF short infinitive

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Chapter 6

Subject inversion in French object relatives: What's your preference?

Céline Pozniak
Université de Paris, Laboratoire de linguistique formelle

Anne Abeillé
Université de Paris, Laboratoire de linguistique formelle

Barbara Hemforth
Université de Paris, Laboratoire de linguistique formelle, CNRS

Subject inversion in French is usually considered to be optional (Le Bidois 1952; Kayne & Pollock 1978) and more costly than variants with preverbal subject. As the result of verb movement (Hulk & Pollock 2001), it is claimed to demand higher processing cost (Holmes & O'Regan 1981). However, some studies suggest that subject inversion in relative clauses may even be favoured by certain semantic or heaviness constraints (Fuchs 2006; Marandin 2011). In this paper, we take an empirical approach to this question. In our corpus study using the French Treebank described in Abeillé et al. (2019), we found that subject inversion in object relatives can be as frequent as cases without inversion. We also found that inversion is preferred with longer subjects and shorter and non-agentive verbs. This pattern was confirmed in an acceptability judgement experiment as well as in a self-paced reading experiment. Thus, object relatives with and without inversion are not merely stylistic variants (i.e. two equivalent syntactic ways of expressing one meaning), but are more or less preferred depending on their properties. Our results are compatible with semantic accounts of relative clause processing (Mak et al. 2006; Traxler et al. 2002).

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1 Introduction

French object relative clauses (ORs) are introduced by *que* and may have a preverbal (1) or a postverbal subject (2) (Le Bidois 1952; Kayne & Pollock 1978).

(1) Object relative with preverbal subject
Le médecin [que l'avocat$_{subj}$ connaît] aime courir.
the physician that the lawyer knows likes run
'The physician [that the lawyer knows] likes running.'

(2) Object relative with postverbal subject
Le médecin [que connaît l'avocat$_{subj}$] aime courir.
the physician that knows the lawyer likes run
'The physician [that the lawyer knows] likes running.'

In this paper, we will address the question of the status of these two types of object relatives. Are they just stylistic variants or do they differ with respect to specific properties beyond subject-verb order? We will conclude from our empirical studies that specific properties make each of them more or less felicitous, thus contributing to the many (variants) to one (meaning) aspect of this volume. We will also show that the choice of a (one) particular object relative structure depends on the combination of (possibly many) factors.

Object relatives with a preverbal subject (OR−inv) are considered canonical while object relatives with a postverbal subject (OR+inv) are often seen as marked and as a stylistic variant (especially for written French). According to semantic and pragmatic theories, the postverbal subject is generally thought of as having properties different from a preverbal subject: the postverbal subject is more likely to be indefinite and focal (Lahousse 2011) and/or long and not agentive (Fuchs 2006; Marandin 2011). Syntactic theories usually consider subject inversion as more complex, and the result of verb movement (Déprez 1990; Hulk & Pollock 2001) or specific linearization rules (Bonami & Godard 2001). However, an inversion analysis is favored in Relativized Minimality (Rizzi 1990; Friedmann et al. 2009), where a preverbal animate subject may interfere with the filler-gap dependency (3), which can be avoided with a postverbal subject (4).

(3) OR−inv
le médecin [que l'avocat connaît __]
the physician that the lawyer knows __
'the physician [that the lawyer knows __]'

(4) OR+inv
le médecin [que connaît __ l'avocat]
the physician that knows __ the lawyer
'the physician [that knows __ the lawyer]'

As for processing theories, differences in linear distance predict that OR+inv should be easier to process than OR−inv. According to Dependency Locality Theory (Gibson 2000), the linear distance between the filler (*que*) and the object gap is shorter in OR+inv (4), leading to a lower storage memory cost than in OR−inv (3). The distance is also shorter between the filler (*que*) and the relative clause verb (*connaît*) if we consider traceless theories of extraction, with a SLASH feature on the verb (Bouma et al. 2001; Sag 2010).

Two (complementary) approaches will be applied in order to put these theories and their conflicting predictions to an empirical test. The first is to look at large corpora, to see how frequent subject inversion is in object relative clauses, and which factors may favour or disfavour it. The second way is to conduct experiments that enable us to test these factors in a controlled environment. In this paper, we will associate corpus studies and experiments in order to provide converging evidence. Previous corpus studies on newspaper texts found a 41% inversion rate for French relative clauses (Fuchs 1997). Fuchs (1997) conducted a corpus study on one issue of the newspaper *Le Monde* and found that relatives with a nominal subject (not only object relative clauses but including those with *dont* 'whose', *où* 'where') were more frequent with a preverbal subject than with a postverbal subject. Based on the frequency distribution in her corpus, she suggests that subject inversion is favoured when the subject is not agentive, inanimate and definite, when it is longer than the verb phrase and when the verb is not agentive. While our own corpus studies will be strongly inspired by Fuchs's analysis, we will restrict our analysis to object relative clauses but also go beyond their approach by testing the different constraints as well as their intercorrelations using state of the art inferential statistics.

On the processing side, previous experimental studies found that object relatives with postverbal subject were more difficult to understand than those with preverbal subject. In an eye-tracking experiment, Holmes & O'Regan (1981) examined participants' eye movements while they read sentences with animate subjects and objects and reversible verbs (*dessiner* 'draw', *voir* 'see'…). Pozniak & Hemforth (2015), also using animate subjects and reversible verbs, conducted an eye-tracking experiment using the visual world paradigm, where participants listened to sentences including subject relative clauses as well as object relative

clauses with postverbal (6) or with preverbal subject (5) while they saw two pictures on a computer screen, one compatible with a subject relative clause interpretation (where the princess draws the fencer) and the other one compatible with an object relative clause interpretation (where the fencer draws the princess). The participants' task was to look at the 'correct' picture, i.e. the picture compatible with the sentence they heard, on a computer screen. More and earlier fixations on the correct picture are interpreted as evidence for easier processing in this paradigm.

(5) OR−inv
Prière de trouver la princesse correcte, c'est-à-dire la belle
please find the princess correct, that is to say the beautiful
princesse [que l'escrimeur dessine] sur l'image.
princess that the fencer draws on the picture
'Please find the correct princess, that is to say the beautiful princess [that the fencer draws] on the picture.'

(6) OR+inv
Prière de trouver la princesse correcte, c'est-à-dire la belle
please find the princess correct, that is to say the beautiful
princesse [que dessine l'escrimeur] sur l'image.
princess that draws the fencer on the picture
'Please find the correct princess, that is to say the beautiful princess [that the fencer draws] on the picture.'

Subject relative clauses, which were tested in both the Holmes & O'Regan (1981) reading experiment and the visual world eye-tracking experiment by Pozniak & Hemforth (2015), were processed faster and led to more fixations on the correct image than both object relative clause variants. However, both studies also found that OR+inv were more difficult to process than OR−inv, contrary to what is predicted by processing theories like DLT or syntactic theories like Relativized Minimality. Processing data from experiments also provide evidence for more fine-grained semantic constraints: Frauenfelder et al. (1980) compared OR+inv with reversible verbs (*connaître* 'know') and animate objects (7) vs. with non-reversible verbs (*publier* 'publish') and inanimate objects (8). Using a phoneme monitoring task (where participants have to press a button as soon as they hear a particular phoneme), they found that OR+inv was easier with inanimate objects (8) than with animate objects. However, their data cannot tell us whether these factors are specific to object relatives with a postverbal subject

(OR+inv) or concern object relatives in general, since this study did not include a comparison of ORs with postverbal and preverbal subject.

(7) Le savant [que connaît le docteur] travaille dans une université
the scientist that knows the doctor works in a university
moderne.
modern
'The scientist [that the doctor knows] works in a modern university.'

(8) Les articles [que publie la revue] demandent une lecture attentive.
the articles that publishes the journal ask for a reading careful
'The articles [that the journal publishes] demand a careful reading.'

Using eye-tracking while reading and self-paced reading paradigms, Baudiffier et al. (2011) directly compared OR−inv and OR+inv. They found that OR−inv were generally easier to process than OR+inv. However, this was particularly the case for ORs with animate subjects and animate objects, while the difference was reduced for ORs with animate subjects and inanimate objects. These experiments mainly focused on the role of animacy for the two types of relatives, but did not test length or other semantic or pragmatic properties that have been suggested to play a role as well (e.g. Fuchs 1997).

In the following sections, we present a new corpus study, based on a syntactically annotated corpus (the French Treebank, Abeillé et al. 2019), and two new experiments. We found that OR+inv can be as frequent as OR−inv, furthermore, they can be as acceptable as OR−inv in two controlled experiments manipulating semantic/pragmatic properties.

2 Inversion in object relatives: a corpus study

We searched for object relatives in the French Treebank (Abeillé et al. 2019)[1], which comprises around 21550 sentences from newspaper texts (*Le Monde* from 1990 to 1993). We extracted object relatives (with *que*) with a nominal subject and obtained 298 ORs in total, 149 of which had a postverbal subject. In order to have a fully parallel comparison for subject inversion, we excluded cleft constructions, appositive relatives, obligatory relatives after demonstratives (*ce que*), relatives with a pronominal subject (*cela* 'this', *certains* 'some') and some errors (clitic subjects). This leaves 178 object relatives, 90 with subject inversion as in (9), and 88 without as in (10).

[1]Available on http://ftb.linguist.univ-paris-diderot.fr/.

(9) …, le conseil régional de Picardie a pris position sur les problèmes
…, the regional council of Picardy has taken a stance on the problems
[que connaît l'audiovisuel public dans la région].
that encounters the audiovisual media in the region
'…, the regional council of Picardy has taken a stance on the problems
[that encounters the audiovisual media in the region].'

(10) Le rôle d'intimidation [que l'armée rouge aura après la
The role of intimidation that the army red will have after the
démilitarisation de l'Allemagne]…
demilitarization of Germany
'The role of intimidation [that the Red Army will have after the
demilitarization of Germany] …'

2.1 Annotation criteria

We annotated our 178 object relatives mainly using criteria from Fuchs (Fuchs 1997; 2006). As illustrated in Table 6.1, we annotated both relatives with animacy of the subject and the object, relative length between the verb and the object as well as length of the relative clause, definiteness of the subject and the object, thematic roles, negation and position of the relative in the sentence[2,3].

[2]Fuchs (2006) did not mention the position of the relative and the negation as criteria for subject inversion.

[3]The corpus with the annotated data can be found on https://osf.io/k97pu/.

Table 6.1: Annotation for object relatives in the corpus

Criteria	Annotation
Relative	With preverbal subject
	With postverbal subject
Animacy	Animate subject and object
	Inanimate subject and object
	Animate subject and inanimate object
	Inanimate subject and animate object
Thematic roles	Intentional subject, affected theme
	No intentional subject, no affected theme
	Intentional subject, no affected theme
	No intentional subject, affected theme
Verb agentivity	Agentive verb (‘to want’, ‘to fight’)
	Non-agentive verb (‘to represent’, ‘to have’)
Verb/subject length (syllables)	Verb longer than subject
	Verb shorter than subject
	Verb as long as subject
Relative clause length	Relative with subject and verb only
	Relative with more constituents than verb and subject
Definiteness	Definiteness of the object of the relative
	Definiteness of the subject of the relative
Negation	Presence of negation
	Absence of negation
Position of the relative	Inside the main clause subject
	Inside the main clause object
	Inside another constituent

2.2 Results

To analyze the corpus data, we ran logistic regression models using the glmer function in the lme4 R package from Bates et al. (2015). The dependent variable was subject inversion, coded as 1 for postverbal subject (subject inversion) and 0 for preverbal subject (no subject inversion). The criteria ,animacy, thematic roles, verb agentivity, verb/subject length, relative clause length, definiteness, negation, and position of the relative clause were included as predictors. They were all coded using mean centering.

We used logistic regressions with simple intercepts (Jaeger 2008) to test whether there is a general difference in frequency between the two types of ORs. No significant difference between ORs with preverbal subject and ORs with postverbal subject could be established ($z=-.15$, $p>.1$).

As for the factors we annotated in our corpus (subject definiteness, negation, animacy, verb agentivity, subject/verb length, relative clause length, position of the relative and object definiteness), we decided to run a logistic regression model combining them all as predictors. It makes sense to analyze them in one model because this allows us to establish the independent contribution of highly intercorrelated factors (the factor Verb Agentivity is linked to Thematic Roles, for example). The model including only the statistically significant predictors is presented in Table 6.2. Positive estimates correspond to an increase in the number of postverbal subjects such that OR+inv is more likely for short ORs with definite objects, non-intentional subjects and with verbs that are shorter than the subject.

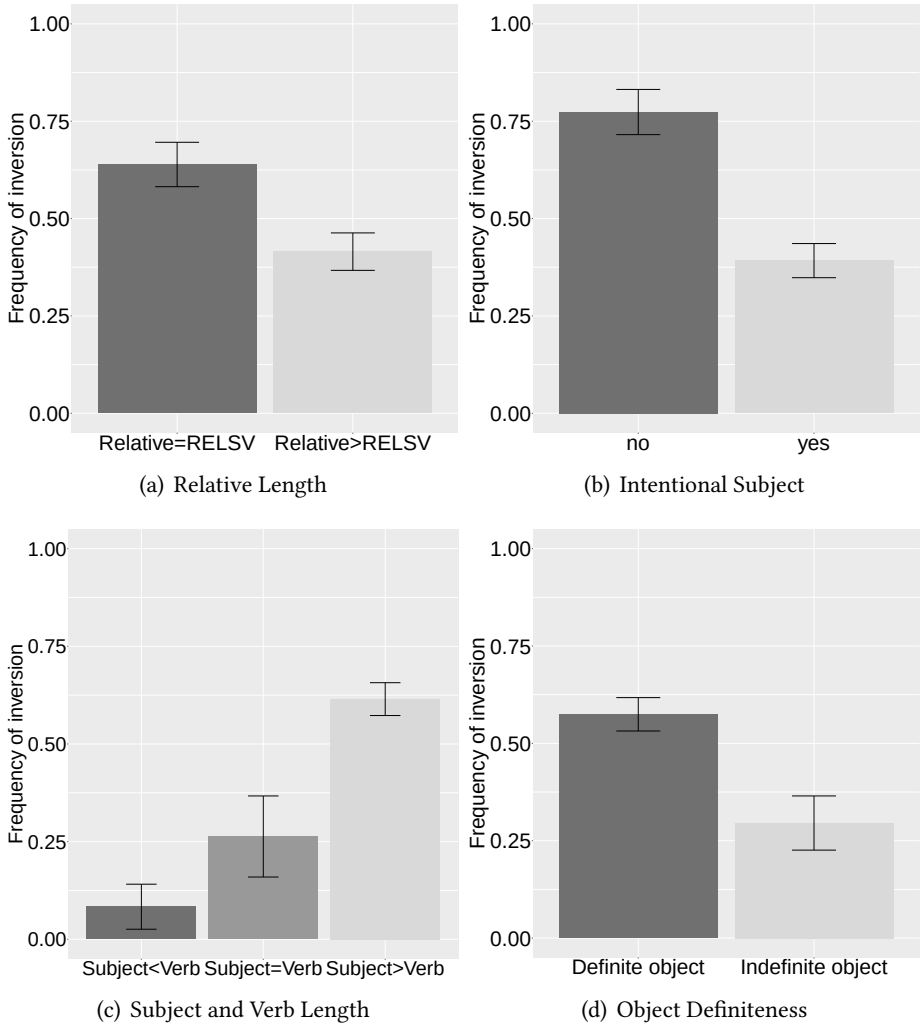
Table 6.2: Significant factors with logistic regression model for subject inversion. The intercept corresponds to indefinite object/short relative/verb longer than subject/non-intentional subject.

Fixed effects	E	SE	Z	P<
Intercept	−0.03606	0.19566	−0.184	0.1
Definite object	1.25588	0.47194	2.661	0.01
Long relative	1.04969	0.41009	2.560	0.05
Verb shorter than subject	1.48045	0.63099	2.346	0.05
Intentional subject	−1.45056	0.55517	−2.613	0.01

The factors that did not significantly contribute to the model are the following: position of the relative clause (inside main clause subject or main clause object), animacy of subject or object, affected theme and verb agentivity. However, the fact that Verb Agentivity did not contribute significantly to the model can be explained by the fact that an agentive verb needs an intentional subject, so these predictors are highly correlated ($r=.6$, $t=10.08$, $p<.001$). The independent variables that significantly influence subject inversion are shown in Figure 6.1.

2.3 Interim discussion

The corpus study shows that subject inversion can be as frequent as preverbal subjects for object relatives with a nominal subject. It also shows that object



(a) Relative Length

(b) Intentional Subject

(c) Subject and Verb Length

(d) Object Definiteness

Figure 6.1: Significant factors on subject inversion (corpus study)

relatives with pre- and postverbal subjects have different properties: A preverbal subject is more frequent when the object is indefinite and the subject intentional (implying agentivity of the verb), and when the relative is short (including only the subject and the verb) and with a subject that is shorter than the verb. A postverbal subject is more frequent when it is longer than the verb, when it is non-intentional and has a definite object, and when the relative clause is long. The relative length effect (verb shorter than the subject) is in line with processing theories like DLT which predict processing difficulty with a long intervening subject between *que* and the verb (or between *que* and the postverbal gap), thus favouring subject inversion. It may also be explained by a more general tendency to put longer (heavier) constituents at the end of the sentence (Behaghel 1909; Wasow 2002).

Prosodic factors may also play a role in explaining why a short relative (subject and verb only) favours inversion. If one considers the general tendency to have balanced prosodic constituents, and that a prosodic boundary usually occurs between the subject and the verb (Di Cristo 2016), (11) has a less natural prosodic structure than (12) (with a longer relative) or (13) (with subject inversion).

(11) les problèmes (que l'audiovisuel) (connaît).
the problems that the audiovisual knows
'the problems that the audiovisual knows…'

(12) les problèmes (que l'audiovisuel) (connaît dans la région)
the problems that the audiovisual knows in the region
'the problems that the audiovisual knows in the region'

(13) les problèmes (que connaît) (l'audiovisuel)
the problems that knows the audiovisual
'the problems that the audiovisual knows'

The definiteness effect can be explained by the relative discourse status of the subject and the object: in the context of an object relative clause, a definite object is more topical than the subject, and a less topical subject is more likely to be postverbal (Kampers-Manhe et al. 2004). The effect of subject intentionality or agentivity of the verb is in line with Marandin (2011) and Bonami & Godard (2001), suggesting that postverbal subjects lose their dynamic and agentive properties. The corpus analysis thus shows that semantic/pragmatic features differ for object relatives with a preverbal subject and object relatives with a postverbal subject. Verb semantics, length and definiteness seem to play an important role, meaning that subject inversion in object relative clauses is not merely a

stylistic variant. However, corpus studies suffer from the problem that the factors of interest are often intercorrelated, as we have seen for the intentionality of the subject and agentivity of the verb. Also, the constraints we annotated may be affected by some other variables co-varying in the corpus that we have not taken into account. In order to have a more controlled picture of the usage difference, we therefore tested these factors with two experimental studies.

3 Subject inversion in object relatives: an acceptability judgement task

In order to better understand the use of object relatives with preverbal and postverbal subjects, we ran an acceptability judgement task manipulating some of the factors found in the corpus study.

3.1 Material

We manipulated three variables: subject position (preverbal/postverbal), verb semantics (agentive/non-agentive) and subject length (long/short). As for verb semantics, pairs of agentive and non-agentive verbs were created with the same number of syllables. Verb agentivity is highly correlated with subject intentionality, as we saw in the preceding section, and easier to control in the experimental materials. Concerning subject length, the subject was treated as short when it was only composed of the article and the noun, whereas it was considered as long when a noun complement and/or an adjective was included.

Thirty-two items were created with four items per condition (Latin square design), as shown in Table 6.3. Forty-four fillers were added as distractors. The subject was always animate (humans, human groups or nouns symbolizing a collective group like a firm or a country) and the object inanimate, which favors object relative processing across the two variants (Frauenfelder et al. 1980; Mak et al. 2006). The experimental materials were inspired by the sentences from the corpus study. All relatives were short (relativizer, subject, verb), the object and the subject were definite, and all relatives modified the main clause subject. Subject length was manipulated by adding a modifier or a complement to the subject noun; the agentivity condition was an alternation between two related verbs, one non-agentive like *cost* making the subject non-intentional, and one agentive like *pay* making the subject intentional.[4]

[4]The materials and the entire analysis can be found on https://osf.io/k97pu/.

Table 6.3: Examples of sentences used in the acceptability judgement task: subject inversion (Inv ±), verb agentivity (Ag ±), subject length (Long ±)

Inv	Ag	Long	Example
−	−	−	Le prix astronomique que la firme coûte énerve considérablement les dirigeants. the price astronomical that the company costs irritates considerably the managers 'The astronomical price that the company costs considerably irritates the managers.'
+	−	−	Le prix astronomique que coûte la firme énerve considérablement les dirigeants. the price astronomical that costs the company irritates considerably the managers 'The astronomical price that the company costs considerably irritates the managers.'
−	−	+	Le prix astronomique que la firme agroalimentaire coûte énerve considérablement les dirigeants. the price astronomical that the company agri-food costs irritates considerably the managers 'The astronomical price that the agri-food company costs considerably irritates the managers.'
+	−	+	Le prix astronomique que coûte la firme agroalimentaire énerve considérablement les dirigeants. the price astronomical that costs the company agri-food irritates considerably the managers 'The astronomical price that the agri-food company costs considerably irritates the managers.'
−	+	−	Le prix astronomique que la firme paie énerve considérablement les dirigeants. the price astronomical that the company pays irritates considerably the managers 'The astronomical price that the company pays considerably irritates the managers.'
+	+	−	Le prix astronomique que paie la firme énerve considérablement les dirigeants. the price astronomical that pays the company pays irritates considerably the managers 'The astronomical price that the company pays considerably irritates the managers.'
−	+	+	Le prix astronomique que la firme agroalimentaire paie énerve considérablement les dirigeants. the price astronomical that the company agri-food pays irritates considerably the managers 'The astronomical price that the agri-food company pays considerably irritates the managers.'
+	+	+	Le prix astronomique que paie la firme agroalimentaire énerve considérablement les dirigeants. the price astronomical that pays the company agri-food irritates considerably the managers 'The astronomical price that the agri-food company pays considerably irritates the managers.'

3.2 Participants

Eighty French native speakers (56 women, mean age: 36 years, σ=18) volunteered to participate in the experiment, which was run on IbexFarm (Drummond 2013). They were recruited via the RISC (http://www.risc.cnrs.fr) platform.

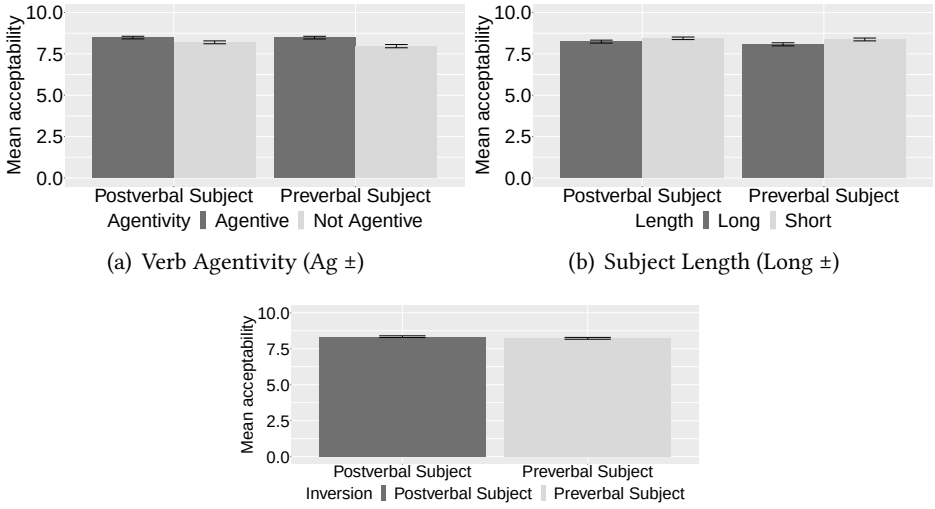
3.3 Procedure

Participants read sentences on a computer screen at a location of their choice. They had to judge the acceptability of each sentence on a scale from 1 (not at all acceptable) to 10 (fully acceptable). The experiment lasted about 15 minutes.

3.4 Results

We analyzed the acceptability judgements with generalized linear mixed models (Baayen et al. 2008), using the lmer function in R with the lme4 package from

Bates et al. (2015). As predictors, we included subject length (short, long), verb semantics (agentive, non-agentive) and subject position (postverbal, preverbal). We applied mean centered coding for all predictors. Acceptability judgements are the dependent variable in the model. Participants and items were included as random variables. We used a 'maximal model', by including by-participants and by-items random intercepts as well as random slopes for all the relevant fixed factors (Barr et al. 2013). We enforced zero correlations between random effects in order to avoid overparameterization or false convergence (Bates et al. 2015). Figure 6.2 illustrates the effects of the three independent variables on judgements.



(a) Verb Agentivity (Ag ±)

(b) Subject Length (Long ±)

(c) Subject Inversion (Inv ±)

Figure 6.2: Influence of verb agentivity, subject length and subject inversion on acceptability

When looking at subject position, the model shows that relatives both with and without inversion are rated well (higher than 8/10). Object relatives with postverbal subject are considered marginally more acceptable than object relatives with preverbal subject (8.34 vs. 8.22, t=1.751, p=.08).
Main effects of agentivity (t=2.925, p<.01) and subject length (t=3.322, p<.01) were found, meaning that sentences are rated better when the verb is agentive and the subject short. We also found an interaction between those two variables (t=−2.571, p<.05): sentences with short subjects received higher ratings when the verb is not agentive. Otherwise, no significant interaction between the three factors was found.

3.5 Interim discussion

The acceptability judgements showed that relatives both with preverbal subject and with postverbal subject are well acceptable, which is in line with what was found in the corpus study (the two possibilities were used about equally often). The results showed that object relatives with postverbal subject are in fact judged slightly better, contrary to the results from previous experiments (Holmes & O'Regan 1981; Baudiffier et al. 2011; Pozniak & Hemforth 2015), which only considered ORs with animate objects and reversible verbs. This can be explained by the fact that all objects were definite in our material and all relatives were short, meaning that, as shown in the corpus study, all our materials already realized two of the constraints that make object relatives with postverbal subject are favored, compared to object relatives with preverbal subject.

No interaction was found, however, between subject position, agentivity, and subject length. One reason for this lack of an effect could be that both relatives are perfectly grammatical and that participants chose a rather conscious and metalinguistic approach to the task, which may have obscured subtle differences between object relatives with preverbal subject and object relatives with postverbal subject. In order to have a more fine-grained analysis of processing at every point in the sentence as well as more spontaneous data, we decided to run a self-paced reading experiment with the same material.

4 Subject inversion in object relatives: a self-paced reading experiment

Our acceptability judgement task only showed global acceptability ratings of object relatives with preverbal and postverbal subject. This paradigm cannot differentiate which part of the sentence makes a relative clause more or less acceptable and natural. That is why we ran a self-paced reading experiment as well.

4.1 Material

The items used were the same as in the acceptability study and the conditions were the same as well. 16 fillers were added, as well as 24 comprehension questions: 14 questions for experimental items and 10 for fillers, around 50% of all the trials.

4.2 Participants

Forty-nine French native speakers (36 women, mean age: 29 years, σ=10) participated online in the experiment via the IbexFarm platform. They were recruited on the RISC platform.

4.3 Procedure

Participants read sentences on a computer screen at a place of their choice. Sentences appeared one word at a time in a moving window paradigm (participants had to press the spacebar each time to make the following word appear). After reading each sentence, they had to judge its acceptability on a scale from 1 (not at all acceptable) to 10 (fully acceptable). They had to answer a question about the previous sentence in around 50% of the trials. The experiment lasted about 15 minutes.

4.4 Results

Results were analyzed with generalized linear mixed models using the lmer function. Independent variables were again subject length, verb semantics, and subject position, with mean centered coding applied for all predictors. Random variables were participants and items. The dependent variable was the mean reading time on every region of the sentence. Models take into account log-transformations of reading times as well as general length.

Again, we used a 'maximal model', by including by-participants and by-items random intercepts as well as random slopes for all the relevant fixed factors (Barr et al. 2013). We enforced zero correlations between random effects in order to avoid overparameterization or false convergence (Bates et al. 2015).[5]

4.4.1 Comprehension questions

The percentage of correct answers to comprehension questions was above 90% in all eight conditions. Logistic regression models do not show a significant difference between the conditions.

4.4.2 Mean reading times

For the statistical analysis, we divided the items into six regions of interest: antecedent of the relative (object), relativizer, subject/verb, verb/subject, main

[5]The entire analysis can be found on https://osf.io/k97pu/.

clause verb, end of the sentence. This is illustrated in Table 6.4 for conditions without subject inversion and in Table 6.5 with subject inversion. Figure 6.3 represents the results for all regions and all conditions.

Table 6.4: Regions without subject inversion

1	2	3	4	5	6
Le prix astronomique	que	la firme (agroalimentaire)	coûte/paie	irrite	considérablement les dirigeants.
The price astronomical	that	the company (agrifood)	costs/pays	irritates	considerably the managers.

Table 6.5: Regions with subject inversion

1	2	3	4	5	6
Le prix astronomique	que	coûte/paie	la firme (agroalimentaire)	irrite	considérablement les dirigeants.
The price astronomical	that	costs/pays	the company (agrifood)	irritates	considerably the managers.

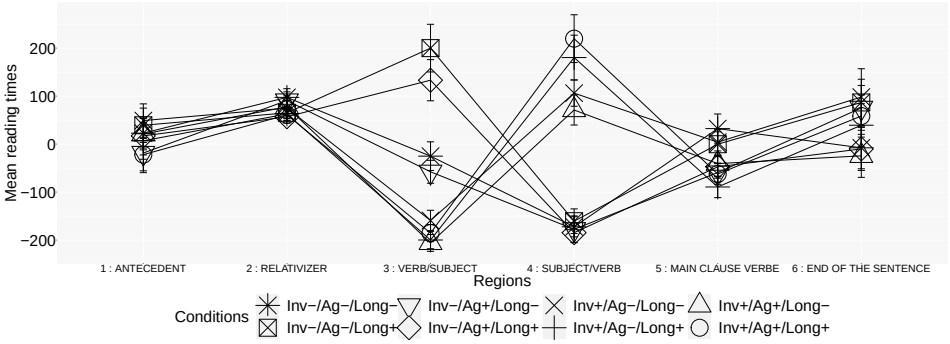


Figure 6.3: Residual reading times for the eight conditions in each region of the sentences

In this paper, we focus on region 5 (main clause verb) since this region is identical across conditions. It appears after the relative clause and may show differences in processing. Figure 6.4 represents mean residual reading times for the main clause verb (region 5).

