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Syntax & Semantics WS2019/2020

Lecture 9: Intermediate Summary

22/11/2019, Christian Bentz

Overview

Comments on Exercises in Week 3:

- Its actually 12 not 6 possible sentences for the Nhanda PSG since the same noun can be used twice without further constraints
- Exercise 4c): we have to further specify the constraint *all rules have to be applied once* to *all rules have to be applied once* ***within the same rewrite process***. In this case, it is impossible to rewrite S twice in the same process.

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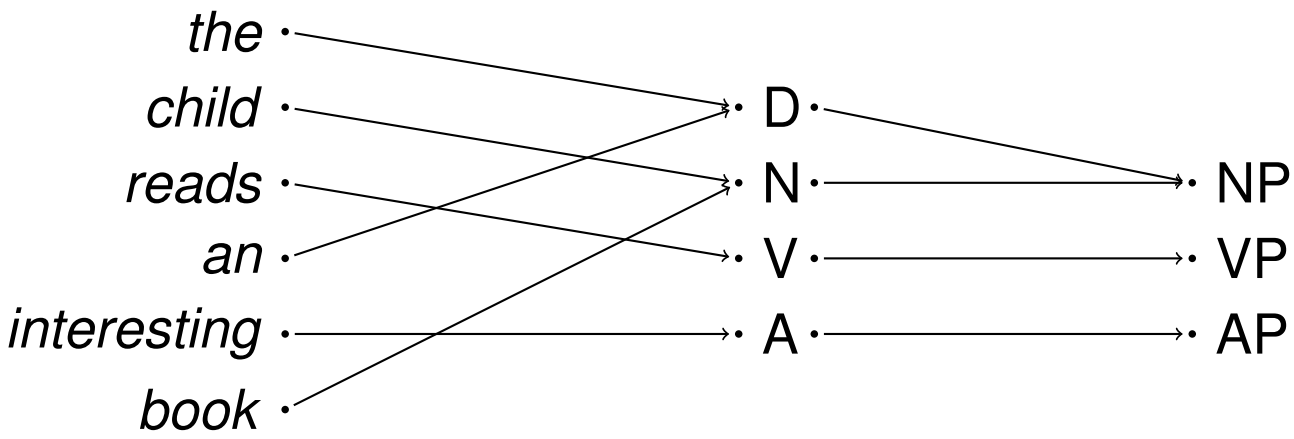
Lecture 1: Combinatoriality

Combinatoriality in Syntax

(1) Words: the child reads an interesting book
POS: D N V D A N
Phrases: [NP [VP [NP [AP]]]]

Mapping from words to (unique) POS to (unique) Phrases:



Combinatorial Possibilities

Words

with replacement:
$n^{words} = 6^6 = 46656$

without replacement:
$n^{words} = 6! = 760$

the child reads an interesting book
book the child reads an interesting
interesting book the child reads an
an interesting book the child reads
reads an interesting book the child
child reads an interesting book the
an child reads the interesting book
book an child reads the interesting
interesting book an child reads the
the interesting book an child reads
reads the interesting book an child
child reads the interesting book an
etc.

POS

with replacement:
$n^{POS} = 4^4 = 256$

without replacement:
$n^{POS} = 4! = 24$

D N V A
A D N V
V A D N
N V A D
D V N A
A D V N
N A D V
V N A D
etc.

Phrases

with replacement:
$n^{phrases} = 3^3 = 27$

without replacement:
$n^{phrases} = 3! = 6$

NP VP AP
AP NP VP
VP AP NP
VP NP AP
AP VP NP
NP AP VP

Combinatoriality: Important Take-Home-Message

The possibilities of combining words to strings of words, i.e. phrases and sentences, quickly explode into an unmanagable number. Mapping them to more general categories, like POS and phrases, helps to reduce the combinatorial possibilities. Further constraints on the order of these categories further reduces the possible set of sentences.

However: In order to do this, we need to define what POS and phrases, i.e. constituents are.

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Lecture 2: Constituency & POS

Constituency

tree
NOUN

big [tree]
ADJ [NOUN]

a [big [tree]]
DET [ADJ [NOUN]]

sees [a [big [tree]]]
VERB [DET [ADJ [NOUN]]]

Kim [sees [a [big [tree]]]]
PROPN [VERB [DET [ADJ [NOUN]]]]

Substitution Test

he knows [the man]
he knows [a woman]

Pronominalization Test

[the girl] reads a book
[she] reads a book

Question Formation Test

[the girl] reads a book
[who] reads a book

Permutation Test

everybody will know [this man]
[this man], everbody will know

Fronting Test

Das Kind liest [dieses Buch]
[Dieses Buch] liest das Kind

Coordination Test

[To have the cake] and [to eat it] is impossible

Universality of Constituency (?)

Thalanyji (?, Pama-Nyungan(?))

(2) Kupuju-lu **kaparla-nha** yanga-lkin **wartirra-ku-nha**
child-ERG dog-ACC chase-PRES woman-DAT-ACC
"The child chases the woman's dog."

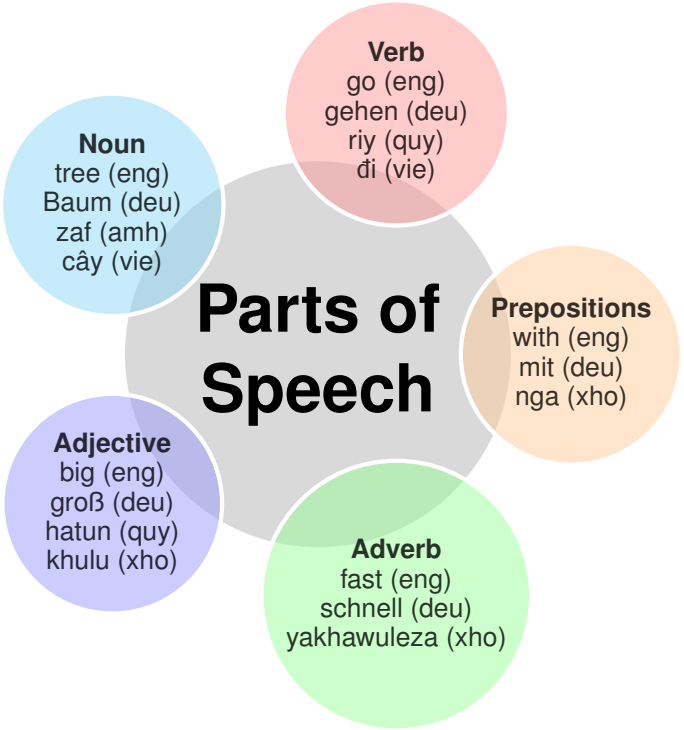
> "Note how possessive modifiers – coded by a special use of the dative case – additionally pick up the case of the noun they modify, as with the accusative -nha on "dog" and "woman-Dat" [...] It is this case-tagging, rather than grouping of words into constituents, which forms the basic organizational principle in many Australian languages."

Evans & Levinson (2009), p. 441.

