



Syntax & Semantics WiSe 2020/2021

Lecture 10: Government & Binding (GB)

10/12/2020, Christian Bentz



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Q&As

In the lecture on X bar theory, you introduced the rule $N(\bar{N}) \rightarrow N PP$ (as opposed to $N(\bar{N}) \rightarrow N(\bar{N}) PP$) with the example "father of Peter". Your argument for the necessity of the $N PP$ rule was that it disallowed phrases like "father right of Peter". However, according to the PP rules, $PP \rightarrow AP P(\bar{N})$, which could be rewritten as "right of Peter", so it actually seems to me that constructions like "father right of Peter" are still possible with the $N PP$ rule. What changed is not the PP , but the noun, which cannot have a complement or adjunct any more (e.g. "oldest father of Peter" would not make sense since Peter only has one father, and even if "old father of Peter" does make sense, "old" would then be an adjunct to "father of Peter", not to "father").

Yes, I think this is correct. See next slide.

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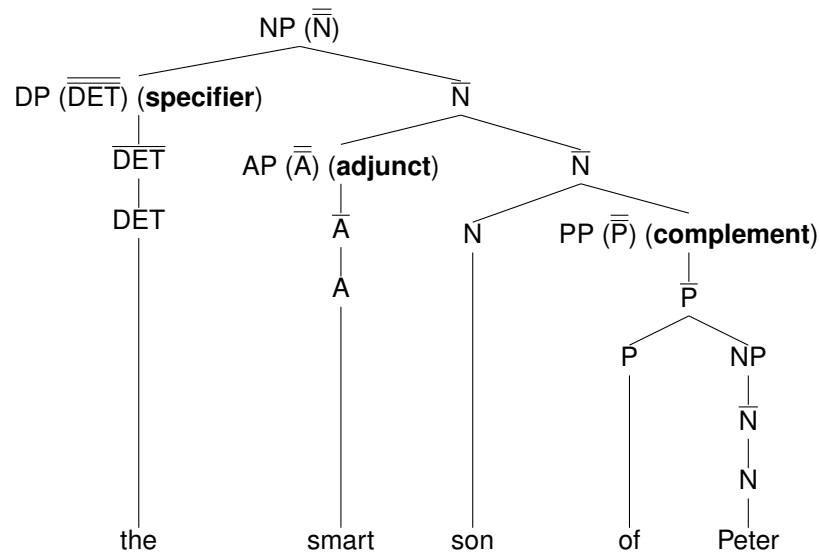
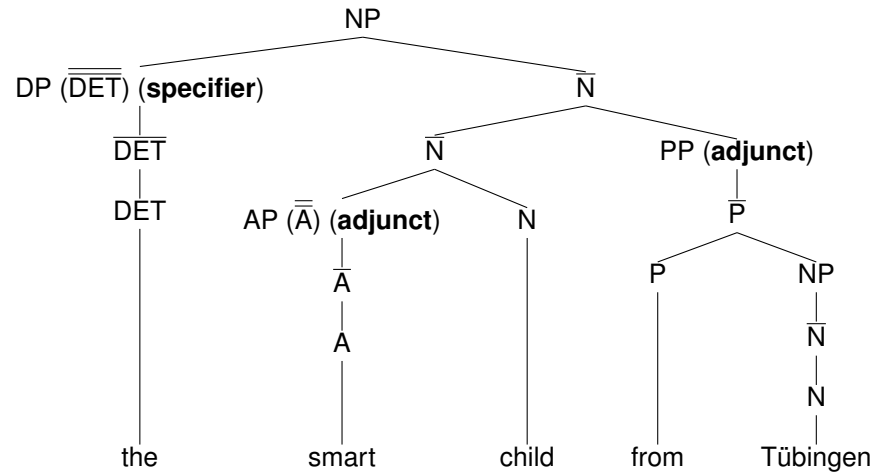
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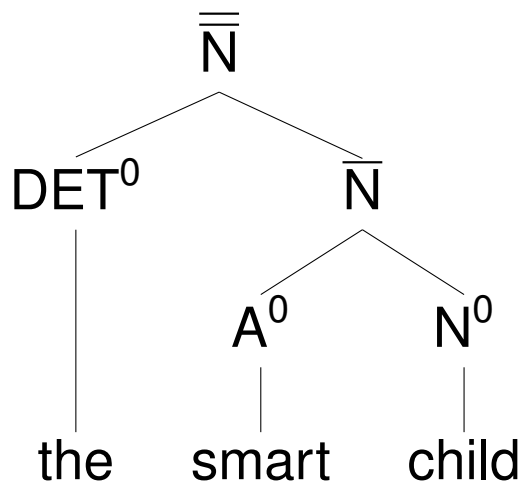


Section 1: Recap of Lecture 9



The bar(s) in X-bar theory

The bar is simply a notational convention to indicate the **level or position of a symbol** in the phrase structure tree – in relation to the level of the symbol that it is dominated by.



Equivalent Notations:

$\overline{\overline{N}} = NP$

$\overline{N} = NP$ or N

$N^0 = N$ (of terminal rewrite)

Note: The bars represent so-called *projection levels*. Level 0 (no bar), level 1 (one bar), level 2 (two bars).

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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:¹

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

“These rules state the following: a noun phrase consists of a determiner and a nominal element (\bar{N}). This nominal element can consist of an adjective and a nominal element, or just a noun. Since \bar{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.

¹These rewrite rules also adhere to the binarization constraint but they wouldn't have to.

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Other Adjuncts (PPs and Relative Clauses)

“Thus far, we have discussed how we can ideally integrate adjectives into our rules for the structure of noun phrases. Other adjuncts such as **prepositional phrases** or **relative clauses** can be combined with N in an analogous way to adjectives [...]”

4. $\bar{N} \rightarrow \bar{N}$ PP (e.g. the woman from Stuttgart)
5. $\bar{N} \rightarrow N$ PP (e.g. father of Peter)
6. $\bar{N} \rightarrow \bar{N}$ REL (e.g. the woman who ...)

Müller (2019). Grammatical theory, p. 66.

Note: Rule 5. is a special rule for so-called *relational nouns* (e.g. *father (of)*, *son (of)*, *picture (of)*). Here, the PP is considered a direct complement of the noun (i.e. a possessive construction would be incomplete without it).

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Prepositional Phrases

In order to cover such examples including an indication of measurement (e.g. *shortly, one step*) we can choose the following set of X-bar rules:

$$8. PP \rightarrow NP \bar{P}$$

$$9. PP \rightarrow AP \bar{P}$$

$$10. PP \rightarrow \bar{P}$$

$$11. \bar{P} \rightarrow P NP$$

Müller (2019). Grammatical theory, p. 72.

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Adjective Phrases

Therefore, he proposes the following rules:

$$12. AP \rightarrow \bar{A}$$

$$13. AP \rightarrow AdvP \bar{A}$$

$$14. \bar{A} \rightarrow A PP$$

$$15. \bar{A} \rightarrow A$$

Müller (2019). Grammatical theory, p. 74.

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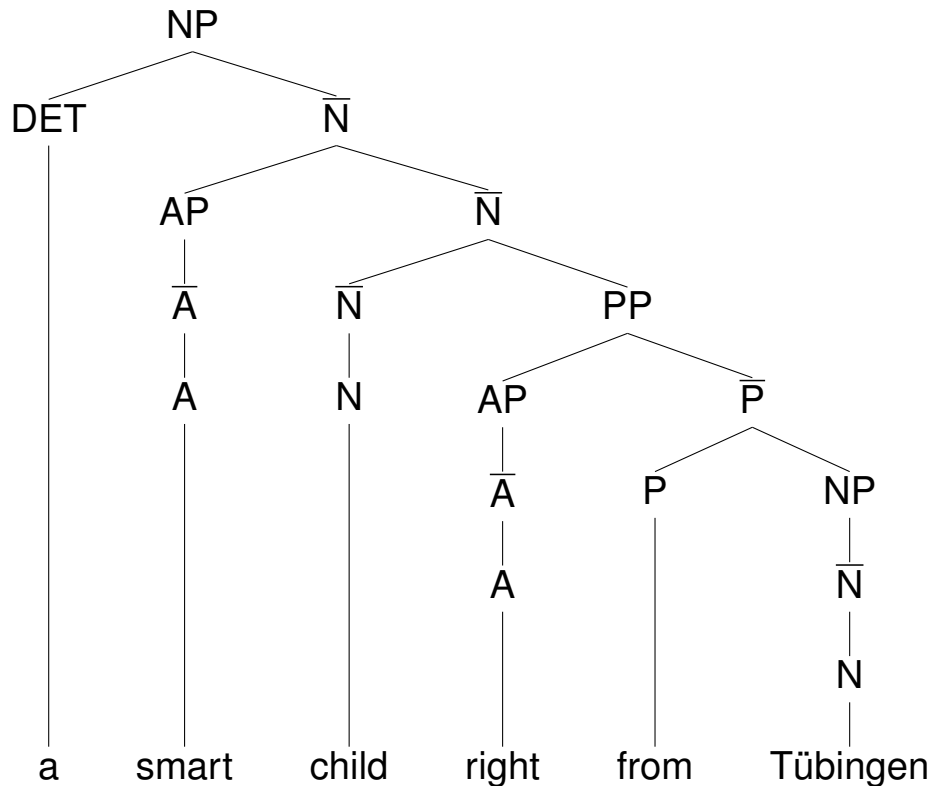
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Full Example