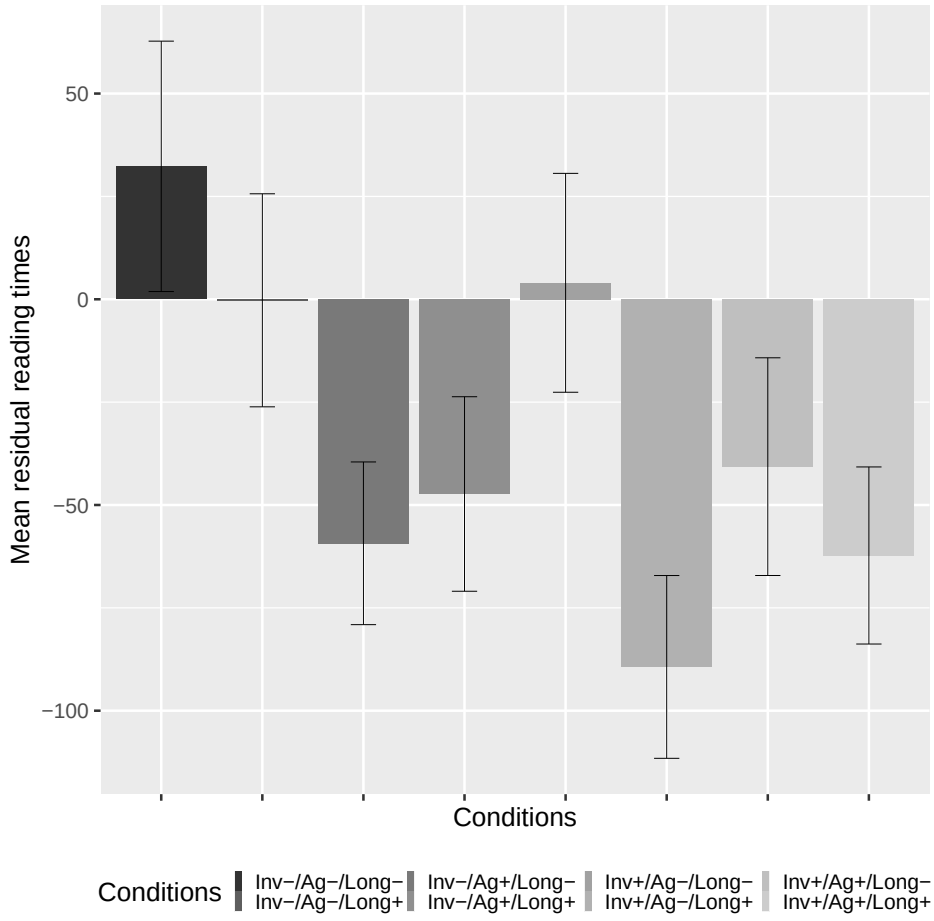


Figure 6.4: Mean residual reading times in the main verb region. Error bars represent standard errors.

In region 5 (figure 6.4), we found a general effect of verb semantics (t=2.26, p<.05): reading non-agentive verbs took longer than reading agentive verbs. An interaction between subject length and verb semantics is also observed (t=2.59, p<.05): reading times are longer with short subjects and non-agentive verbs compared to long subjects and agentive verbs. We also found a marginal effect of subject position (t=−1.81, p=.08): relatives with a postverbal subject seem to be read faster than relatives with a preverbal subject.

Interestingly, when subsetting relatives with postverbal subject, we found an effect of subject length (t=−2.06, p<.05) as well as an interaction between verb

agentivity and subject length (t=−3.08, p<.01). [6] This means that when the verb is not agentive, relatives are read faster with a long subject rather than with a short subject, whereas there is no difference at all in relatives with agentive verbs. Non-agentive verbs with long subjects correspond to the most felicitous context in the corpus study for relatives with postverbal subject. As for relatives with preverbal subject, an effect of verb semantics is found (t=−2.70, p<.05): relatives with preverbal subject are read faster when the verb is agentive.

4.5 Interim discussion

As in the acceptability judgements, object relatives with a postverbal subject are no more difficult to process than object relatives with a preverbal subject in our study - contra Holmes & O'Regan (1981), Baudiffier et al. (2011); Pozniak & Hemforth (2015). The self-paced reading study also showed an effect of length and semantics in the main clause verb region (just after the relative): relatives with a short, preverbal subject and an agentive verb are read faster than when the verb is not agentive. Reading times in the same region showed that relatives with a long, postverbal subject and a non-agentive verb are easier to process than when the subject is long. Both of these combinations echo the specific conditions for pre- and postverbal subjects that we identified in the corpus analysis. Overall, the experiment suggests that subject length and verb semantics play a role in the position of the subject in object relative clauses.

5 Discussion and conclusions

Predictions and data on the usage of object relative clauses with postverbal subject in French are inconsistent in the linguistic as well as in the psycholinguistic literature. There seems to be some general understanding that they are marked, more complex, less frequent and harder to understand than object relatives with preverbal subject. This general understanding, however, goes against predictions of some syntactic approaches (e.g. Relativized Minimality, Rizzi 1990) as well as some psycholinguistic processing theories (e.g. DLT, Gibson 2000). Previous qualitative corpus studies (Fuchs 1997) as well as psycholinguistic experiments point to an even more complex picture where a variety of constraints has to be

[6] We had to remove the interaction of the fixed factors in the random variables to make the model converge: *m1=lmer(log(reaction) Sémantique + Longueur + length + (Sémantique*Longueur + 1||sujet) + (Sémantique + Longueur + 1 ||item), data=inversion, control = lmerControl(optimizer = "optimx", calc.derivs = FALSE,optCtrl = list(method = "nlminb", starttests = FALSE, kkt = FALSE)))*

taken into account.

This inconsistency in the literature led us to the hypothesis that treating object relative clauses with pre- or postverbal subject as just two more or less complex or marked variants may be the wrong approach. What if these two variants are not basically different in acceptability or processing complexity but just favored by different sets of properties? Increased processing complexity of ORs with postverbal subject would then be the consequence of using materials more adapted to ORs with preverbal subject. Testing this hypothesis requires an approach based on controlled empirical data. Therefore, we decided to run a written corpus study, followed by acceptability judgements and a self-paced reading experiment.

Contrary to previous corpus studies (Fuchs 1997), who claimed a slight advantage for preverbal subject overall (all relatives confounded), we found that subject inversion can be as frequent as preverbal subjects in French object relatives under fully controlled conditions. Thus, frequency per se does not predict a preference for one or the other as was found in Frauenfelder et al. (1980) or Pozniak & Hemforth (2015).

Corpus annotation on the French Treebank (Abeillé et al. 2019) also shows that object relatives with preverbal and postverbal subjects have different properties and are used in different contexts. Logistic regression models (Baayen et al. 2008) show that semantic factors (agentivity and intentionality) as well as length play a significant role in subject inversion.

In order to see whether these properties differentiate object relatives with preverbal and postverbal subject, we manipulated them in two experimental studies: an acceptability judgement study and a self-paced reading experiment. The acceptability judgement experiment shows that subject inversion is rated highly acceptable and might even be preferred in object relative clauses under the right circumstances, contrary to previous experimental studies (Holmes & O'Regan 1981; Baudiffier et al. 2011; Pozniak & Hemforth 2015). The self-paced reading experiment shows that verb agentivity and subject length both play a role in the use of object relatives with preverbal subject and with postverbal subject. A non-agentive verb and a long subject make OR+inv easier to process. However, we did not test other semantic factors such as object definiteness. More experiments examining semantic and discourse factors are needed to complete the picture. The results of our experiments were also not as clear cut as we might have wished. This may be due to the fact that they were run on an internet platform, where the experimental environment is much less controlled than in the lab.

Overall, our results cannot be explained by theories which would consider postverbal subjects generally more complex than preverbal subjects as proposed by some of the syntactic theories mentioned in the introduction. They cannot be explained either by processing theories such as DLT, which predicts a systematic advantage for subject inversion, or by syntactic theories like Relativized Minimality that may similarly predict an advantage for inversion. Depending on semantic properties, object relatives with a postverbal subject are not always easier or harder to understand than object relatives with a preverbal subject as suggested in the psycholinguistic literature, which is mainly focused on reversible relative clauses with animate subjects and objects, mostly using agentive verbs (Holmes & O'Regan 1981; Baudiffier et al. 2011; Pozniak & Hemforth 2015).

To conclude, our three empirical studies emphasize the role of length and semantic/pragmatic factors (Mak et al. 2006; Traxler et al. 2002). The role of subject length could be explained by Dependency Locality Theory (Gibson 2000) or by a more general tendency to put longer constituents at the end of the sentence (Behaghel 1909; Wasow 2002). The role of verb agentivity could be explained by semantic theories (Fuchs 2006; Marandin 2011).

Our studies also show that subject inversion is not marked and is no less frequent than preverbal subject in French object relatives. Relatives with postverbal subject, which existed in Ancient French (Buridant 1999; Fuchs & Le Goffic 2006) coexist now with relatives with preverbal subject and can be felicitous depending on their semantic/pragmatic properties. Thus, we propose that subject inversion is not just a stylistic variant. Object relatives with preverbal or postverbal subject can be seen as two variants of a grammatical construction with different usage profiles and each can be more appropriate than the other in the right context.

Abbreviations

OR	Object Relative
OR+inv	Object Relative with subject inversion
OR−inv	Object Relative without subject inversion
DLT	Dependency Locality Theory

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Chapter 7

Negative conjuncts and negative concord across the board

Manfred Sailer
Goethe-Universität Frankfurt a.M.

Frank Richter
Goethe-Universität Frankfurt a.M.

Negative concord is a prominent one-to-many correspondence between form and meaning at the syntax-semantics interface, in which one semantic function may correlate with several semantic exponents. Languages are typically classified as showing negative concord or not, yet they all seem to exhibit the same interpretation strategy of conjoined negative noun phrases, i.e. cases like *no lecture and no seminar*. We will analyze this construction within a framework of a constraint-based, underspecified syntax-semantics interface (*Lexical Resource Semantics*, LRS, Richter & Sailer 2004). We will combine an earlier LRS analysis of cross-linguistic variation of negative concord with a new analysis of coordination. The latter will make it necessary to integrate into LRS so-called *equality up-to* constraints, which were originally introduced in Pinkal (1999) as a core type of constraint for underspecified semantic systems. We show that the resulting analysis captures the negative-concord-like behavior of conjoined negative noun phrases even in a non-negative concord language like Standard German.

1 Introduction

The occurrence of multiple potential markers of negation within a single sentence has been a prominent topic within research on the syntax-semantics interface, see Giannakidou (2005) for an overview. An important distinction is typically made on the basis of the interpretation assigned to such constellations: In

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negative concord (NC) languages, the sentences receive a single-negation reading (SN). This is illustrated for Polish in (1). *Non-NC* languages have a double negation reading (DN), as shown for Standard German (StG) in (2). The sentences are ambiguous between SN and DN in optional NC languages, such as French, see (3).

(1) **Nikt** **nic** nie powiedział. (Polish)
nobody nothing NM said (SN)
'Nobody said anything.'

(2) **Niemand** hat **nichts** gesagt. (StG)
nobody has nothing said (DN)
'Nobody didn't say anything.'

(3) **Personne** n' a **rien** dit. (French)
nobody NM has nothing said (SN, DN)

SN readings in NC-languages are an instance of a many-to-one relation at the syntax-semantics interface: there are several potential markers of negation in syntax, but only one negation in the interpretation. Consequently, this poses a problem for standard views of compositionality – see Sailer (2016) for an elaboration of this point. There are, however, constellations in which non-NC languages show interpretations that are similar to what has been observed for NC-languages, see for example Puskás (2012) and Larrivée (2016). In this paper, we are concerned with one of these constellations.

In the present paper, we will investigate the interpretation of a conjunction of negative noun phrases (CNNP), as illustrated for the three languages above in (4)–(6). As indicated, we find the same interpretation for all three languages. We will show that the interpretation of CNNP is an instance of NC, even in a non-NC language like StG.

(4) Alex nie napisał [**żadnego** listu i **żadnego** e-maila] (Polish)
Alex NM wrote no letter and no e-mail (SN)
'Alex didn't write any letter or any e-mail message.'

(5) Alex hat [**keinen** Brief und **keine** e-Mail] geschrieben. (StG)
Alex has no letter and no e-mail message written (SN)

(6) Alex n' a écrit [**aucune** lettre et **aucun** message électronique].
Alex NM has written no letter and no message electronic
(French)
(SN)

In Section 2, we will present the core empirical properties of CNNP in German. We will show that they are problematic for analyses of negation in StG in Section 3. We will then outline our semantic analysis in Section 4. In Section 5, the framework of semantic combinatorics of *Lexical Resource Semantics* (LRS) is introduced as a basis for formulating our analysis within this framework in Section 6. We will also show how our NC-like analysis of negated conjuncts in StG carries over to languages with very different sentential negation systems such as Polish or French. In Section 8, we will consider data with an anaphoric relation between the two conjuncts. We will end with a short conclusion (Section 9).

2 Data: Negative conjuncts in Standard German

StG is not an NC language. The empirical situation for the interpretation of sentences with two n-words in StG is briefly sketched on the basis of corpus data in Sailer 2018: 242–245. This study confirms that the co-occurrence of two n-words in one sentence as in (2) is generally avoided. Many speakers do not find such sentences easily interpretable. Those who understand them perceive a DN reading, as indicated above. For examples with CNNP no such problems arise.

For analogous French and English data, Larrivée (2016: 188, footnote 1) quotes a reviewer's comments on CNNP. Larrivée's reviewer argues that the sentence in (7) has neither a reading in which the second negative NP is interpreted as an indefinite in the scope of negation – which would correspond to an NC reading, see (7a) – nor does the sentence have a DN reading. In a DN reading, the two negations would cancel each other out, and the meaning would correspond to (7b). The interpretation rather corresponds to that of a conjunction of two clauses with one negative NP each, as in (7c). Larrivée's reviewer indicates that this reading can be derived with a categorial grammar combinatorics as in Keenan & Faltz (1985).[1]

[1]The basic idea behind the hypothetical paraphrases in (7) are the following logical representations:

(i) "NC" reading: $\neg\exists x(\phi \wedge \exists y(\phi' \wedge \psi))$

(ii) "DN" reading: $\neg\exists x(\phi \wedge \neg\exists y(\phi' \wedge \psi))$
$\equiv \forall x\neg(\phi \wedge \neg\exists y(\phi' \wedge \psi)) \equiv \forall x(\neg\phi \vee \neg\neg\exists y(\phi' \wedge \psi))$
$\equiv \forall x(\phi \supset \neg\neg\exists y(\phi' \wedge \psi)) \equiv \forall x(\phi \supset \exists y(\phi' \wedge \psi))$

(7) I want no dogs and no cats.
   a. ≠ I want no dogs and any cats. (“NC”)
   b. ≠ I want every dog and some cat(s). (“DN”)
   c. = I want no dogs and I want no cats.

The StG sentence in (5) has the same kind of reading, shown in (8). Below the paraphrase, we provide a formal rendering.[2]

(8) Alex hat **keinen** Brief geschrieben und Alex hat **keine** e-Mail
Alex has no letter written and Alex has no e-mail mess.
geschrieben.
written
‘Alex didn’t write a letter and Alex didn’t write an e-mail message.’
$\neg\exists x(\textbf{letter}(x) : \textbf{write}(\textbf{alex}, x)) \wedge \neg\exists y(\textbf{e-mail-mess}(y) : \textbf{write}(\textbf{alex}, y))$

We will call this analysis *bi-propositional* as it contains a conjunction of two sentential formulæ. A bi-propositional semantic analysis does not require a syntactic analysis in terms of two clauses, i.e., sentence (7) need not be analyzed as being syntactically derived from its paraphrase in (7c). In the system presented in Keenan & Faltz (1985), for instance, the bi-propositional reading is derived from a conjunction of two noun phrases. We will pursue a similar syntactic structure below.

There is, however, evidence that such a bi-propositional analysis of CNNP is not always possible. In (9) we see that a reciprocal pronoun may take the entire conjunction as its antecedent.[3] No bi-clausal paraphrase can be given for such constructions, which is demonstrated by the oddity of example (10).[4]

(9) Ich habe gestern [**keinen** Hund und **keine** Katze] miteinander
I have yesterday no dog and no cat with each other
streiten hören.
quarrel heard
‘Yesterday I heard [no dog and no cat] quarrel with one another.’

[2] Throughout this paper, we will state the semantic representation of generalized quantifiers in the form “quantifier variable (restrictor : scope)”.

[3] We will mark reflexive and reciprocal pronouns with a wavy underline.

[4] See for example Winter (2001) for a number of cases in which no bi-propositional analysis is possible. In the semantics literature, it is common to distinguish between *boolean* and *non-boolean* coordination instead of bi- and mono-propositional coordination. We prefer to stick to the latter terminology, though.

(10) * Ich habe gestern **keinen** Hund miteinander streiten hören und
I have yesterday no dog with each other quarrel heard and
ich habe gestern **keine** Katze miteinander streiten hören.
I have yesterday no cat with each other quarrel heard

Standard tests confirm that the negation in the conjunction expresses a clausal negation rather than a constituent negation. First, we can add a negative polarity item (NPI) such as *jemals* 'ever'.[5] The adjusted version of example (9) is given in (11).

(11) Ich habe [**keinen** Hund und **keine** Katze] *jemals* miteinander streiten
I have no dog and no cat ever with each other quarrel
hören.
heard
'I heard [no dog and no cat] ever quarrel with one another.'

Second, we can continue sentence (9) with the German equivalent of *and neither does X*, see (12).[6]

(12) (9) und Alex auch nicht.
and Alex also not
'... and neither did Alex.'

This shows that the negation in example (9) takes clausal scope. At the same time, the conjunction as a unit serves as the antecedent for the reciprocal pronoun. Consequently, we need to pursue a mono-propositional analysis of CNNP.

However, we cannot discard the option of a bi-propositional analysis entirely. In example (13), all speakers obtain a bi-propositional reading, i.e. a reading in which there is a disagreement among the children and a disagreement among the adults, see (13a). Many speakers do not accept the reading (13b), in which the quarrel happens across the two groups.

(13) [**Keine** Kinder und **keine** Erwachsenen] haben gestritten.
no children and no adults have quarreled
'No children and no adults quarreled.'
a. = The children did not quarrel with one another and the adults did not quarrel with one another.

[5] NPIs are written in italics in our examples.
[6] This negativity test is also applied in Zeijlstra (2018).

b. ≠ The children did not quarrel with the adults and the other way around. (for many speakers)

If we put the conjuncts in singular the sentence is often uninterpretable, marked with "#".

(14) # [**Kein** Kind und **kein** Erwachsener] haben gestritten.
no child and no adult have quarreled
≠ 'No child and no adult quarreled.' (for many speakers)

The verb *streiten* 'to quarrel' requires a group as its subject when used intransitively. Example (14) shows that many speakers consider such a group formation impossible in this constellation. In (13), the conjuncts are in plural, so each conjunct provides the required group argument. However, at least some speakers do seem to obtain a reading for (14), and this reading can be emphasized by adding *miteinander* to the sentence, which other speakers consider degraded or unacceptable, marked with "%".

(15) % [**Kein** Kind und **kein** Erwachsener] haben miteinander gestritten.
no child and no adult have with.each.other quarreled
= 'No child and no adult quarreled with one another.'

The same judgment pattern emerges for universally quantified conjuncts: for many speakers the plural version in (16) lacks the reading in which there is a cross-group quarrel, and the singular version in (17) is not interpretable for these speakers. Other speakers, who seem to be in the minority, have an additional cross-group reading for (16), and do get a reading for (17). The reading they obtain for (17) can be emphasized by adding *miteinander* to the sentence, as in the corresponding (15). For this reading *haben* must have plural agreement with the coordinated subject.

(16) Alle Kinder und alle Erwachsenen haben gestritten.
all children and all adults have quarreled
'All children quarreled among themselves and all adults quarreled among themselves.'
≠ 'All children quarreled with all adults.' (for many speakers)

(17) Jedes Kind und jeder Erwachsene %haben/ *hat gestritten.
every child and every adult have/ has quarreled

We do not know the conditions under which a bi-propositional reading seems required (for some speakers) or strongly preferred (for others). It seems clear to us, however, that there are two readings, one mono-propositional and one bi-propositional. Consequently, we will assume that CNNPs are in principle ambiguous, but that there are factors enforcing a mono-propositional reading (such as reciprocals with singular conjuncts), and also factors enforcing a bi-propositional reading (for many speakers). While these factors are not clear to us at present, an adequate theory must certainly provide representations for both. Restrictions that explain majority preferences or completely exclude one of the readings under certain circumstances can be added to this general theory as they are being worked out. They might be additional grammatical constraints or processing constraints.[7]

So-called *split-readings* are an interesting property of German negative NPs, which became prominent in formal semantic discussion through Jacobs (1980). According to a favored analysis, a sentence with a negative indefinite will have a semantic representation involving a negation and an existential quantifier. However, Jacobs (1980) showed that the existential quantifier need not be in the immediate scope of the negation. Penka & von Stechow (2001) illustrate this with the example in (18) with an intervening modal operator.

(18) Monika *braucht* **keinen** Vortrag zu halten.
Monika need no lecture to give
'Monika need give no lecture.'
= 'It is not the case that it is necessary that Monika gives a lecture.'

The verb *brauchen* 'need' in (18) is an NPI expressing a necessity modality. Consequently, it enforces wide scope of the negation. The semantic representation corresponding to the relevant reading is given in (19).

(19) $\neg\Box(\exists x(\textbf{lecture}(x) : \textbf{present}(\textbf{monika}, x)))$

We can modify example (18) slightly to show that CNNP has the same type of split reading.

(20) Monika *braucht* [**keinen** Vortrag und **kein** Seminar] zu halten.
Monika need no lecture and no seminar to give
'It is not the case that Monika is obliged to give a lecture and it is not the case that Monika is obliged to give a seminar.'

[7] Some of these restrictions will follow from our treatment of distributive and collective predicates.

We used a bi-propositional paraphrase in (20). To show that split readings are also available with mono-propositional readings, we construct a sentence with *brauchen* and a reciprocal.

(21) Du *brauchst* [**keinen** Vortrag und **kein** Seminar] miteinander zu
you need no lecture and no seminar with each other to
vergleichen.
compare
'You don't need to compare any lecture with any seminar.'
= 'It is not the case that you are obliged to compare a lecture and a seminar with each other.'

To sum up the discussion so far, a CNNP can serve as antecedent to a reciprocal pronoun, it expresses a clausal negation, and this negation can have wide scope over the existential quantifier (originating from *kein-* 'no') and the intervening material.

Before closing the data discussion, we would like to point to another intriguing property of CNNP. For many cases of CNNP a natural paraphrase would contain a negation plus a *disjunction* of indefinite noun phrases rather than a conjunction. Such a disjunctive paraphrase can be given for example (20) above, see (22).

(22) It is not the case that Monika is obliged to give a lecture or a seminar.
= (20)

In fact, using a conjunction in a mono-clausal paraphrase would not yield the correct interpretation. Such a hypothetical paraphrase of (20) is given in (23).

(23) It is not the case that Monika must give a lecture and a seminar. ≠ (20)

Sentence (23) expresses the idea that Monika is not obliged to give both a lecture and a seminar. Sentence (20), however, expresses the idea that Monika is not obliged to do either of the two. We call this property the "disjunction" effect of CNNP.

It is important that the predicate used in (23) is distributive, i.e. we cannot distinguish between a bi-propositional and a mono-propositional analysis on the basis of the truth conditions. If we insert a reciprocal, as in (24), there is no bi-propositional reading and, consequently, there is no equivalence between a bi- and a mono-propositional analysis.

(24) It is not the case that Monika must compare a lecture and a seminar with each other.

Related to the disjunction effect is another observation: CNNP is missing a reading that is available for a negated sentence with conjoined indefinite noun phrases, namely the "not-both" reading.

We can use a neg-raising constellation (Horn 1978) to show a contrast between CNNP and negated occurrences of conjoined indefinite noun phrases. In such a constellation the negation is in the higher clause but its effect is visible in the embedded clause – as shown by the licensing of the NPI *brauchen* 'need'. The example in (25) is compatible with two readings: one reading in which the speaker thinks that Monika needs to teach neither a lecture nor a seminar, and a second reading in which the speaker thinks that she is not obliged to teach both types of classes, but maybe one of them.[8]

(25) Ich glaube **nicht**, dass Monika [einen Vortrag und ein Seminar] zu halten
I think not that Monika a lecture and a seminar to teach
braucht.
need
Reading 1: 'I think that Monika is not obliged to teach either a lecture or a seminar.'
Reading 2: 'I think that Monika is not obliged to do both: teach a lecture AND a seminar.'

In contrast to the data with negated indefinites in a neg-raising constellation, CNNP only allows for the first reading, i.e. the reading that Monika needs to teach neither type of class. This is shown in (26).

(26) Ich glaube, dass Monika [**keinen** Vortrag und **kein** Seminar] zu halten
I think that Monika no lecture and no seminar to teach
braucht.
need
Reading 1: 'I think Monika is not obliged to teach either a lecture or a seminar.'
Reading 2: # 'I think that Monika is not obliged to do both: give a lecture AND give a seminar.'

[8] We find a disambiguating effect of stress in (25), as observed for English in Szabolcsi & Haddican 2004: 226: Reading 2 requires stress on *und* 'and', whereas Reading 1 allows for no stress on the conjunction particle.

If we enforce a mono-propositional reading, the two constellations are paraphrases, i.e., the sentences in (27) and (28) have the same truth conditions: the speaker thinks that there is no pair consisting of a lecture and a seminar such that the two need to be compared. This corresponds to the English sentence in (29).

(27) Ich glaube **nicht**, dass Monika einen Vortrag und ein Seminar
I think not that Monika a lecture and a seminar
(miteinander) vergleichen muss.
with each other compare must

(28) Ich glaube, dass Monika **keinen** Vortrag und **kein** Seminar
I think that Monika no lecture and no seminar
(miteinander) vergleichen muss.
with each other compare must

(29) I believe that Monika need not compare a(ny) lecture and a(ny) seminar.

To summarize these observations, the disjunction reading seems to be obligatory with CNNP independently of whether we are forced to have a mono-propositional analysis or not. For non-negative indefinites in the scope of negation, the disjunction reading is not obligatory. The difference in readings between (25) and (27) can be taken as additional support for our decision to assume that both a mono-propositional and a bi-propositional reading should be derivable for conjoined noun phrases.

This leaves us with a number of challenging properties of CNNP: (i) we cannot analyze it as a bi-propositional construction in all cases, (ii) we must permit split readings of the negation component and the existential component of the determiner, and (iii) we have to account for the disjunction effect. In addition, since CNNP uses no construction-specific lexical items nor a special syntactic form, no special apparatus should be required in its analysis.

3 Related Analyses

To our knowledge, CNNP has not been studied in the formal syntactic and semantic literature. For this reason, we will not be able to compare our approach to a concrete existing proposal. Consequently, we will limit ourselves here to the following questions: (i) How do existing proposals treat the difference between NC and non-NC languages? (ii) How do they derive split readings?

The introduction of split readings into the discussion of StG negation in Jacobs (1980) encouraged analyses that treat determiner *kein-* 'no' as an indefinite in the scope of a negation. The most prominent recent approaches to negative noun phrases in StG are formulated within the framework of *Transparent Logical Form* (TLF), presented in von Stechow (1993) and Heim & Kratzer (1998). Within TLF, a level of syntactic representation, called *Logical Form* (LF), displays the scope relations of the operators in a sentence by their c-command relations. Given this assumption, any negative clause must have a syntactic position that is associated with the scope of the negation. It thus follows from the availability of split readings that the position of the negation-node must be higher in the LF tree than the position marking the scope of the indefinite. An overview of the analyses of negation within this research strand is given in Zeijlstra (2016).

If the indefinite associated with the n-word is treated in exactly the same way semantically as the indefinite article, we would predict that there is no difference in meaning between an overt negation marker with an indefinite and the occurrence of the negative indefinite. We saw above with the examples in (25) and (26) that this is not the case for CNNP. Thus any analysis of this type must still be able to distinguish semantically between a plain indefinite and a negative indefinite.

A further challenge of this type of approach lies in the syntactic constellation that must hold between the abstract negation-node and the node marking the scope of the existential. Because of the availability of split readings, this constellation cannot be one of immediate scope. Surface adjacency is a good candidate.[9]

The adjacency condition is illustrated in (30). Given the word order in the sentence, the scope of the negation must be below *öfters* 'several times', i.e., the negation-expressing (covert) node must be adjacent to the n-word.[10]

(30) Alex hat für die Sitzungen öfters **kein** Buch gelesen.
Alex has for the class meetings several times no book read

[9]Surface adjacency is mentioned in Penka (2011) as a licensing condition on negative indefinites (NI) in German, where Op¬ stands for a (phonologically empty) negation that occurs as a terminal node in the structure. The condition in (i) is taken from Penka 2011: 112.

(i) Licensing condition for NIs in German:
NIs have to be adjacent to an abstract negation Op¬ in the surface syntax.

[10]When the adverb overtly follows the n-constituent, as in (i), only the reading in (30b) is possible.

(i) Alex hat für die Sitzungen **kein** Buch öfters gelesen.
Alex has for the class meetings no book several times read

a. = 'It was several times the case that Alex did not read a book before the class meetings.'
b. ≠ 'It is not the case that Alex read a book several times before the class meetings.'

The adjacency requirement cannot mean the adjacency of the indefinite word and the negation-expressing node, as the indefinite may be embedded inside a larger noun phrase. This is shown in (31). We use an NPI in the sentence to show that there is a negation taking sentential scope.

(31) [Der Besuch **keines** amerikanischen Präsidenten] hat *jemals* so viel
the visit of no American president has ever so much
Begeisterung ausgelöst wie der von Kennedy in Berlin.
enthusiasm caused as that by Kennedy in Berlin
'The visit of no American president has ever caused as much enthusiasm as that of Kennedy in Berlin.'

We saw in (20) that conjoined n-constituents can license NPIs. This effect is also observed with n-words deeply embedded in conjuncts. This is shown in (32).

(32) Maria hat sich [[über Geschenke von **keinem** Verwandten] und [über
Maria has REFL about presents from no relative and about
Glückwünsche von **keinem** Freund]] *jemals* so sehr gefreut wie
wishes from no friend ever so much been excited as
bei ihrer Hochzeit.
on her wedding
'Maria was never as excited [[about any relative's presents] and [about any friend's wishes]] as at her wedding.'

These data show that an analysis in which n-constituents are decomposed syntactically into a negation-expressing node and an existential determiner needs to be both restrictive and flexible with respect to the semantic and syntactic relation holding between the two components.[11]

[11] Zeijlstra (personal communication) points out that the adjacency requirement is also problematic for English in examples such as (i). English being an SVO language, the non-finite verb stands between the negation and the direct object.

(i) You need wear no tie.
'It is not the case that you are obliged to wear a tie.'

We can now turn to two concrete proposals within the TLF tradition. One line of research within this tradition is the work of Penka and her co-authors (Penka & von Stechow 2001; Penka & Zeijlstra 2011; Penka 2011; 2012). Penka treats expressions like *kein* 'no' semantically as indefinites that carry a syntactic requirement to occur in the right constellation with a negation-expressing node.[12] In StG, negation is typically contributed by a phonologically empty element. The fact that n-words carry this special licensing requirement can be used to distinguish between a negative indefinite and a plain indefinite.

To account for the non-NC character of StG, Penka assumes that each n-word needs to satisfy its licensing requirement against a separate negation-node. CNNP might be problematic for this assumption as we have two n-words but only one negation. There would, of course, not be a problem for the bi-propositional readings that could be derived from an underlying bi-clausal syntactic analysis. As we have argued, however, we have empirical evidence that a mono-propositional analysis is required as well.

