Hilfszettel zur Klausur
von Tim S., Seite 1 von 2

1 Intro

Form and meaning pairs

Syntax morphosyntactic and POS level

Semantics mapping of utterances to the "real world", translation into another language, translation into a universally valid logical form

Combinatorial structure a small number of meaningless building blocks (phonemes, parts of syllables) combined into an unlimited set of utterances (words and morphemes)

Compositionality hallmark of human language syntax and semantics, as it enables the infinite use of finite means

Non-Adjacency non-linearity of syntax, or long-distance dependency, elements of a sentence which depend on each other, do not necessarily occur next to each other in linear order

Constituency

basic elements/units (orthographic words) and combinations (phrases)

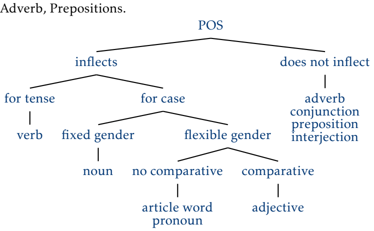
Wordhood criterion free occurrence, external mobility and internal fixedness, non-interruptibility, non-selectivity, non-coordinatability, anaphoric islandhood, nonextractability, morphophonological idiosyncrasies, derivations from biuniqueness

Constituency tests:

- **Substitution Test**
  he knows [the man] → he knows [a woman] ✓
- **Pronominalization Test**
  he knows [the man] → he knows [him] ✓
- **Question Formation Test**
  Whom does he know? – [The man]. ✓
- **Permutation Test**
  he knows [the man] → [the man] he knows ✓
  he knows [the man] → he [the man] knows x
- **Fronting Test**
  he knows [the man] → [the man] he knows ✓
- **Coordination Test**
  he knows [the man] → he knows [the man] and [the woman] ✓

POS

classes of words that each lexical item is assigned to according to its morphosyntactic properties. According to Müller (2019: 18) the basic POS are Verb, Noun, Adjective, Adverb, Prepositions.



Universality of Word Classes (POS): nouns, verbs, adjectives, adverbs.

Problems: number of basic POS can differ according to the framework; controversial whether all language have the basic POS; abbreviations for POS differ accross frameworks; isolating languages have very little or no inflections, decision tree not apply

Head

the element which determines the most important properties of the constituent/phrase; determines the composition of the phrase

Example	Head	Phrase Type
she knows the man	knows (V)	VP
he is smart	smart (A), is (V)	AP, VP
smart woman	woman (N)	NP
the woman	woman (N)	NP
the man's cat	cat (N)	NP
very beautiful	beautiful (A)	AP
very quickly	quickly (Adv)	AdvP
in the library	in (P)	PP

projection of the head The combination of a head with another constituent

maximum projection A projection which contains all the necessary parts to create a well-formed [i.e. grammatically correct] phrase of that type (a sentence is the max. projection of a finite verb)

Arguments strictly required elements by the head

Adjuncts optional elements (typically adj., adv. and PP)

Valence

Sentence	Type	Valency
it rains	impersonal	avalent(0)
he sleeps	intransitive	monovalent(1)
he hits Ben	transitive	bivanlent(2)
he gives Ben a book	ditransitive	trivalent(3)

two-place predicate ≠ transitive Passicization test: e.g. Alfred weighs 70 kg -> 70 kg were weighed (by Alfred), not transtive

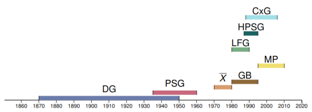
Grammatical Functions

Subject(Agent) agreement with the finite verb; nominative case in non-copular clauses; omitted in infinitival clauses; optional in imperatives

Object(Patient) all arguments whose form is directly determined by a given head; direct object - directly affected by the action denoted by the verb, e.g. He gave his wife a **necklace**

Possible Orders SOV, SVO, VSO, VOS, OVS, OSV

Syntactic Frameworks



Dependency Grammar(DG) Most basic syntactic concepts (headedness, valency, POS, grammatical functions) were already relevant

Phrase Structure Grammar(PSG) added a strong constituency component via re-write rules. This also gave rise to tree and bracket representations

X-bar Theory took PSGs to a higher level of abstraction by introducing X-bar-rules

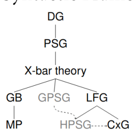
Government & Binding(GB) tendency of further abstracting away from surface structure to understand deep structure was followed up. The principle of government is introduced to deal with case assignment, while binding deals with anaphora resolution. The field quickly fragmented into different definitions of such principles

Minimalist Program(MP) strongly reduces the GB apparatus in order to base syntactic theory on a few core operations (i.e. merge and move). Another divergence from GB and X-bar theory is that it uses features for structure building (rather than phrase structure rules)

Lexical Functional Grammar(LFG), Head-Driven Structure Grammar(HPSG) focus on lexicalization of syntactic structure by introducing feature descriptions in matrix form. This also rendered tree/bracket notations rather marginal

Construction Grammar breaks with a core concept of syntax, and promotes moving away from compositionality towards holistic patterns, i.e. constructions, which are learned and stored if sufficiently frequent.