Rewrite Rules

1. $NP \rightarrow DET \bar{N}$
2. $\bar{N} \rightarrow AP \bar{N}$
3. $\bar{N} \rightarrow N$
4. $\bar{N} \rightarrow \bar{N} PP$
5. $\bar{N} \rightarrow N PP$
6. $\bar{N} \rightarrow \bar{N} REL$
8. $PP \rightarrow NP \bar{P}$
9. $PP \rightarrow AP \bar{P}$
10. $PP \rightarrow P$
11. $P \rightarrow P NP$
12. $AP \rightarrow \bar{A}$
13. $AP \rightarrow AdvP \bar{A}$
14. $\bar{A} \rightarrow A PP$
15. $\bar{A} \rightarrow A$

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



Examples of \bar{X} rules

Rewrite Rules

1. **NP** → **DET** \bar{N}
2. \bar{N} → AP \bar{N}
3. \bar{N} → N
4. \bar{N} → \bar{N} PP
5. \bar{N} → N PP
6. \bar{N} → \bar{N} REL
8. **PP** → **NP** \bar{P}
9. **PP** → **AP** \bar{P}
10. PP → \bar{P}
11. \bar{P} → P NP
12. AP → \bar{A}
13. **AP** → **AdvP** \bar{A}
14. \bar{A} → A PP
15. \bar{A} → A

Bar-notation:

1. $\bar{\bar{N}} \rightarrow \overline{\overline{\text{DET}}}$ ¹ \bar{N}
8. $\bar{\bar{P}} \rightarrow \bar{\bar{N}} \bar{\bar{P}}$
9. $\bar{\bar{P}} \rightarrow \bar{\bar{A}} \bar{\bar{P}}$
13. $\bar{\bar{A}} \rightarrow \overline{\overline{\text{Adv}}} \bar{\bar{A}}$

X-bar rule:

$$\bar{\bar{X}} \rightarrow \overline{\overline{\text{specifier}}} \bar{\bar{X}}$$

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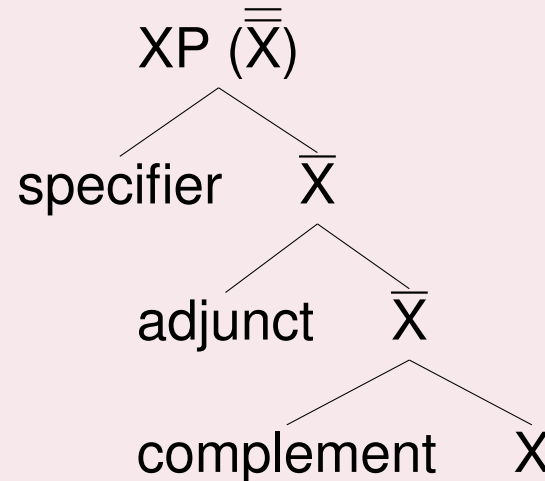
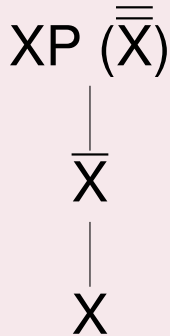
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¹ Note that this means we need two more re-write rules, and hence have several unary branches for determiners: e.g. DP ($\overline{\overline{\text{DET}}}$) → $\overline{\overline{\text{DET}}}$ → DET → the.



Maximal and Minimal \bar{X} phrases

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



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

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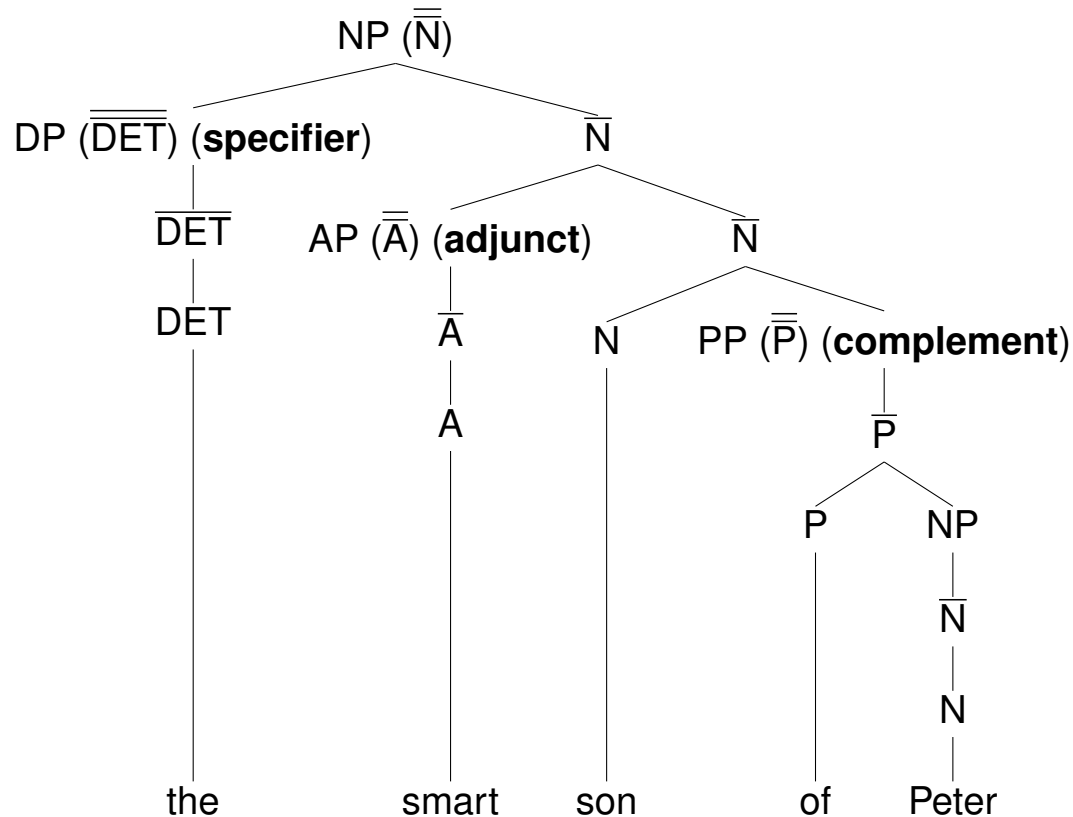
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Example of Maximal \bar{X} -Phrase



Note: *son* is here a *relational noun*. With the example above (the smart child from Tübingen) the analysis is slightly different. Namely, the PP *from Tübingen* would not be considered a complement, but an adjunct.

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Section 2: Historical Notes



Historical Perspective

“*Transformational Grammar* and its subsequent incarnations (such as Government and Binding Theory and Minimalism) were developed by Noam Chomsky at MIT in Boston (Chomsky 1957; 1965; 1975; 1981a; 1986a; 1995b). [...] The different implementations of Chomskyan theories are often grouped under the heading *Generative Grammar*. This term comes from the fact that phrase structure grammars and the augmented frameworks that were suggested by Chomsky can generate sets of well-formed expressions [...]”

Müller (2019). Grammatical theory, p. 83.

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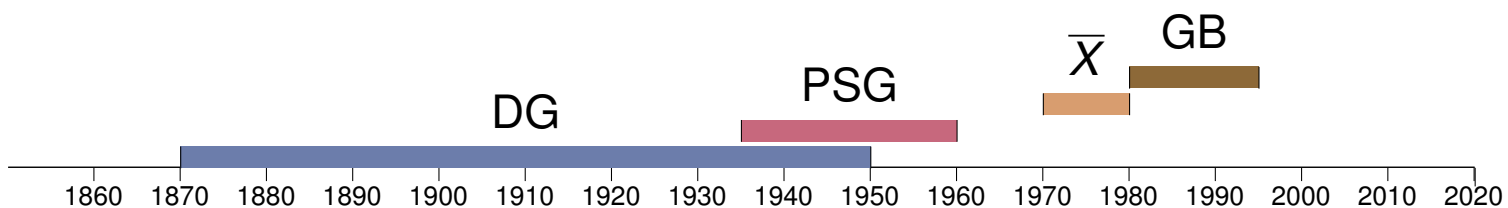
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Note: The chronology bars indicate the rough time period where the first and foundational works relating to a framework were published. All of the theories discussed here still have repercussions also in current syntactic research.