A second approach to n-words is found in the work of Zeijlstra, starting with Zeijlstra (2004). Our presentation will be based on Zeijlstra (2014), which is a recent and technically precise formulation of his theory. Zeijlstra assumes that n-words in non-NC languages are lexically specified as being semantically negative. In addition, he proposes syntactic features, uNEG and iNEG, to capture the language- and item-specific distribution of n-words and negative markers. He accounts for the split readings of StG by postulating two features on n-words: one being responsible for negation, one for the existential interpretation. These two features can be checked in different places in the syntactic tree. These places, then, mark the scope of the two components.

It is important for our discussion here that Zeijlstra treats n-words in NC languages as different from n-words in non-NC languages. As in the case of Penka's approach, it is not clear how his approach generalizes to CNNP as we do not know his analysis of coordination. CNNP might, however, not be straightforward to capture: since n-words contribute a semantic negation in his analysis and each contributed negation needs to be interpreted, Zeijlstra might be forced into a bi-propositional analysis of CNNP and might not be able to describe data that require a mono-propositional semantic representation.

The challenge of CNNP in the current state of discussion of negation and non-NC languages lies in the combination of two properties: First, we are forced

[12] Technically, she assumes an uninterpretable NEG feature on negative indefinites that must be checked by an interpretable NEG feature in a certain syntactic constellation.

to assume a mono-propositional analysis – at least for cases in which a bi-propositional analysis is not possible. Second, as a consequence thereof, there can only be one negation in the interpretation of CNNP, even if StG usually exhibits 1-to-1 correspondence between n-words and semantic negations.

4 The semantics of conjunctions of negative noun phrases

In this section, we will discuss the semantic representation that we consider adequate for the CNNP construction. In particular, we will emphasize that the proposed representations are motivated by the observations in Section 2. We will not be concerned with the question of how these representations can be connected to a syntactic analysis of the CNNP sentences until Section 6. In Section 4.1, we adopt the analysis of mono-propositional noun phrase conjunction from Chaves (2007), in which the conjunction introduces a new, plural discourse referent – which will account for the data on reciprocals as in (9). In Section 4.2, we propose that a negation can take wide scope over the conjunction to account for NPI-licensing. We will show that we can capture the disjunction effect.

4.1 Conjunction

In this subsection, we will propose an analysis of the semantics of the conjunction of quantified noun phrases. Negation will not play a role in this subsection. We assume a division of labor between the mono- and the bi-propositional analyses: While the bi-propositional analysis may be considered more basic, the mono-propositional analysis is available whenever there is no possible bi-propositional analysis, as in cases with a collective predicate or some other indication of collectivity, such as a reciprocal pronoun. Our mono-propositional analysis will be a variant of the analysis developed in Chaves (2007).

The semantic representation of the bi-propositional reading of a conjunction is straightforward and does not require special discussion here. For the mono-propositional analysis, however, we need to introduce plural individuals and tuples. Since we cannot present a semantic analysis of plural here, we will keep this discussion as general as possible. For our examples, it is enough if we treat plural individuals as sets, in contrast to collective individuals such as *committee* or *deck of cards* (Link 1983).

Whether a predicate is interpreted collectively, distributively, or has both readings in a given sentence is determined lexically or contextually.[13] An obligatorily

[13] See Winter (2001: 46) for a classification of various lexically and constructionally conditioned collective interpretations of verbs, adjectives, and nouns.

distributive predicate such as **sleep** is true of a set if and only if every element is in the set of sleepers. We need tuples to account for collective predicates and the reciprocal readings. To give a simple example, the predicate **meet** takes a set of pairs as its argument and holds of this set of pairs if and only if every pair in the set is such that the first element of the pair meets the second element.[14]

The denotation of the predicates **sleep** and **meet** is given in (33), where S, S_1, and S_2 are sets of individuals. The denotation of the predicate **sleep** is defined in (33a) by distribution over all its elements. In contrast to this, the predicate **meet** in (34b) is obligatorily collective. To determine whether we can say of a set that its elements met, we need to look at all non-reflexive pairs of this set and determine whether all of these pairs met. Consequently, the predicate **meet** ranges over sets of pairs. There is however the option of type coercion for **meet**: if its argument is a simple set, this set can be treated as if it is a (non-reflexive) subset of the Cartesian product with itself.

(33) a. For each set S, $[\![\textbf{sleep}]\!](\mathsf{S}) = 1$ iff for each $\mathsf{o} \in \mathsf{S}$, o is asleep.

b. For each set $\mathsf{S}_1, \mathsf{S}_2$,

i. $[\![\textbf{meet}]\!](\mathsf{S}_1 \times \mathsf{S}_2) = 1$
iff for each $\langle \mathsf{x}_1, \mathsf{x}_2 \rangle \in \mathsf{S}_1 \times \mathsf{S}_2$ such that $\mathsf{x}_1 \neq \mathsf{x}_2$, x_1 and x_2 meet, and

ii. $[\![\textbf{meet}]\!](\mathsf{S}_1) = 1$ iff $[\![\textbf{meet}]\!](\mathsf{S}_1 \times \mathsf{S}_1) = 1$

The difference in the denotation of the predicates allows us to have no difference in the formulæ. This is shown in (34).

(34) a. Some students slept in the library.
$\exists z(|z| \geq 1 \wedge \textbf{student}(z) : \textbf{sleep}(z))$.

b. Some students met in the library.
$\exists z(|z| \geq 1 \wedge \textbf{student}(z) : \textbf{meet}(z))$.

Besides predicates, other elements have an influence on the interpretation of plurals as well, such as markers of distributivity (*each*), collectivity (*together*), or reciprocity (*each other*), see Sternefeld (1998).

Chaves (2007) shows how conjuncts contribute to the discourse referent of the overall conjunction. He assumes a new discourse referent for the conjunction.

[14] As discussed in Sabato & Winter (2012), for reciprocal readings, predicates differ with respect to the exact requirements on which tuples need to be included in their denotation. The initial example in Sabato & Winter (2012) is the contrast between *know each other* and *be standing on each other*. See also Winter (2016) for detailed considerations of various types of collective predicates.

This referent is a set containing the elements denoted by the conjuncts. We can illustrate this first with the conjunction of two proper nouns as in (35). As shown in the semantic representation, the conjunction is specified in such a way that each conjunct must be a member of the set z.[15]

(35) Alex and Kim met.
$\exists z((\mathbf{alex} \in z \wedge \mathbf{kim} \in z) : \mathbf{meet}(z))$

To combine our assumptions about collective predicates with Chaves's theory of coordination, we need to depart from Chaves's analysis slightly: instead of assuming that there is a simple set built by the conjunction, we assume that there is tuple formation, i.e., in (35), z is not $\{[\![\mathbf{alex}]\!], [\![\mathbf{kim}]\!]\}$, but rather the Cartesian product $\{[\![\mathbf{alex}, \ldots]\!]\} \times \{[\![\mathbf{kim}, \ldots]\!]\}$.

Applying this to our example, we arrive at the semantic representation in (36). We use $\pi_i z$ to identify the i-th position in the tuple z – and, by extension, if z is a set of tuples, $\pi_i z$ is the set of all elements that occur in the i-th position in any of the tuples in z.

(36) $\exists z((\mathbf{alex} \in \pi_1 z \wedge \mathbf{kim} \in \pi_2 z) : \mathbf{meet}(z))$

Given the way we have defined the denotation of the predicate **sleep** in (33a), there is no mono-propositional analysis for an analogous sentence with *sleep*. This is shown in (37).

(37) Alex and Kim slept.
$\exists z((\mathbf{alex} \in \pi_1 z \wedge \mathbf{kim} \in \pi_2 z) : \mathbf{sleep}(z))$ (type clash!)

The formula in (37) is ill-formed: z must refer to a subset of a Cartesian product of two sets, but **sleep** is only defined for sets of objects, not for sets of tuples of objects.

Similarly, there is no bi-propositional analysis for the sentence in (35). The hypothetical formula is given in (38). This formula is not well-formed as the predicate **meet** requires a set as its argument, not an individual.

(38) Hypothetical bi-propositional analysis of (35):
$\mathbf{meet}(\mathbf{alex}) \wedge \mathbf{meet}(\mathbf{kim})$

If the conjoined noun phrases are plural, we do, of course, get both a mono- and a bi-propositional analysis. This is shown in (39).

[15] Since z is existentially quantified over, we do not need to enforce that z be exhaustively specified through the conjuncts, i.e., there might be more elements in z.

(39) Die Kinder und die Erwachsenen haben gestritten.
the children and the adults have quarreled.
a. Mono-propositional reading: 'The kids quarreled with the adults.'
b. Bi-propositional reading: 'The kids quarreled among themselves and the adults quarreled among themselves.'

An advantage of the analysis in Chaves (2007) is that it carries over directly to quantified noun phrases. In (40) we give an example with the conjunction of a proper noun and a quantified noun phrase. As can be seen, the quantified noun phrase *many students* is integrated into the semantic representation in such a way that it takes conjunction-internal scope with just the membership requirement in the discourse referent of the conjunction, z, as its scope, i.e., $\mathbf{Many}\, y\, (\mathbf{student}(y)\ :\ y \in \pi_2 z)$

(40) Alex and many students met in the library.
$\exists z((\mathbf{alex} \in \pi_1 z \wedge (\mathbf{Many}\, y\, (\mathbf{student}(y)\ :\ y \in \pi_2 z))) : \mathbf{meet}(z))$

Example (40) also points to a final adjustment that we need to make. It can be understood in such a way that the argument of the predicate **meet** is the set containing Alex and many students. This means that the students meet one another as well as Alex, not just Alex meeting each of the many students. We can derive this reading using the truth conditions of **meet** in (33b-ii).

We will illustrate this with the example in (41). This sentence has a reading in which the predicate **meet** would just take a set of one-tuples as its argument. This can be expressed in the semantic representation given below the sentence.

(41) Alex, Kim, and Robin met in the library.
$\exists z((\mathbf{alex} \in \pi_1 z \wedge \mathbf{kim} \in \pi_1 z \wedge \mathbf{robin} \in \pi_1 z)\ :\ \mathbf{meet}(z))$

In order to capture the systematic ambiguity of either keeping the conjuncts separate or merging them into a set of one-tuples, we will write $\pi_{\geq 1} z$ instead of $\pi_2 z$ to indicate the position in the tuple to which the second conjunct makes its contribution. In (41), z is, consequently just a set of one-tuples, which we can treat as a simple set. We can interpret $\mathbf{meet}(z)$ according to the truth conditions given in (33b-ii), i.e., as equivalent to $[\![\mathbf{meet}]\!]([\![z]\!] \times [\![z]\!])$. The interpretation of sentence (40) as many students meeting one another and Alex follows in the same way. The semantic representation given above needs to be changed slightly, using $\pi_{\geq 1} z$ instead of $\pi_2 z$ in the second conjunct.

In this subsection, we have presented a semantic analysis for mono-propositional readings of conjoined noun phrases. While our approach relies on

the insights of Chaves (2007), we provided a tuple-based formulation of some of his core ideas. We can, now, combine the analysis of conjunction with an analysis of n-words.

4.2 Wide-scope negation and the disjunction effect

N-words are often analyzed as existential quantifiers in the scope of negation, which is exactly what we will do here. We saw in the data discussion that CNNP introduces a negation that takes scope over the rest of the sentence. In (42), we show the semantic representation for a simple CNNP-sentence.

(42) Alex vergleicht/ liest [**keinen** Brief und **keine** e-Mail].
Alex compares/ reads no letter and no e-mail message
Alex is comparing / reading no letter and no e-mail message.

a. Mono-propositional (for *vergleichen* 'compare'):
$\neg\exists z((\exists x(\mathbf{letter}(x) : x \in \pi_1 z) \wedge \exists y(\mathbf{e\text{-}mail\text{-}mess}(y) : y \in \pi_{\geq 1} z)) : \mathbf{compare}(\mathbf{alex}, z))$

b. Bi-propositional (for *lesen* 'read'):
$\neg\exists x(\mathbf{letter}(x) : \mathbf{read}(\mathbf{alex}, x)) \wedge \neg\exists x(\mathbf{e\text{-}mail\text{-}mess}(x) : \mathbf{read}(\mathbf{alex}, x))$

According to the mono-propositional reading, there is no set of pairs z that contains pairings of letters with e-mail messages such that Alex is comparing any of the items in this tuple. For the strictly distributive interpretation of the complement of the predicate **read**, we find a coordination of two negated formulæ with identical or parallel expressions in their scope.

The formulæ in (42) also account for the NPI-licensing potential of CNNP: there is a negation in the semantic representation that takes scope over the contribution of the NPI. Consequently, we expect NPIs to be possible in each conjunct and in the rest of the clause. This is the case, as shown in (43).

(43) [[**Kein** Student, der *jemals* in meinem Kurs war,] und [**kein** Student,
no student who ever in my course was and no student
der *jemals* in deinem Kurs war,]] wird *jemals* vergessen, was dort
who ever in your course was will ever forget what there
unterrichtet wurde.
taught was
'No student who has ever been in my class and no student who has ever been in your class will ever forget what was taught there.'

Finally, we will show how the disjunction effect follows from the introduced representations. The bi-propositional formula from (42) is logically equivalent to the one given in (44), in which there is a disjunction in the restrictor of the existential quantifier, i.e., the quantification takes any x into consideration that is a letter or an e-mail message.

(44) $\neg\exists x((\textbf{letter}(x) \vee \textbf{e-mail-mess}(x)) \wedge \textbf{read}(\textbf{alex}, x))$

The equivalence between (42b) and (44) follows directly: if nothing that is either a letter or an e-mail message is being read by Alex, this is the same as saying that Alex is neither reading a letter nor an e-mail message. This means, there is no letter such that Alex is reading it and there is no e-mail message such that Alex is reading it, either.

The formula in (44) shows that the expression in (42) captures the disjunction effect, i.e., while the conjoined noun phrases are combined logically with a conjunction, the overall interpretation is rather like a disjunction.

As Zeijlstra (personal communication) pointed out to us, a mono-propositional analysis would lead to a "not both" reading for a CNNP sentence with a distributive predicate: if Alex were reading a letter but no e-mail message, there would not be a pair or a plural object containing both a letter and an e-mail message being read by Alex. We saw in Section 4.1, example (37), that a distributive predicate cannot take a tuple as its argument. Consequently, a mono-propositional analysis of a CNNP sentence with a verb like *read* would lead to a type clash.

We can now turn to the contrast between CNNP and the negation of conjoined indefinite noun phrases, illustrated in examples (25) and (26) above. The contrast only arose in the cases in which a bi-propositional reading is possible. We observed that CNNP excludes a "not both" reading, which is readily available for negated conjoined indefinites.

(45) a. "not both" reading:
$\neg(\exists x(\textbf{lecture}(x) : \textbf{teach}(\textbf{monika}, x))$
$\wedge\exists x(\textbf{seminar}(x) : \textbf{teach}(\textbf{monika}, x)))$

b. "neither" reading:
$\neg\exists x(\textbf{lecture}(x) : \textbf{teach}(\textbf{monika}, x))$
$\wedge\neg\exists x(\textbf{seminar}(x) : \textbf{teach}(\textbf{monika}, x))$

The difference between the two readings lies in the scope of the negation: for the "not both" reading, the negation has wide scope over the two conjoined propositions, in the "neither" reading each of the conjuncts keeps its negation. We will have to provide an analysis that allows for split readings with

CNNP on the one hand but, on the other, blocks wide-scope negation for the bi-propositional interpretation.

In this section, we introduced and discussed a semantics of negated, potentially plural, noun phrases. We showed that this semantics is compatible with our observations on CNNP. In the next section, we will present the framework of the semantic combinatorics that we will adopt for our analysis of the data.

5 Lexical Resource Semantics

Lexical Resource Semantics (LRS, Richter & Sailer 2004) is a system of constraint-based, underspecified semantic combinatorics. It has been developed to account for problems with a traditional concept of compositionality. The basic idea behind any LRS analysis is that the syntactic structure should be determined by syntactic considerations and the semantic representation by semantic considerations. This sets LRS apart from LF-approaches as those mentioned in Section 3, which assume a syntactic representation that directly reflects the semantic representation. It is also different from categorial grammar, which questions the entire notion of an independent syntactic constituent structure. From its first publications on, negation and negative concord, as well as other cases of semantic concord, played an important role in the development of LRS.[16] We will present the necessary background on LRS in Section 5.1. In Section 5.2, we will go through four aspects of *one-to-many* correspondences that follow from the general architecture of LRS. We will use these to introduce the LRS treatment of negation and coordination.

5.1 Underspecified constraint-based combinatorics

In LRS, we use a standard semantic representation language, like the one used in Section 4. We enrich this language with *metavariables*, which we will write as upper case letters.[17] A metavariable can denote any formula of the underlying semantic representation language. For any formulæ $\phi_1, \ldots \phi_n$ of our extended language and any metavariable A, $A[\phi_1, \ldots \phi_n]$ restricts the denotation of A to formulæ containing all of $\phi_1, \ldots \phi_n$ as subexpressions. When convenient, we may

[16] Richter & Sailer (2001) look at the occurrence of multiple interrogatives, Sailer (2004b) discusses temporal concord, and Sailer (2010) proposes a semantic concord-analysis of cognate objects.

[17] We will be using a variant of the notation introduced in the computational implementation of LRS in Penn & Richter (2004; 2005).

write $\phi \lhd A$ to express that A must refer to an expression from our underlying representation language that contains the denotation of ϕ.

LRS is a constraint-based framework in the sense that all words and phrases *constrain* the possible semantic representation of a sentence. There are two basic types of constraints: *contribution constraints* and *component constraints*. Contribution constraints determine which constants, variables, predicates, and operators of the representation language occur. For example, the name *Alex* determines that whenever it is used in a sentence, the semantic representation of this sentence will contain an occurrence of the constant **alex**. In LRS, contribution constraints can only be made by lexical elements, i.e., LRS heavily relies on "lexical resources".

Component constraints indicate which expressions must be a component of other expressions. All meta-expressions of the form $A[\phi_1, \ldots \phi_n]$ or $\phi \lhd A$ are component constraints. Component constraints restrict the possible readings of a sentence. They can be imposed by lexical elements but also by the syntactic structure, i.e., by the principles of semantic combinatorics.

In (46), the semantic constraints of the word *niemand* 'nobody' are shown. Whenever the word is used, there will be a negation in the sentence, an existential quantification binding the variable x, the variable x itself, and the formula $\mathbf{person}(x)$. In addition to these contribution constraints, there are also a number of component constraints: (i) the existential quantifier is in the scope of the negation – though not necessarily in its immediate scope, (ii) the formula $\mathbf{person}(x)$ occurs in the restrictor of the existential quantifier, and (iii) the scope of the existential quantifier contains variable x at least once.

(46) *niemand* 'nobody': $\neg A[\exists x(B[\mathbf{person}(x)] \,:\, B'[x])]$

The semantic constraints of a verb are shown in (47). The verb contributes a predicate, **sleep**, and its application to the discourse referent of its subject. However, it does not contribute that discourse referent. This is an indirect contribution constraint, i.e. the occurrence of some expression x is required but the expression is not contributed. We indicate indirect contribution constraints by using a gray background with white font instead of black on white, i.e., x instead of x. All expressions from our semantic representation language that are not included in a contribution constraint in a given linguistic sign will be marked in this way.

(47) *schläft* 'is asleep': $C[\mathbf{sleep}(x)]$

For the purpose of semantic combinatorics, we add three more diacritic markings to our metaformulæ. For each nominal expression, we will mark its discourse referent by a wavy underlining, i.e. $\underset{\sim}{x}$. The semantics associated with a phrase will be called its *external content*, marked as ${}^{\#}\phi$. The *internal* content will be the part of the semantic contribution of the head of a phrase that is scoped over by all semantic operators that occur as non-heads in this phrase. This is displayed as $\{\phi\}$. The discourse referent, the external content, and the internal content percolate along the syntactic head projection.

We will enhance the two lexical specifications we have so far by these three additional markings.

(48) *niemand* 'nobody': $\neg A[{}^{\#}\exists\underset{\sim}{x}(B[\{\mathbf{person}(x)\}] : B'[x])]$

schläft 'is asleep': ${}^{\#}C[\{\mathbf{sleep}(x)\}]$

When we combine the two words, we get the clause in (49). Since the verb is the syntactic head of the clause, the external and internal content of the clause are the same as those of the verb as given in (48).

(49) (dass) niemand schläft
that nobody is.asleep
'that nobody is asleep'
Constraints: ${}^{\#}C[\neg A[\exists x(B[\mathbf{person}(x)] : B'[x])], \{\mathbf{sleep}(x)\}]$
$\mathbf{sleep}(x) \triangleleft B'$

There are some more combinatorial constraints. In this paper, we need the principles for quantified expressions and the so-called *External Content Principle*. We will briefly illustrate these.

First, we assume a number of combination-specific principles. When a quantified noun phrase is the non-head combining with a head, then the head's internal content is a component of the quantifier's scope. This can be seen in the second constraint given in (49). When a quantificational determiner combines with the rest of a noun phrase, the internal content of the rest of the noun phrase will be a component of the determiner's restrictor.

Second, the *External Content Principle* constrains the external content. It has various clauses, which are contingent on the structural completeness of a linguistic sign. For each phrase, there will be some expression that satisfies all constraints contributed by the daughters. This is the expression denoted by the metavariable C in (49). For a complete utterance, there is an even stronger constraint: The external content of an utterance is a formula that consists all and only

of those logical expressions mentioned in contribution constraints and satisfies all component constraints. Given the constraints in (49), there is exactly one formula satisfying the External Content Principle on utterances: $\neg\exists x(\mathbf{person}(x) : \mathbf{sleep}(x))$.

We can verify that this formula is a possible semantic representation of the sentence by assigning subexpressions of the formula to the metavariables in (49). If we get an assignment that is consistent with the constraints, the formula is a possible reading of the sentence. We will call such an assignment of expressions to metavariables a *plugging*, following the terminology of Bos (1996). The relevant plugging for our example is given in (50).

(50) $B' = \mathbf{sleep}(x)$ $\quad B = \mathbf{person}(x)$
$A = \exists x(\mathbf{person}(x) : \mathbf{sleep}(x))$ $\quad C = \neg\exists x(\mathbf{person}(x) : \mathbf{sleep}(x))$

5.2 One-to-many relations in LRS

The basic mechanism of LRS is sufficient to capture one-to-many relations at the syntax-semantics interface. We will go through the following four of such one-to-many relations in this subsection: (i) scope ambiguity, (ii) split readings, (iii) semantic concord, and (iv) implicit semantic material. We will go through these four in this subsection.

5.2.1 Scope ambiguity

Scopally ambiguous sentences have been the primary motivation for the development of underspecified semantics in computational linguistics, see Pinkal (1996) and Bos (1996). Such sentences are instances of one-to-many correspondences, as there is one syntactic form associated with more than one semantic representation. Our metaformulæ are ambiguous if and only if there is more than one possible plugging.

This can be illustrated with the following example sentence. The semantic constraints contributed by the words are given in (52).

(51) Jeder schläft nicht.
everyone is.asleep not
'Everyone is not asleep.'

(52) *jeder* 'every': $^{\#}\forall\underset{\sim}{x}(B[\{\mathbf{person}(x)\}] : B'[x])$
nicht 'not': $\neg A$

Combining the lexical constraints with those for *schläft* 'is.asleep' in the standard way, we arrive at the metaformula in (53).

(53) $^{\#}C[\neg A, \forall x(B[\mathbf{person}(x)] : B'[x]), \{\mathbf{sleep}(x)\}]$
$\mathbf{sleep}(x) \triangleleft B'$ and $\mathbf{sleep}(x) \triangleleft A$

In this metaformula, the relative scope of the negation and the universal quantifier is not constrained. Consequently, there are two possible pluggings. In (54), the reading with wide scope for the negation is given, in (55), the negation is interpreted in the scope of the universal quantifier.

(54) $B = \mathbf{person}(x)$ $B' = \mathbf{sleep}(x)$
$A = \forall x(\mathbf{person}(x) : \mathbf{sleep}(x))$ $C = \neg\forall x(\mathbf{person}(x) : \mathbf{sleep}(x))$
Resulting reading: $\neg\forall x(\mathbf{person}(x) : \mathbf{sleep}(x))$

(55) $B = \mathbf{person}(x)$ $B' = \neg\mathbf{sleep}(x)$
$A = \mathbf{sleep}(x)$ $C = \forall x(\mathbf{person}(x) : \neg\mathbf{sleep}(x))$
Resulting reading: $\forall x(\mathbf{person}(x) : \neg\mathbf{sleep}(x))$

As this example illustrates, we can derive more than one reading, depending on how we interpret the metavariables. In (54), the quantified formula is in the immediate scope of the negation, it equals A. In the second reading, (55), the negation is in the scope of the quantifier, B', and the negated expression equals B'.

5.2.2 Split readings

In the narrow-negation reading, the negation is interpreted as taking scope over the atomic formula $\mathbf{sleep}(x)$ and within the scope of the quantifier. This way of talking about the reading in (55) characterizes this reading as a form of "intervention" or, in fact, as some "split reading". A split reading can always arise when a word contributes lexical constraints with at least one operator and does not fully specify the scope of this operator.

Let us give a very simple example for illustration. We assume a purely epistemic interpretation of the modal verb *müssen* 'must' in (56). There are three such epistemic readings, differing with respect to the scope of the negation, as indicated by the paraphrases and by the semantic representations.[18,19]

[18] We write "□" for the necessity operator. Of course, (56) has deontic readings as well.

[19] Readings in which the necessity operator has scope over negation are clearly dispreferred in German. As Zeijlstra (personal communication) pointed out to us, the reading in (56c) is certainly not common, if available at all. For us, it seems available in principle, though we assume that its degradedness follows from other, general scope preferences of the modal operator.

(56) Niemand muss schlafen.
nobody must sleep

a. 'For nobody is it necessary to sleep.' $\neg\exists x(\textbf{person}(x) : \Box\textbf{sleep}(x))$

b. 'It is not necessary that anybody sleeps.' $\neg\Box\exists x(\textbf{person}(x) : \textbf{sleep}(x))$

c. 'It is necessary that nobody sleeps.' $\Box\neg\exists x(\textbf{person}(x) : \textbf{sleep}(x))$

We give a very simple set of semantic constraints for the verb *müssen* 'must' in (57).

(57) *müssen* 'must': $\Box(D)$

Given the lexical and combinatorial constraints, we arrive at the metaformula in (58) for sentence (56). Semantically, the modal behaves like the negation in (53). It introduces a propositional operator and requires that the internal content of the verb *schlafen* 'sleep' be in its scope. The resulting underspecified formula is given in (58).

(58) $^{\#}C[\neg A[\exists x(B[\textbf{person}(x)] : B'[x])], \{\textbf{sleep}(x)\}, \Box(D)]$
$\textbf{sleep}(x) \lhd B'$ and $\textbf{sleep}(x) \lhd D$

There are three possible pluggings for this metaformula: the scope of the modal operator can contain only the verb's internal content, that plus the existential quantifier, or the entire negated formula. In (59), the readings are shown together with the relevant parts of these three pluggings.

(59) a. Reading 1: $\neg\exists x(\textbf{person}(x) : \Box(\textbf{sleep}(x)))$
$D = \textbf{sleep}(x)$ (i.e., $D = B'$)

b. Reading 2: $\neg\Box(\exists x(\textbf{person}(x) : \textbf{sleep}(x)))$
$D = \exists x(\textbf{person}(x) : \textbf{sleep}(x))$ (i.e. $D = A$)

c. Reading 3: $\Box(\neg\exists x(\textbf{person}(x) : \textbf{sleep}(x)))$
$D = \neg\exists x(\textbf{person}(x) : \textbf{sleep}(x))$

The difference between the first and the second reading is real but subtle: In the first reading, the predicate **person** is not interpreted in the scope of the modal operator. If it is a world-dependent predicate, as is often assumed in intensional semantics, there might be an individual *a* that is a person in one world but not in another world. In Reading 1 we quantify existentially over persons in the world of evaluation, in Reading 2 over individuals that are persons in the modally quantified world.[20]

[20]This contrast is clearer in examples like (i):

5.2.3 Semantic concord

The examples discussed so far show that the underspecification mechanism accounts for both scope ambiguity and split readings. We can now turn to concord, which we will illustrate with negative concord. We assume that the analysis of all languages with n-words is based on the same lexical semantic contribution independently of a language's NC-type, i.e. whether it is an NC language like Polish, a non-NC language like German, or an optional NC language like French. The languages have the same underspecified semantic representations of sentences with n-words, but different types of languages use different interpretation strategies, i.e. impose different constraints on the kinds of pluggings they allow (Richter & Sailer 2006). As mentioned at the beginning of this chapter, French allows for a SN and a DN reading of a sentence with two n-words. This is shown in (60).

(60) Personne (ne) connaît personne.
nobody NE knows nobody

a. SN: 'Nobody knows anybody'
$\neg\exists x(\mathbf{person}(x) : \exists y(\mathbf{person}(y) : \mathbf{know}(x, y)))$

b. DN: 'Everyone knows someone'
$\neg\exists x(\mathbf{person}(x) : \neg\exists y(\mathbf{person}(y) : \mathbf{know}(x, y)))$
$\equiv \forall x(\mathbf{person}(x) : \exists y(\mathbf{person}(y) : \mathbf{know}(x, y)))$

Let us consider how we derive these readings. Ignoring the pre-verbal negation marker *ne*, we assume the following lexical constraints for the words in the sentence.

(61) a. Subject: *personne* 'nobody': $\neg A[{}^{\#}\exists\underset{\sim}{x}(B[\{\mathbf{person}(x)\}] : B'[x])]$

b. Complement: *personne* 'nobody': $\neg D[{}^{\#}\exists\underset{\sim}{y}(E[\{\mathbf{person}(y)\}] : E'[y])]$

c. Verb: *(ne) connaît* 'NE knows': ${}^{\#}C[\{\mathbf{know}(\boxed{x}, \boxed{y})\}]$

(i) Michelle wollte keinen Präsidenten heiraten.
Michelle wanted no president marry
'Michelle did not want to marry a president.'
Reading 1: It is not the case that there is a current president such that Michelle wanted to marry him.
Reading 2: It is not the case that Michelle wanted to marry someone who was a president at the time of their wedding.
Reading 3: What Michelle wanted was not to get married to a person who was president at the time of their wedding.

When these lexical constraints are combined in a sentence, we arrive at the semantic constraints in (62). This metaformula contains all constraints from the lexical entries. In addition, the combinatorial principles enforce that the verb's internal content be in the scope of each of the two quantified noun phrases.

(62) $^{\#}C[$
$\neg A[\exists x(B[\mathbf{person}(x)] : B'[x])]$, (subject)
$\neg D[\exists y(E[\mathbf{person}(y)] : E'[y])]$, (object)
$\{\mathbf{know}(x, y)\}]$ (verb)
and $\mathbf{know}(x, y) \triangleleft B'$ and $\mathbf{know}(x, y) \triangleleft E'$

For simplicity, we will ignore the possible ambiguity of the relative scope of existential quantifiers contributed by the subject and the object and assume that the subject outscopes the object here. What is relevant for us, however, is to consider the negation(s). We need to remember that we are working in a *constraint-based* framework. This means that our metaformulæ impose constraints on what the real formulæ can look like. An n-word therefore states that the semantic representation in which it occurs must contain a negation and that this negation must take scope over the existential quantifier that binds the discourse referent associated with the n-word.