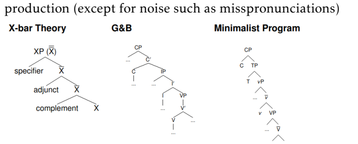
Syntactic Framework Tree:



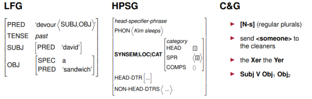
Basic Concepts:

	Const.	POS	Heads	Valency	Gram. Functions
DG	x	✓	✓	✓	✓
PSG	✓	✓	✓	✓	x
X-bar	✓	✓	✓	✓	✓
G&B	✓	✓	✓	✓	✓
MP	✓	✓	✓	✓	✓
LFG	✓	✓	✓	✓	✓
HPSG	✓	✓	✓	✓	✓
C&G	✓	✓	✓	x	✓

Transformational Framework there is some underlying template (i.e. deep structure) which is adapted by transformations and movements to give rise to the full variety of sentence structures encountered in linguistic production (except for noise such as mispronunciations)



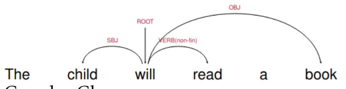
Constraint-Based Framework capture syntactic relationships by structural frames (e.g. feature matrices, constructions) which constrain how elements can be combined and slots are filled



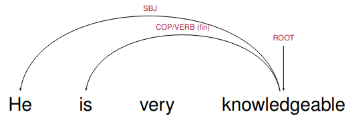
2 Dependency Grammar

curved arrows from the head to the dependent

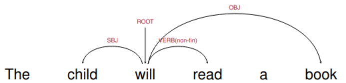
auxiliary verbs



Copular Clauses



Dative Alternation



Determiners DET, depends on the noun.

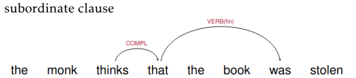
ADV depends on the verb or the ADV

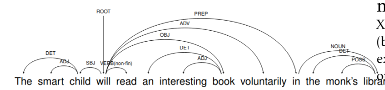
ADJ depends on the noun

PP in PP, noun depends on preposition, other elements depend on the noun

POSS possessor depends on possessee

Complementizer Phrase complementizer (e.g. that) depends on the head-verb, itself is the head of the subordinate clause





head-initial languages transitive sentences generally start with a verb, dependencies project forwards

head-final languages dependencies project backwards

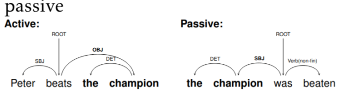
head-medial languages dependencies project in both directions

linearization dependency grammars often not require particular rules for the linearization of words; appropriate for languages with discontinuous constituents

free word order linearization might not be required

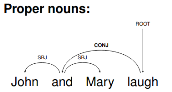
fixed word order lack of linearization constraints licenses ungrammatical sentences

passive

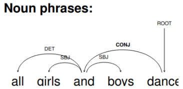


coordination

Proper nouns:



Noun phrases:



crossing dependencies non-projective

two competing pressures shpe word order dependency length minimization; predictability maximization

3 Phrase Structure Grammar

Grammar g <T, NT, S, R>

Language set of all strings g can generate

L(PSG) = {(the, child, reads, a, book), (a, child, reaeds, the, book), (the, book, reads, a, child), (a, book, reads, the, child)}

Rewrite tree notation, rewrite notation and bracket notation are structurally equivalent

Feature of PSG strongly restrict the number of possible sentences via linearization constraints in the non-terminal rules

binarization constraint all rewrite rules have only 1 symbol on the left and maximally 2 symbols on the right

Rewrite	Rule
S	–
NP V NP	6
DET N V NP	7
DET N V DET N	7
DET N reads DET N	5
the N reads DET N	1
the child reads DET N	3
the child reads a N	2
the child reads a book	4

Terminals
$T = \{a, book, child, reads, the\}$

Non-Terminals
$NT = \{DET, N, NP, V\}$

R (Terminals)
1. DET → the
2. DET → a
3. N → child
4. N → book
5. V → reads

R (Non-Terminals)
6. S → NP V NP
7. NP → DET N

Expanding PSG vocabulary, morphology

Problems complicated agreement systems; implementing morphological features

verb position verb-final, verb-medial, verb-initial, transitive, ditransitive (introduction of recursive rule will lead to generation of ungrammatical sentences

passive VP -> AUX VP (aux: is), have to formulate different phrase structure rules for active and passive sentences

Pros implements linearization constraints exlicitely; grounded on solid mathematical footing (automata theory); can be extended to model morphological features; easily implementable in computational frameworks

Cons not all languages need rules (free word order); cumbersome to implement morphological features; excludes semantic aspects from grammaticality; infinite number of PSGs without further constraints

4 Chomsky Hierarchy

Notational Concentions

T: lower case Latin letters(e.g. a,b,c,x,y,z)

NT: upper case Latin letters(e.g. A,B,C,X,Y,Z)

strings of T and NT symbols: lower case greek letters(e.g. α, β, γ

Regular lanugages/finite state grammars/type 3

X -> x, X -> xY

(beware: different usages: X -> YZ where Y ≠ Z)

examples: set of strings following the pattern x**ny**m; set of strings such that number of 'a's is a multiple of 4; set of natural numbers that leave a remainder of 3 when divided by 5...