“A more extensive discussion of certain of the more technical notions appears in my paper "On Binding" (Chomsky, 1980a; henceforth, OB). [...] I will consider a number of conceptual and empirical problems that arise in a theory of the OB type and will suggest a somewhat different approach that assigns a more central role to the notion of government; let us call the alternative approach that will be developed here a "government-binding (GB) theory" for expository purposes.”

Chomsky (1981). Lectures on government and binding, p. 1.

Noam Chomsky

Lectures on Government and Binding

The Pisa Lectures

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Section 3: Basic Definitions



Additional Symbols in GB

Appart from the non-terminal symbols that we have introduced in the lectures on PSG and \bar{X} theory,² there are further symbols introduced within GB. These are in particular:

- ▶ **C**: *Complementizer* (subordinating conjunctions such as *that*)
- ▶ **I**: *Finiteness* (as well as Tense and Mood); also *Infl* for *Inflection* in earlier work, and *T* for *Tense* in more recent work.
- ▶ **D**: *Determiner* (article, demonstrative); though this is equivalent to the symbol DET that we used before.

Müller (2019). Grammatical theory, p. 95.

²Note that the transition from \bar{X} theory to GB is not clear cut, such that certain notational conventions can be found in both.

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Projection Levels

“In \bar{X} theory, one normally assumes that there are at most two projection levels (X' and X''). However, there are some versions of Mainstream Generative Grammar and other theories which allow three or more levels (Jackendoff 1977; Uszkoreit 1987).”

Müller (2019). Grammatical theory, p. 96.

- ▶ X^0 : same as before (symbol that leads to the terminal symbol).³
- ▶ X' : intermediate projection (equivalent to \bar{X})
- ▶ XP : highest projection (X'' or $\bar{\bar{X}}$)

³Müller calls this “head”. This is only true if we assume that each word by itself always constitutes a phrase that it is heading.

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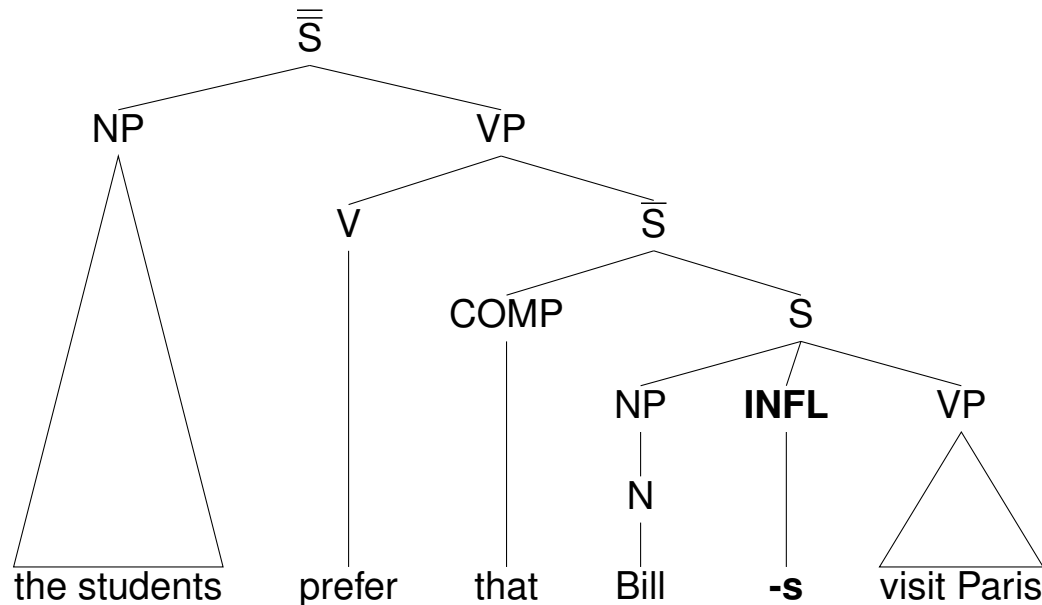


The Inflection Symbol (I)

Chomsky introduces the inflectional symbol (as INFL) in the following sentence in bracket notation:

the students [_{VP} prefer [_S COMP [_S Bill **INFL** [_{VP} visit Paris]]]]

Chomsky (1981). Lectures on government and binding, p. 19.



Note: Don't worry about the tree notation here. For example, \bar{S} and COMP will later be replaced by \bar{C} and C.

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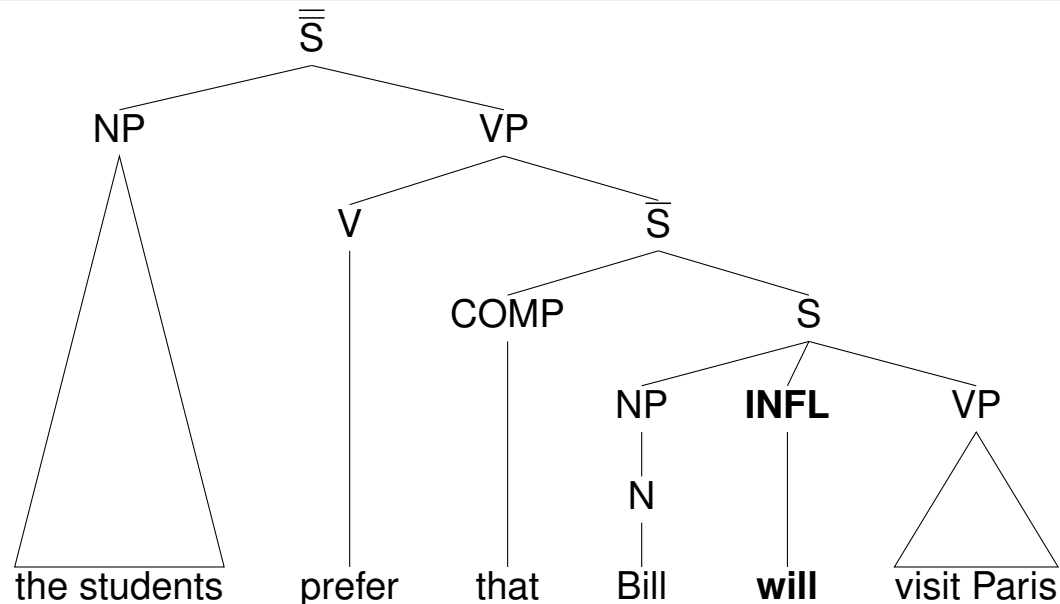
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The Inflection Symbol (I)

The idea that INFL should be in this position, namely before the verb it is actually attached to in linear order, comes from the fact that (in English) auxiliary verbs also appear in this position, and these are the finite (i.e. inflected) elements of the sentence. Hence, both auxiliary and non-auxiliary constructions can be captured by the same underlying tree structure.



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Important Take-Home-Message

As this example of inverted linear order (*-s visit*) shows, syntacticians – in the tradition of generative grammar – have grown accustomed to deviations between so-called *Deep Structure* (e.g. INFL VP) and *Surface Structure* (e.g. *visit-s*). This is seen as a necessary prerequisite for fitting all possible grammatical sentences of a given language into the same underlying mould.

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Problem: Irregulars

In English, the third person plural *-s* is highly regular, i.e. attaching to any verb stem for ensuring agreement. Similarly, in German, the third person *-t* attaches to the (sometimes modified) verb stem. But how about languages where these inflections do not exist (e.g. Mandarin Chinese), or where the finite forms are derived from roots in more complicated ways (e.g. template morphology in Standard Arabic)?

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English (eng,
Indo-European)

read-**s** (read)
speak-**s** (speak)
see-**s** (see)
go-**es** (go)

Mandarin Chinese
(cmn, Sino-Tibetan)

kàn (kàn)
shuō (shuō)
kàn (kàn)
qù (qù)

Standard Arabic
(arb, Afro-Asiatic)

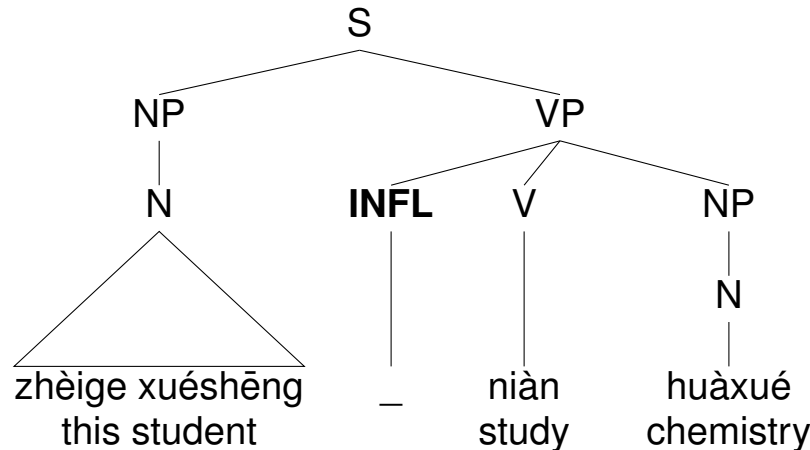
tagra'/yaqra' (qira'atan)
tataḥDath/yataḥDath (tahaDuthan)
tara/yara (ru'yatan)
tathhab/yathhab (thahaban)
(p.c. Hebah Ahmed)



Problem: Language Diversity

We can make adhoc assumptions to save our template, e.g. positing empty elements (e.g. INFL $\rightarrow \epsilon$) in languages (or particular sentences) where the inflectional category does not seem to exist. However, notice that we here essentially shoehorn a language into a structural analysis template that was developed for English.