Under the DN reading of sentence (60), this constraint is satisfied for both of the n-words: for each n-word, we have a negation scoping over the corresponding existential quantifier. Note that the outmost negation, in fact, has both of these quantifiers in its scope. We can now turn to the SN reading. Maybe surprisingly, it also satisfies the constraints of the n-words: each of the existential quantifiers is in the scope of a negation in the semantic representation. In (63), we indicate the pluggings responsible for the two readings.

(63) a. DN:
$A = \exists x(\mathbf{person}(x) : \neg\exists y(\mathbf{person}(y) : \mathbf{know}(x, y)))$
$B = \mathbf{person}(x)$ $B' = \neg\exists y(\mathbf{person}(y) : \mathbf{know}(x, y))$
$C = \neg\exists x(\mathbf{person}(x) : \neg\exists y(\mathbf{person}(y) : \mathbf{know}(x, y)))$
$D = \exists y(\mathbf{person}(y) : \mathbf{know}(x, y))$
$E = \mathbf{person}(y)$ $E' = \mathbf{know}(x, y)$

b. SN:
$A = \exists x(\mathbf{person}(x) : \exists y(\mathbf{person}(y) : \mathbf{know}(x, y)))$
$B = \mathbf{person}(x)$ $B' = \exists y(\mathbf{person}(y) : \mathbf{know}(x, y))$
$C = \neg\exists x(\mathbf{person}(x) : \exists y(\mathbf{person}(y) : \mathbf{know}(x, y)))$
$D = \exists x(\mathbf{person}(x) : \exists y(\mathbf{person}(y) : \mathbf{know}(x, y)))$
$E = \mathbf{person}(y)$ $E' = \mathbf{know}(x, y)$

The relevant parts of the pluggings are the values for the scopes of the negations, *A* and *D*. In the DN reading, these are assigned distinct formulæ. In the SN reading, they are identical.[21]

LRS is a genuinely ambiguity-friendly system. Therefore, the ambiguity that we find for optional NC languages is accounted for without any additional assumptions. For strict NC languages and for non-NC languages, we need to impose constraints that reflect the interpretation strategies of these languages. In other words, such languages have additional principles that filter out one of the pluggings from (63). The constraints required for this are elaborated in some detail in Richter & Sailer (2006) and we will just summarize them briefly here.

For a strict NC language like Polish, we require that the external content of a verb contain at most one negation that takes scope over the verb's internal content. This constraint excludes the DN-plugging in (63a). The interpretive strategy of NC languages is very simple and leads to slim semantic representations. This might account for the fact that NC is the typologically most frequent interpretation strategy for sentences with two n-words.

A non-NC language like German, on the other hand, employs a different strategy, which Richter & Sailer (2006) call *negation faithfulness*, alluding to the optimality theoretic account of negation systems in de Swart (2010). This faithfulness constraint is given in (64) in a form that is adapted to the present notation and relativized to headed phrases.

(64) Negation Faithfulness Constraint (NFC, adapted from Richter & Sailer 2006)
In every headed phrase, whenever one daughter has a constraint $\neg A$ and another daughter has a constraint $\neg B$, the overall phrase has a constraint $A \neq B$.

Given the NFC, the German equivalent of sentence (60) has a constraint on its semantic representation that requires that *A* (the scope of the negation contributed by the subject) and *D* (the scope of the negation contributed by the complement) be distinct. This rules out the plugging in (63b), which leads to the SN reading.

5.2.4 Implicit semantic material: Identical material

In this subsection, we will discuss cases in which there seems to be more material required in the semantic representation than is apparently contributed by the

[21] Egg (2010) notes that LRS is the only system of underspecified semantic combinatorics that allows this type of identity of the interpretation of metavariables.

elements overtly occurring in syntax. An obvious case in point is ellipsis, but more relevant to us here is the bi-propositional analysis of sentences with NP conjunction.

While the three one-to-many phenomena discussed earlier in this section have been studied intensely in LRS, no work on elliptical constructions exists so far. However, the technique that we will use to account for elliptical data has been applied in previous approaches: in Sailer (2004c) for LRS and in Bonami & Godard (2007) for a version of *Minimal Recursion Semantics*. We will concentrate here only on bi-propositional interpretations of sentences with conjoined noun phrases, i.e., there is not necessarily any material missing in syntax, but we have one sentence that receives the same semantic representation as a conjunction of two sentences.

We can illustrate this with the sentence in (65), for which we intend to derive the bi-propositional reading given below the example.

(65) Ein Hund und eine Katze schlafen.
a dog and a cat are.asleep
$(\exists x(\mathbf{dog}(x) \,:\, \mathbf{sleep}(x)) \wedge \exists x(\mathbf{cat}(x) \,:\, \mathbf{sleep}(x)))$

The important aspect here is the lexical specification of the coordination particle. We can safely assume that the particle selects its conjuncts. In HPSG, a selector has access to syntactic and semantic information of the selected elements. We argued in Richter & Sailer (2004) and Sailer (2004a) that the discourse referent marker of the selected element should be visible for selection.[22]

With these assumptions, we can provide the semantic constraint of the coordination particle *und* 'and' in (66).

(66) *und* 'and': $\{(F[\underset{\sim}{x}] \wedge G[\underset{\sim}{x}])\}$
where x is the discourse referent marker of both conjuncts.

The word *und* contributes a logical coordination. It states that the two conjuncts and the overall conjunction use the same variable for their discourse referents.

In (67), we provide the semantic constraints for the two conjuncts in (65).

(67) a. *ein Hund* 'a dog': $A[^{\#}\exists\underset{\sim}{x}(B[\mathbf{dog}(x)] \,:\, B'[x])]$
b. *eine Katze* 'a cat': $D[^{\#}\exists\underset{\sim}{x}(E[\mathbf{cat}(x)] \,:\, E'[x])]$

[22] We also assume that the "main" lexical semantic predicate contributed by a word should be visible. We will ignore this "main" content in the present paper, though.

These combine into the conjoined noun phrase *ein Hund und eine Katze*, whose constraint is given in (68). The resulting constraint collects the constraints of the coordination particle and the two conjuncts.

(68) *ein Hund und eine Katze* 'a dog and a cat':
$H[F[x] \wedge G[x]$, (coordination particle)
$A[\exists x(B[\{\mathbf{dog}(x)\}] : B'[x])]$, (first conjunct)
$D[\exists x(E[\{\mathbf{cat}(x)\}] : E'[x])]]$ (second conjunct)

When this combines with the verb, we arrive at the metaformula in (69).

(69) ${}^{\#}C[\{\mathbf{sleep}(x)\}$, (verb)
$H[F[x] \wedge G[x]$, (coordination particle)
$A[\exists x(B[\mathbf{dog}(x)] : B'[x])]$, (first conjunct)
$D[\exists x(E[\mathbf{cat}(x)] : E'[x])]]]$ (second conjunct)

There are two pluggings that satisfy the constraints expressed in the metaformula in (69). Let us focus on the variant in (70) first.

(70) Plugging for (65):
a. first conjunct:
$A = \exists x(\mathbf{dog}(x) : \mathbf{sleep}(x))$
$B = \mathbf{dog}(x)$ $B' = \mathbf{sleep}(x)$
b. second conjunct:
$D = \exists x(\mathbf{cat}(x) : \mathbf{sleep}(x))$
$E = \mathbf{cat}(x)$ $E' = \mathbf{sleep}(x)$
c. conjunction:
$F = A = \exists x(\mathbf{dog}(x) : \mathbf{sleep}(x))$
$G = D = \exists x(\mathbf{cat}(x) : \mathbf{sleep}(x))$
$H = (\exists x(\mathbf{dog}(x) : \mathbf{sleep}(x)) \wedge \exists x(\mathbf{cat}(x) : \mathbf{sleep}(x)))$
d. overall sentence:
$C = H = (\exists x(\mathbf{dog}(x) : \mathbf{sleep}(x)) \wedge \exists x(\mathbf{cat}(x) : \mathbf{sleep}(x)))$

This plugging is exactly the intended, bi-propositional semantic representation that should be associated with sentence (65).

An important aspect of this plugging is that the same formula, $\mathbf{sleep}(x)$ occurs in both the scope of the first and the scope of the second conjunct (B' and E' respectively). This might be a surprising result but, again, it follows directly from our constraint-based view on semantic combinatorics: the verb constrains the

overall logical form in such a way that it must contain the formula **sleep**(x), but it does not limit the number of occurrences of this formula to exactly one.[23]

As mentioned earlier, there is a second plugging for sentence (65). It is like the first one for the metavariables A, B, D, and E. The diverging values for the other metavariables are given in (71).

(71) Alternative plugging for (65):

a. first conjunct: see (70a)

b. second conjunct: see (70b)

c. conjunction:
$F = D = \exists x(\mathbf{cat}(x) : \mathbf{sleep}(x))$
$G = A = \exists x(\mathbf{dog}(x) : \mathbf{sleep}(x))$
$H = (\exists x(\mathbf{cat}(x) : \mathbf{sleep}(x)) \wedge \exists x(\mathbf{dog}(x) : \mathbf{sleep}(x)))$

d. overall sentence:
$C = H = (\exists x(\mathbf{cat}(x) : \mathbf{sleep}(x)) \wedge \exists x(\mathbf{dog}(x) : \mathbf{sleep}(x)))$

The difference between the two pluggings is just in the order in which the two conjuncts occur. While truth-conditionally equivalent, the order in the semantic representation should reflect the syntactic order.[24]

The reason for the existence of the second plugging is the fact that the lexical entry of the conjunction particle only mentions the discourse referent markers of the two conjuncts, which are constrained to be identical. Therefore, there is nothing connecting the syntactic order of the conjuncts to their order in the semantic representation.[25]

We will first propose a constraint to eliminate the plugging in (71) and then consider additional arguments in favor of our analysis. We introduce the *Conjunct Integrity Constraint* (CIC) in (72), a constraint that will connect the semantic contribution of the conjuncts to their syntactic position in the conjunction.

[23] See Sailer (2004c) for a use of the same technique for some non-standard cases of idiom modification and Bonami & Godard (2007) for an application in an analysis of evaluative adverbs.

[24] This is particularly relevant when using a dynamic semantic representation language such as the one of *Discourse Respresentation Theory* (Kamp & Reyle 1993) or *Dynamic Predicate Logic* (Groenendijk & Stokhof 1991).

[25] Using the "main" content, mentioned in footnote 22 would allow us to establish this connection, as these would be **dog** and **cat** for the two conjuncts, respectively. This solution is, however, not general enough, as it would not solve the problem illustrated with example (73) below.

(72) Conjunct Integrity Constraint (CIC)
If the discourse referent marker of a conjunction with internal content $\kappa_1 \wedge \kappa_2$ and those of its conjunct daughters are identical, then every element contributed within the first conjunct daughter must be in κ_1 and every element contributed within the second conjunct daughter must be in κ_2.

The effect of the CIC is that all elements contributed by the NP *ein Hund* 'a dog' in (65) must be in the first semantic conjunct and those contributed by *eine Katze* 'a cat' in the second conjunct. This makes the plugging in (70) the only possible interpretation of the metavariables in the underspecified representation.

This constraint has additional important effects. Consider example (73), in which we use the same head noun in the two conjuncts but have different adjectives and determiners. Below the example, we indicate two potential readings. Both readings respect the lexical and structural constraints of LRS, but the second reading violates the CIC.

(73) [Every big dog and some small dog] ran through the yard.
   a. CIC conform reading:
   $\forall x((\mathbf{dog}(x) \wedge \mathbf{big}(x)) : \mathbf{run}(x)) \wedge \exists x((\mathbf{dog}(x) \wedge \mathbf{small}(x)) : \mathbf{run}(x))$
   b. CIC non-conform reading:
   $\# \forall x((\mathbf{dog}(x) \wedge \mathbf{small}(x)) : \mathbf{run}(x)) \wedge \exists x((\mathbf{dog}(x) \wedge \mathbf{big}(x)) : \mathbf{run}(x))$

In (73b), the contributions of the adjectives occur in the wrong conjuncts. Because of the different determiners, this actually leads to a truth-conditional difference between the two readings. The CIC will rule out (73b): as the constant **big** is contributed within the first syntactic conjunct, it must occur in the first semantic conjunct, and analogously for **small**.

A natural objection to the CIC would be that the problem it is supposed to solve is an artifact of the decision to have identical discourse referent markers for all conjuncts and the overall conjunction in the bi-propositional analysis. Our analysis might be perceived as counter-intuitive if one associates the discourse referent marker directly with the entity in the world that a conjunct refers to. After all, the conjoined noun phrases do not refer to the same entity – even if one pursues a referential approach to quantification as in Lücking & Ginzburg (2019). Our examples show that the variable x in the semantic representations in (65) and (73) is bound by two different quantifiers within the formulæ. Consequently, the variable x only has bound occurrences and its occurrences in one conjunct are

independent of those in the other conjunct. A referential identity is not implied semantically.

The use of identical discourse referent markers has two important advantages: First, there is a uniform, surface-oriented syntactic analysis for sentences with conjoined noun phrases, i.e., both the mono-propositional and the bi-propositional analysis are treated the same. Second, the ordinary semantic combinatorics and the ordinary linking mechanism apply when the conjoined NPs combine with the verb.[26]

Just as we saw with the interpretation strategies for sentences with multiple n-words, we can – and in fact need to – impose constraints on the possible pluggings of bi-propositional conjunction. The Conjunction Integrity Constraint makes it possible to derive a bi-propositional reading from a mono-clausal, surface-oriented syntactic analysis and the ordinary argument-identification, i.e. linking, mechanism of LRS.

5.2.5 Implicit material: Equality up-to constraints

We need to consider not only how the semantic contributions of the individual conjuncts are integrated, but also how these contributions interact with material outside the conjunction. As shown in example (73), each of the conjoined quantifiers takes scope over the semantic contribution of the verb. However, we have not looked at a situation yet in which something takes scope over the conjunction. A simple example of this case is given in (74).

(74) Alex might eat a salad and a dessert.

a. Partially bi-propositional reading:
$\Diamond(\exists x(\mathbf{salad}(x) : \mathbf{eat}(\mathbf{alex}, x)) \wedge \exists x(\mathbf{dessert}(x) : \mathbf{eat}(\mathbf{alex}, x)))$

b. Fully bi-propositional reading:
$\Diamond(\exists x(\mathbf{salad}(x) : \mathbf{eat}(\mathbf{alex}, x))) \wedge \Diamond(\exists x(\mathbf{dessert}(x) : \mathbf{eat}(\mathbf{alex}, x)))$

Below the example, we indicate two potential bi-propositional readings. In the *partially bi-propositional reading* in (74a), the modal operator, $\Diamond$, takes scope over the entire representation of the rest of the conjunction. We call it "partially bi-propositional", because the modal operator is the highest operator in the representation of the sentence, but the two conjuncts still represent the semantics of propositions related to the clause, not only to the material from the overtly

[26] In Section 8, we will consider cases of anaphoric relations across conjuncts, which seem problematic for this assumption.

conjoined noun phrases. The second reading is fully bi-propositional: the conjunction is the highest operator and the modal appears in both conjuncts.

The partially bi-propositional reading can be derived easily, without any new constraints. It is the fully bi-propositional reading that poses a challenge: since the word *might* occurs only once in the sentence, the modal operator $\Diamond$ is contributed just once. However, the two occurrences of the operator $\Diamond$ have different formulæ in their scope. The first occurrence includes the predicate **salad** in its scope, the second the predicate **dessert**.

Niehren et al. (1997) and Pinkal (1999) introduce *equality up-to constraints* for cases of ellipsis as in (75).[27] Such constraints capture the observation that whatever the relative scope of the two quantifiers in the first part of the sentence, will also be the relative scoping in the representation of the elided part.

(75) Two European languages are spoken by every linguist, and two Asian languages are, too.

The basic idea is to say that an elliptic construction specifies that the two conjuncts have the same semantic representation with the only difference that the occurrence of the translation of *two European languages* in the first conjunct will be replaced with the translation of *two Asian languages* in the second conjunct. Pinkal's notation is "$X/U \sim Y/V$", which stands for: the formula Y is just like X except for containing the subformula V where X has the subformula U. The characterization shows that an equality up-to constraint is a *resource multiplier* since, of course, all subexpressions of X and Y that contain U and V as subparts, respectively, are not identical.

(76) The LRS-version of equality up-to:
$X/U \sim Y/V$ is a contribution constraint saying that:
for every expression X' such that $X[X'[U]]$, there is a contribution constraint requiring the occurrence of an expression Y', $Y[Y'[V]]$, which is just like X' but having V as a subexpression where X' has U.

Note that $X/U \sim Y/V$ is not symmetric: it adds contribution constraints to Y, but does not add any component to X. This is intended as Y represents the part that is not overtly present in the sentence.

We use an equality up-to constraint in the lexical entry for the bi-propositional conjunction particle, shown in the revised lexical semantic specification in (77).

[27] While Pinkal (1999) writes *equality upto*, we adopt the hyphenated version used in Niehren et al. (1997).

In this lexical sign, we have augmented the entry from (66) with an equality up-to constraint requiring that there be some subexpression U of the first conjunct and some subexpression V of the second conjunct such that the two conjuncts are equal up to the difference between U and V.

(77) Lexical specification of the conjunction particle (revised)
and: $\{(F[\underset{\sim}{x}] \wedge G[\underset{\sim}{x}])\}$ and $F/U \sim G/V$

where U and V are such that $F[U[x]]$ and $G[V[x]]$.

If we look at the two readings of (74), we find the following contribution constraints for the conjunction particle.

(78) a. Partially bi-propositional reading: *and*: $F[x] \wedge G[x]$
b. Fully bi-propositional reading: *and*: $F[x] \wedge G[x, \Diamond(V)]$

As shown in (78), in the case of the partially bi-propositional reading, we have a situation in which $F = U$ and $G = V$. Consequently, no additional contribution constraints are added by the equality up-to constraint.

For the fully bi-propositional reading, the modal operator is added as having scope over both conjuncts separately. The two conjuncts are equal with respect to the implicitly added operators. They differ, however, with respect to the rest in that the first conjunct contains the expression $\exists x(\mathbf{salad}(x) \,:\, \mathbf{eat}(\mathbf{alex}, x))$ as the scope of the modal operator and the second conjunct has the expression $\exists x(\mathbf{dessert}(x) \,:\, \mathbf{eat}(\mathbf{alex}, x))$ in the parallel position in the second conjunct.

It is important to note that the readings discussed in this subsection do not violate the CIC from (72). In each reading, the semantic material contributed in the first conjunct daughter appears within the first conjunct, and the material from the second conjunct daughter within the second conjunct.

What is missing for our analysis is a principle that specifies further embedding constraints when the two conjuncts are combined with the conjunction particle. This is done in the *Conjunction Parallelism Constraint* (CPC) in (79).

(79) Conjunction Parallelism Constraint (CPC)
In a conjunction phrase with an internal content of the form $F \wedge G$, for each expression H which occurs only in one conjunct,
1. H is contributed by the conjunct daughter linked to that conjunct, or
2. there is an expression H', where either H or H' is contributed by the conjunction particle, such that for some J, J', $H/J \sim H'/J'$.

The CPC encodes the observation that the conjuncts may only differ with respect to material that has been explicitly contributed by the conjunct daughters or that embeds such material. The first clause of this constraint requires that all contributions of a conjunct daughter actually occur in the conjunct to which this daughter is linked.[28] Implicit material is material that is contributed by the conjunction particle. Such material can be equal up-to the material contributed in the conjunct daughters – as the modal operator in the fully bi-propositional reading of (74).

The concept of equality up-to constraints has not been implemented in LRS so far.[29] The version we presented here tries to capture the original intuitions formulated in Pinkal (1999). As mentioned above, Pinkal introduces this type of constraint for elliptical constructions as in (75), but we use them for simple NP-coordinations. It should also be noted that the equality up-to contribution constraint in (77) is different in nature from the previous contribution constraints: instead of specifying a concrete contribution, it is an abstract characterization of what is to be contributed. While this is different from what we have seen in this paper so far, it is not completely new for LRS: a similar kind of semantic underspecification in the lexicon is used in Lahm (2018) for the optional presence of pluralization operators in the semantics of verbs.

In this section, we showed that LRS allows for various types of one-to-many correspondences at the syntax-semantics interface such as scope ambiguity, split reading, semantic concord, and semantically implicit material of two types. We will make use of all of them in our analysis of CNNP.

[28] In its version in (79), the first clause of the CPC covers the effect of the CIC in (72). However, we will see later that the CIC still has its place in our analysis of conjunction.

[29] In a recent talk, Park et al. (2020) propose an LRS-analysis of gapping. We repeat their running example in (i), adapting the semantic representations to our notation.

(i) John can't live in LA and Mary in New York.
   a. Distributive-scope reading: $\neg\Diamond(\textbf{live-in}(\textbf{john}, \textbf{la})) \wedge \neg\Diamond(\textbf{live-in}(\textbf{mary}, \textbf{ny}))$
   b. Wide-scope reading: $\neg\Diamond(\textbf{live-in}(\textbf{john}, \textbf{la}) \wedge \textbf{live-in}(\textbf{mary}, \textbf{ny}))$

In the distributive-scope reading, the two occurrences of the negation and the modal operator have distinct formulæ in their scope in the two conjuncts. However, apart from the material contributed in the gapped clause, **mary** and **ny**, their scope is identical. In the spirit of the present paper, gapping would be seen as another application of equality up-to constraints. Park et al. (2020) do not elaborate on the equality up-to aspect of their analysis.

6 Analysis

6.1 Conjunction

We have already seen how we can derive a bi-propositional reading of sentences with conjoined noun phrases. In the present subsection, we will extend our analysis of conjunction to mono-propositional readings. In (80), we repeat the mono-propositional semantic representation of sentence (35), which contained conjoined proper nouns.

(80) Alex and Kim met. (= (35))
$\exists z((\mathbf{alex} \in \pi_1 z \wedge \mathbf{kim} \in \pi_{\geq 1} z) \,:\, \mathbf{meet}(z))$

Our lexical specification for the coordination particle in (66) will not be sufficient to derive this reading, therefore we introduce a new, plural discourse referent, z, and define what elements need to be in z.[30]

(81) Mono-propositional *and*:
$^{\#}\exists \underset{\sim}{z}(\{(F[\,x\, \in \pi_1 z] \wedge G[\,y\, \in \pi_{\geq 1} z])\} \,:\, H[z])$
where x is the discourse referent marker of the first conjunct, and y the discourse referent marker of the second conjunct.

Using this specification for the coordination particle, we can derive the mono-propositional representation in (80).

The lexical specification in (81) is sufficient to derive all mono-propositional representations from Section 4.1. We shall illustrate this with example (40), in which one of the conjuncts is a quantifier, repeated as (82).

(82) Alex and many students met in the yard. (= (40))
$\exists z((\mathbf{alex} \in \pi_1 z \wedge (\mathbf{Many}\, y\, (\mathbf{student}(y) \,:\, y \in \pi_{\geq 1} z))) \,:\, \mathbf{meet}(z))$

The semantic constraints of the conjuncts are given in (83).

(83) a. *Alex*: $^{\#}\{\underset{\sim}{\mathbf{alex}}\}$

b. *many students*: $^{\#}\mathbf{Many}\, \underset{\sim}{x}\, (B[\{\mathbf{student}(x)\}] \,:\, B'[x])$

[30] It is quite common to assume two readings for English *and*, one corresponding to logical conjunction – our bi-propositional *and* – and one to some group/plurality formation – our mono-propositional *and*. Such an assumption can be found, for example, in Partee & Rooth (1983). More recently, Mitrović & Sauerland (2016) argue for it on the basis of typological evidence.

Together with the translation of the conjunction particle, the previous two constraints lead to the following constraint for the entire conjunction phrase *Alex and many students*.

(84) $A[^{\#}\exists\underset{\sim}{z}$
$(\{(F[\mathbf{alex} \in \pi_1 z]$ (first conjunct)
$\wedge G[x \in \pi_{\geq 1} z]])\}$ (second conjunct)
$: H[z]),$ (scope of the conjunction)
$\mathbf{Many}\, x\, (B[\mathbf{student}(x) : B'[x]])]$

The only plugging that is compatible with these constraints is given in (85).

(85) $F = \mathbf{alex} \in \pi_1 z$ (first conjunct)
$B = \mathbf{student}(x)$ (restrictor of **Many**)
$B' = x \in \pi_{\geq 1} z$ (scope of **Many**)
$G = \mathbf{Many}\, x\, (\mathbf{student}(x) : x \in \pi_{\geq 1} z)$ (second conjunct)
$H = \mathbf{meet}(z)$ (scope of the conjuction)
$A = \exists z((\mathbf{alex} \in \pi_1 z) \wedge (\mathbf{Many}\, x\, (\mathbf{student}(x) : x \in \pi_{\geq 1} z)) : \mathbf{meet}(z))$

We do not need a constraint such as the CIC, (72), for the mono-propositional conjunction because the discourse referent markers of the conjuncts and the overall conjunction are all distinct. Therefore, the order of the conjuncts within the semantic representation can be fixed in the lexical entry of the conjunction particle. Furthermore, any modifiers or determiners within a conjunct will be connected to the conjunct-specific discourse referent marker. The CPC, (79), does not have an effect in the mono-propositional case either, as there is no shared, implicit material in the two conjuncts.

6.2 Negated conjuncts

All LRS techniques that we have introduced above come together in our analysis of CNNP. We will assume the lexical entries of n-words and coordination particles motivated in the preceding sections as well as the combinatorial constraints illustrated so far. We will first look at the general syntactic and semantic conditions and show how we can derive the mono-propositional and the bi-propositional readings of CNNP. We will then explain how our analysis leads to the properties of CNNP from Section 2 such as the availability of split readings and the disjunction effect.

6.2.1 Semantic Across-the-Board exception

We gave a brief characterization of German as a non-NC language in Section 1 and its LRS analysis in Section 5.2.3. We accounted for the non-NC-hood of StG by assuming a *Negation Faithfulness Constraint* (NFC) in (64). According to this constraint, whenever more than one daughter contributes a negation in a headed phrase, the negations have to be distinct.

Independently of our concrete assumptions about the syntax of coordination, it is uncontroversial that coordination has its own syntactic structure and should not be treated as an ordinary headed phrase. As the NFC only enforces negation faithfulness in headed structures, it does not have an effect in coordination structures in general, also including StG. Thus StG may show an NC-like behavior in exactly these structures.

In our semantic analysis of the mono-propositional readings of CNNP in Section 4, we provided semantic representations in which (i) the negation has wide scope over the existential quantifier contributed by the coordination particle, (ii) there is only one negation in the resulting semantic representation, and (iii) this reading is only possible if each conjunct contains an n-word. To enforce these three properties, we will assume a semantic analogue of the syntactic *Across-the-Board* (ATB) exception to the *Coordinate Structure Constraint* (CSC), the ban of syntactic movement out of a conjunct from Ross (1967). The ATB exception says that material may be moved out of a conjunct as long as it is moved out of every conjunct.[31]

We can, now, rephrase the conditions on CNNP as an ATB phenomenon: a negation from one conjunct can only have scope over the entire conjunction if all conjuncts contribute the same negation. Such a semantic ATB exception is independently motivated. For the ATB exception to make sense, we must show that there is a semantic CSC. This has been argued for in Winter 2001: 83, for example. Copestake et al. 2005: 323 provide example (86) to show that the modal adverb *probably* cannot take scope over both conjuncts if it occurs in one.

(86) Sandy stayed and probably fell asleep.
(≠ Sandy probably stayed and fell asleep.)

Chaves 2007: 86–89 argues against the applicability of the CSC to scope. Instead, he considers conjunct-internal scope as a reading preference and allows for

[31] Chaves (2012) shows that the CSC and its ATB exception can be reduced to a semantic requirement, using a semantic combinatorial framework similar to ours. In his approach, symmetric coordination is analyzed as the formation of a plural event, i.e. via a conjunction analogous to the effect of our mono-propositional conjunction particle. He, then, assumes that syntactically extracted elements are obligatorily distributed over all conjuncts.

wide scope of individual conjuncts. He provides examples such as (87), for which a wide-scope interpretation of the modal adverb is available even if it only occurs in one conjunct.

(87) Kim probably is playing Juliet and Fred is playing Romeo.

We suspect that the adverb in (87) is treated as a parenthetical. This is confirmed by the sentence in (88), where it follows the finite verb. In this position, the adverb is usually phonologically integrated and, thus, has a non-parenthetical interpretation. The wide-scope interpretation of *probably* is not available for this sentence.[32]

(88) Kim is probably playing Juliet and Fred is playing Romeo.
≠ Probably, Kim is playing Juliet and Fred is playing Romeo.

Chaves (2007) uses *Minimal Recursion Semantics* (Copestake et al. 2005), a framework that does not allow two words to make identical semantic contributions. Consequently, he cannot derive a real ATB reading, i.e., an interpretation with two syntactic occurrences of *probably* but a single interpretation. If we alter example (86) in such a way that there is the same adverbial in both conjuncts, we can find a reading in which there is a single ATB-interpretation of the adjunct's scope. This is illustrated in (89). The second reading is the relevant ATB interpretation. According to our intuitions, this reading is not available if the adverb *wahrscheinlich* 'probably' occurs in only one of the conjuncts.

(89) Sandy ist wahrscheinlich geblieben und ist wahrscheinlich
Sandy has probably stayed and has probably
eingeschlafen.
fallen.asleep
'Sandy probably stayed and probably fell asleep.'
Reading 1: Sandy probably stayed and Sandy probably fell asleep.
Reading 2: Probably, Sandy stayed and fell asleep.

Having given some negation-independent empirical motivation of semantic CSC with a corresponding ATB exception, we can turn to the formulation of the

[32] Chaves (2007) also provides examples in which the second conjunct contains a pronoun that is interpreted as coreferential to or bound by an NP in the first conjunct. We will address these data in Section 8.

relevant constraints. The *Conjunct Integrity Constraint* in (72) expresses exactly the observation behind the Coordinate Structure Constraint, i.e., the insight that the material contributed within a conjunct needs to stay within this conjunct. What is missing so far, however, is a semantic analogue to the ATB exception. This is stated in the reformulation of the CIC in (90). As we will see in the discussion of individual examples, the final part of the CIC in this version will allow for CNNP. The negation contributed within one conjunct can take wide scope over the entire conjunction if and only if it is contributed within both conjuncts.

(90) Conjunct Integrity Constraint with Semantic ATB exception (CIC, second version)
In every coordination phrase, for each H contributed by one conjunct daughter, H must not occur in a conjunct in which it is not contributed and may only have scope over the conjunction if it is contributed by the other conjunct daughter as well.

6.2.2 A simple example

With all constraints in place, we can now analyze a sentence with CNNP. We use a version of our running example but use a collective predicate, see (91), to illustrate the mono-propositional reading.

(91) Alex vergleicht [**keine** Briefe und **keine** Mails].
Alex compares no letters and no e-mail messages

The semantic constraints of the two conjuncts are given in (92). The noun phrases are interpreted exactly in the way illustrated for n-constituents in Section 5.2.3.

