Building structure

1 Constituents as a window into underlying hierarchical structure

Last week: 9 constituency tests

(1) **The results of some constituency tests:**

"I saw a bear with a telescope."

a. I have the telescope:

I saw a bear with a telescope [I] [[saw [a bear]] [with [a telescope]]]

b. The bear has a telescope:

I saw a bear with a telescope [I] [saw [a bear [with [a telescope]]]]

Constituency tests show us that some parts of sentences seem to act as a unit for the purposes of various linguistic processes. But what exactly are these constituents?

(2) **Hierarchical structure hypothesis:**

Sentences have an internal structure (*phrase structure*, *constituent structure*) which is organized hierarchically:

- The largest unit is the entire sentence itself.
- The smallest units are individual words (or morphemes).
- Each unit in this structure (except the entire sentence) is contained within a another unit in the structure.

a. This hierarchical organization is psychologically real (at some level of abstraction).

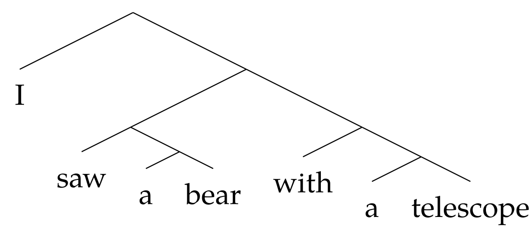
b. Constituency tests are a test for these "units."

(3) **Constituency test results that are predicted to be impossible by (2):**

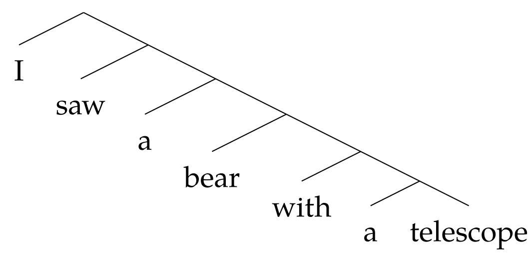
blah blah blah blah blah blah blah blah blah blah blah

We represent such structures as (upside-down) *trees*:

(4) a.



b.



Each "node" in the tree should behave as a constituent. This includes the root node and leaf nodes: by hypothesis, the entire sentence and individual words are constituents.

(5) **Tree geometry terms:**

a. *root*, *leaf*, *branching node*, *non-branching node*

b. *mother*, *daughter*, *sister*[1]

Three notes about the trees in (4) and trees in general:

- Each mother has two daughters: these trees are *binary*. We will assume that trees are always binary. We'll see one reason why this should be the case later today, from how we think about structure-building.[2]

- There is one node in (4) for which we have not clearly motivated constituency; compare with (1). The motivation for this constituency comes from (a) analogy and (b) semantics.[3]

- For our purposes, trees will encode *word order* as well as *constituency*. That is, the two trees in (6) are not the same:

  (6) a. [a bear] b. [bear a]

  In particular, (6a) is a possible structure in English, whereas (6b) is not.[4]

- Recall that the difference in constituency between (4a) and (4b) reflects a difference in interpretation between (1a) and (1b). This is because the constituent structure (tree) is used to compute the interpretation of the sentence.

  This allows us to look at sentences in other languages with *glosses* and *free translations* and make a guess about their constituency. (Warning: This is only a hint.)

(7) **"I saw a bear with a telescope" in Japanese:**

a. Watashi-wa bōenkyō-de kuma-o mi-ta.
I-TOP telescope-INST bear-ACC see-PAST
'I saw a bear, using a telescope.'

b. Watashi-wa bōenkyō-o mot-ta kuma-o mi-ta.
I-TOP telescope-ACC hold-PAST bear-ACC see-PAST
'I saw a bear that is holding a telescope.'

TOP = topic; INST = instrumental case; ACC = accusative case

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[1] We don't talk about *nieces*, but we'll see this type of relation next week. No I don't know why they're all female.

[2] But the strongest motivation for strictly binary trees comes from how we model the relationship between syntax and semantics... which we study in EL4203 on Fridays.

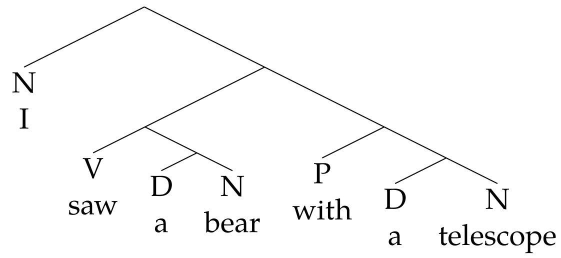
[3] See for example Partee 1973.