If...then...; either...or...; the..., is...; in natural languages cannot be generated by regular grammars

Limitations: for certain constructions, e.g. of the anbn type, they will also generate ungrammatical sentences; since at least 1 terminal symbol has to be produced in every rewrite, no higher level patterns (phrase structures) can be captured

Context-free languages/type 2

X -> β, only allow 1 single non-terminal on the left hand side, but an arbitrary string of terminals and non-terminals on the right hand side.

Examples of generated languages:

mirror langauge abba, abccba, acbddcba...

palidrome language: aba, bab, abba...

languages with form x**ny**mz**mw**n

Natural language not context-free? (Swiss German ambncmdn, Bambara)

Summary: more powerful than regular grammars; taken its binarized version, boils down to having 1 additional rule pattern compared to regular grammars X -> YZ (Y=Z allowed)

type	restriction on A	restriction on B
0	at least one non-terminal	none
1	at least one non-terminal	at least as many symbols[1] as A
2	exactly one non-terminal	none
3	exactly one non-terminal	terminal(s) followed by at most one non-terminal

Context-sensitive languages/type 1

$\varphi_1 X \varphi_2 \rightarrow \varphi_1 \beta \varphi_2$, X is a single non-terminal X, the context may be null

alternative version: $\alpha \rightarrow \beta$, with β at least as long as α

example: copy language aa, abab, abcabc...

languages with strings of form x**ny**nz**n

set of all prime numbers (where each number represented by a string of length I(x))

assumption that natural languages are at least mildly context-sensitive

Recursively enumerable languages/type 0

$\alpha \rightarrow \beta$

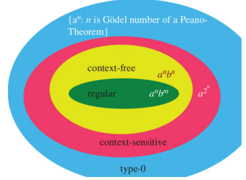
Classical hierarchy

regular (a**nb**m) finite-state automaton

context-free (a**nb**n) push-down automaton

context-sensitive (a**2**n) linear-bounded automaton

type-0 (a**n) Turing machine



5 X-bar Theory

bars represent projection levels

introducing 2 bar-levels (e.g. NP and N-bar) allows us to apply recursiveness where necessary, but also avoid it where it would lead to ungrammatical structures

Rewrite Rules

1. **NP → DET N̄**
2. NP → N̄
3. N̄ → AP N̄
4. N̄ → N
5. N̄ → N̄ PP
6. N̄ → N PP
7. N̄ → N̄ REL
8. **PP → NP P̄**
9. **PP → AP P̄**
10. PP → P̄
11. P̄ → P NP
12. AP → Ā
13. **AP → AdvP Ā**
14. Ā → A PP
15. Ā → A
16. S → NP VP
17. VP → V̄
18. V̄ → V
19. VP → AUX V̄
20. **V̄ → V NP**
21. V̄ → V̄ AdvP
22. V̄ → V̄ PP

etc.

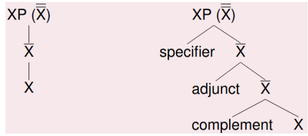
X' rules the structural similarities be captured by use X as a placeholder, e.g.

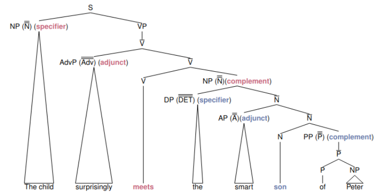
X"->specifier" X'

X'->adjunct"X', or X'->X' adjunct"

X'->X complement"

minimal and maximal X' phrases





Pros explicitely models the productiveness of natural language by recursively applying rules (but also possible in classical PSGs)

Abstracts away from particular phrase types and formulates more general rules (X-bar rules)

morphological features can be implemented

Cons an inflation of unary branches, analyses of simple sentences daunting

Justifying the higher level X rules based on empirical data (i.e. grammatical and ungrammatical sentences) becomes increasingly difficult and controversial.

6 Government & Binding

Transformational Grammar and its subsequent incarnations (such as Government and Binding Theory and Minimalism) were developed by Noam Chomsky

The different implementations of Chomskyan theories are often grouped under the heading Generative Grammar, it comes from the fact that phrase structure grammars and the augmented frameworks that were suggested by Chomsky can generate sets of well-formed expressions

additional symbols:

C: Complementizer (subordinating conjunctions such as "that")

I: Finiteness (as well as Tense and Mood)

D: Determiner (article, demonstrative)

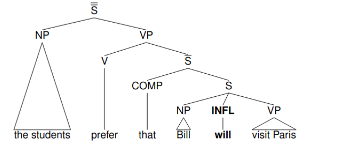
projection levels X0: symbol that leads to the terminal symbol

X': intermediate projection

XP: highest projection (X")

Inflectional symbol INFL e.g. will, -s

both auxiliary and non-auxiliary constructions can be captured by the same underlying tree structure



problem: missing inflections, irregulars, language diversity

a structural analysis template that was developed for English

Deep Structure e.g. INFL VP

Surface Structure e.g. visit-s

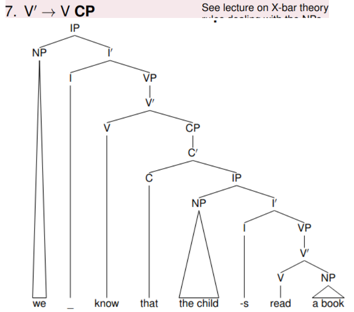
CP and IP instead of S symbol, Complementizer Phrase and Inflectional Phrase as layers above the verb phrase