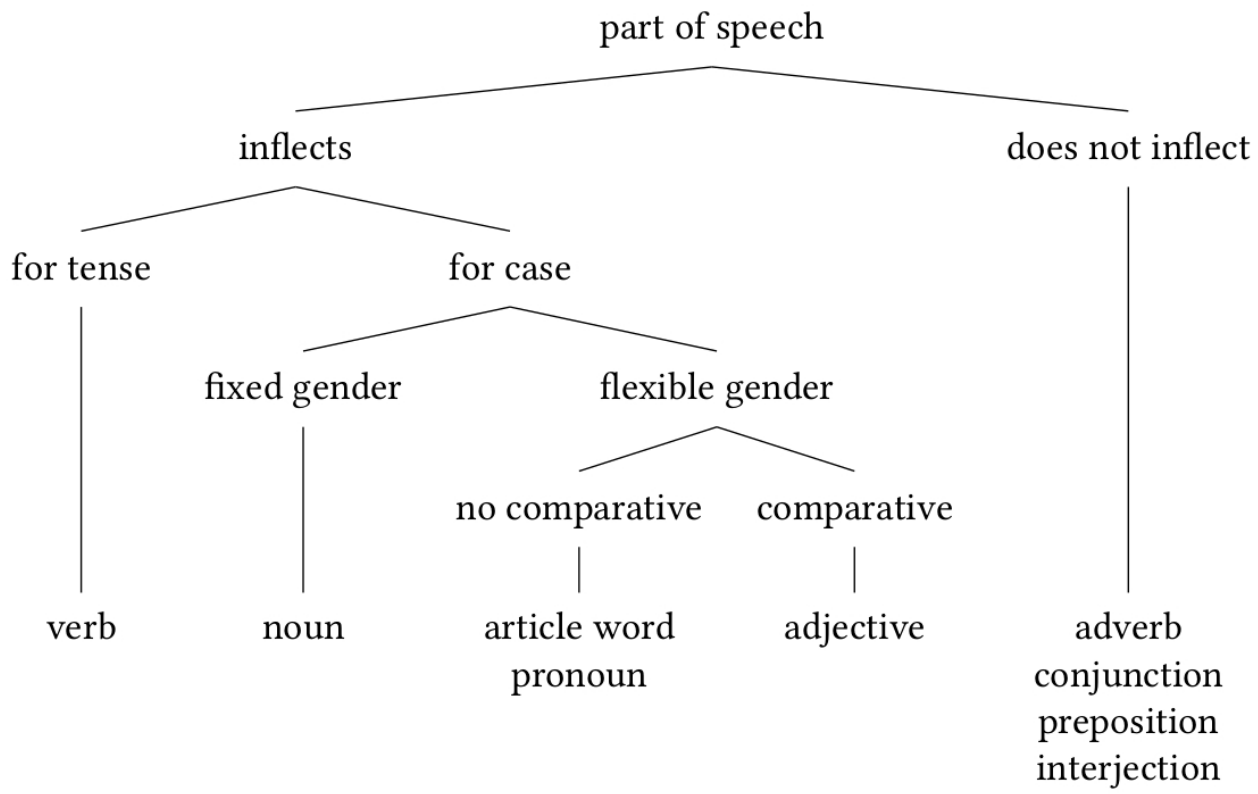
Note however: We don't know what the different constituent tests above would say about the constituency of *kaparla-nha wartirra-ku-nha*. This is only possible with a detailed knowledge of how the language is used.

Definition

Parts of Speech are 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*.



Decision Tree



Müller (2019). Grammatical theory, p. 24.
Based on Duden Grammar by Eisenberg et al. (2005).

Example: Determining POS

(3) Das ist ein **schön-er** Baum
This is a beautiful-M.NOM.SG tree-M.NOM.SG
"This is a beautiful tree."

(4) Ich seh-e ein-en **schön-en** Baum
I see-1SG DET-M.ACC.SG beautiful-M.ACC.SG tree
"I see a beautiful tree."

(5) Das ist ein-e **schön-e** Blume
This is DET-F.NOM.SG beautiful-F.NOM.SG flower-F.NOM.SG
"This is a beautiful flower."

(6) Der Baum ist **schön-er** als die Blume
The tree is beautiful-more than the flower
"The tree is more beautiful than the flower."

POS inference:
"schön" → inflects → for case (i.e. (3) vs. (4)) → has flexible gender (i.e., (3) vs. (5)) → has a comparative form (i.e. (6)) → adjective
Beware: nouns have fixed grammatical gender (e.g. Baum (M), Blume (F)), but additional morphology might reflect biological gender (e.g. Student (M), Student-in (F)).

Summary: Problems with POS

- **Problem 1**: The number of basic POS can differ according to the framework any particular researcher adheres to (e.g. Interjection, Conjunction, etc. might be seen as additional POS).
- **Problem 2**: It is controversial whether all languages even have the basic POS mentioned above.
- **Problem 3**: The abbreviations used for POS can also differ across frameworks.
- **Problem 4**: Isolating languages have very little or no inflections. According the the Decision Tree all words in these languages would be in the class of adverbs, conjunctions, etc.

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Lecture 3: Heads & Valence

Definition

"The **head** of a constituent/phrase is the element which determines the *most important properties* of the constituent/phrase. At the same time, the head also determines the *composition of the phrase*. That is, the head requires certain other elements to be present in the phrase."

Müller (2019). Grammatical theory, p. 28.

Example:

Ayacucho Quechua (quy, Quechuan)

(7) wayna runa mikuy-ta yanu-n
young man.NOM.SG food-ACC cook-PRS.3SG
"The young man cooks the food."

Verb Phrases

Alfred **sleeps**
The child **will** read an interesting book in the library

Copular Clauses

she is **smart**
that's pretty **awesome**

Noun Phrases

beautiful **summer**
the **summer**

Possessor Noun Phrases

Tom's **car**

Adjective Phrases

very **fast**
pretty **green** outside for winter

Prepositional Phrases

to town
outside the house

Arguments

The head of a phrase requires certain other elements to be present in order to form a *maximal projection*. These *strictly required* elements are called **arguments** of the head (sometimes also called *dependents* of the head, though the term *dependent* normaly also includes adjuncts).

Adjuncts

Beyond the obligatory arguments, there are also *optional* elements that might be used to further modify the utterance. These are called **adjuncts**. Typical adjuncts are adjectives, adverbials and prepositional-phrases.[1]

Müller (2019). Grammatical theory, p. 30-34.

[1] Müller 2019, p.34) points out how in some cases these are also obligatory, e.g. with the German reflexive verb *sich befinden* "to be located", which requires a prepositional phrase, e.g. *in der Stadt* "in town" to form a grammatical sentence.

Valence according to Tesnière

> *"Nous avons vu qu'il y avait de verbes sans actant, des verbes à un actant, des verbes à deux actants et des verbes à trois actants."*
>
> *Tesnière (1959). Éléments de syntaxe structurale, p. 238.*

Sentence Type:	impersonal sentence	intransitive sentence	transitive sentence	ditransitive sentence
Valency:	avalent (0)	monovalent (1), one-place predicate	bivalent (2), two-place predicate	trivalent (3), three-place predicate

Note: Müller states that the pronouns in expletives (e.g. *it rains*) should be considered obligatory arguments of the verb, while Tesnière explicitely calls them "sans actant".

Beware: Terminological Confusion

"The classic division describes all verbs which have an object which becomes the subject *under passivization* as *transitive*. Examples of this are verbs such as *love* or *beat*. *Intransitive* verbs, on the other hand, are verbs which have either *no object*, or one that *does not become the subject* in passive sentences."

Müller (2019). Grammatical theory, p. 42.

Beware: According to this classic division two-place predicates (requiring two arguments for a maximal projection) are not necessarily considered transitive verbs.

i.e. *two-place* $\neq$ *transitive*

Grammatical Functions: Subject

The following syntactic properties defining a subject are cited by Müller:

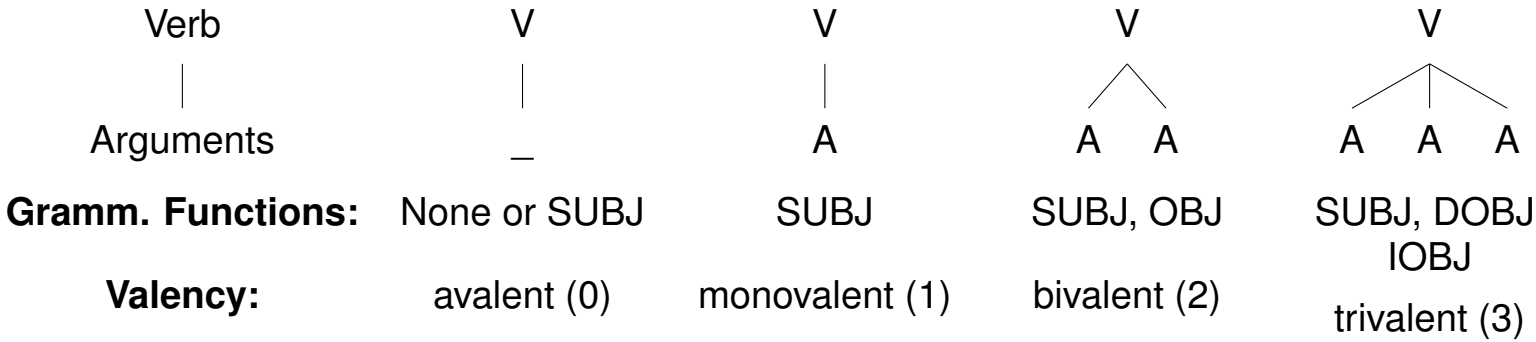
- agreement of the finite verb with it
- nominative case in non-copular clauses
- omitted in infinitival clauses
- optional in imperatives

Müller (2019). Grammatical theory, p. 35.