Mandarin Chinese (cmn, Sino-Tibetan)



Sackmann (1996), p. 261.

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Back To English

If we accept the inflectional symbol as a fact of our rewrite rules then they need to be extended in the following way:

1. $S \rightarrow NP VP$
2. $S \rightarrow NP \mathbf{INFL} VP$

Müller (2019). Grammatical theory, p. 96.

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The CP and IP (and VP)

However, remember from last lecture on X-bar theory that in order to capture the recursive nature of human language there have to be rules with the same category symbol on the left- and right-hand side (e.g. $\bar{N} \rightarrow A \bar{N}$). Chomsky therefore introduced the **Complementizer Phrase (CP)** and the **Inflectional Phrase (IP)** as layers *above* the verb phrase such that:

1. $CP \rightarrow C'$
2. $CP \rightarrow NP C'$
3. $C' \rightarrow C IP$
4. $IP \rightarrow NP I'$
5. $I' \rightarrow I VP$
6. $VP \rightarrow V'$
7. $V' \rightarrow V CP$
8. $V' \rightarrow V NP$

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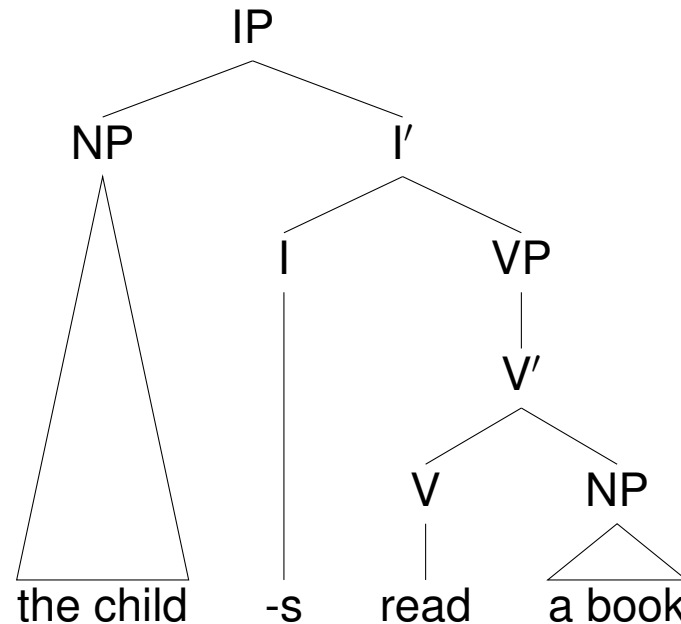
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Inflectional Phrase

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.



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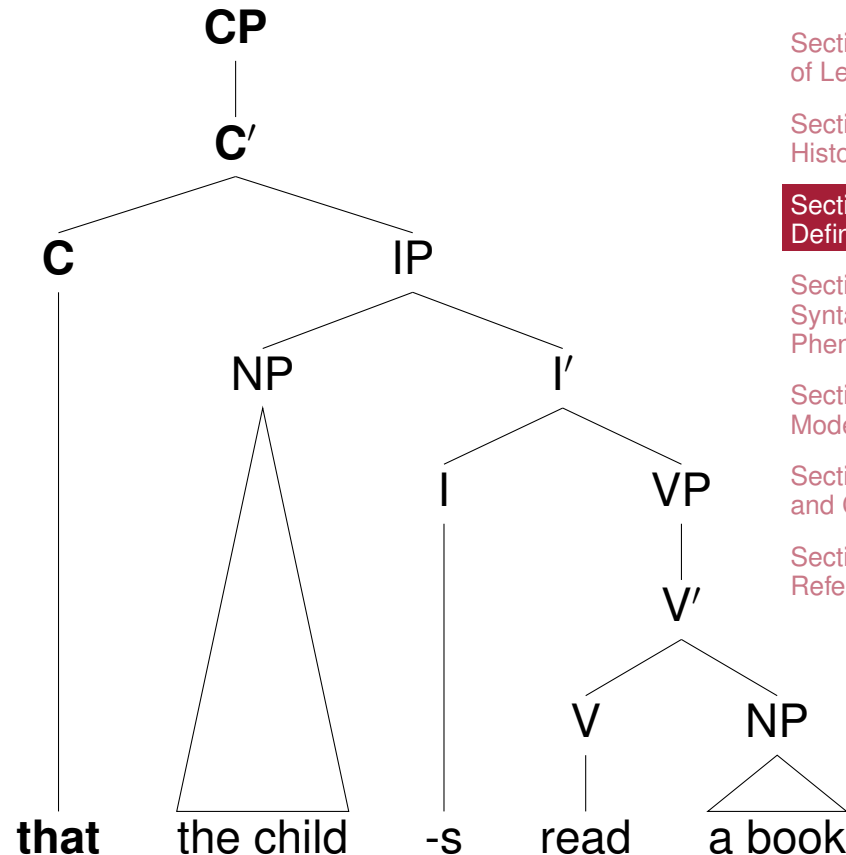
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Complementizer Phrase

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.



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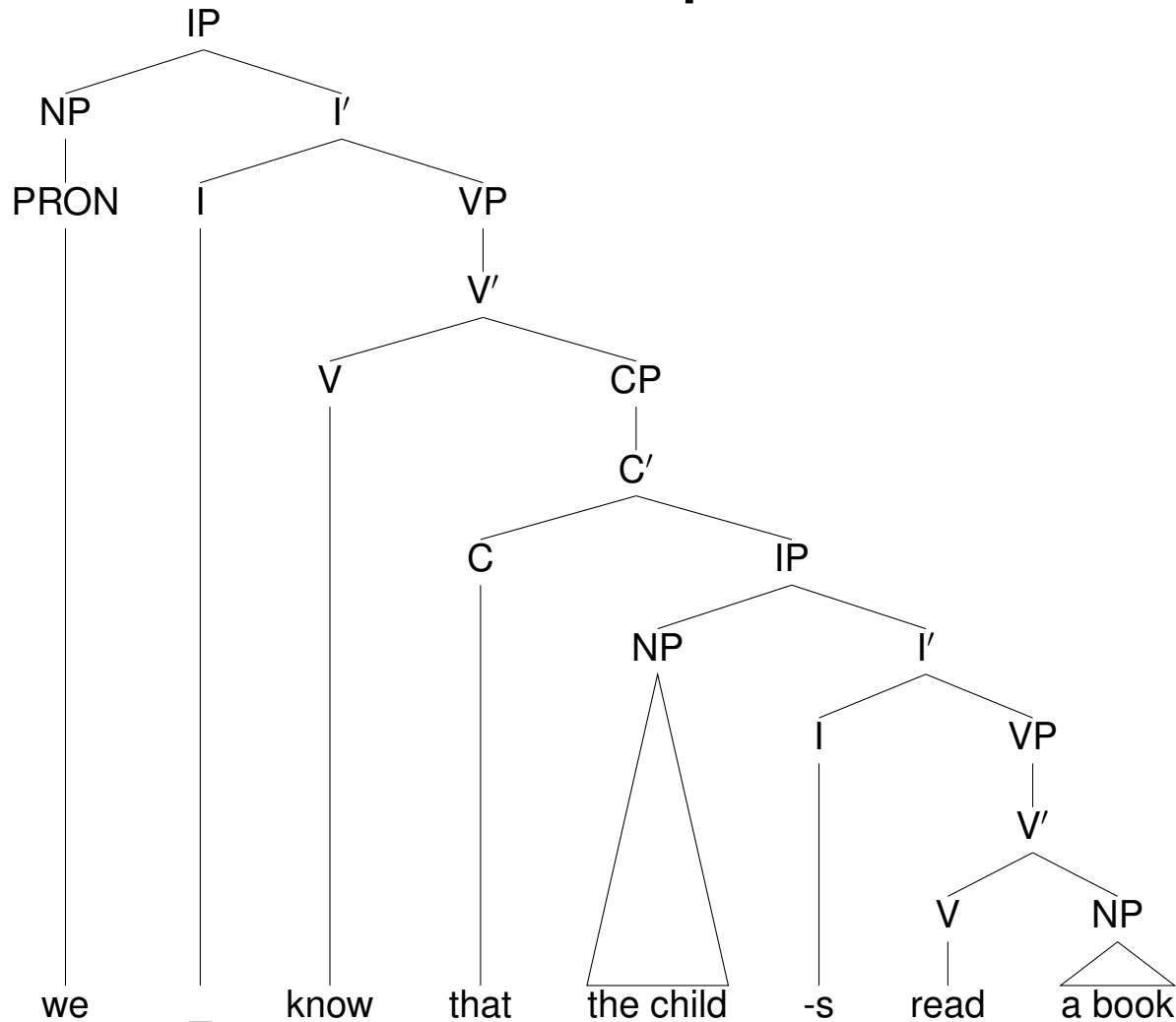
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Full Example



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Movement

“Since the inflectional affix precedes the verb [in deep structure], some kind of **movement operation** still needs to take place [to derive the actual surface structure]. There are two suggestions in the literature: one is to assume lowering, that is, the affix moves down to the verb [...]. The alternative is to assume that the verb moves up to the affix [...] I [...] assume that the verb moves from V to I in English [...]”