(92) a. *keine Briefe*: $\neg A[^{\#}\exists x(B[\{\mathbf{letter}(x)\}] : B'[x])]$
b. *keine Mails*: $\neg D[^{\#}\exists y(E[\{\mathbf{mess}(y)\}] : E'[y])]$

The two conjuncts combine with the mono-propositional coordination particle, which leads to the following overall constraint for the conjunction.

(93) a. *und*: $^{\#}\exists z(\{(F[x \in \pi_1 z] \wedge G[y \in \pi_{\geq 1} z])\} : H[z])$
b. *keine Briefe und keine Mails*:
$I[^{\#}\exists z(\{(F[x \in \pi_1 z] \wedge G[y \in \pi_{\geq 1} z])\} : H[z]),$
$\neg A[\exists x(B[\mathbf{letter}(x)] : B'[x])],$
$\neg D[\exists y(E[\mathbf{mess}(y)] : E'[y])]]$

When we add the verb and the subject, we arrive at the constraint in (94).

(94) $^{\#}J[I[\exists z((F[x \in \pi_1 z] \wedge G[y \in \pi_{\geq 1} z]) : H[z]),$ (coordination particle)
$\neg A[\exists x(B[\textbf{letter}(x)] : B'[x])],$ (first conjunct)
$\neg D[\exists y(E[\textbf{mess}(y)] : E'[y])],$ (second conjunct)
$\{\textbf{compare}(\textbf{alex}, z)\},$ (verb)
$\textbf{alex}]]$ (subject)

The intended mono-propositional reading can be derived with the following plugging.

(95) $B = \textbf{letter}(x) \qquad B' = x \in \pi_1 z$
$E = \textbf{mess}(y) \qquad E' = y \in \pi_{\geq 1} z$
$F = \exists x(\textbf{letter}(x) : x \in \pi_1 z)$
$G = \exists y(\textbf{mess}(y) : y \in \pi_{\geq 1} z)$
$A = D = \exists z((\exists x(\textbf{letter}(x) : x \in z) \wedge \exists y(\textbf{mess}(y) : y \in z))$
$: \textbf{compare}(\textbf{alex}, z))$
$J = I = \neg\exists z((\exists x(\textbf{letter}(x) : x \in \pi_1 z) \wedge \exists y(\textbf{mess}(y) : y \in \pi_{\geq 1} z))$
$: \textbf{compare}(\textbf{alex}, z))$

In this plugging, the two conjuncts both introduce a contribution constraint for a negation, $\neg A$ and $\neg D$ respectively. Eventually, we end up with just a single negation, as the plugging assigns the same formula to both A and D. The first conjunct constraints the negation $\neg A$ to take scope over the existential quantification over letters, the second conjunct constrains $\neg D$ to scope over the existential quantification over e-mail messages. By having wide scope over both conjuncts, both these requirements can be satisfied by a single negation.

The plugging in (95) also satisfies the CIC: while there is a semantic operator contributed by one conjunct that takes scope over the entire conjunction, this very operator is contributed by all conjuncts.

When we look at the constraints gathered in (94), we could imagine a plugging in which both negation contributions have wide scope over the coordination but are not identical. This would result in the semantic representation in (96). This semantic representation violates the CIC, because the negation operators differ, i.e., this is not an ATB exception.

(96) $\neg\neg\exists z((\exists x(\textbf{letter}(x) : x \in \pi_1 z) \wedge \exists y(\textbf{mess}(y) : y \in \pi_{\geq 1} z))$
$: \textbf{compare}(\textbf{alex}, z))$

Another case that is excluded by CIC is given in (97). Here, the negation contributed by the first conjunct takes wide scope. The one contributed by the second conjunct, however, takes conjunct-internal scope. Even though this semantic representation satisfies the constraints collected in (94), it violates CIC.

(97) $\neg\exists z((\exists x(\mathbf{letter}(x) \,:\, x \in \pi_1 z) \wedge \neg\exists y(\mathbf{mess}(y) \,:\, y \in \pi_{\geq 1} z)) \,:\, \mathbf{compare}(\mathbf{alex}, z))$

We should also consider the derivation of the bi-propositional reading of a sentence with CNNP. To ensure that we have a bi-propositional reading, we replace the collective verb in (91) with a non-collective one, *beantworten* 'answer'. For this reading, the syntactic analysis is the same, but we need to choose a different interpretation of the conjunction particle, namely the one in (77). This choice has the effect that the discourse referent markers in both conjuncts and for the overall conjunction are identical. Since our example sentence does not contain semantic material that will take scope over the conjuncts, the equality up-to constraint does not add additional contribution constraints and we can ignore it.

(98) a. *und*: $\{(F[\underset{\sim}{x}] \wedge G[\underset{\sim}{x}])\}$ and $F/U \sim G/V$

b. *keine Briefe*: $\neg A[^{\#}\exists x(B[\{\mathbf{letter}(x)\}] \,:\, B'[x])]$

c. *keine Mails*: $\neg D[^{\#}\exists x(E[\{\mathbf{mess}(x)\}] \,:\, E'[x])]$

When we combine these conjuncts with the coordination particle, we get the following overall constraint for the conjunction.

(99) *keine Briefe und keine Mails*:

$I[(F[x] \wedge G[x])]$, (coordination particle)

$\neg A[\exists x(B[\mathbf{letter}(x)] \,:\, B'[x])]$, (first conjunct)

$\neg D[\exists x(E[\mathbf{mess}(x)] \,:\, E'[x])]]$ (second conjunct)

The CIC in its first version in (72) allows us to constrain this further: we know that all contribution constraints of the first conjunct must be within F and all those of the second conjunct within G. We can incorporate this into the constraint above, which results in the contraint in (100).

(100) *keine Briefe und keine Mails*:

$I[\{(F[\underset{\sim}{x}, \neg A[\exists x(B[\mathbf{letter}(x)] \,:\, B'[x])]]$

$\wedge G[\underset{\sim}{x}, \neg D[\exists x(E[\mathbf{mess}(x)] \,:\, E'[x])]])\}]$

With the verb and the subject, we arrive at the overall constraint in (101).

(101) $^{\#}J[I[F[x, \neg A[\exists x(B[\mathbf{letter}(x)] : B'[x])]]$ (first conjunct)
$\wedge G[x, \neg D[\exists x(E[\mathbf{mess}(x)] : E'[x])]]]),$ (second conjunct)
$\{\mathbf{answer}(\boxed{\text{alex}}, \boxed{x})\},$ (verb)
$\mathbf{alex}]]$ (subject)

In this constraint, each conjunct must contain a negation of its own. Therefore, the two negations cannot be identical, i.e., there is no plugging in which $A = D$. Instead, we get a plugging that leads to the reading in (102).

(102) $\neg\exists x(\mathbf{letter}(x) : \mathbf{answer}(\mathbf{alex}, x)) \wedge \neg\exists x(\mathbf{mess}(x) : \mathbf{answer}(\mathbf{alex}, x))$

For this reading, we must use the semantic material contributed by the subject and the verb in both conjuncts, i.e., both conjuncts have the same formula as their scope. In other words: $B' = E' = \mathbf{answer}(\mathbf{alex}, x)$. We had seen in Section 5.2.4 that this is possible and necessary for phenomena in which semantic material is used more often than its contributing syntactic elements occur in the structure.

If we use the refined version of the CIC in (90), a semantic ATB exception is allowed in principle. This licenses a second potential bi-propositional reading, the one given in (103). In this reading, the negations contributed by the two conjuncts are assumed to be identical and to take wide scope over the conjunction. This corresponds to a semantic ATB exception for the bi-propositional coordination. As such, it is compatible with the CIC from (90). As this is not a possible reading of the sentence, we will show how it can be blocked.

(103) $\neg(\exists x(\mathbf{letter}(x) : \mathbf{answer}(\mathbf{alex}, x)) \wedge \exists x(\mathbf{mess}(x) : \mathbf{answer}(\mathbf{alex}, x)))$

The examples with *probably* in (89) showed that we do not want to exclude an ATB exception for a bi-propositional coordination in general. It, thus, seems that unavailability of the reading derives from the properties of the n-words.

N-words are special in that they express indefinites that are in the scope of a sentential negation. The basic intuition of our explanation is that the negation contributed by an n-word is confined to the clause containing the n-word. We can define a semantically negative clause in English as a clause in which the internal content of the highest verb of the sentence is in the scope of negation within its external content. The internal content of the verb need not be in the immediate scope of the negation, though: there may be quantifiers or modal operators taking intermediate scope between the negation and the internal content of the verb. However, there must not be an intervening logical connective.

This is reminiscent of the situation found in languages which require a negative marker on the verb in negated sentences, such as Polish. For Polish, Richter & Sailer (2006) formulate an LRS version of the Neg Criterion from Haegeman & Zanuttini (1996), requiring that whenever a verb is in the scope of negation in its external content, that negation must be contributed by the verb. For English, there is no such contribution requirement. Nonetheless, there is a similar connection between the verb's semantics and the negation. In (104) we attempt a definition of what is a negated clause.

(104) English negated clause:
An English clause is *negated* iff its internal content is in the scope of negation within its external content and there are no intervening connectives.

This independently relevant characterization of a negated sentence is sufficient to exclude the reading in (103). The internal content of the sentence is **answer**(**alex**, x). While the semantic ATB exception allows the negations contributed in the conjuncts to take wide scope over the overall conjunction, this leads to a constellation that does not express a negated sentence.

We have seen how we can derive the mono-propositional and the bi-propositional readings for CNNP in LRS. To do this, we did not have to change anything in the analysis of StG as a non-NC language. We modified the CIC to include the semantic analogue of the empirically well-motivated Coordinate Structure Constraint with the ATB exception to extraction from conjuncts.

6.2.3 Split readings

We have seen in Section 5.2.2 that LRS allows us to capture split readings of n-words. The important part of the lexical specification on an n-word is that there is a metavariable between the negation and the existential quantification contribution constraints, i.e., the specification is of the form $\neg A[\exists x(\ldots)]$. We will show that the same is true for CNNP, in both the mono-propositional and the bi-propositional reading.

We will analyze the example sentence in (105) in this subsection. Since the example uses the NPI *brauchen* 'need', the negation must take scope over the semantic contribution of the modal verb.[33] Furthermore, narrow scope of the

[33]The NPI requirement of *brauchen* 'need' can be expressed as an indirect contribution constraint in LRS, see (i). The modal verb contributes a necessity operator and requires that this operator

existential quantifier contributed by the n-constituents is the most natural reading. Below the example, we provide the semantic representation for the mono-propositional reading.

(105) a. Alex *braucht* [**keine** Briefe und **keine** e-Mails]
Alex needs no letters and no e-mail messages
(miteinander) zu vergleichen.
with each other to compare

b. Mono-propositional reading:
$\neg\Box\exists z((\exists x(\mathbf{letter}(x) : x \in \pi_1 z) \wedge \exists y(\mathbf{mess}(y) : y \in \pi_{\geq 1} z))$
$: \mathbf{compare}(\mathbf{alex}, z))$

The analysis of this example is more or less parallel to that of the mono-propositional reading of (91). The two conjuncts both contribute constraints of the form $\neg A[\exists x(\ldots)]$. So, they both leave room between the negation and the existential quantifier. For the sentence without an additional modal operator, the set-valued discourse referent z is introduced in the scope of this negation. Consequently, nothing speaks against also adding the modal operator contributed by *brauchen* 'need'.

The modal verb *brauchen* requires that the core meaning of the verb it embeds occur in its scope. In this example, the formula $\mathbf{compare}(\mathbf{alex}, z)$ is required to be in the scope of $\Box$. This constraint is satisfied in the indicated reading as well.

The CIC is equally satisfied: both conjuncts contribute a negation, so this negation can outscope the overall conjunction. CIC does not require that the outscoping operator have immediate scope over the conjunction, so intervening material is not excluded.

We can equally derive a bi-propositional analysis of the split reading. The semantic representation of such a reading is given in (106).

(106) a. Alex *braucht* [**keinen** Brief] und [**keine** e-Mail] zu
Alex need no letter and no e-mail message to

be in the scope of a negation, though it does not contribute the negation. This encoding was proposed in Penn & Richter (2005).

(i) *brauchen*: $\neg A[\Box(B)]$

A more refined approach to NPIs within LRS is pursued in Richter & Soehn (2006) and Sailer (2009).

beantworten.
answer
'Alex need not answer any letter and Alex need not answer any e-mail message.'

b. Bi-propositional reading:
$\neg\Box\exists x(\textbf{letter}(x) \,:\, \textbf{answer}(\textbf{alex}, x))$
$\wedge\neg\Box\exists x(\textbf{mess}(x) \,:\, \textbf{answer}(\textbf{alex}, x))$

In this representation, the modal operator $\Box$ occurs twice, but the two occurrences have different scopes. For this purpose, the equality up-to extension of the lexical entry of the coordination particle is needed.

The constraints of the two conjuncts are as given above in (98). Combining them with the bi-propositional coordination particle leads to the constraint in (107). This constraint already contains the occurrence of the modal operator in the second conjunct, $\Box(V)$. This anticipates the combination with the modal verb in the sentence and the occurrence of the modal operator in the first conjunct. The constraint $\Box(V)$ is contributed by virtue of the equality up-to extension of the coordination particle.

(107) *keinen Brief und keine e-Mail*:
$I[\{F[\underset{\sim}{x}, \neg A[\exists x(B[\textbf{letter}(x)] \,:\, B'[x])]]$
$\wedge G[\underset{\sim}{x}, \Box(V), \neg D[\exists x(E[\textbf{mess}(x)] \,:\, E'[x])]]\}]$

When the coordinated noun phrases combine with the verb *beantworten* 'answer', we get the following constraint.

(108) *keinen Brief und keine e-Mail zu beantworten*:
$^{\#}J[I[F[x, \neg A[\exists x(B[\textbf{letter}(x)] \,:\, B'[x])]]$ (first conjunct)
$\wedge G[x, \Box(V), \neg D[\exists x(E[\textbf{mess}(x)] \,:\, E'[x])]]]$, (second conjunct)
$\{\textbf{answer}(\boxed{\text{alex}}, \boxed{x})\}]$ (verb)

The modal *brauchen* 'need' contributes a modal operator that takes scope over the internal content of the VP, **answer**(**alex**, x), which is also the internal content of the modal verb. The subject, *Alex*, only contributes the name constant **alex**. The constraint for the overall sentence is given in (109).

(109) $K[J[I[F[x, \neg A[\exists x(B[\textbf{letter}(x)] \,:\, B'[x])]]$ (first conjunct)
$\wedge G[x, \Box(V), \neg D[\exists x(E[\textbf{mess}(x)] \,:\, E'[x])]]]$, (second conjunct)
$\{\textbf{answer}(\boxed{\text{alex}}, \boxed{x})\}]$, (verb)
$\Box(U[\textbf{answer}(\boxed{\text{alex}}, \boxed{x})])$, (modal verb)
$\textbf{alex}]$ (subject)

Finally, we provide the plugging that leads to the intended reading in (110).

(110) $A = \Box(U) = \Box(\exists x(\mathbf{letter}(x) : \mathbf{answer}(\mathbf{alex}, x)))$
$B = \mathbf{letter}(x) \qquad B' = \mathbf{answer}(\mathbf{alex}, x)$
$D = \Box(V) = \Box(\exists x(\mathbf{mess}(x) : \mathbf{answer}(\mathbf{alex}, x)))$
$E = \mathbf{mess}(x) \qquad E' = \mathbf{answer}(\mathbf{alex}, x)$
$F = \neg\Box(\exists x(\mathbf{letter}(x) : \mathbf{answer}(\mathbf{alex}, x)))$
$G = \neg\Box(\exists x(\mathbf{mess}(x) : \mathbf{answer}(\mathbf{alex}, x)))$
$I = J = K = F \wedge G$
$= \neg\Box(\exists x(\mathbf{letter}(x) : \mathbf{answer}(\mathbf{alex}, x)))$
$\wedge\neg\Box(\exists x(\mathbf{mess}(x) : \mathbf{answer}(\mathbf{alex}, x)))$
$U = \exists x(\mathbf{letter}(x) : \mathbf{answer}(\mathbf{alex}, x))$
$V = \exists x(\mathbf{mess}(x) : \mathbf{answer}(\mathbf{alex}, x))$

The plugging in (110) satisfies the constraint from (109). The conjunction is the highest operator in the resulting representation. The two negations are interpreted within their respective conjuncts. The equality up-to constraint allows us to use the modal operator $\Box$ twice, though with not fully identical formulæ in the scope of the two occurrences.

Without the equality up-to extension, the only possible reading would be a non-split reading, i.e., a reading in which the modal operator is in the scope of the existential quantifiers, given in (111). We can still derive this reading, as the equality up-to part is optional.

(111) Bi-propositional reading with narrow scope of the modal operator:
$\neg\exists x(\mathbf{letter}(x) : \Box\mathbf{answer}(\mathbf{alex}, x))\wedge\neg\exists x(\mathbf{mess}(x) : \Box\mathbf{answer}(\mathbf{alex}, x))$

Just as shown above for the structurally simpler example (103), we do not get a bi-propositional analysis in which there is just one negation in the overall semantic representation. In other words, the formula in (112) cannot occur as the semantic representation of our example sentence since there is a coordination intervening between the internal content of the verb, $\mathbf{answer}(\mathbf{alex}, x)$, and the negation, i.e., this semantic representation does not express a negated sentence.

(112) $\neg(\Box(\exists x(\mathbf{letter}(x) : \mathbf{answer}(\mathbf{alex}, x)))$
$\wedge\Box(\exists x(\mathbf{mess}(x) : \mathbf{answer}(\mathbf{alex}, x))))$

We have shown that the split readings can be derived for both the mono-propositional and the bi-propositional analysis of CNNPs. For the first case, we made use of the semantic ATB-exception incorporated into the CIC in (90). For the second case, we saw the effect of the equality up-to constraint and the non-applicability of the semantic ATB exception.

6.2.4 Disjunction effect

Before we close the presentation of the analysis, we should have another look at the *disjunction effect*. We saw that distributive readings only emerge under a bi-propositional analysis. The bi-propositional formula from (42), repeated in (113a), is logically equivalent to the one given in (113b), in which there is a disjunction in the restrictor of the existential quantifier, i.e., the quantification takes any assignment for x into consideration that is a letter or an e-mail message.

(113) a. $\neg\exists x(\mathbf{letter}(x) : \mathbf{write}(\mathbf{alex}, x)) \wedge \neg\exists x(\mathbf{mess}(x) : \mathbf{write}(\mathbf{alex}, x))$
b. $\neg\exists x((\mathbf{letter}(x) \vee \mathbf{mess}(x)) : \mathbf{write}(\mathbf{alex}, x))$

Our analysis has a number of attractive features: We can assume a surface-oriented syntactic analysis, i.e., an analysis in terms of noun phrase coordination, and the conjunction particle *und* 'and' is translated as ordinary boolean conjunction. Nonetheless, we derive a bi-propositional semantic representation which is equivalent to a disjunctive mono-propositional representation.

We can now turn to the contrast between CNNP and the negation of conjoined indefinite noun phrases, illustrated in examples (25) and (26) above. The contrast only arises in cases in which a bi-propositional reading is possible. We observed that CNNP does not allow for a "not both" reading, while this reading is readily available for negated conjoined indefinites. We exclude the "not both" reading for CNNP as a consequence of deriving the disjunction effect.

We will show how we derive the "not both" reading for conjoined indefinite noun phrases. We repeat the relevant sentence in (114). Again, we use the NPI-verb *brauchen* 'need' to guarantee that the negation is interpreted in the embedded clause. For the purpose of this subsection, we are only interested in narrow scope readings of the indefinite noun phrases.

(114) Alex glaubt nicht, dass Monika eine Vorlesung und ein Seminar zu
Alex believes not that Monika a lecture and a seminar to
halten braucht.
teach need
'Alex doesn't think that Monika need teach a lecture and a seminar.'

Before considering the example in (114), we will start with the simpler sentence in (115). This example has neither a modal nor an attitude predicate, but will still allow us to describe the relevant readings.

(115) Es stimmt nicht, dass Monika eine Vorlesung und ein Seminar hält.
it is true not that Monika a lecture and a seminar teaches
'It is not true that Monika teaches a lecture and a seminar.'

If we interpret the embedded sentence first and then add a negation through the main clause, we arrive at the semantic representation in (116) with a wide-scope negation over the conjunction. By de Morgan's laws, this is logically equivalent to a disjunction of two negated formulæ.

(116) $\neg(\exists x(\textbf{lecture}(x) : \textbf{teach}(\textbf{monika}, x)) \wedge \exists x(\textbf{seminar}(x) : \textbf{teach}(\textbf{monika}, x)))$
$\equiv (\neg\exists x(\textbf{lecture}(x) : \textbf{teach}(\textbf{monika}, x))) \vee (\neg\exists x(\textbf{seminar}(x) : \textbf{teach}(\textbf{monika}, x)))$

The formulæ in (116) are true as long as Monika does not teach both a lecture and a seminar. This covers the "neither" case, but is weaker in that it is also compatible with a situation in which Monika teaches a lecture but not a seminar, or the other way around.

We can now turn to the more complex example in (114). This example includes a modal verb to ensure a neg-raising reading. In the following, we will, however, ignore the semantic contribution of the modal verb. In an LRS analysis of neg-raising, Sailer (2006) assumes that the negation that is syntactically part of the matrix clause is interpreted inside the embedded clause. This leads to the semantic representation in (117).

(117) $\textbf{believe}(\textbf{alex}, \neg(\exists x(\textbf{lecture}(x) : \textbf{teach}(\textbf{monika}, x)) \wedge \exists x(\textbf{seminar}(x) : \textbf{teach}(\textbf{monika}, x))))$

This formula expresses the "not both" reading. This shows that we correctly derive the difference between CNNP and coordinated non-negative indefinites in the scope of negation.

7 Consequences of the analysis

In this section, we will put our analysis of CNNP in StG in the context of related data: First, we will look at CNNP in languages with negative concord, Section 7.1. Second, we will compare CNNP to coordination with the negative coordination particles *neither …nor* in Section 7.2.

7.1 Application to NC languages

A basic assumption of the LRS approach to negation is that there is no difference in the lexical specifications of n-words in NC and non-NC languages. The differences lie in the interpretational strategies and in the inventory of words associated with negation. Since coordination structures are exempt from the Negation Faithfulness Constraint in StG, a semantic representation can be derived that is based on the same mechanism that we use for negative concord, namely the identity of semantic contributions.

This leads to the prediction that NC-languages should behave just like StG with respect to the interpretation of CNNP. In this paper, we cannot fully explore this prediction. We will briefly consider French, an optional NC language, but have to postpone the application to an obligatory NC language such as Polish.

A French CNNP-sentence is given in (118). The sentence has the same truth conditions as the corresponding StG example sentences. In particular, we get the disjunction effect, i.e., a "neither" reading.

(118) [**Aucun** train et **aucun** [bus ou car]] ne partait de la gare de
no train and no bus or coach NM left from the station of
Meaux …
Meaux
'Neither trains nor buses or coaches left from Meaux station.'
(www.leparisien.fr/seine-et-marne-77/meaux-bloques-a-la-gare-les-voyageurs-pas-en-colere-mais-resignes-07-02-2018-7546974.php, 2018-04-28)

French also allows negated conjuncts to act as complements of a collective verb. This is shown in (119).[34] This points to a mono-propositional analysis for French CNNP.

(119) Léo n' a comparé [**aucuns** romans et **aucuns** poèmes].
Léo NM has compared no novels and no poems
'There are no novel-poem pairs such that Léo compared the novel and the poem.'

To complete the similarity between French and StG, we find split readings in French as well, see (120).

[34] The availability of a mono-propositional reading seems to be as restricted as in StG, i.e., many speakers may reject this reading.

(120) Monique n' est obligée de diriger [**aucune** communication et **aucun** séminaire].
Monique NM is obliged to give no lecture and no seminar
'It is not the case that Monique is obliged to teach a lecture and a seminar.'

We take this parallel behavior as support for our approach: The lexical encoding of n-words is the same in NC and non-NC languages, but they show different interpretational strategies in headed structures. In coordinated structures, however, there are no differences in the interpretation strategies, consequently, the same readings obtain, independently of a language's NC status.

Given the repertoire of negation-related expressions in French and the interpretation strategies of French, the negative determiner *aucun* 'no' is not as common as its StG counterpart *kein-*. Again, this is independent of the different NC statuses of French and StG. Standard English is a non-NC language like StG, but, just as French, uses verbal negation more frequently than StG. Therefore, negative determiners are much less common in English than they are in StG.

7.2 CNNP vs. *neither nor*

We have characterized CNNP as giving rise to a "neither" reading in many places in this paper. Whereas CNNP has not received systematic attention in the literature, negative conjunctions of the *neither nor*-type have been explored (de Swart 2001; Doetjes 2005; Gajić 2016).

Sticking to StG data, we see that *neither nor* conjuncts as in (121) cannot serve as a collective antecedent for a reciprocal pronoun.

(121) ?* Alex hat [weder einen Roman noch ein Gedicht] miteinander verglichen.
Alex has neither a novel nor a poem with each other compared
'There is no novel-poem pair such that Alex compared the novel with the poem.'

The same can be shown with an inherently reflexive collective predicate in (122).

(122) ?* [Weder ein Kind noch ein Erwachsener] haben sich getroffen.
neither a child nor an adult have REFL met
'There had not been a meeting between a child and an adult.'

Based on these observations, we conjecture that *weder noch* 'neither nor' always gives rise to a bi-propositional semantic representation. This is in line with Winter 2001: 33, who argues that all coordination particles except for *and* and its cognates in other languages trigger a bi-propositional analysis.

The example in (123) shows that we can find split readings with *weder noch* 'neither nor', which is parallel to what we found with the bi-propositional readings in CNNP-sentences.

(123) Monika *braucht* [weder einen Vortrag noch ein Seminar] zu halten.
Monika need neither a lecture nor a seminar to teach
'Monika need not teach a lecture and Monika need not teach a seminar.'

We will not give an analysis of *weder noch* 'neither nor', especially since we do not want to commit ourselves to a particular syntactic analysis for the conjunction particles. The data discussed in this subsection, however, suggest that an LRS analysis would include lexical entries for the conjunction particles that are like the lexical entry for bi-propositional *und* 'and' in (77), but include a negation. This is sketched in (124).

(124) *weder noch* 'neither nor': $\{(\neg F[\underset{\sim}{x}] \wedge \neg G[\underset{\sim}{x}])\}$, $F/U \sim G/V$

In this section, we briefly explored the consequences and predictions of our analysis of CNNP in StG to two related phenomena – CNNP in an optional NC language and *neither nor* coordination.

8 Anaphoric relations among the conjuncts

It is essential for our analysis of the bi-propositional reading that the two conjoined noun phrases have the same index. While this is an example of a one-to-many relation – the same index being used in two conjuncts – it might have undesired consequences. A potentially problematic example is given in (125). In this example, the second conjunct contains a pronoun that is coindexed with the first conjunct, but the second conjunct refers to a different entity.[35]

[35]The classical example of this constellation is given in (i), which is discussed in Moltmann 1992: 24, for example.

(i) Every man and his dog left.

(125) a. Alex adores [a French actress]$_i$ and [(some of) her$_i$ films]$_j$.
b. = Alex adores [a French actress]$_i$ and Alex adores [(some of) her$_i$ films]$_j$.

In this section, we will first look at such data independently of negation, then we will discuss corresponding constellations for CNNP cases.

8.1 Anaphoric relations in non-negated conjuncts

To get a better idea of the correct analysis of sentences such as (125), it is worth looking at analogous examples with other determiners. In (126), a universal determiner is used. As above, the anaphorical relation between the conjoined NPs is possible. Nonetheless, a bi-clausal paraphrase as in (126b) is not possible, as the universal quantifier does not easily allow for cross-sentential anaphora (Kamp 1981). This shows that these data cannot be captured in a straightforward way in an analysis that uses (126b) as the syntactic basis for the surface noun phrase conjunction in (126a).

(126) a. Alex adores [every French actress]$_i$ and [(some of) her$_i$ films]$_j$.
b. * Alex adores [every French actress]$_i$ and Alex adores [(some of) her$_i$ films]$_j$.

The data are equally problematic for both our mono-propositional and our bi-propositional approach. A mono-propositional analysis will be confronted with the same problem as (126b), i.e., the universal quantifier contributed in the first conjunct only has scope within the first conjunct and cannot bind a variable in the second conjunct. It is furthermore doubtful that we can pursue a mono-propositional analysis for the sentences (125a) or (126a). The sentences use a distributive predicate and, as we saw above, mono-propositional readings are dispreferred. The anaphoric relation in the given sentences is, however, unproblematic.

The problem for the bi-propositional approach is different. Our bi-propositional semantic representations rely on using the same discourse referent marker for both conjuncts. This does not seem possible in examples like (125a) and (126a).

We will show how the present approach can be extended to capture the data with anaphoric relations across the conjuncts. The basic idea of our analysis will be that the quantifier in the first conjunct in (125a) and (126a) takes wide scope over both conjuncts. To achieve this, we will apply an *existential split*, i.e., we will

introduce an additional existential quantifier in the scope of the overt quantifier. Let us introduce the necessary tools step by step.

(127a) shows a simple quantified formula in which the variable x is bound. In (127b), the scope of the determiner is enhanced by an existential quantifier binding the variable x. The original quantifier, Q binds a new variable, y, and we need to replace all free occurrences of x in the restrictor of Q with y. In the scope of the quantifier, the restrictor of the existential quantifier is the formula $x = y$. As indicated, the two expressions in (127a) and (127b) are logically equivalent.

(127) For each variable x, y, each formula ϕ, ψ that has no free occurrence of y, and for each determiner Q:

a. $Qx(\phi : \psi)$

b. $\equiv Qy(\phi\langle x/y\rangle : \exists x(x = y : \psi))$
where $\phi\langle x/y\rangle$ is a formula that is identical to ϕ but with every free occurrence of x replaced with y.[36]

Existential split has no truth-conditional effect, but it allows us to introduce a new variable in the scope of the determiner. So far, the lexical contribution of a logical determiner always had the form in (127a). We propose that it can, alternatively, have the form in (127b). The corresponding lexical specifications for *every* are given in (128).

(128) a. Simple specification: ${}^{\#}\forall\underset{\sim}{x}(A[x] : A'[x])$

b. Split specification: ${}^{\#}\forall y(A[x]\langle x/y\rangle) : B[\exists\underset{\sim}{x}(x = y : A'[x]])$

The split specification makes it necessary to change our variable management. Now there are two variables associated with the noun phrase, x and y. The variable y will be used internal to the noun phrase, i.e., as the discourse referent marker of the noun and the determiner. The variable x is used outside the noun phrase, for argument-identification, i.e. linking. Therefore, this variable is used as the discourse referent marker of the quantified NP. As the variable x will be related to the verb's argument structure, it is this variable that will be used for anaphoric binding. The variable y, on the other hand, is essential for all other cases of binding and coreference. This includes binding into another conjunct, as in example (126a). This is shown in (129), where we indicate the discourse referent marker for the bi-propositional reading on each noun, each determiner,

[36] We use this idionsyncratic notation for the replacement of subexpressions instead of the more common $[x/y]$ to avoid ambiguous use of the square brackets.

and each noun phrase in the conjunction. In addition we mark the variable bound by the determiner in the noun phrases with an exclamation mark. In the second conjunct, the determiner *some* and the head noun *films* have the same discourse referent marker x and this is also the variable bound by the quantifier. In the first conjunct the head noun has the discourse referent marker y, which is bound by the universal quantifier, marked as $y!$. However, the discourse referent marker of the determiner and the first conjunct is x.