IP symbol essentially replaces the starting symbol S in GB analyses, the subject is considered the specifier of the IP, and the object is the complement of the IP

CP is yet another level above the VP, relevant when a complementizer is used, but also for other syntactic phenomena

1. **CP** → C′
2. CP → NP C′
3. C′ → C IP
4. IP → NP I′
5. I′ → I VP
6. VP → V′
7. V′ → V **CP**
8. V′ → V′ AdvP
9. V′ → V′ PP
10. V′ → V
11. V′ → V NP
12. NP → DET N′
13. etc.

See lecture on X-bar theory



Movement the verb moves up to the affix

Trace when an element moves into another position in the tree, it leaves a trace in the position where it was before

Pros Formulates a highly abstract and general template (D-Structure) which can be used to model all types of sentences and syntactic phenomena (at least aims to)

Cons requires many complicated mechanisms (movement, empty elements, case assignments...) to derive the set of possible sentences; lack of precise formulizations of these mechanisms has resulted in GB (and other Mainstream Generative Grammar approaches) being largely ignored by computational linguists

Government

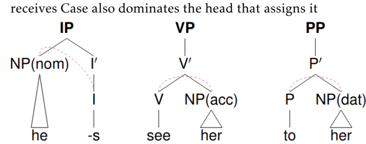
used in connection with case assignment between an I (e.g.will) and its specifier (e.g. the subject in nominative case), and between a verb head (e.g. read) and its complement (e.g. a book) in accusative/dative case)

case principle V assigns objective case (accusative) to its complements if it bears structural case

When finite, INFL assigns case to the subject

prepostions assign cases to the NPs they head

every maximum projection (XP) that dominates the NP that receives Case also dominates the head that assigns it



Government alpha governs beta iff:

(i) alpha is a head, and

(ii) every XP that dominates alpha also dominates beta, and

(iii) every XP (other than IP) that dominates beta also dominates alpha

(dominate means a certain element is the mother-node or higher up in the tree of another element)

problems unclear what exactly the relationship between case assignment and government is; case assignment can only work between some governor and a XP, unclear how this case then gets assigned to the elements further down the branches

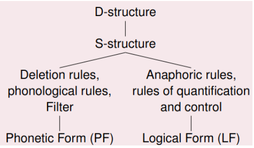
Binding

to determine when a reflexive anaphor, e.g. herself, is used instead of one of the pronouns she or her

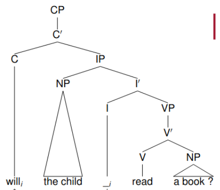
Binding alpha binds beta iff:
(i) alpha does not dominate beta,
(ii) the mother-node that dominates alpha also dominates beta
(iii) alpha and beta are coindexed
(the first two clauses simply mean that alpha c-commands all categories below its own mother node)
principles of binding theory (A) Pronouns (non-reflexive) must not be bound in their governing Inflectional Phrase (IP)
(B) reflexive Pronouns must be bound in their governing Inflectional Phrase (IP)
(C) Full NPs (aka denoting expressions) must not be bound (accounts for the fact that the same full NP cannot be used again in ta single sentence, but have to be represented by a pronoun)
every maximum projection (XP) that dominates the NP that receives Case also dominates the head that assigns it
problems several possible usages of reflexive and non-reflexive pronouns do not conform to the rules of Binding Theory; no clear rules which NPs and pronouns are co-indexed.

Syntactic Phenomena

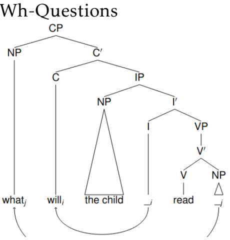
T model (called by its shape when you invert it), a schematic representation of all the underlying processes assumed for generating well formed sentences in GB theory



D-Structure the underlying template or mould that is used to build all grammatical sentences in a given language
S-Structure derived by transformations which allow to move elements around and reassign cases
surface structure is not necessarily the actual string or phonemes that you might read or hear, deletions and phonetic rules might still apply
Deletion rules can be applied to the surface structure, indicated by underscores
Phonetic Form regular changes to the surface structure, e.g. wants to->wanna
Logical Form only marginally discussed, through binding theory (anaphora resolution)
Yes/No questions

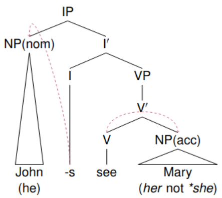


Wh-Questions

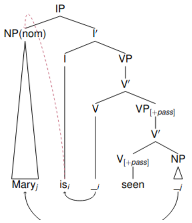


Verb position verb position can be handled by flexibly changing the order of elements in the rewrite rules for IP and VP
parameters introduced to explain how variation (e.g. in verb position) across languages of the world can be explained against the backdrop of the same underlying deep structure
Fronting fronted element moved into positions of higher level phrases (CP and IP), like wh-movement or movement of auxiliaries in questions
Passive the same underlying deep structure as active constructions