Müller (2019). Grammatical theory, p. 100.

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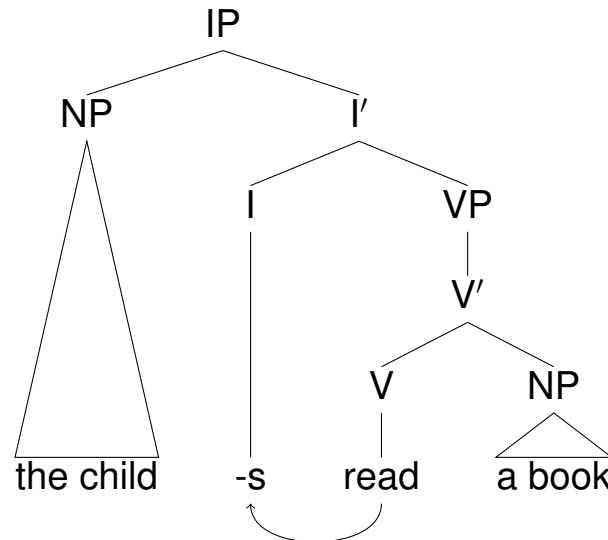
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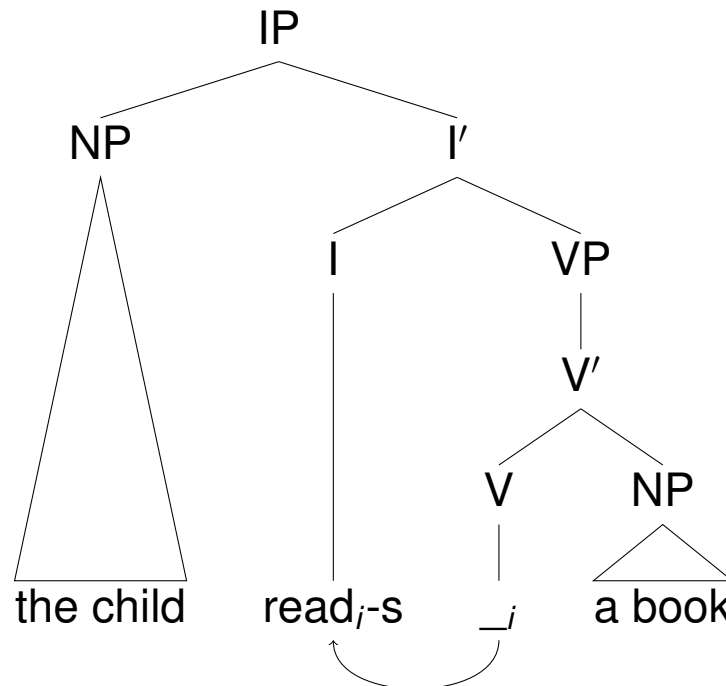
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Trace

When an element moves into another position in the tree, it leaves a so-called **trace** in the position where it was before. The trace is an empty element that is typically marked by an underscore <_> and an index (often starting with i, and j, k, etc. for further traces) which is then also found on the moved element.



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Notation Glossary

A: adjective

AP: adjective phrase

Adv: adverb

AdvP: adverbial phrase

C: complementizer (i.e. *that*)

D: determiner

I: finiteness or inflection

IP: inflectional phrase

N: noun

NP: noun phrase

P: preposition

PP: prepositional phrase

PRON: pronoun

REL: relative clause

V: verb

VP: verb phrase

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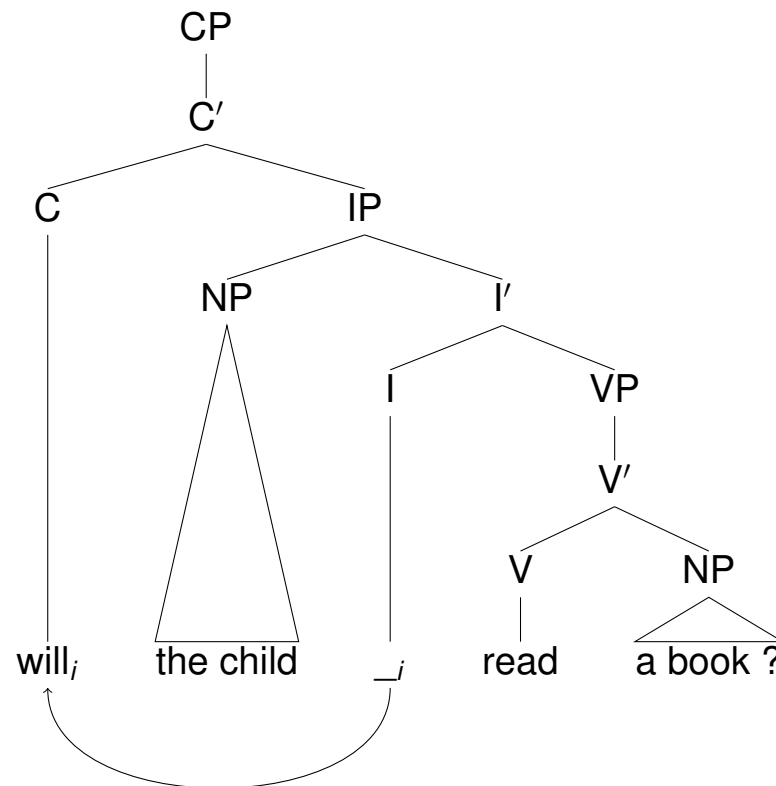
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Yes/No Questions

In some languages, including English and German, the finite verb “moves” to the beginning of the sentence to form a yes/no question. In the GB framework, this means that the verb moves into the Complementizer (C) position.

Note: The auxiliary *will* is now under the non-terminal symbol C which actually stands for a different part-of-speech category, i.e. complementizer (*that*). So here the consistency of classing lexical items under the correct POS symbols is now given up in favor of maintaining the same deep structure template.



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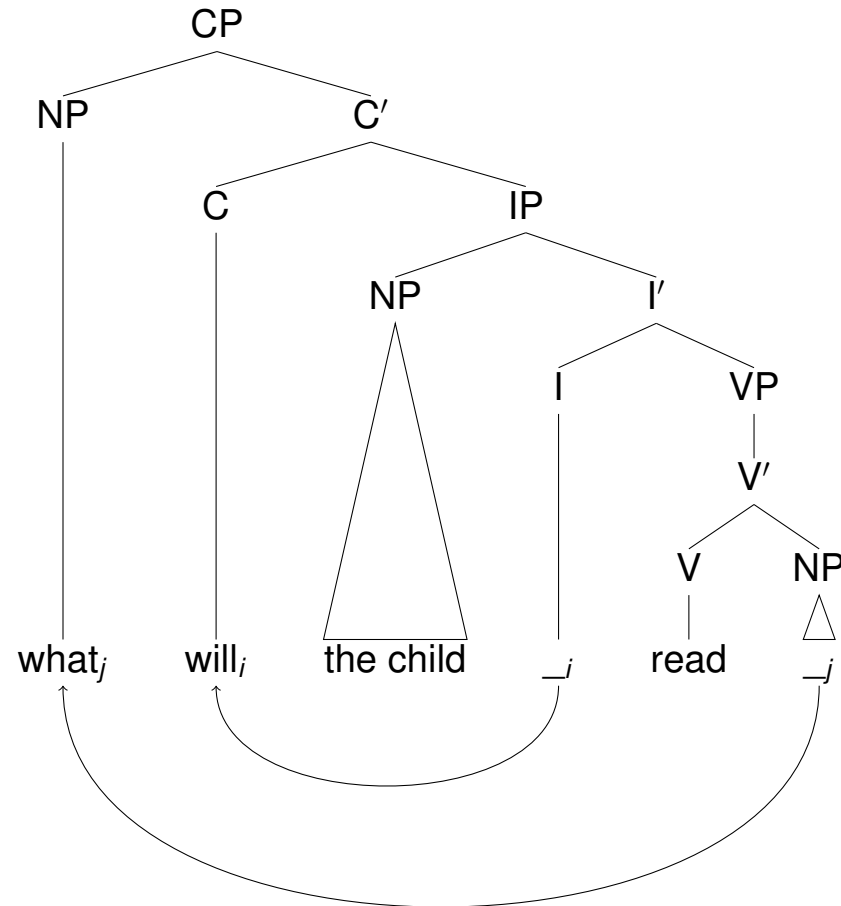
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Wh-Questions

In wh-questions, it is assumed that the wh-word is in the complement position of the verb phrase in deep structure (i.e. *what* → *the book*). It then moves to the NP position of the CP to form the surface structure realization.