Valence and Grammatical Functions

"If we can be clear about what we want to view as a subject, then the definition of *object* is no longer difficult: objects are all other arguments whose form is directly determined by a given head. [...] it is commonplace to talk of *direct objects* and *indirect objects*. The direct object gets its name from the fact that – unlike the indirect object – the referent of a direct object is directly affected by the action denoted by the verb."

Müller (2019), p. 38.



Notation: DOBJ (direct object), IOBJ (indirect object)

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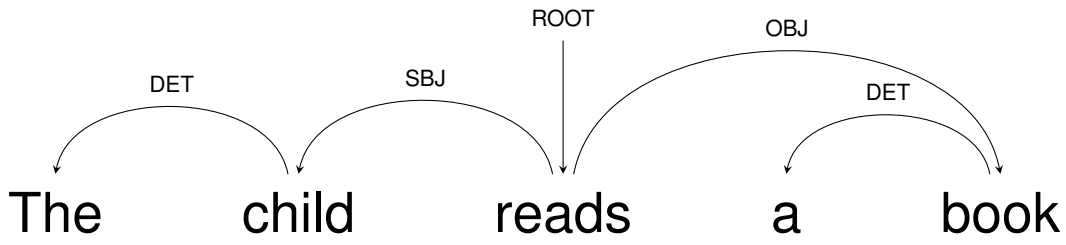
Lecture 4: Dependency Grammar

The Representational Format

There are (at least) *three different ways* of illustrating a dependency grammar analysis of a given phrase/sentence (see Müller 2019, p. 268-269). We here generally follow the approach by Hudson (2007), namely, illustrating dependencies by curved arrows from the head to the dependent.[2]

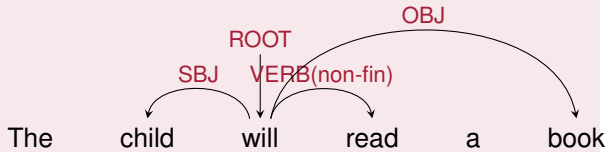


Adopted from Müller (2019). Grammatical theory, p. 369.

[2]There is an online tool at www.spacy.io that automatically generates lemmas, POS, etc. for sentences of a set of languages (English, German, French, etc.). This can also be used to generate dependency graphs.

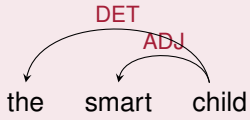
Main Verbs

Auxiliary Verbs

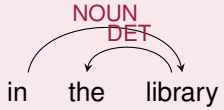


Determiners

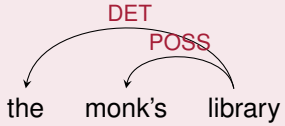
Adjectives



Prepositional Phrases



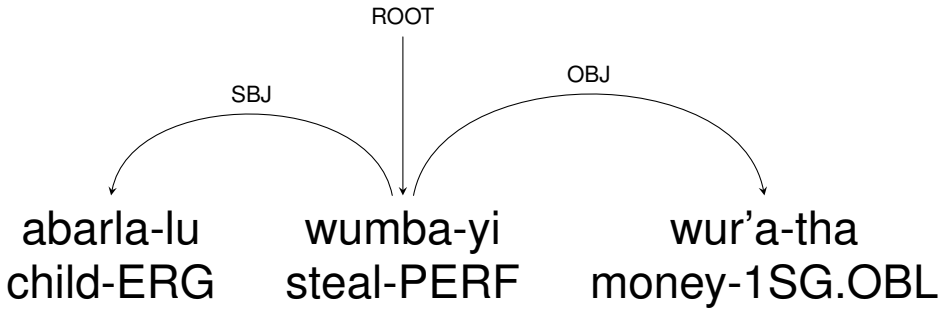
Possessor Phrases



Linearization: Free Word Order

If a language has **completely free word order**, then linearization might not be required by the syntactic framework. All orders are grammatical and hence "licensed". See the permutation examples below.

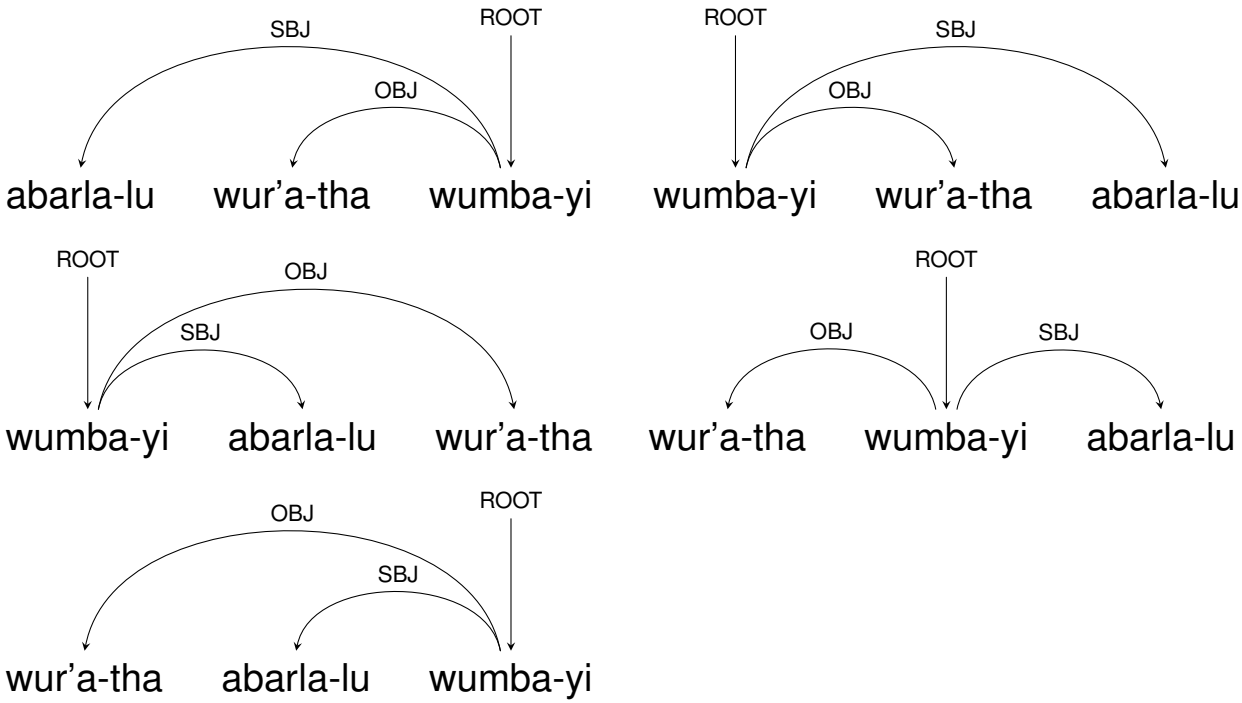
Nhanda (nha, Pama-Nyungan)



"The child stole my money."