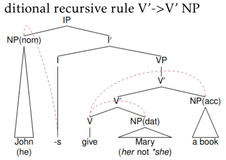
Active(D-Structure)



Passive(S-Structure)



Ditransitives problematic for GB analysis, need an additional recursive rule V'->V' NP



Problems: implies a verb can take arbitrarily large number of complements; run into problems with Binding Theory when reflexive pronouns are used

7 Minimalism

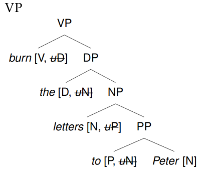
Features core part of minimalist syntax, refers to a feature value not a feature label, e.g. verbs might have the features past, plural, etc.
categorial features POS, phrase symbol, e.g. A, N, V, NP, VP...
ϕ-features features relevant for agreement, e.g. PERSON, NUMBER, GENDER
case features e.g. nominative, accusative
strong features features may be strong or weak, strong features make syntactic objects move to higher positions
interpretable/uninterpretable features interpretable in English

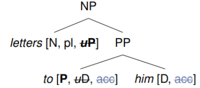
Type	Labels	Values
categorial	POS	N, P, NP, VP, etc.
ϕ-features (nouns)	GENDER	masc, fem, neut
	NUMBER	sg, pl
	PERSON	1, 2, 3 pers
Semantically interpretable features of verbs	TENSE	present, past
	ASPECT	perfective, imperfective

uninterpretable in English

Type	Labels	Values
ϕ-features (verbs)	NUMBER	sg, pl
	PERSON	1, 2, 3 pers
Case features	CASE	nominative, accusative
strong/weak F	_	strong, weak

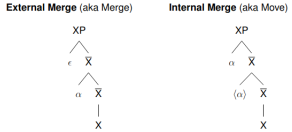
differs corss-linguistically, e.g. GENDER feature is interpretable for English, not for German
Feature Checking a core mechanism within Minimalist Syntax, links features with phrase structure, hence replaces traditional phrase structure rules
requirement: uninterpretable features must be checked, and once checked they delete
checking of categorial features: NP, NP with adjective, DP, VP



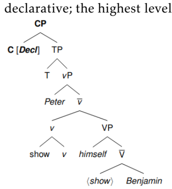


checking agreement features: Agree mechanism to check other features in addition to selectional features
agreement features can be checked in a sister node or further down the tree, whereas categorial features have to be checked in the sister node (or right below the sister node) of the feature to be checked

Merge and Move external merge (aka Merge): simply combines 2 elements like "theänd "book"
internal merge (aka Move(α)): movement of constituents, adjoins some part of one linguistic object to the left of the respective object, the original position (i.e. trace) is indicated by <α>
these have to be motivated by feature checking and essentially replaces phrase structure rules



Phrase Structure
First merge - complements: combines a head with a single complement to create a complete phrase (XP)
Second merge - specifiers: combines a head with a specifier
little v: modelling ditransitives with reflexive pronouns, another higher level of the verb phrase, preferred by many practitioners of MP
Tense Phrase (TP): corresponds to IP in GB analysis
Complementizer Phrase (CP): in contrast to GB, full sentences in MP are always complementizer phrases; if C is empty, it still contributes to clause-type feature, e.g. Decl for declarative; the highest level phrase in MP

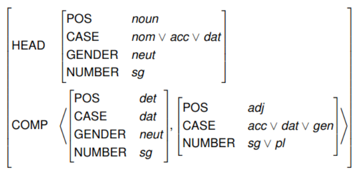


Differences between Minimalism and GB structure building relies on feature checking not rewrite rules; there is just merge(external) and move(internal merge) applied in any order rather than D- and S- structure; case assignment no longer handled with the principle of government but by feature checking (Agree)
Pros reduce the operations assumed for structure building (feature checking, merge and move) and hence more evolutionary plausibel; 1 complement (first merge) and several specifiers (second merge) leads to a strictly binary structure without lots of unary branches (in X-bar theory)
Cons not fully formalized, hard to implement computationally; quickly fragmented into many divergent frameworks, development of implementations of large grammar fragments is hard

8 Lexical Functional Grammar

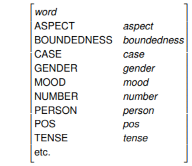
developed in the 80s by Joan Bresnan and Ron Kaplan, they view LFG as a psycholinguistically plausible alternative to transformation-based approaches, forms part of West-Coast linguistics
Untyped Feature Descriptions matrices that contain inflectional
problem: syncretism, the same form fills different cells in inflectional paradigms -> use disjuction (or statement)
embedding: one feature description might be embedded in another feature description
path: a sequence of features which immediately follow each other, e.g. derivational morphology
list: we can use a list of feature values (and statment)

phrase: *dem grünen Haus*

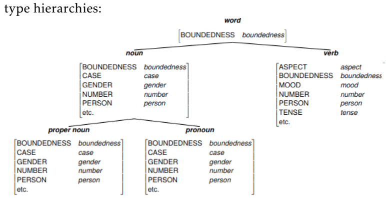


Typed Feature Descriptions i.e. feature structure, the type determines the template of feature labels that can be filled with values
inheritance: subordinate types inherit the features of their superordinate types