(129) Alex adores [every$_{x,y!}$ French actress$_y$]$_x$ and [some$_{x!}$ of her$_y$ films$_x$]$_x$

This example shows that, as before, the discourse referent of each nominal head is bound by its quantificational determiner, and the discourse referent marker of the quantificational determiner is the same as that of the noun phrase. However, these two relations are now split over two variables: y for the nominal head and x for the noun phrase *every actress* in our example.

The corresponding constraints on the discourse referent markers are given in (130). In all previous LRS publications, the discourse referent marker was shared between a mother node and its head daughter. We have to change this in such a way that it percolates from the non-head daughter in cases in which the non-head daughter is a logical determiner.

(130) a. In a head-specifier phrase with a non-head with a quantificational external content, the discourse referent marker of the phrase is identical with that of the specifier.

b. In all other cases, the discourse referent marker of the head and the mother are identical.

The new percolation mechanism is illustrated for our example in (131).

(131) a. *actress*: **actress**($\underset{\sim}{y}$)

b. *every*: $^{\#}\forall y(A[y] : B[\exists \underset{\sim}{x}(x = y : A'[x]])$

c. *every actress*: $^{\#}\forall y(A[\textbf{actress}(y)] : B[\exists \underset{\sim}{x}(x = y : A'[x]])$

The new, split, encoding of the quantifiers opens up the possibility to insert operators that are in the scope of the quantifier but have scope over the embedded existential. This option is indicated in (128b) by the metavariable B.

We can now capture the examples with anaphoric binding into the second conjunct using the existentially split version of the determiner. In these cases,

the semantics of the second conjunct will take scope below the external content of the first conjunct. In (132) this is shown for the bi-propositional analysis of sentence (126a).

(132) Bi-propositional representation of example (126a):

$$\forall y(\textbf{actress}(y) : (\exists x(x = y : \textbf{adore}(\textbf{alex}, x)) \wedge \exists x(\textbf{film-of}(x, y) : \textbf{adore}(\textbf{alex}, x))))$$

As in the simple cases discussed in Section 4.1, the two conjuncts have identical discourse referent markers, x, and they have the same expression in their scope, $\textbf{adore}(\textbf{alex}, x)$. What is new is that the universal quantifier, $\forall y$, contributed in the first conjunct constituent takes scope over both conjuncts in the semantic representation. There, it binds the variable y and can, now, bind an occurrence of this variable in the second conjunct as well.

The cases with anaphoric relations from the first conjunct into the second conjunct are not licensed by the CIC as stated in (90). The universal quantifier in (132) is contributed inside the first conjunct daughter only, yet it has scope over the entire conjunction. We think that this type of wide scope is, nonetheless, an instance of the ATB exception, as it is only possible if the quantifier binds a variable in the second conjunct. Seen this way, the second conjunct does contribute some part of the operator that takes wide scope, namely the variable that it binds. To have a general term for this, we will define the notion of *anchoring* as in (133).

(133) A semantic expression A is *anchored* in a constituent c iff it is contributed by c or it binds a variable that is contributed in c.

The more tolerant version of the ATB exception that we are going to pursue in this section has been put forward in Fox (1995) and Sauerland (2003). They assume that raising a quantifier is possible out of the first conjunct when it binds a trace in the first conjunct and a variable in the second conjunct.[37] The following can be considered an LRS adaptation of their proposal.

Before we can state the final version of the ATB exception, we need to address a technical issue: in existentially split readings, the overall quantifier is only contributed by one of the conjuncts, and so is everything in its restrictor – $\textbf{actress}(y)$ in our example. This can be seen as an instance of *semantic pied-piping*, i.e., the expression $\textbf{actress}(y)$ may occur outside the representation of

[37] Both of these publications mention Ruys (1993) as the original source of this generalization. Unfortunately, we were not able to get hold of a copy of that work.

the conjunct daughter in which it is contributed because it is the restrictor of the quantifier that takes wide scope.

To allow for semantic pied-piping and to restrict it at the same time, we introduce the notion of *contributionally closedness up-to*, defined in (134). This notion allows us to refer to a set of semantic contributions that form a contingent expression with a potential hole in it.

(134) Contributional closedness up-to:
For each set of expressions Φ and each expression ψ, Φ is *contributionally closed up-to* ψ, Φ/ψ, iff there exists an expression ϕ such that every subexpression of ϕ is an element of Φ or a subexpression of ψ, and ψ and every element of Φ is a subexpression of ϕ.

The usefulness of this definition for our analysis is clear when we look at our analysis in (132), repeated in (135a). Contributional closedness up-to allows us to separate the semantic representation into two parts: the representation of the conjunction, which is the expression ψ from the definition, given in (135b), and the contributions for the first conjunct that occur outside of the conjunction, i.e. the set Φ from the definition, which is stated as a meta-expression in (135c).

(135) a. $\forall y(\mathbf{actress}(y) :$
$(\exists x(x = y : \mathbf{adore}(\mathbf{alex}, x)) \wedge \exists x(\mathbf{film}(x, y) : \mathbf{adore}(\mathbf{alex}, x)))$
b. $(\exists x(x = y : \mathbf{adore}(\mathbf{alex}, x)) \wedge \exists x(\mathbf{film}(x, y) : \mathbf{adore}(\mathbf{alex}, x)))$
c. $\forall y(\mathbf{actress}(y) : A)$

In this example, the set Φ contains the following expressions: the variable y, the constant **actress**, the formula $\mathbf{actress}(y)$, and the quantified expression $\forall y(\mathbf{actress}(y) : A)$. The overall formula in (135a) is the expression ϕ from the definition. All its subexpressions are either in (135c) or in (135b). Consequently, the expressions that are outside the conjunction constitute a set that is contributionally closed up-to the conjunction.

The universally quantified expression $\forall y(\mathbf{actress}(y) : A)$ is not only contributionally closed up-to the conjunction in (135a), it is also anchored in the second conjunct, because *her* in the second conjunct daughter also contributes the variable, y, which is bound by the universal quantifier. We think that these are exactly the two constraints determining when a semantic ATB exception is possible.

We can use the notions of anchoring and contributionally closedness up-to in our final formulation of the CIC in (136).

(136) Conjunct Integrity Constraint with Semantic ATB exception (CIC, final version)
For each H contributed by one conjunct daughter,
- H must not occur in a conjunct in which it is not contributed,
- H may only have scope over the overall conjunction if it is anchored in the other conjunct daughter as well, and
- H may only occur outside the conjunction if it is part of some subset of the contributions of its conjunct that is contributionally closed up-to some formula that contains the conjunction.

In this reformulation, we no longer require the wide-scope element to be contributed in both conjuncts. It is enough if it is anchored in the sense defined in (133). The semantic representations with existential split discussed in this section satisfy this final version of the CIC.

Existential split also applies to the mono-propositional analysis. We can change our running example to enforce a mono-propositional reading.

(137) Every actress$_i$ and one of her$_i$ fans met right after the premiere.

The semantic representation of this sentence is given in (138). The universal quantifier takes intermediate scope between the existential quantifier over the discourse referent of the conjunction, $\exists z(\ldots)$, and the conjunction.[38]

(138) Mono-propositional representation of example (137):

$$\exists z(\forall y(\mathbf{actress}(y) : (\exists x(x = y : x \in \pi_1 z) \wedge \exists v(\mathbf{fan\text{-}of}(v, y) : v \in \pi_{\geq 1} z))) : \mathbf{meet}(z))$$

The pronoun *her* can now be bound by *every French actress* as the universal quantifier has wide scope over the conjunction. The mentioned intermediate scope of the universal quantifier in (138) seems to be obligatory. In particular,

[38] To allow for this additional universal quantifier, we need to allow that the conjunction, $F \wedge G$, is not an immediate subterm of the restrictor of $\exists z$. The necessary lexical specification is given in (i), where F' is a new metavariable that indicates the possibility of additional material taking scope over the conjunction.

(i) *und*: $^{\#}\exists z(F'[\{(F[\boxed{x} \in \pi_1 z] \wedge G[\boxed{y} \in \pi_{\geq 1} z])\}] : H[z])$

it cannot take scope over $\exists z(\ldots)$. This cannot follow from the lexical specification of the mono-propositional conjunction particle, as our analysis of the standard CNNP cases relies heavily on the possibility that material from inside conjuncts can take wide sope over the group/pair individual z. Consequently, it must be a constraint on the existential split, i.e., there needs to be a constraint on how close the added wide-scope quantifier and the embedded existential quantifier $\exists x(x = y : \ldots)$ must be.

The analysis outlined above predicts the availability of anaphoric relations between the two conjuncts. At the same time, we also predict the contrast between noun phrase conjunction and clausal conjunction in (126). In a mono-clausal syntactic analysis, we expect that a universal quantifier can have scope over the rest of the clause. In a bi-clausal syntactic structure, no such wide scope is possible, and cross-sentential dynamic effects are excluded by the non-dynamicity of the universal quantifier. To achieve this, we adjusted the CIC in such a way that we allow for semantic ATB exceptions in the case of binding.

8.2 Anaphoric relations in CNNP

Some speakers reject all anaphoric links between the conjuncts in CNNP constructions, others accept them when a bi-propositional reading is available. Those speakers who have difficulties getting mono-propositional readings in the first place, find such readings even less acceptable if there is an anaphoric relation between the two conjuncts. Finally, some speakers have no problem with anaphoric relations under any of the readings. These three distinct judgement patterns are shown in (139), where the first sentence illustrates a bi-propositionally interpretable structure, the second sentence an only mono-propositionally interpretable case.

(139) a. */ ok/ ok Alex mag [keine französische Schauspielerin]$_i$ und [keinen ihrer$_i$ Filme]$_j$.
Alex likes no French actress and none of her films.

b. */ */ ok Alex vergleicht [kein Buch]$_i$ und [keine seiner$_i$ Verfilmungen]$_j$ (miteinander).
Alex compared no book and none of its movie renderings (with each other)

We will discuss the two readings separately. The fact that anaphoric relations appear to be less available for the mono-propositional reading meshes well with

the overall tendency that the mono-propositional reading is less easily accessible than the bi-propositional one.

Let us first consider hypothetical bi-propositional analyses of sentence (139a), given in (140) and (141). If the existential quantifier of the first conjunct takes wide scope over the conjunction, so must its negation. For this to be possible, the negation contributed inside the second conjunct daughter has to take wide scope over the conjunction as well, to be a semantic ATB exception.

In (140), however, the negation contributed by the second conjunct daughter is part of the second conjunct in the semantic representation. Consequently, there is a violation of the CIC.

(140) Hypothetical bi-propositional analysis of (139a), first option

$$\#\ \neg\exists y(\mathbf{actress}(x)\ :\ (\exists x(x = y\ :\ \mathbf{like}(\mathbf{alex}, x)) \wedge \neg\exists x(\mathbf{film}(x, y)\ :\ \mathbf{like}(\mathbf{alex}, x))))$$

The semantic representation in (141) respects the CIC. Here, there is only one negation, which takes scope over the entire conjunction.

(141) Hypothetical bi-propositional analysis of (139a), second option

$$\#\ \neg\exists y(\mathbf{actress}(x)\ :\ (\exists x(x = y\ :\ \mathbf{like}(\mathbf{alex}, x)) \wedge \exists x(\mathbf{film}(x, y)\ :\ \mathbf{like}(\mathbf{alex}, x))))$$

This formula represents a reading in which there is no actress such that Alex likes both her and some of her films. This would leave the option that Alex likes some French actress, but just not her films. This is, however, not a possible reading of the sentence, and our principles correctly exclude it: as in (103), this formula cannot express a sentential negation because there is a logical connective intervening between the internal content of the verb, $\mathbf{like}(\mathbf{alex}, x)$, and the negation. Consequently, there is no well-formed bi-propositional analysis of example (139a).

This raises the question what interpretation those speakers have who accept sentence (139a). We will argue that the pronoun in the second conjunct in (139a) is not bound by the quantifier from the first conjunct. This argument is parallel to the argumentation for e-type pronouns in Evans (1977; 1980). First, if the pronoun in the second conjunct were bound, we would get a reading like (141). But such a reading is not available for the sentence.

Second, we require that for all disliked actresses, all their films are also disliked, not just some. The pronoun in the second conjunct in (139a) is interpreted with respect to the set of disliked actresses, i.e. to what is called the RefSet in

the literature on cross-sentential anaphora such as Nouwen (2003) or Lücking & Ginzburg (2019). Consequently, we can give a paraphrase for the sentence in which the possessive pronoun is replaced with a definite noun phrase, see (142).

(142) Alex mag keine französische Schauspielerin und keinen Film [von den französischen Schauspielerinnen, die Alex nicht mag].
'Alex likes no French actress and no movie [of the French actresses that Alex doesn't like].'

We cannot propose a treatment of this type of pronouns in this paper, but the resulting semantic representation of a sentence like (139a) could look as in (143).

(143) Sketch of an e-type analysis of (139a):
$\neg\exists x(\mathbf{actress}(x) : \mathbf{like}(\mathbf{alex}, x)) \wedge \neg\exists x(\mathbf{film}(x, Y) : \mathbf{like}(\mathbf{alex}, x))$,
where Y is the set $\lambda x.(\mathbf{actress}(x) \wedge \neg\mathbf{like}(\mathbf{alex}, x))$.

The important aspect of this representation is that the variable management for our analysis of bi-propositional readings is not problematic. The discourse referent marker in both conjuncts is the same variable, x. The overall sentence is negated as its internal content, $\mathbf{like}(\mathbf{alex}, x)$ is in the scope of negation with no intervening connective. Finally, the possessive pronoun is interpreted as referring to the RefSet, Y, i.e., to the set of all actresses that Alex does not like.

We showed that there is a difference between the cases with real binding into the second conjunct and the cases of more discourse-like pronouns in CNNP. We have to leave for future research the reasons for why many speakers do not easily get the last kind of reading.

Next, we turn to (139b), a sentence in which the conditions for a mono-propositional reading are met. The mono-propositional analysis of the sentence is shown in (144).

(144) Mono-propositional analysis of (139b)

$$\neg\exists z(\exists y(\mathbf{book}(y) : (\exists x(x = y : x \in \pi_1 z) \wedge \exists v(\mathbf{film\text{-}rendering}(v, y) : v \in \pi_{\geq 1} z)) : \mathbf{compare}(\mathbf{alex}, z))))$$

This semantic representation meets the CIC. Each of the conjoined noun phrases contributes a negation, so the negation can take wide scope over the overall conjunction as a semantic ATB exception.

Similarly, the quantifier which we get by the existential split, $\exists y(\mathbf{book}(y) : \ldots)$ in (144) is anchored in both conjuncts: it is contributed in the first and binds a

variable, y, in the second. Given this constellation, there should be no problem with the reading in (144), i.e., our constraints are formulated in such a way that binding into the second conjunct should be possible in a mono-propositional reading.

Since not all speakers accept this constellation, we will show how it can be excluded. One difference between this reading and the earlier, well-formed, examples of split readings is that the two elements that take scope over the entire conjunction are separated from each another. In the present example, the existential quantifier $\exists z(\ldots)$ intervenes between the negation and $\exists y(\ldots)$. If this reasoning is on the right track, all elements from inside individual conjuncts that take scope over the entire conjunction need to form a *contributionally closed up-to* constellation. In other words, the speakers who do not accept (144) have a stricter version of the last clause of the CIC from (136) in which all conjunct-internal contributions that take wide scope need to to be part of a single set which is contributionally closed up-to the conjunction. Such a formulation is given in (145).

(145) Strict version of the last clause of the CIC:
- all H that occur outside the conjunction are part of some subset of the contributions of their conjunct that is contributionally closed up to some formula that contains the conjunction.

With this formulation, the semantic representation in (144) is excluded. There are two hypothetical representations that would not violate this constraint: one in which $\exists y(\ldots)$ takes scope over $\exists z(\ldots)$, and one in which the negation takes narrow scope inside the restrictor of $\exists z(\ldots)$. These two constellations are sketched in (146a) and (146b), respectively. We show that they violate other constraints.

(146) a. $\neg\exists y(\mathbf{book}(y) : \exists z(\exists x(x = y : x \in \pi_1 z) \wedge \exists v(\mathbf{film}(v, y) : v \in \pi_{\geq 1} z) : \mathbf{compare}(\mathbf{alex}, z)))$

b. $\exists z(\neg\exists y(\mathbf{book}(y) : (\exists x(x = y : x \in \pi_1 z) \wedge \exists v(\mathbf{film}(v, y) : v \in \pi_{\geq 1} z))) : \mathbf{compare}(\mathbf{alex}, z))$

In (146a), the quantifier contributed in the first conjunct takes wide scope over the group/pair object z. In our discussion below (138), we argued that such a constellation should be excluded on independent grounds by a – yet to be defined – constraint on what material may intervene between the two quantifiers contributed by an existentially split determiner.

In the representation in (146b), the negation is in the restrictor of the quantifier over the pair individuals. Consequently, the internal content of the verb is not in the scope of negation, the sentence is not negated.

We have discussed possible bi- and mono-propositional analyses of CNNP with anaphoric relations between the two conjuncts. We showed that there cannot be proper binding in the bi-propositional analysis. To the extent that some speakers can interpret such sentences, the pronoun in the second conjunct is not bound by the negative indefinite in the first conjunct but refers to the RefSet established in the first conjunct. For the mono-propositional analysis, the situation is different: there are two versions of the CIC, the weaker version in (136), and the stronger version in (145). Speakers with the weak version accept CNNPs with an anaphoric relation, speakers with the strong version do not.

Since the mechanisms for the bi- and the mono-propositional readings are independent of each other in our analysis, it is possible that some speakers accept the mono-propositional case but not the bi-propositional one. However, mono-propositional readings are less easily available even in the absence of anaphoric relations. Therefore, we are not surprised that we have not yet found a speaker accepting an anaphoric relation in the mono-propositional case but not in the bi-propositional case.

LRS allows for using the same semantic material in different contexts. We showed that assuming identical discourse referent markers for conjoined noun phrases in a bi-propositional reading is compatible with syntactic configurations in which a pronoun in the second conjunct is anaphorically related to the first conjunct.

9 Conclusion

We presented a first systematic analysis of conjoined negative noun phrases (CNNP), a phenomenon whose discussion has previously been restricted to side remarks or footnotes. Our analysis combines an existing analysis of negation with a negation-independently developed analysis of coordination. In other words, we did not need any CNNP-specific assumptions.

It is an important property of CNNP that its readings do not seem to differ between NC and non-NC languages. We attributed this to the fact that coordination is subject to an across-the-board constraint, which is a cross-linguistically robust property of coordination. The NC/non-NC distinction is argued to be based on interpretation constraints that are not at work in coordination.

A constraint-based system of semantic combinatorics such as LRS proved to be apt for modeling the data. LRS is inherently one-to-many friendly. The constraint-based perspective allows a fresh view on the semantic contributions of lexical

items and on interpretation strategies at the phrasal level: by using a particular lexical item, a speaker constrains the semantic representation to contain some constants, variables, etc; by using a particular syntactic construction, the speaker constrains the way in which these pieces of our semantic representation language are combined. The first property makes it very natural to assume that several lexical items require the same semantic constant or operator to occur in the semantic representation. The second property shows that LRS treats ambiguity as the norm rather than the exception and, at the same time, emphasizes the role of syntax and of general interpretation strategies to reduce the amount of ambiguity.

We motivated the Semantic Across-the-Board Constraint by its analogy to ATB constraints in syntax. Its syntactic analogue has been shown to be reducible to an independent semantic effect in Chaves (2012). The same will, hopefully, be true for the version presented in this paper. In its current version, it provides a good starting point for further research in this direction. As it stands, it seems to us that the CIC is valid in both NC and non-NC languages.

In our analysis, we treat CNNP as a residual syntactic construction in StG that requires a negative-concord style interpretation. The relatively clear reading judgements on CNNP help us make this point here. In their work on French, Burnett et al. (2015) show that while French is an optional NC language, there are preferences for particular readings depending on the syntactic constellation, the context, but also on some extra-linguistic properties. A constraint-based system like LRS will allow us to derive all possible readings and, at the same time, to formulate empirically motivated constraints to exclude readings or to impose strong contextual conditions on readings.

Abbreviations

Abbreviation	Full form
ATB	Across-the-Board
CIC	Conjunct Integrity Constraint
CNNP	conjunction of negative noun phrases
CPS	Coordination Parallelism Constraint
CSC	Coordinate Structure Constraint
DN	double negation (reading)
HPSG	Head-driven Phrase Structure Grammar
LF	Logical Form
LRS	Lexical Resource Semantics
NC	negative concord
NM	negative marker (French *ne*, Polish *nie*)
n-word	negative indefinite determiner or pronoun
SN	single negation (reading)
StG	Standard German
TLF	Transparent Logical Form

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Chapter 8

Modification of literal meanings in semantically non-decomposable idioms

Sascha Bargmann
Goethe-Universität Frankfurt a.M.

Berit Gehrke
Humboldt Universität zu Berlin

Frank Richter
Goethe-Universität Frankfurt a.M.

In the literature on idioms, conjunction modification is understood as involving a modifier that does not lexically belong to the idiom at hand, modifying the literal meaning of a noun in that idiom while the idiomatic meaning of the expression as a whole is preserved. The construction relies on the hearer perceiving the idiomatic meaning of the whole and the literal meaning of a part of it simultaneously and in conjunction. We investigate instances of naturally occurring examples of four semantically non-decomposable verb-phrase idioms (two English, two German) whose complements contain such a modifier. We examine the possible interpretations and the contextual conditions of these idiom-modifier combinations. They are particularly interesting instances of one-to-many relations between form and meaning.

1 Introduction

In any comprehensive investigation of one-to-many relations between form and meaning, there is no way around idioms. In nearly all cases, the string that can be interpreted as an idiom (e.g. *pull x's leg* $\rightsquigarrow_{id}$ 'playfully deceive *x*') can also be interpreted literally (*pull x's leg* $\rightarrow_{lit}$ 'pull *x*'s leg'), so that one and the same string

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provides several meanings. This becomes especially obvious in so-called conjunction modification (Ernst 1981), in which a modifier inserted into the nominal complement of a verb-phrase idiom modifies the literal meaning of the noun, while the idiom as a whole is still understood in its idiomatic meaning (*pull x's* tattooed *leg* $\rightsquigarrow_{id}$ 'playfully deceive x' and $\rightarrow_{lit}$ 'x has a tattooed leg').[1] The perceived interpretation of the resulting expression requires both the idiomatic meaning of the idiom and the literal meaning of the idiom's noun.

Overall, Ernst 1981 distinguishes three types of modification in what he calls "extraneous" modifiers in idioms (i.e. modifiers that are not part of the idiom itself): internal modification, external modification, and conjunction modification.[2] The aim of this paper is to explain this tripartite division of idiom modification and then to focus on conjunction modification and corpus examples that fall into this category. As our discussion will show (and as Ernst 1981 already emphasizes as well), it is not always uncontroversial which one(s) of the three categories of idiom modification a specific example falls into. Such complications might ultimately lead to a revision of Ernst's characterizations of the three classes or to a different theory of idiom modification altogether. With our present discussion, we want to contribute to a better understanding of the empirical situation as a necessary foundation to such a revised theory.

The paper is structured as follows. First, we will give a short introduction to Ernst's tripartite division of idiom modification (Section 2). We will then zoom in on conjunction modification and present corpus data on two English and two German semantically non-decomposable verb phrase idioms with the meaning 'die' (*kick the bucket*, *bite the dust*, *den Löffel abgeben* '(lit.) pass on the spoon', and *ins Gras beißen* '(lit.) bite into the grass') that include an extra modifier. We did not always agree on how these idiom-modifier combinations are to be analyzed (Section 3). Before we conclude our paper (Section 5), we will point to some idiom examples beyond modification that nonetheless seem to be analyzable in a similar way to conjunction modification (Section 4).

Our discussion of semantic interpretation will remain mostly nontechnical, although we have a suitably expressive logical language in mind for semantic representations when we explicate the meaning of our examples in English paraphrases. How these representations are to be built from the representations of

[1] Here and in the following, we italicize those words that belong to the idiom, underline the modifier(s), and put single quotation marks around the meaning representations, which we state informally by means of natural language (English) expressions.

[2] As far as we know and as Stathi 2007: 83 states as well, Ernst 1981 is the first to systematically look into modification in idioms. Since our purpose is mainly to study naturally occurring data, rather than to provide a complete account, we will not discuss other, more recent papers on modification (see, for instance, Stathi 2007; Cserép 2010; McClure 2011; Sailer 2017).

words, or how the representations of larger semantically non-decomposable idioms enter the semantic composition mechanism, is an important question, but it is not the focus of the present discussion. Only with an explicit system that answers these questions and governs a precise semantic composition mechanism could we begin a serious investigation of issues concerning compositionality, which are regularly and naturally raised in connection with the analysis of idioms.

When we use the term *compositionality* here, it is meant as a broad reference to a semantic composition operation that starts from simple or phrasal lexical units (the latter being possibly necessary for semantically non-decomposable idioms) and constructs the representations of larger units from them, conditional on syntactic structure. When we say for some examples, following common parlance, that we do not know how to analyze them compositionally, this means that we are unsure how to spell out a composition operation in this sense in full detail. It is not to be understood as a technical statement about the relationship between the syntax and semantic composition mechanism(s) of the grammar framework of choice in which the operation would have to be expressed.[3]

2 Ernst's tripartite division of idiom modification

According to Ernst 1981, modification in idioms is – at least in principle – threeway ambiguous between external modification, internal modification, and conjunction modification. Context and world knowledge narrow down the interpretative options that the semantics provides on the basis of the combination of the meaning of the modifier and the meaning of the idiom.

If an idiom has *internal semantic structure* in the sense that its "particular words [...] correspond to specific independent elements in the idiom's semantic representation" (Ernst 1981: 67), as in *pull strings* ($\rightsquigarrow_{id}$ 'use connections') or *jump on the bandwagon* ($\rightsquigarrow_{id}$ 'join a movement'), the idiom allows for all three modification options. Following Nunberg et al. 1994, we call such idioms *semantically decomposable*. If, by contrast, the idiom has no internal semantic structure, as in *kick the bucket* ($\rightsquigarrow_{id}$ 'die') or *tighten one's belt* ($\rightsquigarrow_{id}$ 'economize'), internal modification is impossible. These idioms we call *semantically non-decomposable*.[4]

[3]Two authors of the present paper have a preference for a constraint-based semantics in HPSG for which compositionality in the traditional sense does not hold, although it formulates a precise *systematic* relationship between syntactic structure and semantic interpretation.

[4]It is important to note at this point that the semantic decomposability of an idiom cannot be proven by simply finding a paraphrase for the idiom in which each word corresponds to exactly

2.1 Internal modification

In internal modification, the literal or figurative meaning of the modifier applies to the idiomatic meaning of the idiom's noun, see (1), Ernst's (8).

(1) In spite of its conservatism, many people were eager to *jump on the* horse- drawn Reagan *bandwagon.*

If you jump on the bandwagon in the idiomatic sense, you join a growing movement (in an opportunistic way or simply for the excitement) once that movement is perceived to be successful.[5] This is directly reflected in Ernst's decomposition of the idiom into two parts and his assumption that the literal and the idiomatic meaning of each part are linked: 'jump on' is linked to 'join', and 'bandwagon' is linked to 'movement'.

In the sentence in (1), there are two modifiers within *jump on the bandwagon*: Reagan and horse-drawn.[6] Together with these modifiers, Ernst argues, the idiom expresses something like 'join the old-fashioned Reagan campaign', i.e. Reagan and horse-drawn modify the noun *bandwagon* on its idiomatic reading, not only syntactically but also semantically. More precisely, the figurative meaning of the modifier horse-drawn ($\rightsquigarrow_{inf}$ 'old-fashioned' or 'behind the times', at least in relation to *bandwagon*) modifies the meaning of the nominal *Reagan bandwagon*, in which the literal meaning of the modifier Reagan ($\rightarrow_{lit}$ 'Reagan') modifies the idiomatic meaning of the noun *bandwagon* ($\rightsquigarrow_{id}$ 'movement').

To conclude, in internal modification, modifiers not only have the form and position (= morphosyntactic characteristics) of prenominal modifiers but also behave like them semantically, as they characterize the meaning of the following nominal. While the noun itself is interpreted in its idiomatic meaning, the interpretation of the modifiers can be literal (as with Reagan) or figurative (as with horse-drawn).

one of the words of the idiom. In order to show that an idiom is semantically decomposable, i.e. that the idiom's meaning disseminates over its words in such a way that each of these words receives a meaning component of the overall meaning of the idiom, it must pass tests like semantic modification of the idiomatic meaning of its nominal part (= Ernst's internal modification), quantifier variation in the idiomatic meaning of its nominal part, and/or anaphoric references to the idiomatic meaning of its nominal part; see Nunberg et al. 1994.

[5] Variations of this idiom are *hop on the bandwagon* and *climb on the bandwagon.* All of them allude to literally jumping/hopping/climbing on the wagon that used to carry (and sometimes still does) the band and the candidate during a political campaign.

[6] Note, however, that Ernst 1981 focuses on the modifier horse-drawn only.

2.2 External modification

In external modification, the literal or figurative meaning of the modifier applies to the idiomatic meaning of the idiom as a whole and functions like a domain adverb, see (2), taken from Ernst 1981: 51.

(2) With that dumb remark at the party last night, I really *kicked the* social *bucket.*

If you kick the bucket in the idiomatic sense, you die. Nothing is said about a bucket or kicking. In (2), we again have a modifier in the idiom: social. In contrast to the situation in (1), however, it is not the case that the modifier modifies the idiomatic meaning of the idiom's noun. Instead, *I kicked the social bucket* means that the speaker did the "bucket-kicking" in the social domain, i.e. she did not die physiologically (if she had, she would not have been able to report that) but only socially. It is not the meaning of the idiom's noun but the meaning of the entire idiom that is modified. Truth-conditionally, the meaning of the sentence in (2) seems to be indistinguishable from the meaning of the sentence in (3):

(3) Socially, I really *kicked the bucket* with that dumb remark at the party last night.

As the modifier in external modification specifies the domain within which the meaning of the idiom applies, Ernst calls external modifiers *domain delimiters*. Typical domain delimiters are adjectives belonging to professional or academic domains, like *political*, *economic*, *musical*, etc. However, there are also non-typical domain-delimiting modifiers that can nonetheless function as domain delimiters in certain contexts, see (4), Ernst's (24).

(4) He denied that the Saudis, angry over [the movie] *Death of a Princess*, were *seeking* some celluloid *revenge* with a movie of their own.

In this example, "celluloid is being used figuratively, and is more or less equivalent to the literal cinematic" (Ernst 1981: 55). From examples like these Ernst concludes that external modification is not restricted to one particular lexical class of adjectives.