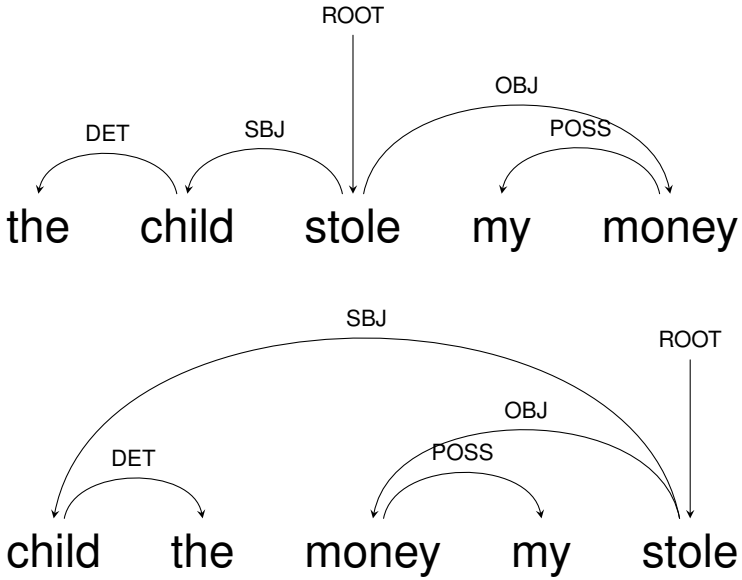
Adopted from Velupillai (2012), p. 282.

Free Permutation:



Linearization: Fixed Word Order

If a language has **fixed word order**, however, then the lack of linearization constraints licenses ungrammatical sentences.



Note that both of these sentences (and all other permutations) are licensed by a dependency grammar that does not specify linearization constraints.

Basic Concepts And Their Importance

- Constituency x
- POS ✓
- Heads ✓
- Valency ✓[3]
- Grammatical Functions (✓)[4]

[3] In order to assign SBJ, OBJ, DOBJ and IOBJ arrows, we need to understand the valency relations. But note that the distinction between arguments and adjuncts is irrelevant (there needs to be an arrow from head to the complement, regardless of whether it is an argument or an adjunct.)

[4] In our version of DG we indicated grammatical functions on dependency arrows (i.e. SBJ, OBJ), but since agreement and case assignment are not explicitely modelled, these functions are secondary.

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Lecture 5: Phrase Structure Grammar

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)

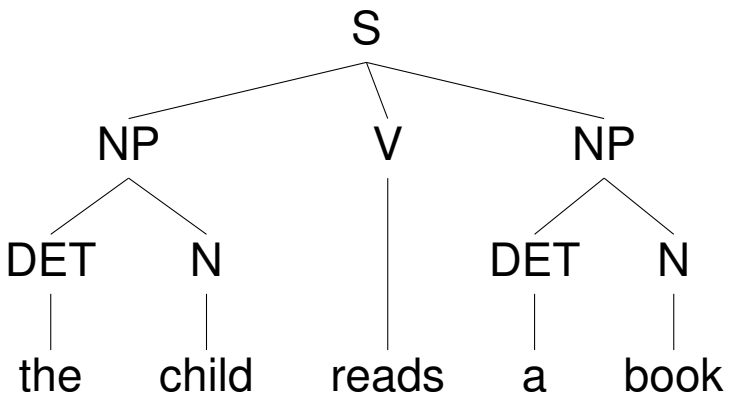
1. DET → the
2. DET → a
3. N → child
4. N → book
5. V → reads

R (Non-Terminals)

6. S → NP V NP
7. NP → DET N

Note: The horizontal line indicates the point where rules exclusively defined with non-terminals ($R(NT)$) end, and rules involving terminals ($R(T)$) start. While the order of application of non-terminal rules is often important, the order of the application of terminal rules is irrelevant.

Bracket Notation



Rewrite Notation

S
NP V NP
DET N V NP
DET N V DET N

DET N reads DET N
the N reads DET N
the child reads DET N
the child reads a N
the child reads a book

[S [NP [DET [the]][N [child]]][V [reads]][NP [DET [a]][N [book]]]][5]

[5]Note: The *Bracket Notation* is yet another equivalent way to visualize the same structure. In fact, the latex code generating this slide takes the bracket notation as input to generate the above tree. There is also an online tool at ironcreek.net/syntaxtree to generate trees based on bracket notation input.

Basic Concepts And Their Importance

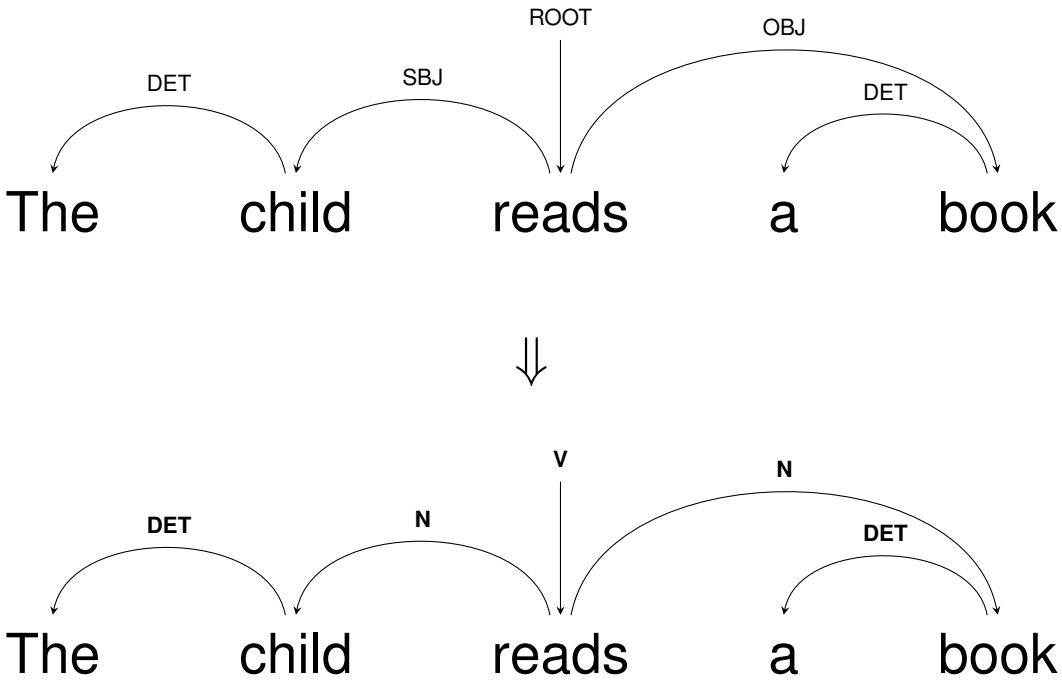
- Constituency ✓
- POS ✓
- Heads ✓
- Valency (✓)[6]
- Grammatical Functions x

[6] Valency indirectly plays a role for classical phrase structure rules since it determines how many non-terminals need to specified on the right side of VP rules. However, the core distinction between arguments and adjuncts is irrelevant.