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Verb Position

Verb position (initial, medial, final) can be handled in GB theory (similar to other PSG based frameworks) by flexibly changing the order of elements in the re-write rules for the IP and the VP.

Black (1999). A step-by-step introduction to the government and binding framework.

Abaza (abq, Abkhaz-Adyge)

- (1) H-pa xs^j/i yijin
our-son milk **drink**.PRF.3SG
“Our son drank milk.”

Tzotzil (tzo, Mayan)

- (2) ?i-s-pet lok’el ?antz ti t’ul-e.
CP-A3-**carry** away woman the rabbit-CL⁴
“The rabbit carried away the woman.”

⁴Abbreviations: CP = completive aspect; CL = clitic; A3 = third person absolutive.

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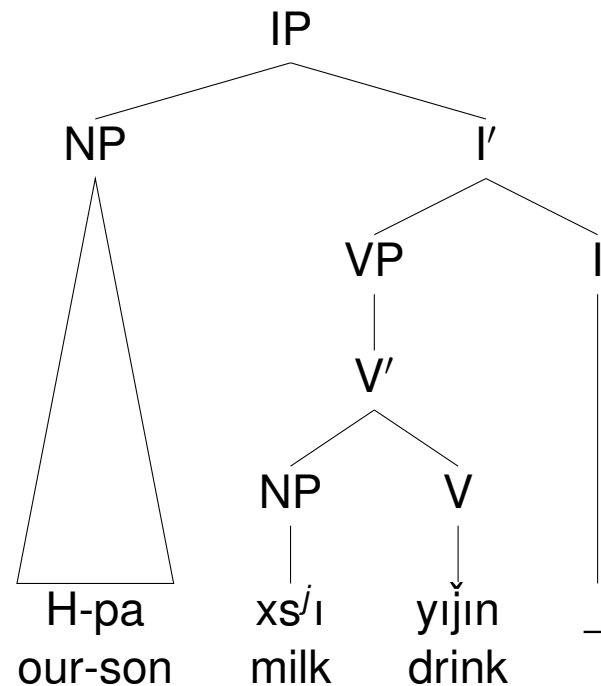
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Verb final position (SOV)

Note: Black (1999), p. 15 gives an alternative notation where the underscore representing an empty element in I is replaced by a feature matrix which reflects the inflectional features of the verb, i.e.

$$\begin{bmatrix} +past \\ 3pers \\ +sg \end{bmatrix}.$$



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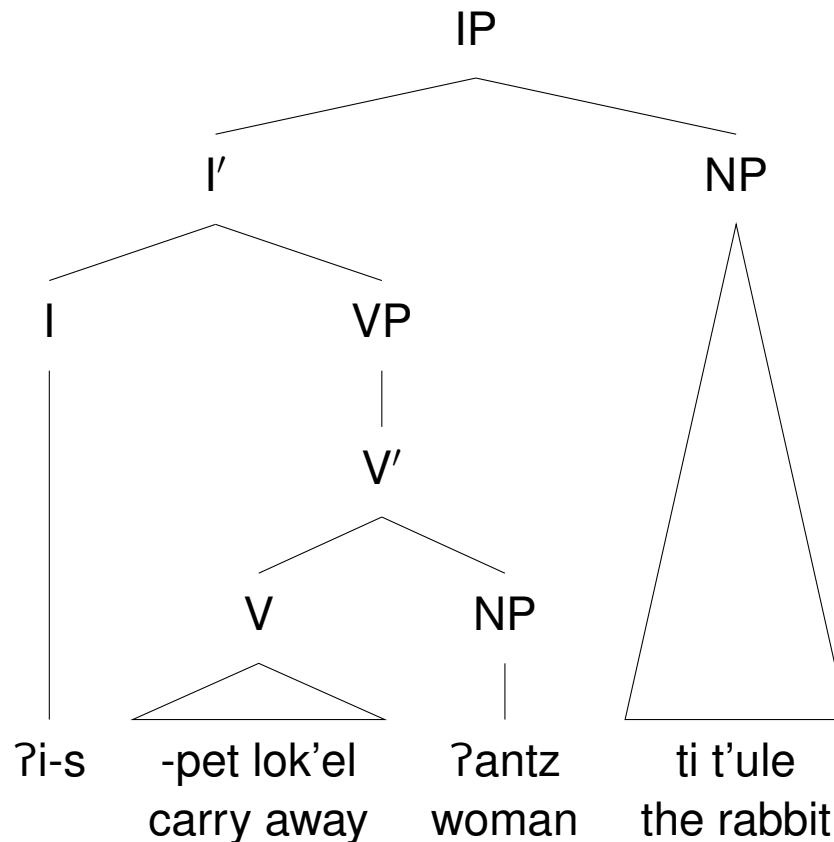
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Verb initial position (VOS)



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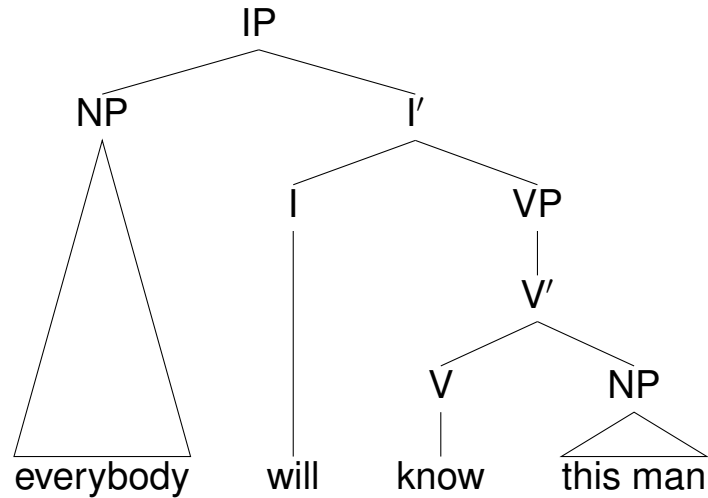
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Fronting

Fronting of elements that are topicalized is handled similar to other types of movement such as wh-movement or movement of auxiliaries in questions (see examples above). Namely, the fronted element(s) can move into positions of higher level phrases (CP and IP).

Regular Structure



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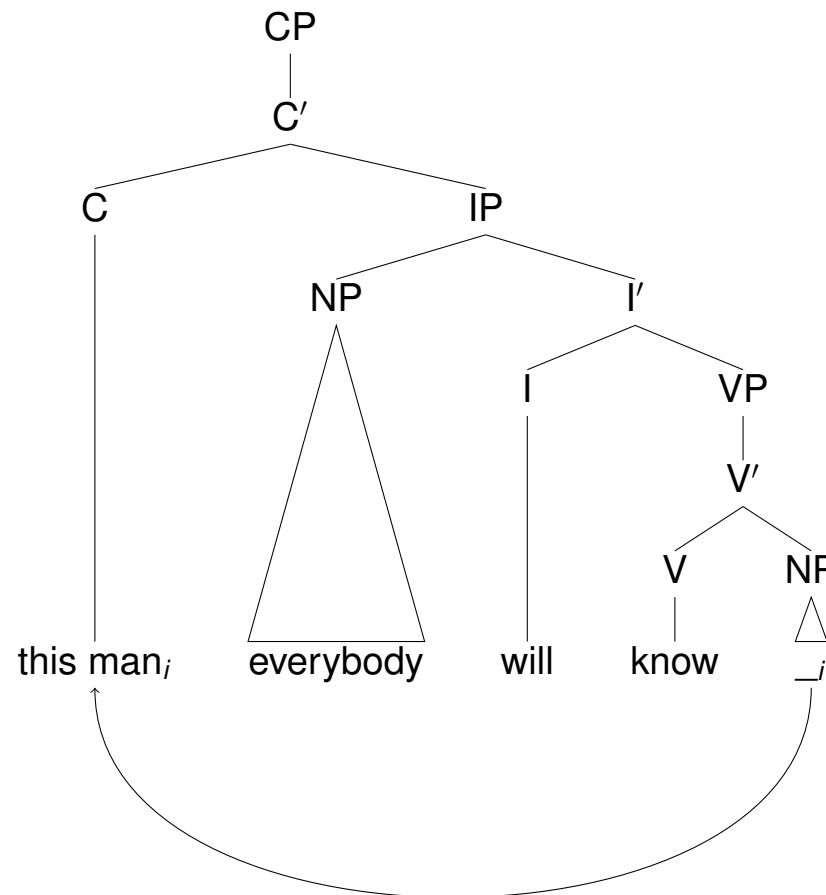
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Fronting

Fronting of elements that are topicalized is handled similar to other types of movement such as wh-movement or movement of auxiliaries in questions (see examples above). Namely, the fronted element(s) can move into positions of higher level phrases (CP and IP).