Possible feature structure of the type *word*:

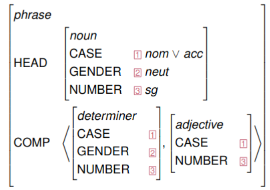


type hierarchies:



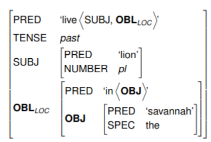
Structure Sharing an identical feature structure is used in different parts of the feature description
e.g. agreement between determiner, adjective and noun in German:

phrase: *das grüne Haus*

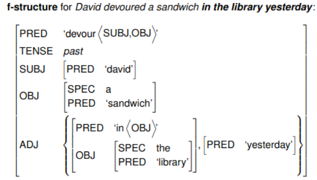


Feature Descriptions and Structures
A feature structure is a more general, stable model of all objects of a given type, while feature descriptions can give only (the relevant) parts of this model
Grammatical Functions
e.g. PRED 'devour<SUBJ,OBJ>'
predicates (PRED) used for all lexical items that contribute meaning to the sentence, the value is either a lexical item(e.g.'David') or a lexical item followed by a list specifing grammatical functions (e.g.'devour<SUBJ,OBJ>')
Syntactic Structure:
Argument Structure(A-Structure)
general representation format: verb<x,y,z,ect.>
ordering: reflects a thematic hierarchy: agent>beneficiary>experiencer/goal>instrument>patient/them
governable grammatical functions functions which have to be specidied by the head of the overall phrase/sentence
SUBJ, OBJ:object
OBJ_{THEME}:secondary object, direct object of a ditransitive sentence (e.g. gave *the book*...)
COMP:sentential complement(that-clause)
OBL:oblique grammatical functions (e.g. OBJ_{LOC}: in..., at... after "located"(obligatory))
non-governable grammatical functions functions that are not specidied by the head (not being arguments of the head)
ADJ(adjuncts), TOPIC, FOCUS(TOPIC and FOCUS can be used to model, e.g. word order variable when particular NPs are topicalized
Functional Structure(F-Structure essentially a feature description for a whole phrase, e.g.:

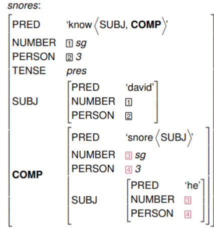
f-structure for *Lions lived in the savannah*:



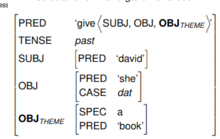
Governable functions: SUBJ, OBL_{LOC}
Non-Governable functions: –
f-structure for *David devoured a sandwich **in the library yesterday***:



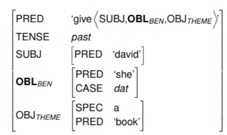
f-structure for *David knows **that** he snores*:



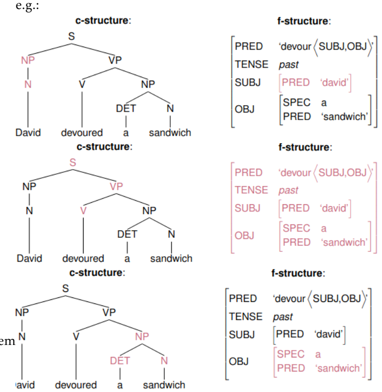
f-structure for *David gave her a book*:



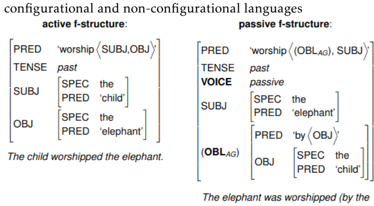
f-structure for *David gave a book to her*:



Constituent Structure (C-Structure) licensed by (binary) phrase structure grammar, uses x-bar structures, e.g.:



summary: each structure models a different dimension of grammatical substance: role(a-structure), syntactic function(f-structure), phrase structure categories(c-structure)
Syntactic Phenomena
Passive simple mapping rule $verb < SBJ, OBJ > \rightarrow verb < (OBJ_{AG}), SBJ >$
translated into differing f-structures, valid for both configurational and non-configurational languages



Pros fully formalized, computationally implementable
flexibility to deal with configurational(fixed word order) and non-configurational(flexible word order) languages
agreement and case assignment are modelled explicitely in the feature descriptions(similar to GPSG)
feature descriptions allow for analyses of long-distance dependencies and passive constructions without recurrence to transformations
Cons Feature descriptions are untyped, which means that generalizations in terms of type hiearchies such as inheritance of features are not available (in contrast to HPSG)
the interactions between a-structure, f-structure, and c-structure are not straightforward, and will require a considerable amount of implementational details