[4] Note that there are some theories — which we may or may not discuss later this semester — under which tree structures just represent constituency but not word order information. For such a theory, (6a) and (6b) would logically be the same object, and a different process would later determine that such trees have the word order "a bear" in English, rather than "bear a."

2 Categories, phrases, and heads

Recall that words have categories:

(8)



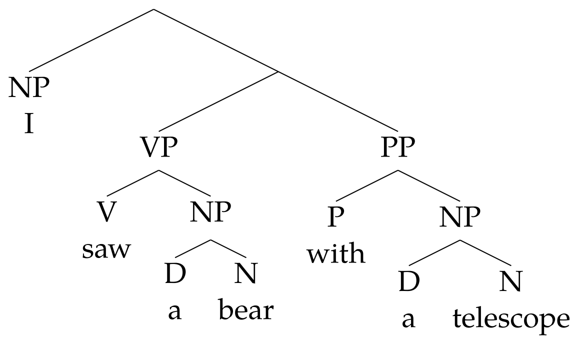
Recall further that different "slots" of sentences require a particular kind of constituent, but not caring too much about their internal structure:

(9) a. I saw [boats] with a telescope.

b. I saw [an unhappy bear at the zoo] with a telescope.

As far as "I saw ... with a telescope" is concerned, all of these phrases in (9) are the same. What's important is that it's a phrase that together behaves like a noun: a *noun phrase* (NP). We can label branching nodes using these kinds of phrasal labels:[5]

(10)



Notice: Every NP contains an N; PPs contain Ps; VPs contain Vs...

(11) ***Endocentricity* hypothesis (part 1):**

Every phrase of category X (XP) has a unique *head* word of category X.

Importantly, this is *not* just about categories. Recall that syntax is sensitive to various additional features of words. Here consider the feature *Number*: singular vs plural.

(12) a. [John] is in the zoo.

b. [The bear that ate a cake] is in the zoo.

c. [The bear that ate many cakes] is in the zoo.

d. * [The bears that ate a cake] is in the zoo.

e. * [The cake-eating bears] is in the zoo.

[5]Subjects are a bit special so I don't label the top parts of the tree. We will talk about subjects in two weeks.

(13) **Endocentricity hypothesis (part 2):**

As far as the outside world is concerned, a phrase XP looks like its head X. Features on X *project* up to XP. (For this reason, XP phrases are often called maximal projections.)

Notice that the subject *I* in (10) was just a noun, but again what the sentence really cares about is that it's an NP; it doesn't care that it happens to just be one word. I therefore indicated that this is an NP as well as an N using a non-branching node.

3 Selection and Merge

Certain heads require that they be a sister to certain kinds of phrases; that they take a certain *argument*. This dependence between certain heads and arguments is called *(c-)selection* or *subcategorization*. We encode these needs as *selectional features*, "*u*X."

(14) **Some features:**[6]

a. saw: [V; *u*N] (Or is "saw" [V; *u*N, *u*N]? Again, subjects are special.)

b. with: [P; *u*N]

c. a bear, a telescope: [N, φ: 3sg]

(15) **Merge($\boldsymbol{\alpha}$, $\boldsymbol{\beta}$)**: (read: 'merge β to α')

For any syntactic objects α, β, where α bears an unchecked selectional feature F and β bears a matching categorial feature, or the Hierarchy of Projections requires that α take β as its complement:

a. check the feature F on α, if any: ~~F~~;

b. let the label γ be the unchecked non-inflectional features of α; and

c. return $[_{\gamma}\ \alpha\ \beta]$ if α is a head and $[_{\gamma}\ \beta\ \alpha]$ otherwise.

This last step (c) may be subject to variation between languages.[7]

(16) **Grammaticality/convergence (first version):**[8]

A structure is grammatical (a derivation *converges*) if it can be built from items in the *lexicon*, using the operations available (Merge,...), and has no unchecked selectional features.

(17) a. * I saw with a telescope.

b. * I [[saw a] [bear [with a telescope]]]

[6]or alternatively, category features sometimes are written on the outside, like V[*u*N] or N[φ: 3sg].

[7]On step (b): In other words, all category features project, all unchecked selectional features project, and no inflectional features project. Inflectional features are therefore found only on heads, never on projections. (At this point, all features are non-inflectional.)

[8]Formulations of Merge, Adjoin, and convergence are based on those from handouts of Jason Merchant's.

4 Adjuncts

(18) **Adjoin(α, β)**: (read: 'adjoin β to α')

For any syntactic objects α, β, where neither α nor β has any unchecked selectional feature, call α the *host* and return $[_{\gamma}\ \alpha\ \beta]$ or $[_{\gamma}\ \beta\ \alpha]$, where the label $\gamma = \alpha$.