2.3 Conjunction modification

In conjunction modification, the last of Ernst's three types of idiom modification and our central topic in this paper, the meaning of the modifier applies to the

meaning of the idiom's noun, just like in internal modification. However, unlike in internal modification, Ernst argues, the modifier does not apply to the idiomatic meaning of the noun but to its literal meaning, and this happens in an additional proposition that is independent of the proposition that expresses the meaning of the idiom. Conjunction modification is exemplified in (5), Ernst's (10), taken from a review of a production of the Shakespearean play *Twelfth Night*:

(5) Malvolio deserves almost everything he gets, but ... there is that little stab of shame we feel at the end for having had such fun *pulling* his cross-gartered *leg* for so long.

If you pull someone's leg in the idiomatic sense, you playfully deceive that person. It need not, and usually does not, have anything to do with that person's leg(s). However, the insertion of the modifier cross-gartered, as in (5), suddenly leads to an interpretation that includes the proposition that Malvolio has a cross-gartered leg, a proposition that is entirely independent of the meaning of the idiom. For reasons of clarity, let us look at a simplified version of (5), namely (6):

(6) We *pulled* Malvolio's cross-gartered *leg*.

According to Ernst, this sentence expresses the conjunction of two independent propositions. Here and in the following, we will spell his analysis out in detail and use the representation format shown in (7) to do so.[7]

(7) Conjunction modification analysis of (6):

s_1: *We pulled Malvolio's ~~cross-gartered~~ leg.*
$\rightsquigarrow_{id}$ p_1: 'We playfully deceived Malvolio.'

s_2: ~~*We pulled*~~ *Malvolio's cross-gartered leg.*
$\rightarrow_{lit}$ p_2: 'Malvolio has a cross-gartered leg.'

p_1 & p_2: 'We playfully deceived Malvolio, who has a cross-gartered leg.'

[7] In our representations and explanations of the conjunction modification analyses, in contrast to our representations and explanations of the natural language examples, we italicize not just the words that belong to the idiom but all words, including the modifier. Moreover, and more importantly, we strike out those words that are not semantically interpreted at a particular instance (this is different from the Minimalist notation, in which strikeout usually represents the deletion of phonological material while keeping that material's meaning). It is important to note here that s_1 and s_2 are, in fact, one and the same string with different parts of that same string being semantically interpreted in s_1 and s_2. For reasons of simplicity, however, we will talk about them as if they were two different strings.

The analysis in (7) expresses that the proposition p_1 ('We playfully deceived Malvolio.') represents the idiomatic meaning ($\rightsquigarrow_{id}$) of the string s_1 (*We pulled Malvolio's leg.*), which is the sentence in (6) without the modifier *cross-gartered*. Without that modifier, s_1 says nothing about Malvolio's leg. The proposition p_2 ('Malvolio has a cross-gartered leg.'), in contrast, is the non-idiomatic and non-figurative (hence $\rightarrow_{lit}$) meaning of the string s_2 (*Malvolio's cross-gartered leg* – the NP-complement of the verb in (6)) and hence does say something about Malvolio's leg, namely that it is cross-gartered. The two independent propositions p_1 and p_2 are then conjoined into p_1 & p_2: 'We playfully deceived Malvolio, and Malvolio has a cross-gartered leg.' Alternatively, and expressed more naturally: 'We playfully deceived Malvolio, who has a cross-gartered leg.'

On top of cases like the one we have just dealt with, Ernst also points to cases in which p_2 is figuratively reinterpreted, see (8), Ernst's (40).

(8) With the recession, oil companies are having to *tighten* their Gucci *belts*.

If you have to tighten your belt in the idiomatic sense, you have to economize. Let us once again simplify the example:

(9) Oil companies have to *tighten* their Gucci *belts*.

Just like "We *pulled* Malvolio's cross-gartered *leg*." in (6), the sentence in (9) expresses the conjunction of two propositions of which the first is idiomatic, whereas the second is non-idiomatic and independent of the first. In contrast to (6), however, the second proposition expressed by (9) is the result of a figurative reinterpretation (subsumed under $\rightsquigarrow_{inf}$ in this paper):[8]

(10) Conjunction modification analysis of (9):

s_1: *Oil companies$_i$ have to tighten their$_i$ ~~Gucci~~ belts.*
$\rightsquigarrow_{id}$ p_1: 'Oil companies have to economize.'

s_2: *~~Oil companies$_i$ have to tighten~~ their$_i$ Gucci belts.*
$\rightarrow_{lit}$ p_2: 'Oil companies have Gucci belts.'
$\rightsquigarrow_{inf}$ $p_{2'}$: 'Oil companies are rich.'

p_1 & $p_{2'}$: 'Oil companies have to economize, and they are rich.'

[8] Here and in the following, we will use the arrow $\rightsquigarrow_{inf}$ whenever a figurative reinterpretation is at play or any other kind of inference needs to be drawn from the literal meaning by taking into account the overall context and/or world knowledge. Note that in a non-figurative inference, the literal meaning that the inference is based on continues to hold, whereas in a figurative reinterpretation, it does not.

The proposition p_1 ('Oil companies have to economize.') is the idiomatic meaning ($\rightsquigarrow_{id}$) of the string s_1 (*Oil companies$_i$ have to tighten their$_i$ belts.*), which is the sentence in (9) without the modifier *Gucci*. The proposition $p_{2'}$ ('Oil companies are rich.'), in contrast, is a figurative reinterpretation of the intermediate proposition p_2 ('Oil companies have Gucci belts.'), which expresses a possessive relation between oil companies (= the possessors) and belts by the luxury brand Gucci (= the possessions), which are symbols of great wealth. This intermediate proposition represents the non-idiomatic and non-figurative (hence $\rightarrow_{lit}$) meaning of s_2 (*their$_i$ Gucci belts*), which is the NP-complement of the verb in (9), in which the reference of the possessive determiner *their$_i$* has already been resolved, so that *their$_i$ Gucci belts* is identical in meaning to *oil companies' Gucci belts*. The two independent propositions p_1 and $p_{2'}$ are then conjoined into 'Oil companies have to economize, and oil companies are rich.' More naturally: 'Oil companies have to economize, and they are rich.' So, neither p_1 nor $p_{2'}$ nor their conjunction says anything about belts or Gucci or Gucci belts, and there is no literal possession of such belts by oil companies.

However, whereas the meaning components of a literal or idiomatic meaning can simply be retrieved from the lexicon, i.e. accessed directly, a figurative interpretation (in (10): 'Oil companies are rich.') is always based on, and hence a reinterpretation of, a literal meaning (in (10): 'Oil companies have Gucci belts.'). Consequently, at one point within the analysis of (9), the literal meaning of the idiom's noun *belts* and the literal meaning of the modifier *Gucci* actually do play a role, just like the literal meaning of the idiom's noun *leg* and the literal meaning of the modifier *cross-gartered* do in the analysis of (6), whose interpretation process does not contain any figurative steps. One of the reasons why a proposition is reinterpreted figuratively can be that its literal meaning does not make much sense, which is the case in (10), as oil companies do not usually have belts.[9]

3 Zooming in on conjunction modification

Before we turn to our corpus examples and their analysis in the spirit of Ernst's (1981) conjunction modification (see Section 3.3 to Section 3.5), let us delineate our general take on conjunction modification (see Section 3.1) and present the four semantically non-decomposable idioms to be studied (see Section 3.2).

[9]However, even if we were talking about people instead of companies, it would not be necessary that those people have (literally possess) Gucci belts, and a figurative reinterpretation would still be possible.

3.1 Our take on conjunction modification

First, we perceive conjunction modification and the modification of literal and idiomatic meanings within idioms in general to be well within the scope of a grammatical theory of idioms. Sometimes these phenomena have been denied this status, being discarded as "word play".[10] Even if conjunction modification were to fall within "word play" (however we define it), it would still involve language and thus should be analyzable.

Second, if conjunction modification, as Ernst claims, adds an independent proposition, it should be a non-restrictive kind of noun modification. Restrictive modification, e.g. in the combination of adjective (A) and noun (N), involves intersecting the set of entities with the property N with the set of entities with the property A, or with subsective As, narrowing the set down to the set of entities that have both the A and the N properties (e.g. *black elephants* have both the black property and the elephant property, or are a subset of *elephants*) and therefore the A denotes a property (see, e.g., Kamp & Partee 1995). Non-restrictive modification, on the other hand, adds a secondary proposition that does not narrow down the nominal property and the role it plays in the primary proposition; therefore the content of the secondary proposition is often analyzed as being outside the main assertion of the first proposition (see, e.g., Morzycki 2015; McNally 2016; and literature cited therein). Propositions, in contrast to properties (predicates) expressed by adjectives or restrictive relative clauses, cannot modify an N restrictively.

Third, we would like to emphasize, just like Ernst does, that semantically non-decomposable idioms only allow for conjunction modification and external modification, as internal modification requires access to an idiomatic meaning of the idiom's noun, which semantically non-decomposable idioms cannot provide. Therefore, if Ernst's hypothesis is correct that modifiers in idioms are in principle three-way ambiguous, focusing on semantically non-decomposable idioms in the empirical investigation removes one level of ambiguity. In the following we therefore restrict our attention to semantically non-decomposable idioms.

3.2 Our four idioms

We chose two English and two German semantically non-decomposable idioms with the meaning 'die', see (11) for the English and (12) for the German idioms.

[10] See, for instance, Schenk 1995 or Nicolas 1995, who claim that any modification of idioms is either (i) external modification or (ii) statistically negligible and outside the scope of a grammatical theory of idioms, which for them are always semantically non-decomposable units.

(11) a. kick the bucket
b. bite the dust

(12) a. den Löffel abgeben
the.ACC spoon on.pass
'(lit.) pass on the spoon'

b. ins Gras beißen
in.the.ACC grass bite
'(lit.) bite into the grass'

We searched for occurrences of these four idioms in combination with modifiers that seemed likely to be of the conjunction modification kind using the corpora 'ENCOW16A (World Englishes)' and 'DECOW16A (German, Austrian and Swiss German)' at webcorpora.org.

In (11) and (12), our four idioms are paired up by language. However, there are good reasons to pair them up instead as in (13) and (14). In order to make those reasons more obvious, (13) and (14) do not contain the original German idioms but their literal translations (as if they existed in English that way).

(13) a. kick the bucket
b. pass on the spoon

(14) a. bite the dust
b. bite into the grass

Whereas buckets and spoons, just like belts, are typical personal possessions, dust and grass can be interpreted as types of ground. Personal possessions and their traits, like their brand and/or their material, invite inferences about their possessors (see, e.g., Belk 1988), while grounds and their traits, like their surface and/or what you find on it, invite *pars pro toto* inferences about the locations that they are a part of (for a somewhat similar reasoning based on conceptual contiguity, see Stathi 2007: 92). Building on this and on Ernst's (1981) definition of conjunction modification, see Section 2.3, we expected that the analyses of our corpus examples would contain a proposition including **die**(x) and a proposition of the form 'x has a MODIFIER bucket/spoon' or 'the dust/grass is MODIFIER'[11]

[11] As Ernst 1981 expresses at the top and bottom of page 60, in (47), and in the middle of page 64, the second conjunct in conjunction modification is not limited to 'x has a MODIFIER y' but can take on different forms. Given that this second proposition is anchored in the first proposition, we adjust its tense/aspect/mood accordingly.

and that it would be necessary at times to reinterpret the latter proposition figuratively, as in the analysis of the Gucci *belts* example in (10), or to draw non-figurative inferences from it.

To make the possessive relation in our first pair of idioms explicit also in cases where there is no possessor (as there is in (6)) or no possessive determiner (as there is in (9)), we will also co-index the definite expressions *the bucket, the spoon* with the subjects, in analogy to (9) (e.g. *the$_i$ bucket*). We treat the definites in these cases as weak possessive definites (in the sense of Poesio 1994; Barker 2005), of the sort we find in (15) (from Le Bruyn 2014).

(15) a. I hit him on the hand.
b. He raised the hand.

Le Bruyn's analysis of the definite in these examples (at some step of the analysis) involves a relation to a PRO that is co-indexed with an (intrinsic) possessor, as in (16) (adapted from Le Bruyn 2014: 324).

(16) the PRO$_i$ hand $\overset{trans}{\rightsquigarrow}$ $\iota z(\mathbf{hand}(z) \wedge \mathbf{intrinsically\_belong\_to}(i)(z))$

In the following, when we use co-indexation on the definites in our idioms (e.g. *the$_i$ bucket*), we will do this as a short-cut for an analysis of the sort in (16), although we are not committed to a particular account of weak (possessive) definites at this point. With these observations in mind, let us turn to our corpus examples.

3.3 Corpus examples of conjunction modification

For each of our four idioms, we will now discuss a corpus example that we think fits Ernst's conjunction modification category. The first example in this line-up is about the death of Hugo Chávez, the former President of Venezuela, see (17).

(17) Venezuela's Friend of the Working Class, Hugo Chávez, *kicked the* golden *bucket* with an estimated net worth of 2 billion dollars.[12]

A conjunction modification analysis of this example in our representation format looks as in (18).

[12]https://canadafreepress.com/article/a-socialism-spill-on-aisle-9 (last accessed on 5 April 2018)

(18) Conjunction modification analysis of (17):

s_1: *Hugo Chávez$_i$ kicked the$_i$ ~~golden~~ bucket.*
$\rightsquigarrow_{id}$ p_1: 'Hugo Chávez died.'

s_2: ~~*Hugo Chávez$_i$ kicked*~~ *the$_i$ golden bucket.*
$\rightarrow_{lit}$ p_2: 'Hugo Chávez had a golden bucket.'
$\rightsquigarrow_{inf}$ $p_{2'}$: 'Hugo Chávez was rich.'

p_1 & $p_{2'}$: 'Hugo Chávez died, who was rich.'

As mentioned underneath (14), the material of a personal possession like a bucket invites inferences about its possessor. And since the material gold is a well-known symbol for wealth, stating that the late Hugo Chávez had a golden bucket (p_2) invites the inference that he was rich ($p_{2'}$). If you take that inference to be a figurative reinterpretation of p_2, which seems to be the most plausible variant here, then nothing is said about Hugo Chávez having a golden bucket. All that you obtain in the end is that he was rich (cf. the analysis of Ernst's Gucci *belts* example in (10)). In conjunction, p_1 and $p_{2'}$ then result in 'Hugo Chávez died, who was rich.[13]

Our second corpus example is about the mentalist Vincent Raven, who, just like Uri Geller, claims to be able to bend spoons by sheer mental power and who almost died from a stroke that he had after falling on his head. See (19) for the example and (20) for the analysis.

(19) Oder Vincent Raven aus Uri Gellers ProSieben-Sendung, der einen Unfall hatte und beinahe *den* verbogenen *Löffel abgegeben* hätte.[14]

[13] An anonymous reviewer correctly observed that sentences such as *Hugo Chávez kicked the* drunk/poor/70-year-old *bucket* cannot (easily) express 'Hugo Chávez died drunk/poor/at the age of 70' and wondered why this should be the case. Following the conjunction modification analysis, the answer would go as follows: Neither literal drunk nor literal poor makes any sense as a modifier of literal *bucket* (a bucket can neither be drunk nor poor). This is different with literal 70-year-old, which does make sense as a modifier of literal *bucket* (a bucket can certainly be 70 years old), but maybe having a 70-year-old bucket (in contrast to having a rusty bucket, for example) is simply not graphic enough to be easily interpreted in a figurative manner.

The above does not mean, of course, that golden is the only possible modifier that can occur within a conjunction modification of *kick the bucket*. Consider the following example: *To her detractors, the "iron lady" has finally kicked the tin bucket – may she rust in peace.* (https://dinmerican.wordpress.com/2013/04/08/53476). Just like literal golden, literal tin does make sense as a modifier of literal *bucket*, as a tin bucket is a steel bucket coated with zinc oxide, which makes the steel more rigid and rugged, and there is an obvious figurative interpretation of the Iron Lady having such a steel bucket, namely that she was tough and uncompromising, as the name *Iron Lady* already indicates.

[14] https://carolin-neumann.de/2009/02/fuehlt-euch-bravo (last accessed on 5 April 2018)

'Or Vincent Raven from Uri Geller's show on ProSieben [German TV channel], who had an accident and almost *passed on the* bent *spoon*.'

(20) Conjunction modification analysis of (19):

s_1: *Vincent Raven$_i$ almost passed on the$_i$ ~~bent~~ spoon.*
$\rightsquigarrow_{id}$ p_1: 'Vincent Raven almost died.'

s_2: ~~*Vincent Raven$_i$ almost passed on*~~ *the$_i$ bent spoon.*
$\rightarrow_{lit}$ p_2: 'Vincent Raven has a bent spoon.'
$\rightsquigarrow_{inf}$ $p_{2'}$: 'Vincent Raven bends spoons.'

p_1 & $p_{2'}$: 'Vincent Raven, who bends spoons, almost died.'

Just as idiomatic *kick the bucket* in English, idiomatic *pass on the spoon* in German means 'die' (p_1). And just as golden in (17) nonetheless applies to the literal meaning of the noun *bucket*, bent in (19) nonetheless applies to the literal meaning of the noun *spoon*, and, here too, this happens in an additional proposition (p_2) that is independent of the proposition that expresses the meaning of the idiom. However, learning that someone has a bent spoon is far less telling than learning that someone has a Gucci belt or a golden bucket. In order for readers/listeners to be able to interpret this, they need some knowledge about Vincent Raven or Uri Geller's show "The next Uri Geller" or a telling linguistic or non-linguistic context, so that they get the inference $p_{2'}$ that Vincent Raven bends spoons. And if they take that inference to be a figurative reinterpretation of p_2, then the content of p_2 plays no role in the final interpretation of (19), so that there is no claim that Vincent Raven actually has a bent spoon.

Our third corpus example is about the three ideals of the French Revolution and the lives that were taken in the attempt to achieve these ideals, see (21).

(21) It was the great Trinity of the French Revolution, and you can still see it carved in stone over town halls and elsewhere in France: 'Liberty, Equality, Fraternity'. But the greatest of these, it turns out, is 'Equality'. 'Liberty' soon *bit the* blood-spattered *dust* along with 'Fraternity' as the drive to the unattainable goal of 'Equality' took over as it was bound to do.[15]

For a conjunction modification analysis of this example, see (22).

[15] http://thebritishresistance.co.uk/tim-haydon/1637-the-destructive-lie-of-equality (could no longer be accessed on 5 April 2018)

(22) Conjunction modification analysis of (21):

s_1: *Liberty bit the ~~blood-spattered~~ dust.*
$\rightsquigarrow_{id}$ p_1: 'Liberty died.'
$\rightsquigarrow_{inf}$ $p_{1'}$: 'Liberty was no longer pursued.'

s_2: *~~Liberty bit~~ the blood-spattered dust.*
$\rightarrow_{lit}$ p_2: 'The dust was blood-spattered.'
$\rightsquigarrow_{inf}$ $p_{2'}$: 'The location was blood-spattered.'
$\rightsquigarrow_{inf}$ $p_{2''}$: 'People lost their lives.'

$p_{1'}$ & $p_{2''}$: 'Liberty was no longer pursued, and people lost their lives.'

If you state that an ideal, like liberty, bit the dust (s_1), you state that it died (p_1). Since an ideal cannot literally die, however, this is to be reinterpreted figuratively, which, in our case, results in something like: 'Liberty was no longer pursued.' ($p_{1'}$).

The inference from 'The dust was blood-spattered.' (p_2) to 'The location was blood-spattered.' ($p_{2'}$) is not something that Ernst assumes. However, as mentioned underneath (14), dust can be interpreted as a type of ground, whose surface and/or what you find on it (like spattered blood) invite *pars pro toto* inferences about the location that the ground is a part of. In an additional inferential step, we take this location to be the location of the event expressed by the idiom.[16] From 'The location was blood-spattered.' ($p_{2'}$), it can then be inferred that people lost their lives ($p_{2''}$), especially in the context of the French Revolution. Combined, $p_{1'}$ and $p_{2''}$ result in 'Liberty was no longer pursued, and people lost their lives.'

Our fourth example is about the 1925 peasant court in the high-lying Renchtal of the Black Forest in Germany, at which the peasant who hosted it during the last week of that year offered his guests a dish that, among others, had cost the lives of several little bunnies, see (23) for the example and (24) for the analysis.

(23) Der vorbedachte Hauswirt hat für die Bedürfnisse seiner Gäste bestens gesorgt. Mehrere Häslein mussten fürs Bauerngericht *ins* schneeige *Gras beißen* und ein Schwein und Kalb das Leben lassen.[17]

[16] In all the examples that follow, we assume that the steps from 'dust/grass' to 'a location that contains the dust/grass' to 'the location of the event in question' are fairly natural inferences that are drawn in discourse, and we will not specify these steps any further.

[17] http://www.museum-durbach.de/heiteres-und-geschichtliches/die-bottenauer-und-ihr-bauerngericht.html (last accessed on 5 April 2018)

'The thoughtful landlord took perfect care of his guests' needs. For the peasant court, several little bunnies had to *bite into the* snow-covered *grass*, and a pig and a calf had to give their lives as well.'

(24) Conjunction modification analysis of (23):

s_1: *Several little bunnies had to bite into the ~~snow-covered~~ grass.*
$\rightsquigarrow_{id}$ p_1: 'Several little bunnies had to die.'

s_2: *~~Several little bunnies had to bite into~~ the snow-covered grass.*
$\rightarrow_{lit}$ p_2: 'The grass was snow-covered.'
$\rightsquigarrow_{inf}$ $p_{2'}$: 'The location was snow-covered.'

p_1 & $p_{2'}$: 'Several little bunnies had to die, and the location was snow-covered.'

Whereas in English you bite the dust, in German you bite into the grass. As a type of ground, grass, just like dust, invites *pars pro toto* inferences about the location that it is a part of, so that we easily get from the grass being snow-covered (p_2) to the location being snow-covered ($p_{2'}$). Apart from the two additional inferences in (22) (from 'Liberty died.' to 'Liberty was no longer pursued.' and from 'The location was blood-spattered.' to 'People lost their lives.'), (24) and (22) work the exact same way.

Conjunction modification is not restricted to prenominal modification, though. In example (25), the modifier is neither an attributive adjective nor a noun but a non-restrictive relative clause. The example is taken from Ludwig Ganghofer's 1914 novel *Der Ochsenkrieg* (English title: *The War of the Oxen*).

(25) Und während die ausgesperrten siebenunddreißig Reiter ein zorniges Geschrei erhoben, kam es innerhalb des Tores zwischen der Besatzung des Grenzwalles und den drei Abgeschnittenen zu einem Scharmützel, in dem der heilige Zeno Sieger blieb; aber zwei von seinen Soldknechten mußten *ins Gras beißen*,
das bei dieser mitternächtigen Finsternis kaum zu sehen war.[18]

'And while the locked out thirty-seven horsemen clamored furiously, there was a skirmish within the gateway between the garrison of the boundary wall and the three horsemen that had been cut off, in which Saint Zeno was victorious; but two of his mercenaries had to *bite into the grass*, which was hardly visible in this midnight darkness.'

[18] http://freilesen.de/werk_Ludwig_Ganghofer,Der-Ochsenkrieg,1106,8.html (last accessed on 5 April 2018)

A conjunction modification analysis of this example looks as in (26).

(26) Conjunction modification analysis of (25):

s_1: *Two of his mercenaries had to bite into the grass,*
~~which was hardly visible in this midnight darkness~~.

$\rightsquigarrow_{id}$ p_1: 'Two of his mercenaries had to die.'

s_2: *~~Two of his mercenaries had to bite into~~ the grass,*
which was hardly visible in this midnight darkness.

$\rightarrow_{lit}$ p_2: 'The grass was hardly visible in this midnight darkness.'

$\rightsquigarrow_{inf}$ $p_{2'}$: 'The location was hardly visible in this midnight darkness.'

p_1 & $p_{2'}$: 'Two of his mercenaries had to die, and the location was hardly visible in this midnight darkness.'

As in (23), *ins Gras beißen* means 'die' here (p_1) – independently of any literal grass – but still the modifier which was hardly visible in this midnight darkness, just like snow-covered in (23), applies to the literal meaning of the noun *grass*, which happens in an additional proposition (p_2) that is independent of p_1. And as in (23), the modification of *grass* is interpreted as a modification of the location of the dying event, just like the modification of *dust* in (21). The additional proposition p_2, which in this case is explicitly given by the non-restrictive relative clause (and therefore is easier to "unpack" than conjunction modification by an adjective or a noun, for which one always has to add a suitable relation to create a proposition), is then interpreted as 'The location was hardly visible in this midnight darkness.' ($p_{2'}$). Together, p_1 and $p_{2'}$ result in: 'Two of his mercenaries had to die, and the location was hardly visible in this midnight darkness.'

In the following section, we will address three examples that are more complex cases of conjunction modification, either because they require additional background knowledge or because they go beyond a simple analysis of conjunction modification involving two propositions, since they involve a third one. After these examples, we will discuss corpus examples for which an analysis in terms of conjunction modification might not be the only option.

3.4 Complex conjunction modification examples

The following example, (27), is taken from a review of *Enigma Rosso* (English title: *Red Rings of Fear*), a 1978 Italian-German-Spanish giallo film. In the example, the idiom *den Löffel abgeben* 'to pass on the spoon' is slightly altered, as it contains *Löffel* 'spoon' in the plural (which might reflect that more than one person

died) and, more importantly for our purposes, the modifier *langen*, which is an inflected form of the adjective *lang* 'long'.

(27) Die Geschichte um die Umtriebe in einem Mädcheninternat, das in Teenagerprostitution verstrickt ist und dessen bezaubernde Zöglinge nach und nach *die* langen *Löffel abgeben*, gibt einen nett anzuschauenden Thriller ab – leider nicht mehr.[19]

'The story of the activities at a girls' boarding school that is entangled in teenage prostitution and whose enchanting pupils, one by one, *pass on the* long *spoons*, makes for a thriller that is nice to watch – unfortunately, that is as far as it goes.'

(28) Incomplete conjunction modification analysis of (27):

s_1: *The enchanting pupils$_i$ pass on the$_i$ ~~long~~ spoons.*
$\rightsquigarrow_{id}$ p_1: 'The enchanting pupils die.'

s_2: ~~*The enchanting pupils$_i$ pass on*~~ *the$_i$ long spoons.*
$\rightarrow_{lit}$ p_2: 'The enchanting pupils have long spoons.'
$\rightsquigarrow_{inf}$ $p_{2'}$: 'The enchanting pupils are ???'

p_1 & $p_{2'}$: 'The enchanting pupils die, who are ???'

Since the proposition 'The enchanting pupils have long spoons.' does not make any sense as the second conjunct of this example (not even considering the larger context of the example and/or the movie itself), that proposition must be figuratively reinterpreted. But how? One remote possibility to make sense of 'The enchanting pupils have long spoons.' would be to evoke yet another idiom, *jemandem die Löffel lang ziehen* '(lit.) pull someone.DAT the spoons long', with a figurative use of *spoons* for *ears*,[20] which is commonly used to refer to a teacher or a parent scolding or punishing a pupil or a child. Under this interpretation, you might infer from p_2 that the pupils have been punished before, or are being punished by being killed, as in (29).

(29) First conjunction modification analysis of (27):

[19] http://www.christiankessler.de/enigmarosso.html (last accessed on 5 April 2018)

[20] This figurative meaning of *spoons* also appears in expressions like *jemandem ein paar hinter die Löffel geben* '(lit.) to give someone.DAT a few behind the spoons' (fig. 'to slap someone'), which might also be the idiom evoked here, and also in *sich etwas hinter die Löffel schreiben* '(lit.) to write oneself.DAT sth. behind the spoons' (fig. 'to make sure to remember sth.').

s_1: *The enchanting pupils$_i$ pass on the$_i$ ~~long~~ spoons.*
$\rightsquigarrow_{id}$ p_1: 'The enchanting pupils die.'

s_2: ~~*The enchanting pupils$_i$ pass on*~~ *the$_i$ long spoons.*
$\rightarrow_{lit}$ p_2: 'The enchanting pupils have long spoons.'
$\rightsquigarrow_{inf}$ $p_{2'}$: 'The enchanting pupils are being / have been punished.'

p_1 & $p_{2'}$: 'The enchanting pupils die, who are being / have been punished.'

The figurative interpretation of p_2 on the basis of *jemandem die Löffel lang ziehen* 'pull someone the spoons long', which results in $p_{2'}$ in (29), might be facilitated by the fact that in this idiom the noun *Löffel* 'spoon' occurs in the plural, just as in (27).

The following example, (30), points to a more plausible option of reinterpreting 'The enchanting pupils have long spoons.' It is about Bertolt Brecht's play *Mutter Courage und ihre Kinder* (English title: *Mother Courage and Her Children*).

(30) Im Nordbayerischen Kurier schrieb Gero v. Billerbeck über "Eine Moritat gegen den Krieg": "Wer mit dem Teufel frühstückt, muss einen langen Löffel haben. Der Feldprediger kennt sich aus und weiß auch, dass dieser Dreißigjährige Krieg ein gottgefälliger Glaubenskrieg ist. Und weil er selbst nicht mitmischt, sondern nur davon profitiert, wie seine Weggenossin Anna Fierling, wird er *den* zitierten langen *Löffel* ebenso wenig *abgeben* müssen [...]"[21]

'In the N.K. [German newspaper] Gero v. Billerbeck wrote about "A Ballad Against the War": "He who sups with the devil must have a long spoon. The field preacher knows his way around and is also aware of the fact that this Thirty Years War is a God-pleasing religious war. And because he does not get involved but only benefits from it, like his companion Anna Fierling, he will not have to *pass on the* quoted long *spoon* [...]"'

A conjunction modification analysis of the example in (30) looks just like the conjunction modification analysis of the example in (27), but now we can make sense of someone having a long spoon, because the beginning of the example in (30) indicates what that is supposed to mean by making reference to the proverb

[21]http://www.luisenburg-aktuell.de/id-2009/articles/bertolt-brecht-mutter-courage-und-ihre-kinder.html (could no longer be accessed on 5 April 2018)

He who sups with the devil must have a long spoon. This proverb expresses a conditional (you sup with the devil ⇒ you have a long spoon) from which we can infer by pragmatic strengthening or conditional perfection (Geis & Zwicky 1971), i.e. by turning the conditional into a biconditional (you sup with the devil ⇔ you have a long spoon), that people with a long spoon sup with the devil and hence, just like the devil himself, must be deceitful. On that account, we get the analysis in (31).

(31) Second conjunction modification analysis of (30):

s_1: *The field preacher$_i$ will not have to pass on the$_i$ ~~long~~ spoon.*
$\rightsquigarrow_{id}$ p_1: 'The field preacher will not have to die.'

s_2: ~~*The field preacher$_i$ will not have to pass on*~~ *the$_i$ long spoon.*
$\rightarrow_{lit}$ p_2: 'The field preacher has a long spoon.'
$\rightsquigarrow_{inf}$ $p_{2'}$: 'The field preacher is deceitful.'

p_1 & $p_{2'}$: 'The field preacher, who is deceitful, will not have to die.'

Analogously, we could now infer from p_2 in (28) ('The enchanting pupils have long spoons.') that the enchanting pupils are deceitful and, on the basis of that inference, complete the analysis of (27) as shown in (32).