9 Construction Grammar

like LFG and HPSG, Construction Grammar forms part of West Coast linguistics. It has been considerably influenced by Charles Fillmore, Paul Key and George Lakoff and Adele Goldberg
Goldbergian Construction Grammar
Construction Any linguistic pattern is recognized as a construction as long as some aspect of its form or function is not strictly predictable from its component parts or from other constructions recognized to exist
patterns are stored as constructions even if they are fully predictable as long as they occur with sufficient frequency, e.g. What be[fin] X doing Y?
all levels of grammatical analysis involve constructions: morpheme, word, complex word, idiom, covariational conditional, ditransitive, passive
Notational Confusion for consistency, we use POS symbols, if necessary, can be further specified by indices

- Complex word (partially filled): **[N-s]** (regular plurals)
- Idiom (partially filled): send $\mathbf{N}_{person(s)}$ to the cleaners
- Covariational Conditional: the $\mathbf{ADJ}_1$**-er** the $\mathbf{ADJ}_2$**-er**[1]
- Ditransitive (double object): $\mathbf{NP}_{Subj}$ **V** $\mathbf{NP}_{Obj_1}$ $\mathbf{NP}_{Obj_2}$

Multiple Constructions an actual expression typically involves the combination of different constructions
(4) What did Liza buy Zach?

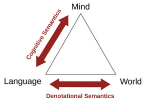
- *Liza, buy, Zach, what, do* constructions (i.e. individual words)
- ditransitive construction
- question construction (wh-word VP)
- subject-auxiliary inversion construction (aux Subj, i.e. *did Liza*)
- VP construction
- NP construction

Arguments for Constructions
1. creativity/productivity: the idea that main verbs specify the valency of whole sentences does not match the creative use of linguistic patterns
2. non-compositionality: many examples across languages where the overall meaning of a sentence is not derivable from the component parts but is rather assigned to the whole construction
3. core and periphery: constructions, while often seen to be part of the periphery, might in fact constitute a core property of language

Pros
not based on an arbitrary distinction between core and periphery of grammar, but tries to cover all linguistic structures within the same framework
has (arguably) high psycholinguistic relevance for both learning and processing
abandons the ideas of headedness and valency, more flexible to deal with the productivity and creativity of languages
Cons
unclear how to identify constructions without recurrence to more traditional analyses such as phrase structure rules and constituency
often only partially formalized, Müller argues that all fully formalized CxG variants are virtually equivalent to HPSG(since they largely use the same formal apparatus

10 Semantics

Form and meaning: The Roots
Level 1: Abstract Relation
Level 2: Concrete Mapping (Denotation)
Level 3: Metalanguage (Translation)
Arbitrariness For most words, the relation between the form (i.e. phonetic shape) of the word and its meaning is arbitrary; Onomatopoeic words are words whose forms are intended to be imitations of the sounds which they refer to. systematic non-arbitrariness, iconicity, systematicity
Compositionality two words might be productively combined to yield a new, predictable meaning. Hallmark of human language (and other communication systems) as it enables the infinite use of finite means. In the case of idioms (e.g. kicking the bucket), the intended meaning of the sentence is not a linear combinatorial derivation of its parts. Rather, a complex meaning is assigned to the whole phrase.
3 levels of meaning word meaning: sentence meaning, utterance meaning
Reference intuitively we are talking about the speaker's use of words to "point to" something in the world
Semiotic Triangle(Triangle of Reference/Meaning) Symbol(language) - World(referent) - Thought/Reference(meaning)
Denotational Semantics focuses on the link between linguistic expressions and the world
Cognitive Semantics focuses on the link between linguistic expressions and mental representations



Referring Expressions

Proper names (Mao Zedong)/rigid designators

"Natural kind" terms (the octopus, humans, methane): names of species or substances

Deictic elements (indexicals: you, here, now): words which refer to something in the speech situation itself.

Anaphoric elements (George... he..., every boy(non-referring anaphora))

Definite descriptions (this book, the sixteenth president): normally used in contexts where the hearer is able to identify a unique referent, but can also be used generically without referring to any specific individual

Indefinite descriptions (a cowboy): may be used to refer to a specific individual or may be non-specific, referring/non-referring/ambiguous

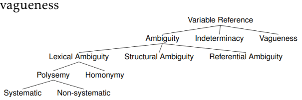
Sense/Denotation

Sense: the aspects of meaning which do not depend on the context of use

Denotation: the sort of meaning which does depend on the context

Word meaning

problem of variable reference, i.e. ambiguity, indeterminacy, vagueness



lexical ambiguity [ambiguous, polysemous] (e.g. beat): words that have two or more senses

structural ambiguity (e.g. Two cars were reported stolen by the Groveton police yesterday): the two senses arise because the grammar of the language can assign two different structures to the same string of words, even though none of those words is itself ambiguous

referential ambiguity: usage of anaphoric expressions with ambiguous antecendents

Lexical Ambiguity

polysemy: one word with multiple senses (e.g. beat) (criteria: semantic feature/component sharing, figurative extension, existence of a primary sense, etymology)

homonymy: different words that happen to sound the same (e.g. can)

another perspective: allows for greater ease of processing by permitting efficient linguistic units to be re-used; a functional property of language that allows for greater communicative efficiency

Indeterminacy a word can have variability in its reference despite having a single defined sense (e.g. cousin)

Vagueness limits of its possible denotations cannot be precisely defined (e.g. tall)