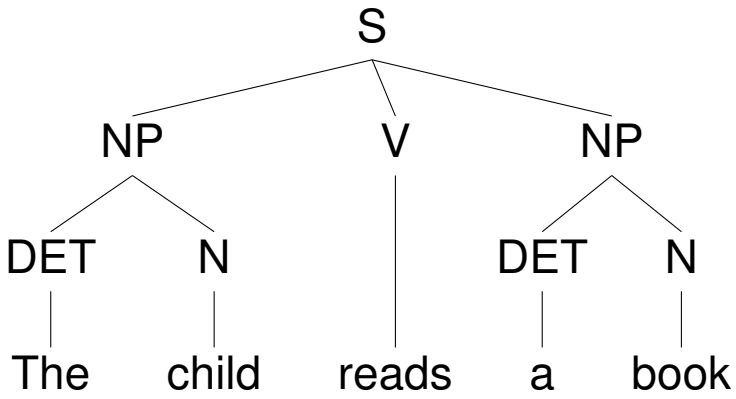
Comparison: DG and PSG

- Linearization (word order) is highly relevant in PSGs but only marginally in DG. Though note that in later versions of PSG, such as GSPG, ordering constraints can also be relaxed via the difference between immediate dominance rules and linear precedence rules (e.g. NP$\rightarrow$ NP VP versus NP$\rightarrow$ NP, VP).
- A *projective* DG analysis of a sentence can be brought into correspondence with a *lexicalized* PSG analysis, i.e. if we use the same POS for both DG and PSG, and if we have PSG rules that always contain the head as a lexical element.

Example: Translation of POS



Example: Lexicalization of PSG Rules

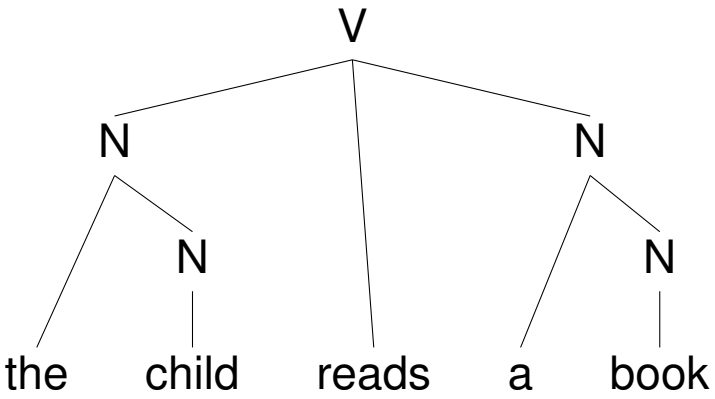


Rewrite Notation

S
NP V NP
DET N V NP
DET N V DET N

DET N reads DET N
the N reads DET N
the child reads DET N
the child reads a N
the child reads a book

Example: Lexicalization of PSG Rules



Note: By requiring that each rewrite rule has a lexical element on the right side, we essentially "push" the rewritings below the horizontal line, i.e. we have a *flat tree structure*.

Rewrite Notation

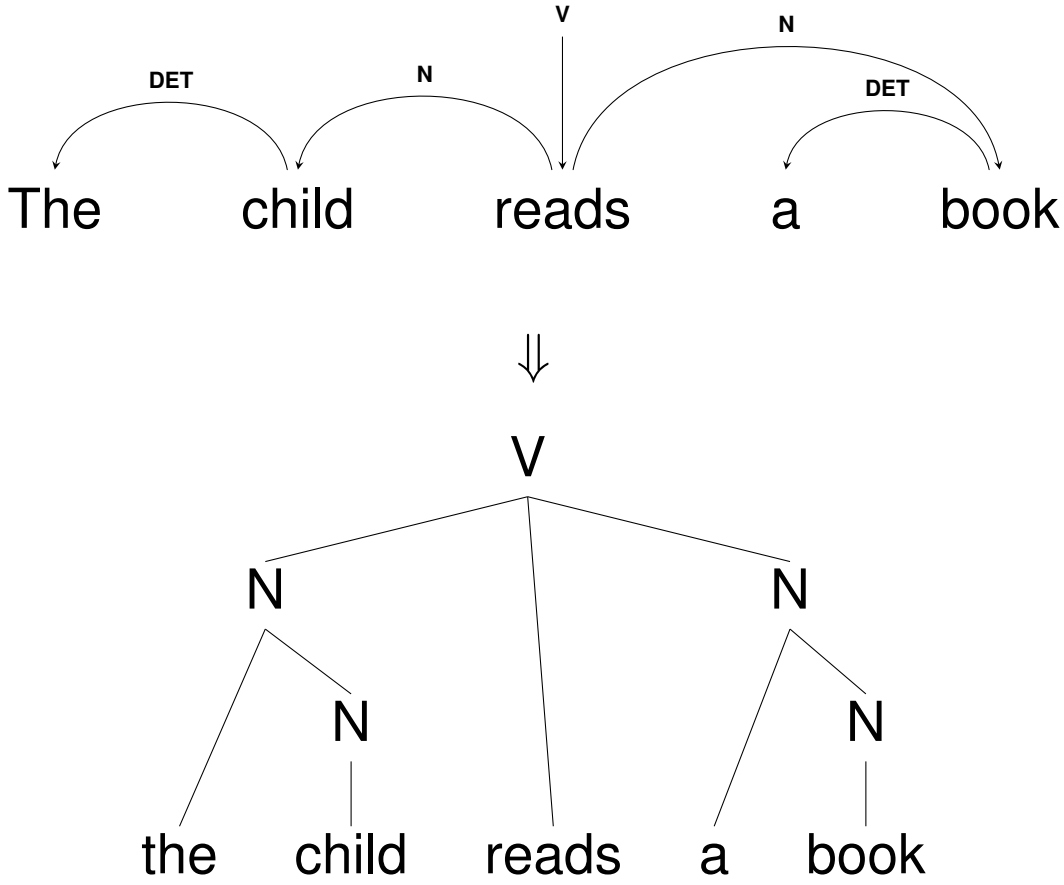
V

N reads N
the N reads a N
the child reads a N
the child reads a book

Rewrite Rules

$V \rightarrow N$ reads N
$N \rightarrow$ the N
$N \rightarrow$ a N
$N \rightarrow$ book
$N \rightarrow$ child

Result: DG to PSG Translation



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Lecture 6: X-bar Theory

Why do we need bars in the first place?

The solution to capture all the noun phrases discussed above is a set of rewrite rules using the bar notation:[7]

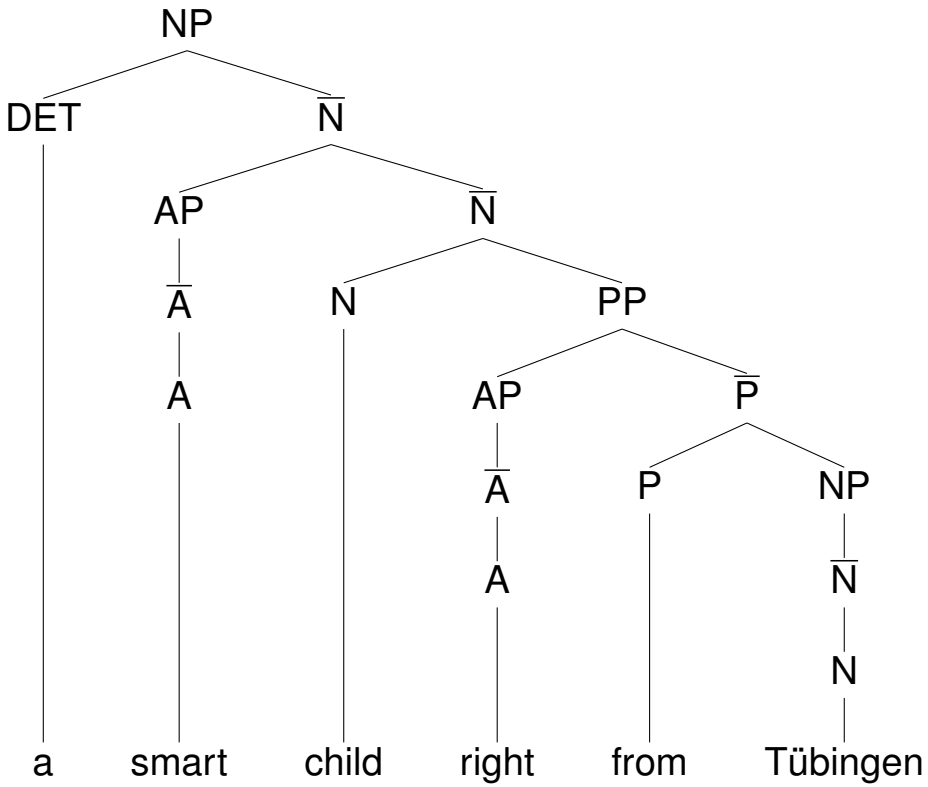
1. NP $\rightarrow$ DET $\overline{\text{N}}$
2. $\overline{\text{N}}$ $\rightarrow$ A $\overline{\text{N}}$
3. $\overline{\text{N}}$ $\rightarrow$ N

"These rules state the following: a noun phrase consists of a determiner and a nominal element ($\overline{\text{N}}$). This nominal element can consist of an adjective and a nominal element, or just a noun. Since $\overline{\text{N}}$ is also on the right-hand side of the rule, we can apply this rule multiple times and therefore account for noun phrases with multiple adjectives [...]"