Fronted Structure



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Passive

Passive constructions are handled in GB with the same underlying deep structure as **active constructions**. Note that this is an important deviation from traditional PSGs. In a traditional PSG you would have to formulate different phrase structure rules for active and passive sentences, while within GB active and passive sentences are connected, i.e. the active sentence is **transformed** into a passive sentence.

Early example of a transformational rule going back to Chomsky (1957):

$NP_1 V_2 NP_3 \rightarrow 3 [_{AUX} be] 2en [_{PP} [_{P} by] 1]$
 John sees Mary \rightarrow Mary $[_{AUX} is] seen [_{PP} [_{P} by] John]$

Müller (2019). Grammatical theory, p. 85.

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Interlude: Case assignment

In order to fully understand the passive transformation in GB we need to know the following principle about case assignment:

Case Principle

- ▶ V assigns objective case (accusative) to its complements if it bears structural case.
- ▶ When finite, INFL assigns case to the subject.

Note: The difference between *structural case* and *lexical case* is discussed in Müller (2019), p. 109-110. However, it is generally controversial whether such a distinction is actually valuable, or if all case should be considered lexical case.

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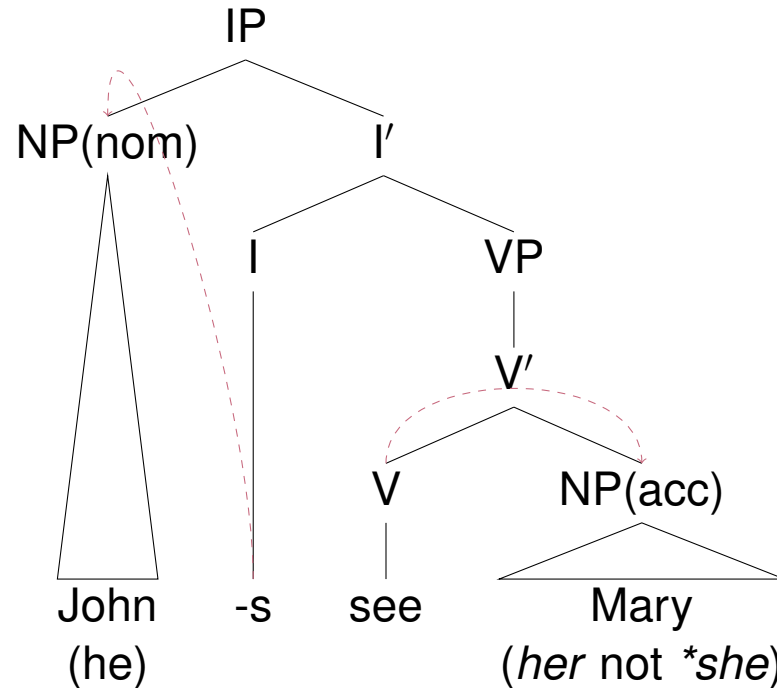
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Active (D-Structure)

Given the case principle, in an **active phrase**, I assigns nominal case to the NP in the specifier position of IP (aka SpecIP), while V assigns accusative case to its complements.



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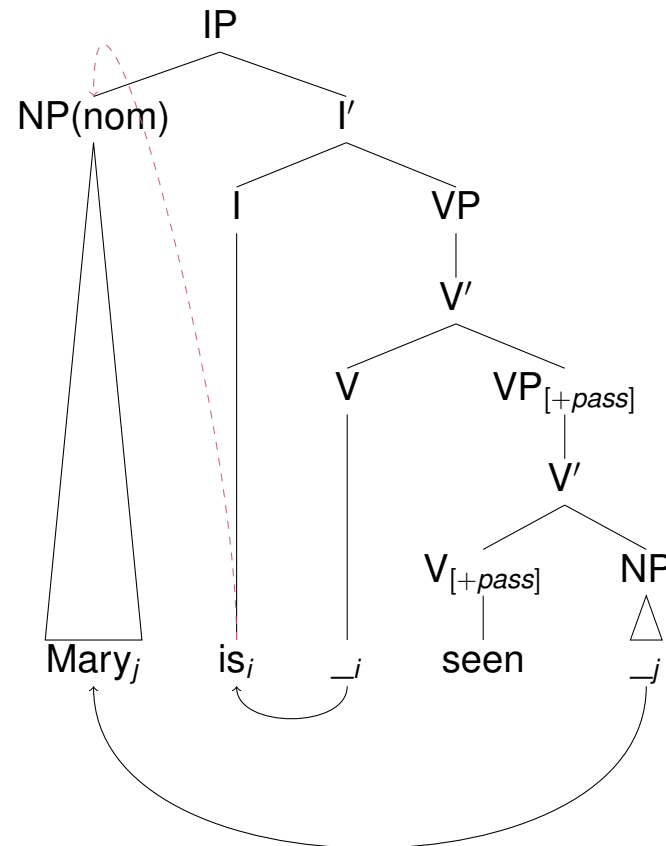
Passive (S-Structure)

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 additional rewrite rule:

$$9. V' \rightarrow V VP$$

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



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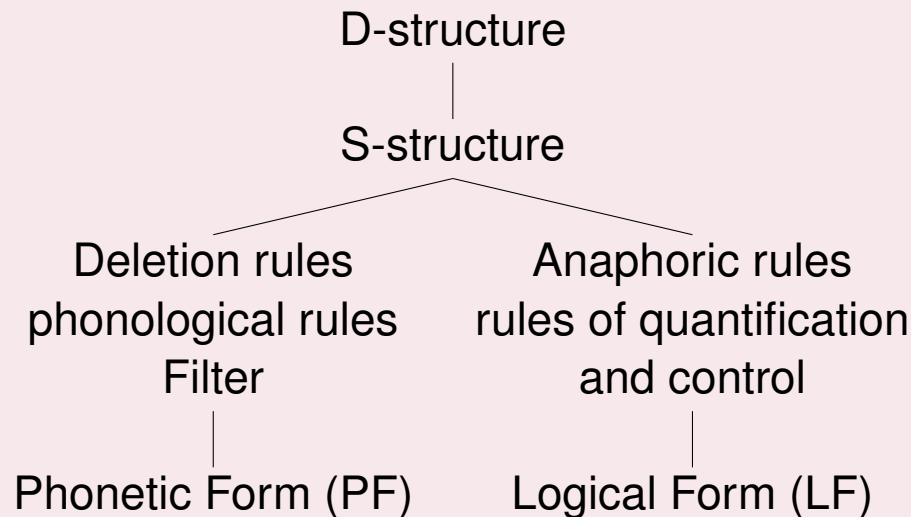


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The T Model

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



Müller (2019). Grammatical theory, p. 88.

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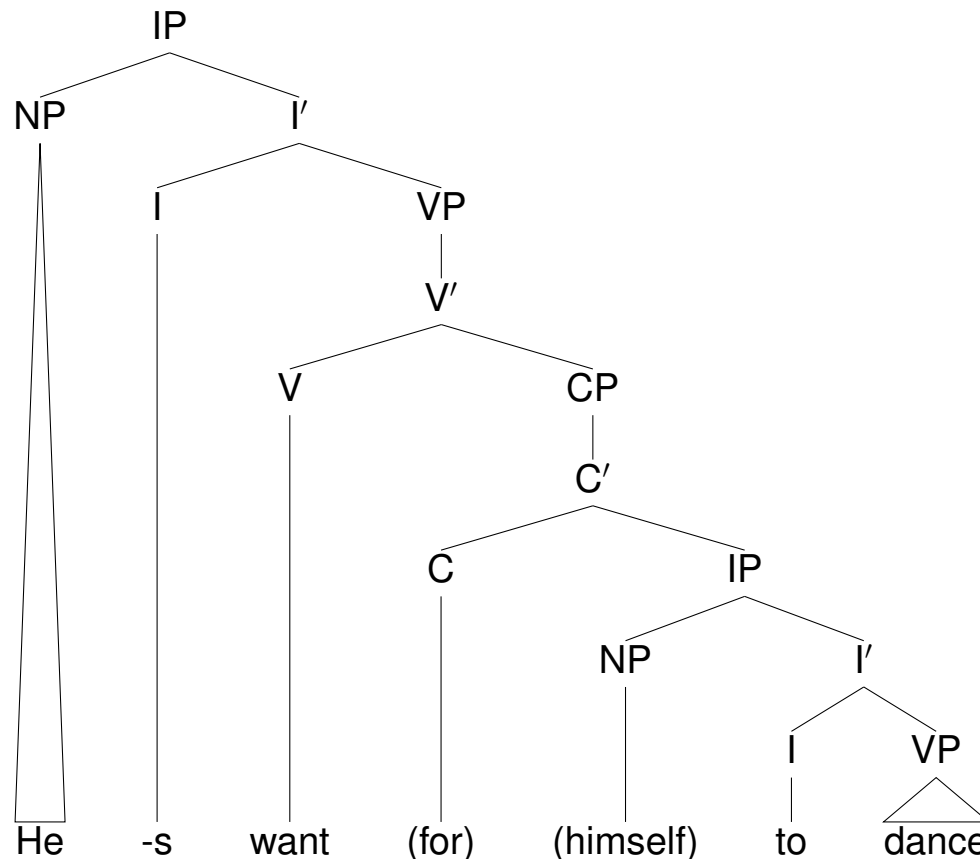
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D-Structure

Deep structure in GB theory refers to the underlying template or mould that is used to build all grammatical sentences in a given language.