Indeterminacy vs. Vagueness

context-dependence: denotation of a vague word depends on the context

borderline cases: vague words display borderline cases due to their gradability

"little-by-little"paradoxes: due to the gradability of vague words, it is hard (impossible?) to determine when a certain denotation is justified (e.g. when exactly does a person with hair become a bald person?)

indeterminacy tends to be language-specific, the degree to which these properties are preserved in translation

Tests

Zeugma Test: on his fishing trip he caught three trout and a cold (lexically ambiguous)

Identity Test: John saw her duck, and so did Bill (lexically ambiguous: interpretations have to be identical)

Sense Relations Test: light - dark, heavy (different sets of synonyms, antonyms)

Contradiction Test: They are not children any more, but they are still my children (true, ambiguous)

Propositional Logic

Why formal logic? overcome ambiguity, determine relationships between meanings of sentences, determine meanings of setences, model compositionality, recursive system.

Definition Proposition The meaning of a simple declarative sentence. The proposition expressed by a sentence is the set of possible cases [situations] of which that sentence is true.

- A sentence S is true of a possible situation *s* if and only if $[\![S]\!]_s = 1$.
- $[\![S]\!]$, in turn, is then the proposition expressed by S, such that: $[\![S]\!] \equiv \{s : [\![S]\!]_s = 1\}$
- A sentence S is true of a possible situation *s* if and only if $s \in [\![S]\!]$, formally: $[\![S]\!]_s = 1$ iff $s \in [\![S]\!]$.

Extensions real-world situations they refer to

Frege's Generalization The extension of a sentence S is its truth value

Types of Sentences and Propositions Analytic sentence(tautology): true in every situation; Contradiction: false in every situation; Synthetic sentence: either true or false depending on the situation

Inference premisses: the facts which form the basis of the inference; conclusions: the fact which is inferred

Syllogism an important variety of deductive argument in which a conclusion follows from two or more premises

Categorical Syllogism A logical argument consisting of exactly three categorical propositions, two premises and the conclusion

Types of Inference inferences based on content words; logical words(propositional logic); quantifiers(predicate logic)

Predicate Logic

Introduce constants and variables representing invididuals and predicates to capture the main structural building blocks of sentences. Introduce quantifiers to allow for quantified statements. **Definition** constant symbols: a, b, c

variable symbols: x, y, z

n-ary/n-place predicate symbols: A, B, C, reflect relations between n elements (n>0)

function symbols: lower case letters (f, g, etc.), take n variables (with n>=0) as their arguments, e.g. f(x): father of x

connectives: $\neg, \wedge, \vee, \rightarrow, \ldots$

quantifiers: $\forall, \exists$

round brackets (), equal sign =

Universal instantiation By using a variable x bound by the universal quantifier (Premise 1), and then specifiyng this variable as a constant symbol (Premise 2)

Existential Generalization By asserting that two predicates are true for the same constant symbol (premise 1 and premise 2)

Evaluation: Model theory a model: (i) the domain, i.e. the set of all individual entities in the situation, (ii) the denotation sets for the basic vocabulary items

N-place predicates are evaluated by whether the constant symbol(s) is a member of the denotation set of the predicate

Logical operators are evaluated the same way as in propositional logic

Quantifiers are evaluated according to subset relations

Valency in Semantics

Verb or VP	Valency	Extension
_ shows _ _	3	set of all triples $\langle a, b, c\rangle$ where a shows b c
_ shows the president _	2	set of all pairs $\langle a, c\rangle$ where a shows the president c
_ shows the president the Vatican Palace	1	set of all individuals (1-tuples) $\langle a\rangle$ where a shows the president the Vatican Palace
The Pope shows the president the Vatican Palace	0	set of all 0-tuples $\langle\rangle$ where the Pope shows the president the Vatican Palace

$[\![S]\!]_s = \{\varnothing\} \equiv 1 \equiv T$, with *s* being a situation in which the Pope *actually* shows the president the Vatican Palace.

$[\![S]\!]_s = \varnothing \equiv 0 \equiv F$, with *s* being a situation in which the Pope *does not* show the president the Vatican Palace.

Formal Composition Compositional semantic theories assume that syntax and semantics work in parallel. For each phrase structure rule that combines two expressions into a larger phrase, there is a corresponding semantic rule which combines the meanings of the parts into the meaning of the newly formed expression

Type theory a formal semantic account enabling compositionality from the most basic entities (type e) to sentences (type t) in a recursive manner

Syntactic trees (here PSG trees) can then be mapped onto type-theoretic trees

Functional Application If α is of type <b, a> and β of type b, then $\alpha(\beta)$ is of type a

Type of Expression	Semantic Type
Proper names	e
Sentences	t
Nouns	$\langle e,t\rangle$
Adjectives	$\langle e,t\rangle$
One-Place Predicates	$\langle e,t\rangle$
Two-Place Predicates	$\langle e, \langle e,t\rangle\rangle$
Three-Place Predicates	$\langle e, \langle e, \langle e,t\rangle\rangle\rangle$
Determiners	$\langle\langle e,t\rangle, e\rangle$
Adverbs	$\langle\langle e,t\rangle, \langle e,t\rangle\rangle$