Müller (2019). Grammatical theory, p. 64.

[7] These rewrite rules also adhere to the binarization constraint but they wouldn't have to.

Full Example



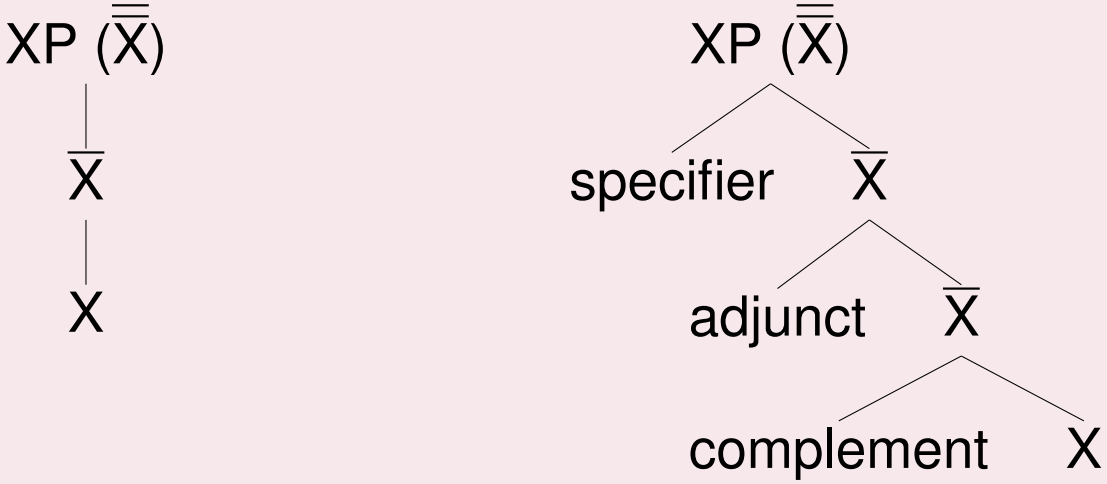
Rewrite Rules

1. NP → DET N̄
2. N̄ → AP N̄
3. N̄ → N
4. N̄ → N̄ PP
5. N̄ → N̄ REL
7. PP → NP P̄
8. PP → AP P̄
9. PP → P̄
10. P̄ → P NP
11. AP → Ā
12. AP → AdvP Ā
13. Ā → A PP
14. Ā → A

Notes: The rule number two was modified (A → AP). Rule number six is not included here as it was replaced by other rules of the X-bar notation.

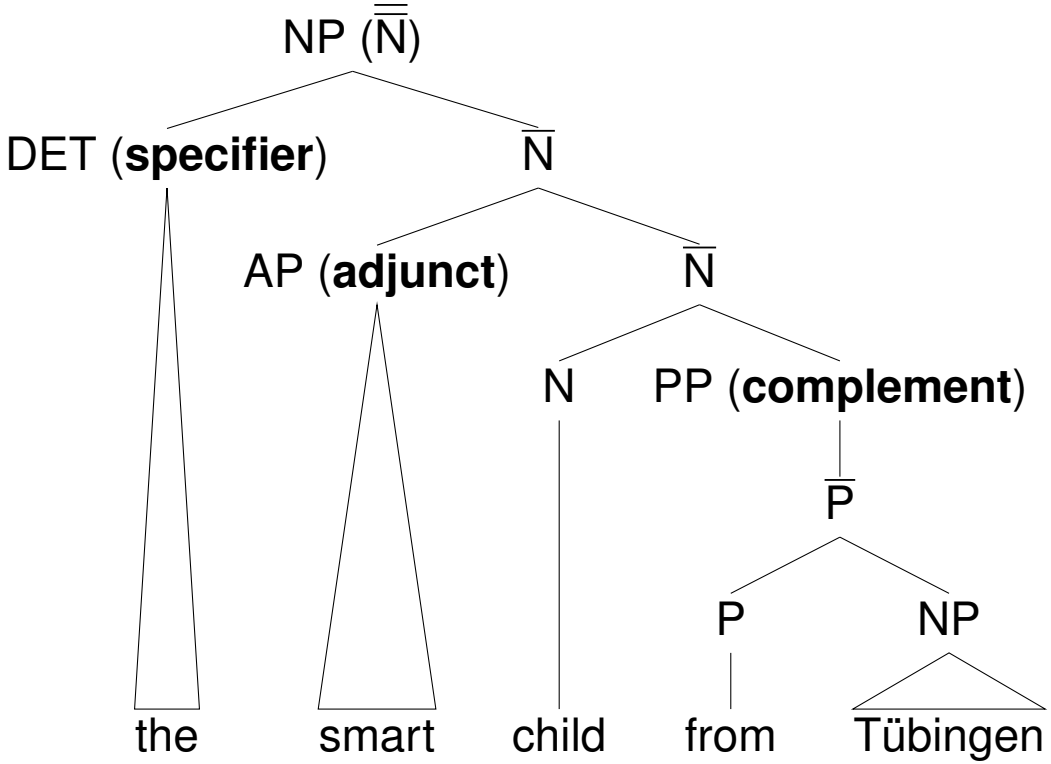
Maximal and Minimal $\overline{X}$ phrases

Given all the generalized $\overline{X}$ rules above we get to the **minimal** and **maximal phrase structure** possible within $\overline{X}$ theory:



Müller (2019). Grammatical theory, p. 76.

Example of Maximal $\overline{X}$ Phrase



Basic Concepts And Their Importance

- Constituency ✓
- POS ✓
- Heads ✓
- Valency ✓[8]
- Grammatical Functions(✓)[9]

[8] Valency now plays a more crucial role as in DG and PSG, since the X-bar scheme explicitely reflects the difference between arguments and adjuncts.

[9] Grammatical functions become more relevant, since the subject is mostly associated with the specifier position and the object(s) with the complement position(s).

Comparison: PSG and X-bar Theory

- The bar notation allows the collapsing of formerly two non-terminal symbols in PSG into one non-terminal, e.g. NP $\rightarrow \overline{\text{N}}$ and N $\rightarrow \overline{\text{N}}$. This trick allows for rules being recursively applied while preserving the constituency of non-terminals on the right side.
- X-bar theory abstracts further away from the non-terminals that were defined in classical PSG (e.g. NPs and VPs) towards general X-bar rules involving XPs.