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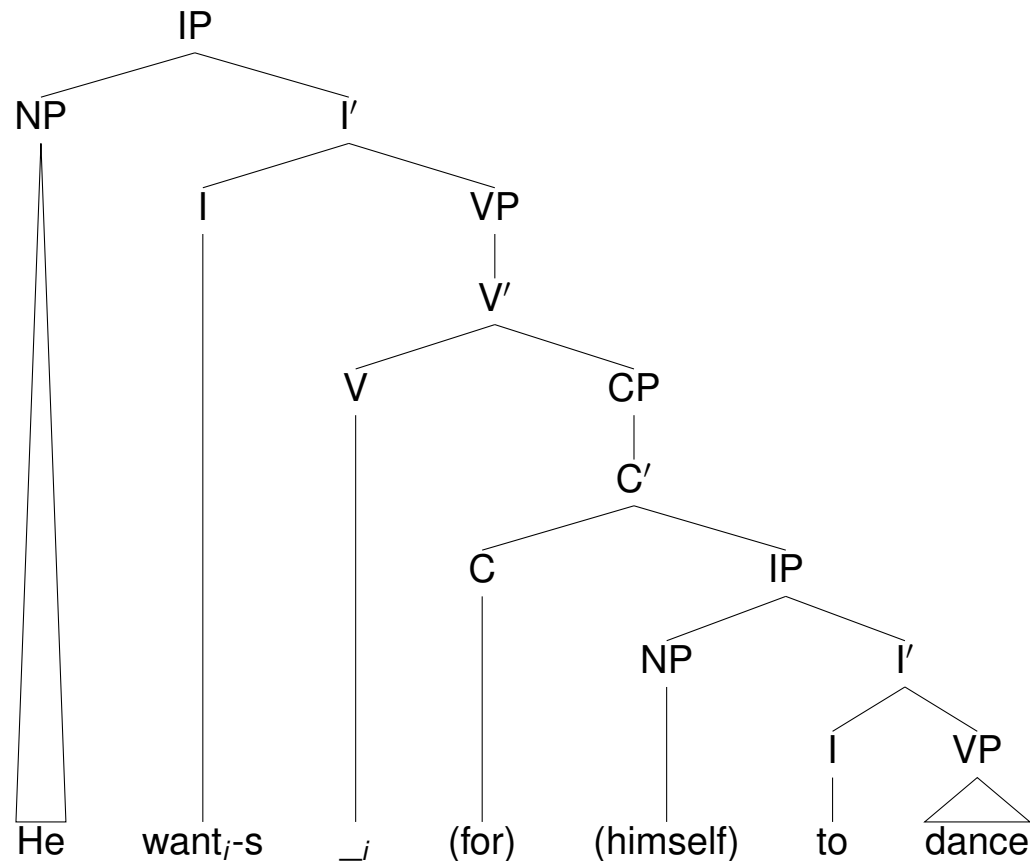
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S-Structure

Surface structure is then derived by transformations which allow to move elements around (move α) and reassign cases.



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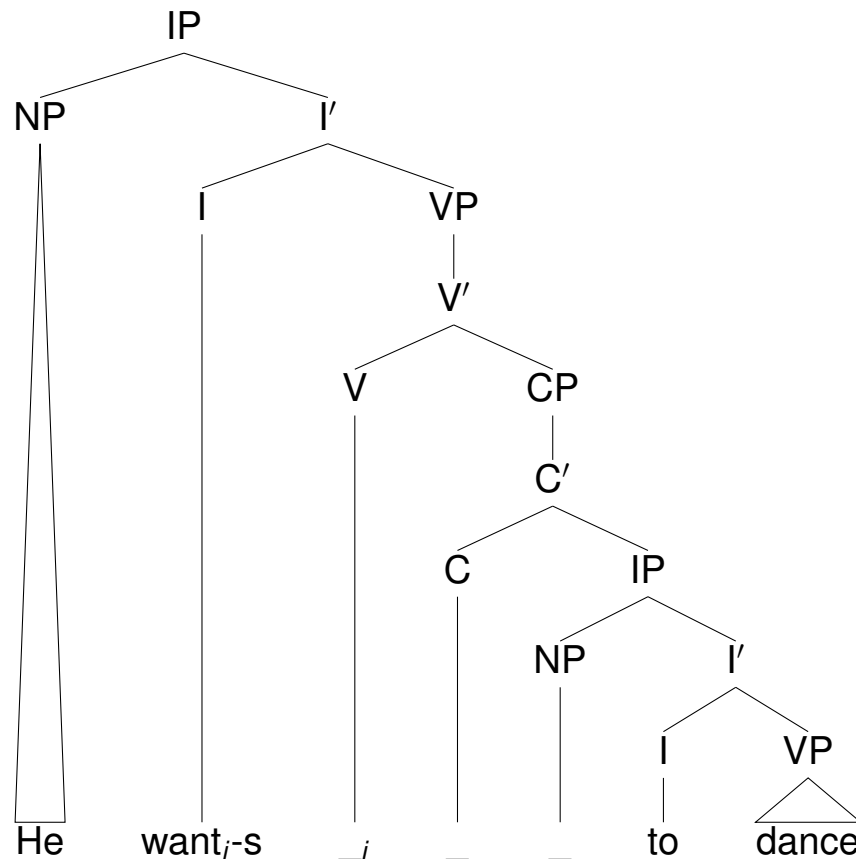
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Deletion Rules

Furthermore, deletion rules can be applied to the surface structure. Note that the underscores here represent deletions, not movement.



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Phonetic Form

Finally, there are certain regular changes to the surface structure based on phonetic processes. An example of such a change is given by Chomsky (1981, p. 21) as *want + to* → *wanna*.

He wants to dance → He *wanna* dance

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Important Take-Home-Message

What is called *S-structure* or *surface structure* in GB theory is not necessarily the actual string of characters or phonemes that you might read or hear. Rather, there are two further levels which intervene between S-structure and the actual phonetic realization. For instance deletions and phonetic rules might still apply.

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Logical Form

Logical Form is not further discussed here, as the underlying concepts are part of the semantics lectures. Just note that in the GB framework questions of LF (i.e. semantics) are addressed at a later stage than D-Structure and S-structure, which again reflects the “primacy” of syntax within this framework.

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Why is the framework called **Government & Binding?**

Remember from the simplified example of case assignment above that there are rules of which elements (e.g. I and V) assign case (e.g. nom, acc) to which other elements (e.g. NPs). Black (1999, p. 37) now states that: “every maximal projection (XP) that dominates the NP that receives Case also dominates the head that assigns it [...]”. This observation then leads to the definition of **Government**:

α GOVERNS β iff

1. α is a head, and
2. every XP that dominates α also dominates β , and
3. every XP (other than IP) that dominates β also dominates α

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Why is the framework called Government & Binding?

“Case Theory determines whether a nominative pronoun, such as *she* or *he*, is used instead of an accusative pronoun, *her* or *him*, or a genitive pronoun like *his*. It is **Binding Theory’s** job to determine when a reflexive anaphor, for example, *herself*, is used instead of one of the pronouns, *she* or *her*.”

Black (1999), p. 40.

1. She/*her/*herself shuddered.
2. Sally enjoyed *she/*her/herself at the party.
3. Sally left a note for *she/her/herself.

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Pros (Advantages)

- ▶ Formulates a highly abstract and general template (D-Structure) which can be used to model all types of sentences and syntactic phenomena (at least that is the aim)

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Cons (Disadvantages)

- ▶ This highly abstract template requires many complicated mechanisms (movement, empty elements, case assignment, etc.) to derive the set of possible sentences of a language
- ▶ The lack of precise formulizations of these mechanisms has resulted in GB theory – and other so-called Mainstream Generative Grammar approaches – being largely ignored by computational linguists. See the discussion in Müller (2019, p. 120).

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Thank You.

Contact:

Faculty of Philosophy

General Linguistics

Dr. Christian Bentz

SFS Wihlemstraße 19-23, Room 1.24

chris@christianbentz.de

Office hours:

During term: Wednesdays 10-11am

Out of term: arrange via e-mail