Whether a constituent is an *adjunct* or not depends on its environment:

(19) a picture [$_{\text{PP}}$ of bears]

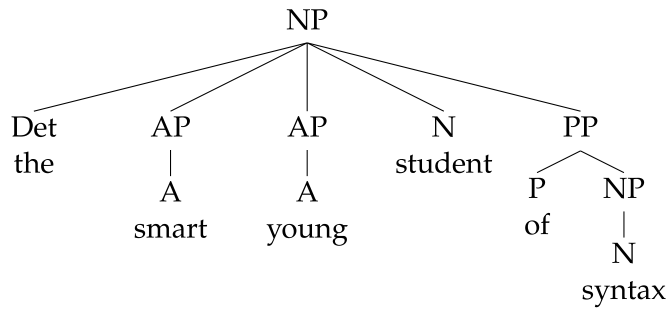
(20) Sarah is fond [$_{\text{PP}}$ of bears].

5 A brief history of phrase structure

(21) **Phrase structure rules:**

(1950's, 60's, 70's...)

- S → NP VP
- VP → V NP (NP)
- NP → Det (AP+) N (PP)
- ...

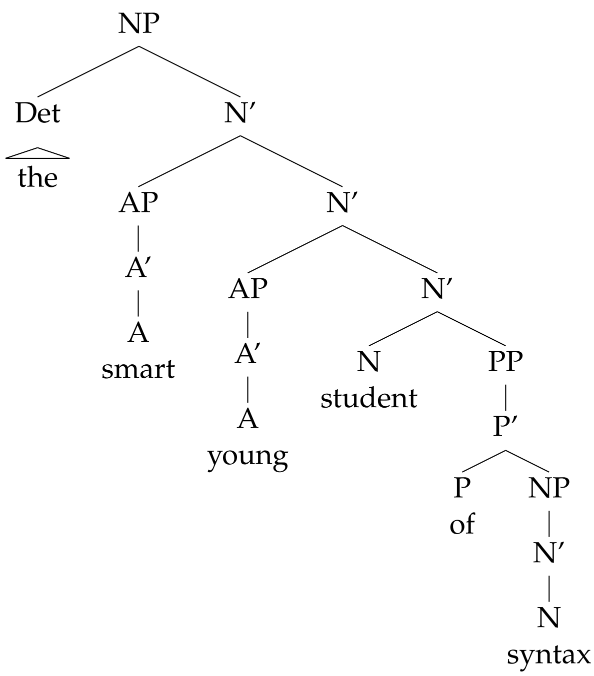


(22) **X-bar theory:** (1970's, 80's, 90's...)

Each XP, of any category, follows a general template:

- XP → (YP) X′
  YP = *specifier*
- X′ → (ZP) X′ or X′ (ZP)
  ZP = *adjunct/modifier*
- X′ → X (WP)
  WP = *complement*

We still use the terms "complement," "specifier," etc. X′ is pronounced "X-bar."



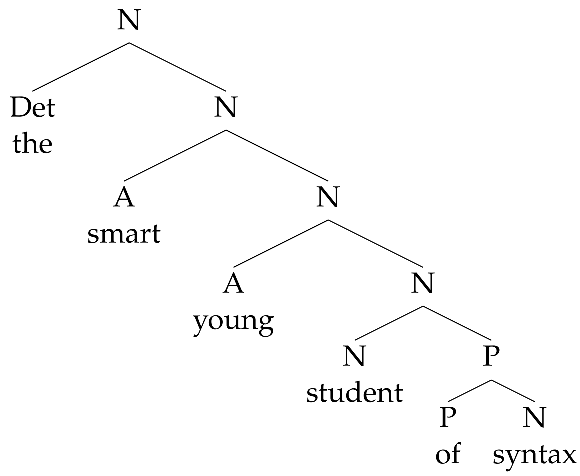
(23) **Bare phrase structure:** (1990's, 2000's...)

This is (roughly) the approach we follow here. Phrases are built using a small set of operations, based on the needs of those ingredients involved, and project features.

If we really care about XP vs X' vs X labels (sometimes we do), we can use an algorithm:

- XP if you do not project up to its mother;
- X if you have no daughters;
- X' otherwise.

Suggestion: In this class, label XPs but don't worry about X-bar's.



References

Partee, Barbara Hall. 1973. Some transformational extensions of Montague grammar. *Journal of Philosophical Logic* 2:509–534.