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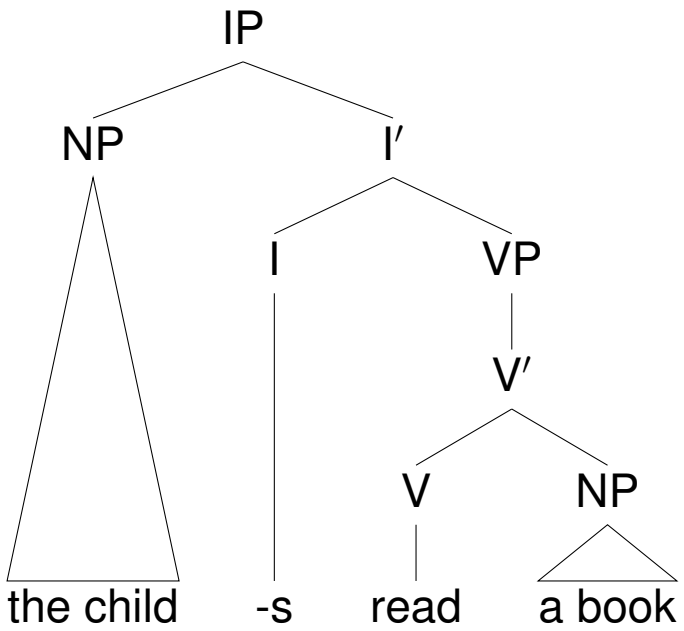
Lecture 7: Government & Binding

Inflectional Phrase

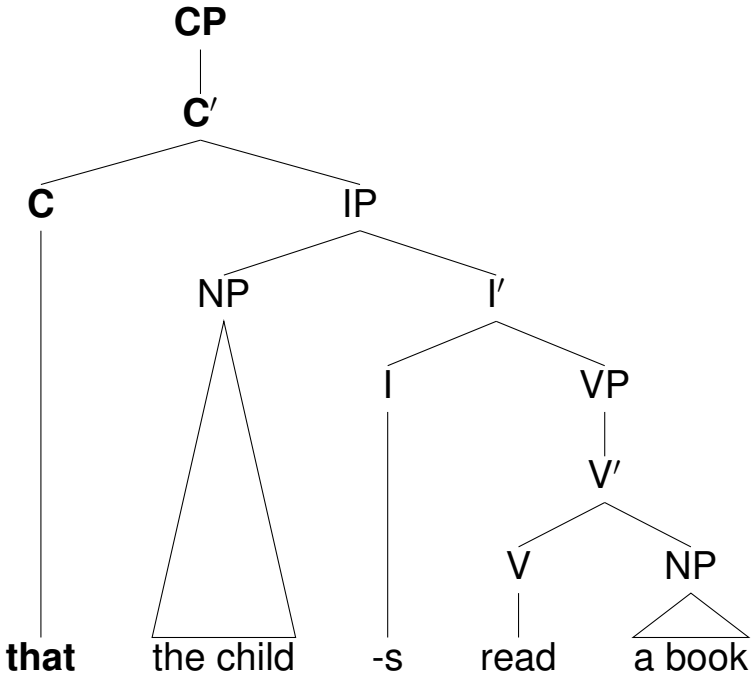
Just as in X-bar theory, we have unary branches from highest level projections to intermediate level projections if there are no other elements involved in the phrase (e.g. VP $\rightarrow$ V′). Also, the subject (the child) is considered the **specifier** of the IP (often referred to as SpecIP), and the object *a book* is the **complement** of the IP.



Complementizer Phrase

The CP is yet another level above the VP. It is relevant when a complementizer is used, but also for other syntactic phenomena, as we will see in the next section.

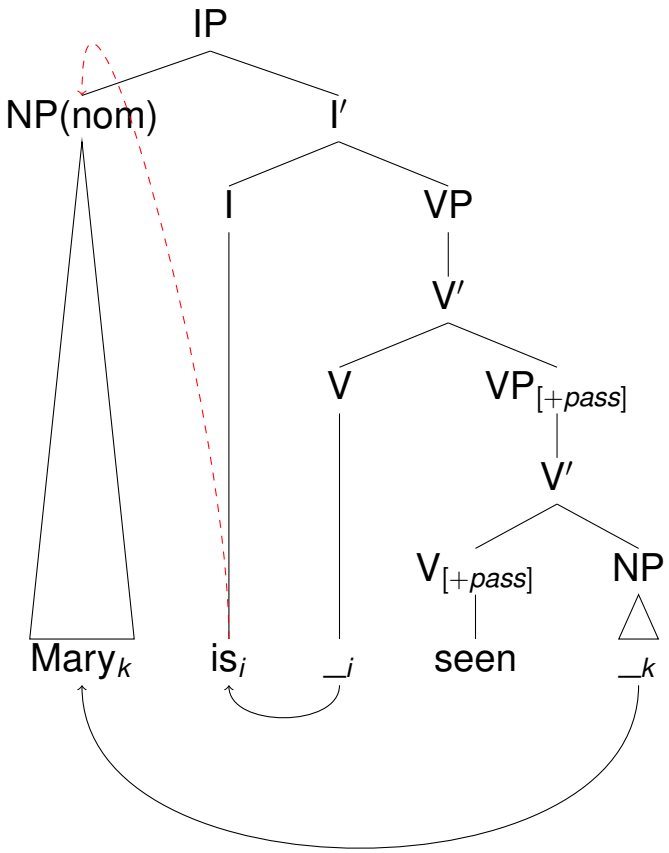
Note: The IP symbol essentially replaces the starting symbol S in GB analyses. Of course, we could keep the starting symbol and rewrite it into IP, but this would be somewhat redundant.



Passive (S-Structure)

In the corresponding passive sentence, firstly, the subject of the active sentence is cancelled. This allows for the accusative object of the active sentence to move into the NP position of the IP. Also, a new verb (is) is "recruited" from the lexicon. This is enabled by the rewriting rule: $V' \rightarrow V\ VP$. Hence, nominative case is then assigned by the auxiliary *is* to the new subject. Accusative case is "absorbed", i.e. not assigned anymore.

see also Black (1999), p. 30-31



Basic Concepts And Their Importance

- Constituency ✓
- POS (✓)[10]
- Heads ✓
- Valency ✓
- Grammatical Functions(✓)[11]

[10] With the introduction of the CP and the C position comes the dillusion of clearly defined POS. Remember that words of different POS classes can now be assigned to C. Also I (finiteness, inflection) is a category that does not map onto classical POS.

[11] Same as for X-bar theory.

Comparison: PSG and GB Theory

- Transformations allow for a systematic underlying connection between constructions such as active and passive, while PSG would have to handle this via separate rules.
- GB (and X-bar theory in some flavors) introduces C and I as non-terminals to enable transformations which require an underlying D-structure template and a S-structure realization via movement and traces.
- The introduction of C and I also leads to a divergence from the formerly fundamental constraint that POS are associated with particular lexical items.

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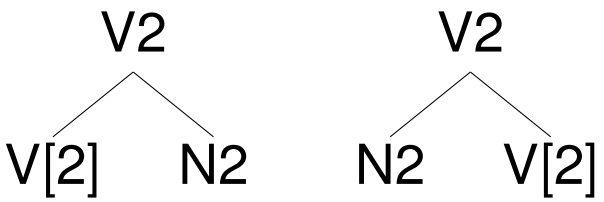
Lecture 8: Generalized Phrase Structure Grammar

GPSG Rules: Immediate Dominance (ID)

Notice a further subtle difference: In GPSG rules, a **comma** is put in between the symbols on the right side of the rewrite rule instead of just a blank space. This means that the **order of the symbols is free** to start with. The rule is then called an **Immediate Dominance (ID)** rule, since it only captures which symbol dominates other symbols.

$$V2 \rightarrow V[2], N2 \equiv V2 \rightarrow N2, V[2]$$

Both tree possibilities are licensed:



GPSG Rules: Linear Precedence (LP)

If linearization constraints are necessary to license the correct word orders, then they are implemented in so-called **Linear Precedence (LP)** rules.

"Of course, in general we will want a grammar to be able to impose some constraints on the linear precedence relations between sisters. In order to do this, we introduce a relation $\prec$, where A $\prec$ B means that As must precede Bs."

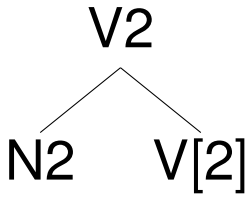
Gazdar et al. (1985). Generalized phrase structure grammar, p. 46.