(32) Complete conjunction modification analysis of (27):

s_1: *The enchanting pupils$_i$ pass on the$_i$ ~~long~~ spoons.*
$\rightsquigarrow_{id}$ p_1: 'The enchanting pupils die.'

s_2: ~~*The enchanting pupils$_i$ pass on*~~ *the$_i$ long spoons.*
$\rightarrow_{lit}$ p_2: 'The enchanting pupils have long spoons.'
$\rightsquigarrow_{inf}$ $p_{2'}$: 'The enchanting pupils are deceitful.'

p_1 & $p_{2'}$: 'The enchanting pupils die, who are deceitful.'

What these examples show is that we sometimes need considerable background knowledge (e.g. of the proverb *He who sups with the devil must have a long spoon.*) to make sense of the idiom-modifier combination and find an appropriate overall interpretation.

Our next example is complex for a different reason than the necessity of considerable background knowledge. It is complex because there is more going on than just conjunction modification. The example is from a German review of *Journey to the Center of Time*, a 1967 U.S. science fiction film, see (33) for the example and (34) for its analysis.

(33) Stanton Sr. war ein gutherziger Millionär, der viel Geld in außergewöhnliche Forschung steckte und leider kürzlich *den* silbernen *Löffel* an Stanton Jr. *abgab*, welcher nix von Friede, Freude, Wissenschaft wissen, sondern Geld machen will und zwar pronto.[22]

'Stanton Sr. was a kind-hearted millionaire who invested a lot of money in extraordinary research and, unfortunately, recently *passed on the* silver *spoon* to Stanton Jr., who does not want to know about peace, joy, science, but wants to make money, pronto.'

(34) Analysis of (33):[23]

s_1: *Stanton Sr.$_i$ passed on the$_i$ ~~silver~~ spoon ~~to Stanton Jr.~~*
$\rightsquigarrow_{id}$ p_1: 'Stanton Sr. died.'

s_2: ~~*Stanton Sr.$_i$ passed on*~~ *the$_i$ silver spoon ~~to Stanton Jr.~~*
$\rightarrow_{lit}$ p_2: 'Stanton Sr. had a silver spoon.'
$\rightsquigarrow_{inf}$ $p_{2'}$: 'Stanton Sr. was rich.'

s_3: *Stanton Sr.$_i$ passed on the$_i$ silver spoon to Stanton Jr.*
$\rightarrow_{lit}$ p_3: 'Stanton Sr. passed on his silver spoon to Stanton Jr.'
$\rightsquigarrow_{inf}$ $p_{3'}$: 'Stanton Sr. passed on his wealth to Stanton Jr.'

p_1 & $p_{2'}$ & $p_{3'}$: 'Stanton Sr. died, who was rich, and he passed on his wealth to Stanton Jr.'

Just like in the analyses of all the previous conjunction modification examples, we have one proposition that includes the idiomatic meaning of the idiom, namely that Stanton Sr. died (p_1), and one proposition in which the literal meaning of the modifier is applied to the literal meaning of the idiom's noun, namely that Stanton Sr. had a silver spoon (p_2), from which we infer that he was rich ($p_{2'}$),[24] as in the Gucci *belts* example in (8) and the golden *bucket* example in (17).

What sets this example apart from all the previous conjunction modification examples, however, is that its analysis does not result in the conjunction of two but three propositions. This is due to the addition of the literal goal argument *to*

[22] http://www.filmflausen.de/Seiten/centeroftime.htm (last accessed on 5 April 2018)

[23] Here, it is not just s_1 and s_2 but s_1, s_2, and s_3 that are one and the same string with different parts of that same string being semantically interpreted in s_1, s_2, and s_3 (cf. footnote 7).

[24] The reinterpretation of 'Stanton Sr. had a silver spoon.' as 'Stanton Sr. was rich.' is additionally facilitated by the existence of the German idiom *mit einem silbernen Löffel im Mund geboren sein* 'to be born with a silver spoon in the mouth' (with its English equivalent *to be born with a silver spoon in one's mouth*), which means that one is wealthy by birth.

Stanton Jr., which, as soon as it is interpreted (s_3), enforces *pass on the spoon* to be literally interpreted as well (p_3) because there is no idiom *pass on the spoon to sb.* In parallel to the figurative interpretation of 'having a silver spoon' (p_2) as 'being rich' ($p_{2'}$), 'passing on your silver spoon to sb' (p_3) is figuratively reinterpreted as 'passing on your wealth to sb' ($p_{3'}$).

In the end, we not only have different interpretations of the idiom's noun *spoon* but also different interpretations of the idiom's verb *pass on*. Whereas p_1 includes the idiomatic meaning of *pass on*, $p_{3'}$ includes its literal meaning in the sense of 'hand down' or 'bequeath', i.e. a change of possession, and the goal phrase specifies the beneficiary of the inheritance.

In the next section, we will discuss a number of examples for which it is less clear that they involve conjunction modification. Those examples caused intense debates among the three authors of this paper, as at least one of the authors preferred to analyze them in terms of what we will call extended external modification, a broader construal of Ernst's external modification not limited to domain delimitation (cf. Stathi 2007: Section 4.2, in which she argues for a similar approach whilst retaining Ernst's original term). In the following section, we will provide reasons why such an extended external modification analysis might be a valid alternative for the examples.

3.5 Controversial cases

We have shown that our four idioms can be divided into two groups, *kick the bucket* and *pass on the spoon* vs. *bite the dust* and *bite into the grass*: buckets and spoons are typical personal possessions, whose properties invite inferences about their possessors, whereas dust and grass can be interpreted as different types of ground, whose properties invite inferences about the event location. When we modify an event location, however, the event is modified as a whole, which opens up the option to analyze such a modification as a type of external modification, not in the sense of Ernst, i.e. as domain delimitation, but in a more general or extended sense. There are two factors that point in this direction.

First, as we noted, Ernst observed that external modifiers often allow an adverbial paraphrase. Given that adverbs, however, are not always domain delimiters (frame-setting sentence adverbials) but can be of various kinds, depending on where they attach and what they modify, we expect external modification in idioms not to be restricted to domain delimiters either. For example, one prominent kind is event-related modification, which, however, still relates to the idiom as a whole and could, for that reason, also be analyzed as a type of external modification.

Second, the data that Ernst uses to illustrate external modification either involve relational adjectives (e.g. *social* in (2)) or prenominal noun modifiers (of the *stone lion* type). These are both types of modifiers that express an underspecified relation between modifier and modifiee (see, e.g., McNally & Boleda 2004), and a hypothesis one could pursue in future research is that this additional relation facilitates external modification.[25] In this section, we discuss examples that could be analyzed in terms of conjunction modification, but which also all contain relational adjectives and therefore could also be analyzed as extended external modification. While we will not offer the details of a compositional analysis of these cases – which we have not done for any of the examples in Section 3.3 and Section 3.4, either – the intuitive idea should be clear.[26]

With these considerations in mind, let us see why the following examples caused controversies among the authors of this paper. Our first example is about a South Tyrolean writer, Norbert Conrad Kaser, who apparently did not find the literature of his fellow writers very compelling, see (35).

(35) Erstes Aufsehen erregte der junge Kaser an einer Studientagung der Südtiroler Hochschulschaft, die in Brixen von Gerhard Mumelter organisiert wurde. Hier meinte er, dass 99% der Südtiroler Literaten am besten nie geboren wären, seinetwegen könnten sie noch heute *ins* heimatliche *Gras beißen*, um nicht weiteres Unheil anzurichten.[27]

The young Kaser caused a first stir at a South Tyrolean study conference, which was organized in Brixen by Gerhard Mumelter. There he said that it would have been better if 99% of South Tyrolean writers had never been born and that they have his blessing to *bite into the* home *grass* by today, so as not to do any more mischief.

If we take this to be conjunction modification, the analysis looks as in (36).

(36) Conjunction modification analysis of (35):[28]

[25] This is not Ernst's observation, who, as we pointed out above, assumes that external modification is not restricted to a particular lexical class of adjectives.

[26] For further discussion and a possible analysis of external modification in this broader, extended sense, see Gehrke & McNally 2019.

[27] http://www.selected4you.de/dolomiten/thema/norbert-c-kaser (last accessed on 5 April 2018); see Stathi 2007: 91 for a variant of this example in which the statement of the young Kaser is reported in direct speech – and not in indirect speech, as in (35).

[28] As *heimatlich* 'of one's home, native, local' (a relational adjective consisting of *Heimat* 'homeland' + the adjectival suffix *-lich*) and *home* are relational (any home must be the home of someone or something), the definite determiner of the verb's internal argument is co-indexed with the verb's external argument, just like in the *kick the bucket* and *pass on the spoon* examples.

s_1: *They$_i$ have his blessing to bite into the$_i$ ~~home~~ grass by today.*
$\rightsquigarrow_{id}$ p_1: 'They have his blessing to die by today.'

s_2: ~~*They$_i$ have his blessing to bite into*~~ *the$_i$ home grass* ~~*by today*~~*.*
$\rightarrow_{lit}$ p_2: 'The grass would be their home grass.'
$\rightsquigarrow_{inf}$ $p_{2'}$: 'The location would be their homeland.'

p_1 & $p_{2'}$: 'They have his blessing to die by today, and the location would be their homeland.'

While p_1 ('They have his blessing to die by today.') is the idiomatic meaning of s_1 (*They$_i$ have his blessing to bite into the$_i$ grass by today.*), $p_{2'}$ ('The location would be their homeland.') is an inference from p_2 ('The grass would be their home grass.'), which again is the non-idiomatic and non-figurative (hence $\rightarrow_{lit}$) meaning of s_2 (*the$_i$ home grass* – the definite NP that is (part of) the verb's internal argument in (35)). The two independent propositions p_1 and $p_{2'}$ are then conjoined into 'They have his blessing to die by today, and the location would be their homeland.' We perceive $p_{2'}$ as some kind of side information (since it is non-restrictive modification) that conveys the idea that the South Tyrolean writers would make sure to die in/on their homeland.

Given the broader understanding of external modification outlined above, where the modifier contributes something external to the idiom (or modifies the idiom as a whole), we might also interpret (35) as in (37):

(37) Extended external modification analysis of (35):[29]

s_1: *They$_i$ have his blessing to* PRO$_i$ *bite into the ~~home~~ grass by today.*
$\rightsquigarrow_{id}$ p_1: 'They have his blessing to die by today.'

s_2: ~~*They$_i$ have his blessing to*~~ PRO$_i$ *bite into the home grass* ~~*by today*~~*.*
$\rightsquigarrow_{id}$ p_2: 'They would die in their homeland.'

p_1 & p_2: 'They have his blessing to die by today, and the dying event would take place in their homeland.'

The analysis of p_1 ('They have his blessing to die by today.') is more or less the same as before: the idiomatic meaning of s_1 (*They$_i$ have his blessing to PRO$_i$ bite into the grass by today.*). The difference lies in p_2 ('They would die in their homeland.'), which comes about by taking the relational adjective *heimatlich* 'of one's

[29] PRO is meant as a convenient notation for indicating an implicit subject argument which plays a role in the analysis. Grammar frameworks without PRO will usually have appropriate counterparts in their structural analyses of our examples.

home, native, local' as specifying the location for the dying event associated with the idiom as a whole and by resolving the relation of home to the subjects of this dying event (to keep things a bit more simple we did not represent this here). This looks more like an analysis in terms of external modification, just not in Ernst's more restricted sense, because the modifier is not a domain delimiter. It is still a non-restrictive kind of modification, but external modification should in principle be possible restrictively and non-restrictively. The two independent propositions p_1 and p_2 are then conjoined into 'They have his blessing to die by today, and the dying event would take place in their homeland.' Again, we perceive p_2 as some kind of side information (since it is non-restrictive modification) that conveys the idea that the South Tyrolean writers might as well die in South Tyrol, where they happen to be.

The example in (38) is similar at first sight.

(38) Auch die deutsche Geschichte mag im Gesamten alles Andere als rosig sein, doch ich lebe in diesem Staate und somit MIT seiner Vergangenheit, seiner Gegenwart und höchstwahrscheinlich auch zukünftig, was da heissen wird, dass ich eines Tages *in* deutsches *Gras beissen* werde.[30]

German history as a whole may be anything but rosy as well, but I live in this country and thus WITH its past, its present and most likely also in the future, which will mean that one day I will *bite into* German *grass*.

An analysis in terms of conjunction modification looks like in (39).

(39) Conjunction modification analysis of (38):

s_1: *One day, I will bite into ~~German~~ grass.*
$\rightsquigarrow_{id}$ p_1: 'One day, I will die.'

s_2: ~~*One day, I will bite into*~~ *German grass.*
$\rightarrow_{lit}$ p_2: 'The grass will be German.'
$\rightsquigarrow_{inf}$ $p_{2'}$: 'The location will be Germany.'

p_1 & $p_{2'}$: 'One day, I will die, and the location will be Germany.'

Again, we infer from the second proposition ('The grass will be German.') that the location of the dying event will be Germany. However, this kind of analysis faces the problem that the modifier in this case does not seem to be adding mere

[30] http://www.chat24.de/archive/index.php?t-256.html (could no longer be accessed on 5 April 2018)

side information, as non-restrictive modification would, but it rather functions as a restrictive modifier. In particular, if we left out the modifier entirely, we would lose the main information of the sentence and it would not make much sense anymore in this context (unlike in our previous example in (35)). So, adding the modifier via conjunction modification wrongly places the meaning of the modifier in the secondary proposition rather than the primary proposition.

Understanding the term *external modification* in a broader, extended sense could be a way out of this dilemma, and we could interpret the whole sentence as one proposition, as in (40).

(40) Extended external modification analysis of (38):

s: *One day, I will bite into German grass.*
$\rightsquigarrow_{id}$ p: 'One day, I will die (my dying will take place) in Germany.'

This interpretation is further facilitated by the fact that *German*, like all ethnic adjectives, is a relational adjective.

Let us now move on to controversial cases in which the referent of the literal meaning of the idiom's noun is a typical personal possession, and let us remind ourselves that personal possessions and their features can invite inferences about their possessors. The example in (41) is about Gid, a hypothetical God-like creature that is postulated and used in a proof of the existence of God in which the author talks about Gid's mortality.

(41) He is presumably mortal himself; at least, being a creature of this universe, when (if) it collapses back to a mathematical point again (called the "Big Crunch"), Gid would die then, if he hasn't already *kicked the* celestial *bucket.*[31]

If we analyze this example in terms of conjunction modification, we get (42).

(42) Conjunction modification analysis of (41):

s_1: *... if Gid$_i$ hasn't already kicked the$_i$ ~~celestial~~ bucket.*
$\rightsquigarrow_{id}$ p_1: '... if Gid hasn't already died.'

s_2: *... ~~if Gid$_i$ hasn't already kicked~~ the$_i$ celestial bucket.*
$\rightarrow_{lit}$ p_2: 'Gid has a celestial bucket.'
$\rightsquigarrow_{inf}$ $p_{2'}$: 'Gid is a celestial being.'

p_1 & $p_{2'}$: '... if Gid, who is a celestial being, hasn't already died.'

[31] http://biglizards.net/blog/archives/2011/08 (last accessed on 5 April 2018)

Under this interpretation we assume the proposition p_2 that Gid has a celestial bucket, from which we infer that Gid is a celestial being ($p_{2'}$), metonymically, like a *pars pro toto* (if his bucket is celestial everything else might as well be, including him). However, it is also clear that this involves an additional step. The simple proposition 'Gid has a celestial bucket' does not provide all of that content by itself.

An alternative analysis of (41) in terms of external modification – this time along the lines of Ernst's original idea that external modifiers are domain delimiters – is shown in (43), where the modification is, again, interpreted restrictively so that we only get one proposition.

(43) External modification analysis (in Ernst's sense) of (41):

s: *... if Gid hasn't already kicked the celestial bucket.*
$\rightsquigarrow_{id}$ p: '... if Gid hasn't already died in the celestial domain.'
$\rightsquigarrow_{inf}$ p': '... if Gid hasn't already ceased to exist as a celestial entity.'

This restrictive, external interpretation of the modifier leads to a completely different understanding though: Here, we assume that Gid might first cease to exist as a celestial entity (as expressed in p') to then become a terrestrial being, a mortal, and die as such when the 'Big Crunch' hits (as the remaining context in (41) suggests). Under the conjunction interpretation in (42), on the other hand, which takes the modification to be non-restrictive, Gid dies only once and happens to be a celestial creature. The question, then, is how the text is actually supposed to be understood.

Yet another interpretation of (41) is provided in (44).

(44) Extended external modification analysis of (41):

s: *... if Gid hasn't already kicked the celestial bucket.*
$\rightsquigarrow_{id+inf}$ p: '... if Gid hasn't already died a celestial death
(which is much more spectacular than an earthly death).'

This is clearly not a conjunction modification interpretation, since we do not add a second proposition (it is again a restrictive kind of modification), but it rather feels like a manner modifier of the event (the idiom as a whole) and should then be taken as yet another instance of extended external modification. This kind of interpretation might lead to an additional inferential step (provided in brackets in p), and it opens up the possibility to analyze an idiom like *kick the MOD bucket* on a par with cognate object constructions of the sort *die a MOD death*, in which the modifiers in question in turn have been taken to be event modifiers (see, e.g., Mittwoch 1998; Sailer 2010).

Finally, example (45) is about giardia, which are microscopic pear-shaped parasites that live in the intestines and cause Giardiasis, a diarrheal disease.

(45) Hi, die Giardien sollen doch bei 60-70˚C *ihren* birnenförmigen *Löffel abgeben.* Warum muss ich dann meine Bettwäsche bei 90˚C kochen?[32]

Hi, the giardia are supposed to *pass on their* pear-shaped *spoon* at 60-70˚C. Why do I have to wash my sheets at 90˚C then?

An analysis of this example as conjunction modification would look like (46).

(46) Conjunction modification analysis of (45):

s_1: *The giardia$_i$ are supposed to pass on their$_i$ ~~pear-shaped~~ spoon at 60-70˚C.*

$\rightsquigarrow_{id}$ p_1: 'The giardia are supposed to die at 60-70˚C.'

s_2: ~~*The giardia$_i$ are supposed to pass on their$_i$ pear-shaped spoon at 60-70˚C.*~~

$\rightarrow_{lit}$ p_2: 'The giardia have a pear-shaped spoon.'

$\rightsquigarrow_{inf}$ $p_{2'}$: 'The giardia are pear-shaped.'

p_1 & $p_{2'}$: 'The giardia, which are pear-shaped, are supposed to die at 60-70˚C.'

As in the conjunction modification analyses of all the previous examples with *kick the bucket* and *pass on the spoon*, we here have a p_2 that includes a possession relation: 'The giardia have a pear-shaped spoon.' Unlike in the previous examples, but just like in *pull sb's leg* in (5) and *tighten one's belt* in (8), this possessive relation is explicitly expressed by a possessive determiner. We then again infer metonymically that if the giardia have a pear-shaped spoon, they themselves are pear-shaped.

However, at this point, the question arises whether we indeed get from the giardia (literally or metaphorically) having a pear-shaped spoon to them being pear-shaped; one author of this paper does not share the intuition that a pear-shaped spoon ever plays a role in this example. In that author's opinion, the modifier seems to be attributed to the possessor right away, without the intermediate step of attaching it to 'spoon', even if syntactically this is where the modifier appears. This seems to indicate that if we explicitly add a possessor via

[32] https://www.katzen-links.de/forum/darmparasiten-giardien/giardien-faq-allumfassende-infosammlung-t69985-p6.html (last accessed on 5 April 2018)

a possessive determiner inside the nominal phrase, we can combine the modifier with that possessor rather than with the noun itself, as in (47).

(47) Possessor modification analysis of (45):

s_1: *The giardia$_i$ are supposed to pass on their$_i$ ~~pear-shaped~~ spoon at 60-70°C.*

$\rightsquigarrow_{id}$ p_1: 'The giardia are supposed to die at 60-70°C.'

s_2: ~~*The giardia$_i$ are supposed to pass on their$_i$ pear-shaped spoon at 60-70°C.*~~

$\rightarrow_{lit}$ p_2: 'The giardia are pear-shaped.'

p_1 & p_2: 'The giardia, which are pear-shaped, are supposed to die at 60-70°C.'

However, it is far from clear how this kind of analysis, which we dubbed possessor modification, would work in terms of a general semantic composition mechanism. Yet, the meaning we get is still: 'And, by the way, the giardia are pear-shaped', which is non-restrictive (as represented by the conjunction of p_1 and p_2 in (47)).

A problem similar to the one of how to analyze the composition of (45) arises with what Ernst 1981: 66 calls 'displaced epithets':

(48) I balanced a <u>thoughtful</u> lump of sugar on the teaspoon.
(P.G. Wodehouse, cited in Hall 1973)

From this example, we conclude that the speaker was thoughtful, not the lump of sugar. The giardia's pear-shaped spoon could then be of this kind, and the analysis would not involve conjunction modification at all. Again we do not have a semantic composition system to describe a displacement of epithets in a way that fits cases like these but does not over-generate and predict all kinds of interpretations to be possible when they are actually not.

On the other hand, if we analyze both examples in terms of something like conjunction modification with a possessive relation, metonymical inferences would get us from the speaker having (as part of balancing) a thoughtful lump of sugar to the speaker being thoughtful, and from the giardia having a pear-shaped spoon to the giardia being pear-shaped. The question then is whether it is a fairly obvious metonymical inference: Is it common to infer from 'I have a thoughtful lump of sugar.' that 'I am thoughtful.'?

In sum, what our examples in this section have shown is that it is not always straightforward to obtain an interpretation for a given modifier that is added to

an idiom, and furthermore that it is not always clear which of Ernst's three categories the kind of modification belongs to. Additionally, in most cases, even in our clear cases of conjunction modification, further inferences had to be drawn. They were not only based on the second proposition alone but also had to take context and world knowledge into account. In this section, we also saw that it might be possible to extend the notion of external modification beyond its original use to cover some other types of modifiers that we encountered. The broader, extended notion of external modification lumps together various types of modification that apply to the idiom as a whole, not just to the idiom's noun. The modifiers can thus be interpreted on a par with adverbials, which also form a heterogeneous group, and we obtain an alternative to an analysis in terms of conjunction modification. External modification could be facilitated or mediated by the use of relational adjectives, though this would be a topic for future research. Finally, we discussed challenges that some of these examples entail for a precise compositional analysis, which we have to leave for future research for all our examples, though.

In the following section, we will briefly show that challenges concerning additional inferences beyond literal, figurative or idiomatic meaning and concerning the adequate formulation of semantic composition principles arise in other idiom data that do not, however, involve the kind of modification discussed so far. These data demonstrate that the observed pattern extends beyond the presence of a modifier that might (or might not) be analyzed in terms of conjunction modification.

4 Beyond modification

In this section, we study two corpus examples of *ins Gras beißen* that do not contain a modifier in the linguistic sense but still contain an adjustment of the idiom's noun *Gras*. As we have seen in (21), (23), (25), (35), and (38), the nouns *Gras* and *dust* lend themselves to a location interpretation and in the context of the idioms invite inferences about the location of the dying event.

Example (49) is from a review of *The Descent Part 2*, a 2009 British horror film.

(49) Erneut werden billige Schockeffekte eingesetzt [... und] wieder ist es in der Höhle meist viel zu hell, und schon wieder mutieren die überlebenden Damen zu wahren Kampfmaschinen, nur um dann doch allesamt *ins Gras* respektive ins Höhlengestein *beißen* zu müssen.[33]

[33] http://www.kreis-archiv.de/filme/descent2.html (last accessed on 5 April 2018)

> 'Once again, there are cheap shock effects, and once again, it is way too bright inside the cave most of the time, and again, the surviving ladies mutate into true battle machines, but in the end they still have to *bite into the grass*, or rather the cave rock.'

Even though *bite into the grass*, or rather the cave rock does not contain a modifier and hence is not an example of idiom modification in the linguistic sense, it still contains an adjustment of the idiom's noun, and this adjustment could be analyzed by dissociating two propositions, just like in conjunction modification, see (50).[34]

(50) Analysis of (49):

s_1: *The ladies have to bite into the grass, ~~or rather the cave rock~~.*
$\rightsquigarrow_{id}$ p_1: 'The ladies have to die.'

s_2: *~~The ladies have to bite into~~ the grass, or rather the cave rock.*
$\rightarrow_{lit}$ p_2: 'The grass is cave rock.'
$\rightsquigarrow_{inf}$ $p_{2'}$: 'The location is cave rock.'

p_1 & $p_{2'}$: 'The ladies have to die, and the location is cave rock.'

As in our analyses of the conjunction modification examples, p_1 is concerned with the idiom (stating that the ladies have to die), whereas p_2 is all and only about the modification of the literal meaning of the idiom's noun, which in this case only applies in the non-linguistic sense, as the added material is neither an adjective, nor a noun, nor a relative clause but the part *respektive ins Höhlengestein* 'or rather into the cave rock', which is combined with *beißen* 'bite' in a parallel fashion as is *ins Gras* 'into the grass'. It is not clear how this interpretation can be obtained compositionally unless we impose a semantic decomposition on the idiom that is assumed to be absent from its conventional form.

A potentially even more problematic example is given in (51).

(51) Das soll er doch gesagt haben, der gute Caesar[,] bevor er statt *ins Gras* in den Marmorboden vom Senat *gebissen* hat.[35]

[34] Alternatively, we could also assume that this adjustment happens in the same proposition (e.g. for (50) we would get something like *The ladies have to bite into the cave rock instead of the grass*). However, no matter which route is ultimately the right one, we are still facing the same kind of compositionality issues outlined here.

[35] http://www.rom-fanclub.de/Episode-1-Folgen-1-12/3719-ReEP01-/-F12-Die-Kalenden-des-Februar/Page-7.html (last accessed on 5 April 2018)

'He is supposed to have said that, our good old Caesar, before he *bit into* the marble floor of the Senate instead of *the grass*.'

In a parallel fashion to the previous example we might analyze this one along the lines of (52).

(52) Analysis of (51):

s_1: *Caesar bit into ~~the marble floor of the Senate instead of~~ the grass.*

$\rightsquigarrow_{id}$ p_1: 'Caesar died.'

s_2: ~~*Caesar bit into*~~ *the marble floor of the Senate instead of the grass.*

$\rightarrow_{lit}$ p_2: 'The grass was the marble floor of the Senate.'

$\rightsquigarrow_{inf}$ $p_{2'}$: 'The location was the marble floor of the Senate.'

p_1 & $p_{2'}$: 'Caesar died, and the location was the marble floor of the Senate.'

This leads to the construction of the proposition p_2 above, and the following inference to the effect that Caesar died on the marble floor of the Senate. Again, we do not know how to get there via standard semantic composition principles. What is even worse is that due to the negation that is part of the semantics of *statt* 'instead of', it is literally stated that Caesar did not bite into the grass. Therefore, our p_1 is not quite right; it should contain a negation. Nevertheless, we still get the interpretation that he died, only not on grass but on the marble floor of the Senate. So since the entire idiom is present, somehow its meaning is present as well. And substituting the literal *marble floor of the Senate* for the idiomatic *grass* has the effect that *grass* is understood literally as well.

5 Conclusion

In this paper, we reviewed Ernst's (1981) classical three types of idiom modification (internal, external, and conjunction modification), followed by a close investigaton of conjunction modification in semantically non-decomposable idioms as a particularly challenging phenomenon for semantic theorizing. In order to get a deeper understanding of the scope of naturally occurring meaning effects in conjunction modification, we studied corpus data of two English and two German semantically non-decomposable idioms with the same idiomatic meaning but

different formal structure. Some of our findings of the effects of idiom modification followed the general pattern of Ernst's observations, while others pointed to a possible relationship with external modification. Patterns of unexpected but apparently systematic inferences and contextual adjustments outside the core cases led us to investigate data beyond modification which demonstrated the need for assuming additional inferential mechanisms and pointed to effects that are clearly outside the range of regular semantic composition.

Many of the corpus examples with our two English and two German "dying idioms" which were originally collected as candidates for conjunction modification were accepted as such by all authors of the present study. In those cases there was agreement that their analysis comprises a main proposition p_1 including the predicate **die**(x) and a secondary proposition p_2 of the form 'x has a MODIFIER bucket/spoon' or 'the dust/grass is MODIFIER'. Often it was also necessary to interpret these forms figuratively or to draw additional inferences from their literal meaning in order to obtain a coherent interpretation in context. Some examples, however, turned out to be controversial, and the available analytical tools did not provide an easy resolution for conflicting intuitions: Whereas some authors analyzed them as conjunction modification in combination with additional inferences, the other(s) preferred (a version of) external modification, where the notion of external modification had to be broadened compared to Ernst's original proposal.

We think that our data show that the distinction between semantically decomposable and semantically non-decomposable idioms might not be as categorical as Nunberg et al. 1994 thought (see also Bargmann & Sailer 2018). These idioms are certainly not a semantically monolithic lexical unit with complex syntactic structure. Not only are speakers aware of their internal structure, they also seem to be ready to fall back on alternative, literal meanings of smaller syntactic units, such as of the nominal head in a noun phrase complement, any time a consistent interpretation in context of all lexical material in a given structure requires their retrieval. The meaning of these smaller units, otherwise unavailable in the idiomatic reading of the complete idiomatic expression, even serves as a basis for further interpretive processes, which can and must be considered in parallel to the idiomatic reading of the idiom as a whole – minus material whose interpretation it cannot integrate. To us it seems that this is a much more complex situation, and truly one-to-many, than most current semantic theories are ready to entertain. At the same time, corpus evidence suggests that the processes involved are far from unsystematic, and should definitely not be discarded into the realm of linguistically inexplicable creative word play.

Whichever way the open issues will ultimately be resolved, we have seen ample evidence that idioms are excellent instances of one-to-many relations between form and meaning, and that this becomes especially obvious in conjunction modification, where the idiomatic and the literal meaning of the idiom need to be present simultaneously.

Abbreviations

s_1	=	string including the idiom and everything else but not the modifier
s_2	=	string consisting of nothing but the NP within the idiom's verb's complement, which includes the modifier
p_1	=	main proposition
p_2	=	secondary proposition
$\rightarrow_{lit}$	=	literal meaning
$\rightsquigarrow_{id}$	=	idiomatic meaning
$\rightsquigarrow_{inf}$	=	figurative interpretation or additional inference within the context

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One-to-Many relations in morphology, syntax, and semantics

The standard view of the form-meaning interfaces, as embraced by the great majority of contemporary grammatical frameworks, consists in the assumption that meaning can be associated with grammatical form in a one-to-one correspondence. Under this view, composition is quite straightforward, involving concatenation of form, paired with functional application in meaning. In this book, we will discuss linguistic phenomena across several grammatical sub-modules (morphology, syntax, semantics) that apparently pose a problem to the standard view, mapping out the potential for deviation from the ideal of one-to-one correspondences, and develop formal accounts of the range of phenomena. We will argue that a constraint-based perspective is particularly apt to accommodate deviations from one-to-many correspondences, as it allows us to impose constraints on full structures (such as a complete word or the interpretation of a full sentence) instead of deriving such structures step by step.

Most of the papers in this volume will be formulated in a particular constraint-based grammar framework, Head-driven Phrase Structure Grammar. The contributions investigate how the lexical and constructional aspects of this theory can be combined to provide an answer to this question across different linguistic sub-theories.