If we have the rules:

(8) V2 $\rightarrow$ V[2], N2

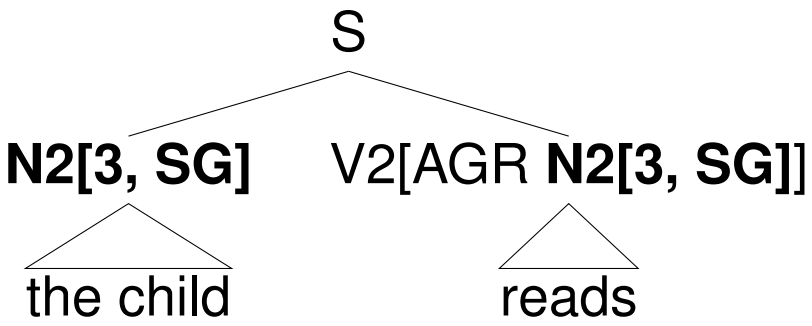
(9) N2 $\prec$ V[2]

This licenses only:



The Control Agreement Principle

In order to model agreement – in the case of English between VPs and NPs – Gazdar et al. (1985, p. 83) introduce the **Control Agreement Principle**. The control relation between the controller and the target is such that the target contains a feature AGR which is then linked to the controller (i.e. filled by the controller). For example, the VP can contain an AGR feature which specifies that it agrees in person and number with the respective NP.



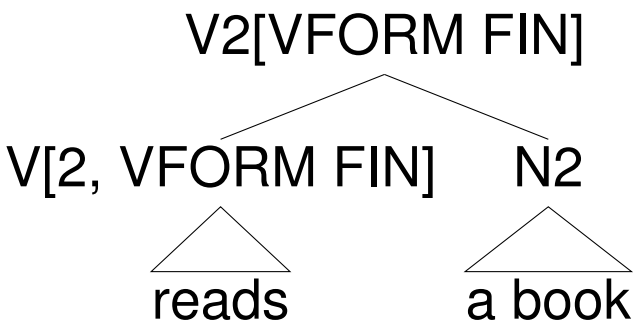
Note: This somewhat contradicts the general idea that the head (i.e. the verb in a verb phrase) assigns agreement features to the subject noun phrase. But note that in practice it does not matter who is the controller and who the target, as long as agreement is guaranteed.

Head Feature Convention (HFC)

This principle can be roughly summarized as: “The mother node and the head daughter must bear the same head features unless indicated otherwise.”

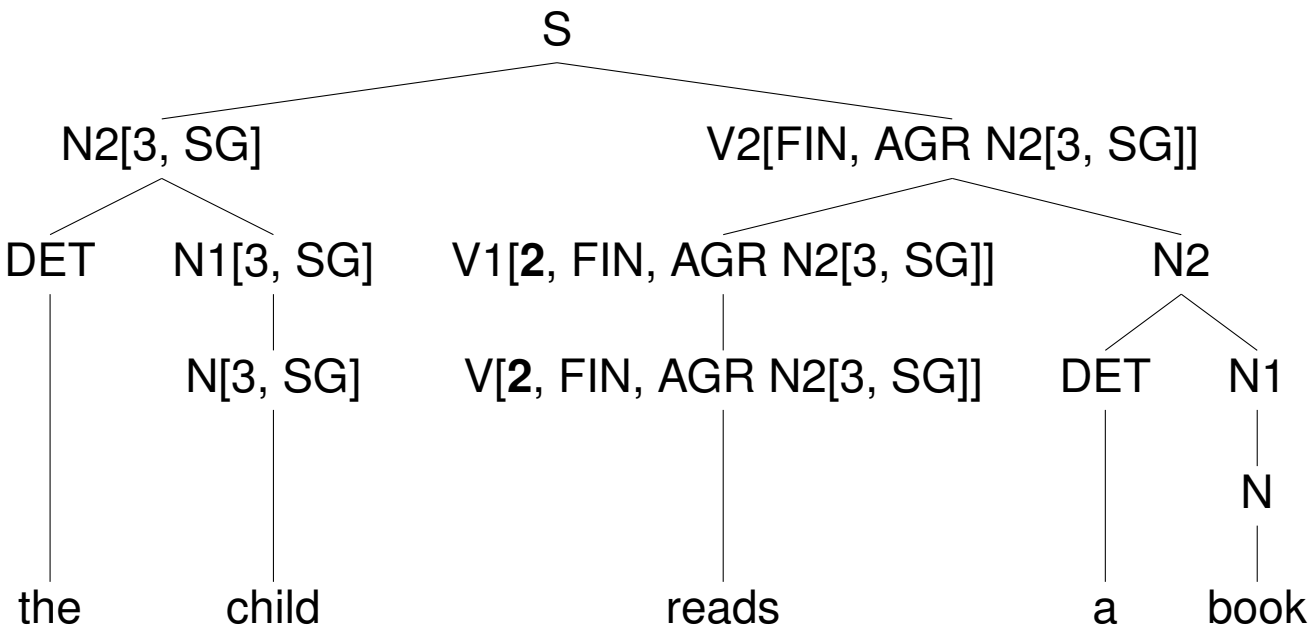
Müller (2019), p. 182.

Note: this does not include the SUBCAT feature. Subcategorization is here modelled as only becoming relevant at the level below the highest projection.



Note: While in the rewrite rules the H notation is used for the head of the VP phrase, in the tree notation Gazdar et al. (1985) use the POS symbol (i.e. V). We here use the POS symbol with feature specifications in both to show the correspondence.

Example of Full Declarative Sentence



ID rules

(10) S → N2[3, SG], V2[FIN, AGR N2[3, SG]]
(11) N2[3, SG] → DET, N1[3, SG]
(12) V2[FIN, AGR N2[3, SG]] → V1[2, FIN, AGR N2[3, SG]], N2
(13) N2 → DET N1

LP rules

(14) N2 ≺ V2
(15) DET ≺ N1
(16) V1 ≺ N2

Basic Concepts And Their Importance

- Constituency ✓
- POS ✓
- Heads ✓
- Valency ✓[12]
- Grammatical Functions x

[12] In a similar vein as for PSGs, valency helps to determine the non-terminals in rewrite rules. However, lexical subcategorization flexibly maps between particular verbs and different rewrite rules, such that verbs can be ambivalent. Also, the distinction between arguments and adjuncts is not important.

Comparison: GB and GPSG

- There is a general lack of detailed formalization in GB (see Müller, 2019, p. 119ff.), while exact formalization is taken up as a challenge in GPSG
- Connections between linguistic structures that are handled via transformations in GB (e.g. passive) are handled with metarules in GPSG, i.e. preserving the context-free nature of the rewrite rules.
- In GPSG, long-distance dependencies are also handled locally, i.e. preserving context-freeness of rules, and hence without recurrence to movement and traces.

Exercise 1: GPSG

Take the following German sentence:

(17) Das Kind ha-t die
the.NOM.SG child.NOM.SG have-3P.SG the.ACC.PL
Bücher gelesen.
book.ACC.PL read.PSP
"The child has read the books."

Assume that the order of words here is representative of German grammar. Note that we have disregarded grammatical gender here. PSP means *past participle* in accordance with the notation by Gazdar et al. (1985). Do the following tasks:

Exercise 1: GPSG

1. Create the GPSG ID rules needed to analyze this sentence. Disregard morphological features for now. Do not use the head notation (H[]) but the actual POS labels. Assume the same SUBCAT for the main verb *read* as defined for English in the lecture. Use the same rule for generating the auxiliary verb *hat* as was used for the copula *be* in the lecture. You do not need to expand N2s into DET and N. You do not need to expand V1s into Vs and then into terminals, just give the V1s.
2. Now give the LP rules.
3. Draw the corresponding tree.
4. Now draw the same tree with the agreement features included which are relevant for agreement between N2s and V2s and V1s, i.e. CASE, VFORM, and AGR values.
5. Do your trees agree with the Head Feature Convention (HFC)?

Section 7: References

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Thank You.

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