Probing structure

LING 200B · Ethan Poole · 4 October 2021

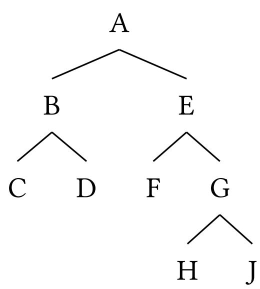
1 Structural relations

- ***Some terminology***
  - TERMINAL NODE: a node that has no branches; a leaf
  - NON-TERMINAL NODE: a node that is not a terminal node; a branching node
  - ROOT NODE: the topmost node in any tree structure[1]
  - LEXICAL ITEM: a set of phonological, semantic, and grammatical features; each terminal node carries a single lexical item

[1] Note that the root node changes throughout the course of the derivation.

- There are relations that hold between constituents in a structure. Two of these, CONTAINMENT and C–COMMAND, are central to syntactic theory. To understand these relations, let us consider the following abstract structure:

(1)



> ⁕ ***Domination / containment***
> Tree structures are mathematically defined in terms of parenthood, so the notion of containment comes for free:[2]
>
> (2) **DOMINATION**
> The set of nodes that x dominates is $\mathrm{D}(x)$, where:
>
> a. $x \in \mathrm{D}(x)$
>
> b. If y is a child of x, then $y \in \mathrm{D}(x)$.
>
> c. If $y \in \mathrm{D}(x)$ and $z \in \mathrm{D}(y)$, then $z \in \mathrm{D}(x)$.

[2] A simple definition: A tree is a tuple $\langle n, \mathrm{C}\rangle$, where n is a node and C is the set of its child nodes.

- ***Examples based on (1)***
  - E dominates F, G, H, and J.
  - A dominates B, C, D, E, F, G, H, and J.

> ⁕ ***C(onstituent)–command***
>
> (3) **C–COMMAND**
> α c–commands β iff (i) neither α nor β dominates the other and (ii) every node dominating α dominates β.

- The definition in (3) can be written more in line with (2), if we so desire:

(4) **c–command**
x c–commands y iff:

a. $x \notin \mathrm{D}(y)$

b. $y \notin \mathrm{D}(x)$

c. $\forall z[x \in \mathrm{D}(z) \rightarrow y \in \mathrm{D}(z)]$

- ***Examples based on (1)***
  - A does not c–command anything.
  - B c–commands E, F, G, H, and J.
  - C c–commands D; D c–commands C.
  - E c–commands B, C, and C.

- ***M-command and government***
There are two other structural relations that are no longer used in syntax, but you might encounter them in older GB-era literature:

(5) **m–command**
α m–commands β iff α does not dominate β, β does not dominate α, and the maximal projection of α dominates β.

(6) **Government**
α governs β iff α is a governor, α m–commands β, and no barrier intervenes between α and β.[3]

[3] In Chomsky (1981), the governors were lexical items and finite Infl/T.

2 Constituency tests

- Syntactic processes target constituents, so we can use syntactic processes to probe for hierarchical structure (a.k.a. constituency structure).
- For all of these tests, constituency is a *necessary*, but not *sufficient* condition.
  - If the test works, then we likely have a constituent.
  - If the test does not work, then it is inconclusive.

⇒ ***Rule of thumb***
To establish that a (sub)string corresponds to a constituent, we want *positive evidence* in favor of that constituency.

2.1 Substitution test

(7) **Substitution test**
If a string of words can be replaced with a single word (typically a proform) and retain the same interpretation, then it is a constituent.

- ***Example***

(8) a. [**That tall bottle of water**] might spill on the table. → **It** might spill on the table.

b. That tall bottle of water might spill on [**the table**]. → That tall bottle of water might spill on **it**.

c. That tall [**bottle of water**] might spill on the table. → That tall **one** might spill on the table.

d. That [**tall bottle of water**] might spill on the table. → That **one** might spill on the table.

e. That tall bottle of water might spill [**on the table**]. → That tall bottle of water might spill **there**.

f. That tall bottle of water might [**spill on the table**]. → That tall bottle of water might **do so**.

g. That tall bottle of water might [**spill**] on the table. → That tall bottle of water might **do so** on the table.

(9) a. That tall bottle of water [**might spill**] on the table. ↛ That tall bottle of water **did so** on the table.

b. That [**tall bottle**] of water might spill on the table. ↛ That **one** of water might spill on the table.

- ***What to substitute in (mostly for English)***
  - DP: pronouns (*it*, *they*, *them*, etc.)
  - NP: *one*
  - VP: *do so*[4]
  - PP: *there* (if directional), *therein*, *thereof*
  - AP: *such*

[4] With *do so*, the ‘single word’ is *so*. The *do* is required to realize tense.

2.2 Coordination test

(10) **Coordination test**
Only constituents of the same kind can be coordinated.

- ***Ramifications***
  1. If X and Y can be coordinated, then X and Y are constituents.
  2. If X and Y can be coordinated, then X and Y are of the same grammatical category.[5]

[5] There are exceptions to this point. For example, in copula constructions, APs and PPs can be coordinated:

(11) Alex is [$_{\text{A}}$ sleepy] and [$_{\text{PP}}$ in bed].

Such facts affect how we analyze these constructions, namely in terms of hidden structure, making the AP and PP the same category, e.g. Pred(icate)P.

- ***Example***

(12) a. Run [**up the hill**] and [**up the mountain**].

b. *Ring [**up the phone company**] and [**up the electricity company**].

- ***Two complications with the coordination test***
The analysis of these constructions is an advanced topic, but it is important to be aware of their existence and to avoid them when using the coordination test:

(13) **Right-node raising**[6]

a. Dorothy bought ‖ and Rose ate ‖ the cheesecake.

b. He could have ‖ and should have ‖ told the truth.

[6] ‖ = a prosodic pause

(14) **Gapping**

a. Blanche ate an apple, and Sophia ~~ate~~ a pear.

b. Blanche went to the movies, and Sophia ~~went~~ to the mall.

2.3 Other tests

- ***Ellipsis test***
  If a string of words can be elided, then it is a constituent:

(15) a. That bottle of water might have ~~spilled on the table~~.

b. That bottle of water might ~~have spilled on the table~~.

- ***Displacement test***
  If a string of words can be displaced (i.e. moved), then it is a constituent:

(16) Rose danced extremely frantically at the party.

a. **At the party**, Rose danced extremely frantically ___ .

b. **Extremely frantically**, Rose danced ___ at the party.

c. ***Frantically at**, Rose danced extremely ___ the party.

- ***Cleft test***
  If a string of words can be clefted, then it is a constituent:[7]

[7] Cleft: It's A that B

(17) a. It's **under the bed** that ___ is the best place to hide.

b. It's **the woman in the red coat** that I saw ___ .

c. *It's **the woman in** that I saw ___ the red coat.

3 Classical Binding Theory

- In addition to constituency tests and distributional facts, structure can be diagnosed using c–command relations. The main syntactic dependency that relies on c–command is BINDING.[8]

[8] Most of the core original observations come from Lees and Klima (1963) and Lasnik (1976).

- Binding Theory (BT) aims to accounts for restrictions on how referential nominal expressions (i.e. non-quantificational DPs) can be interpreted with respect to one another:

(18) **Bolded elements can refer to the same individual**

a. **Alex** came in.

b. Then, **Alex** left.

c. **She** took **her** umbrella.

d. **She** hurt **herself** with it when **she** tried to open it.

e. **The idiot** can't even open an umbrella!

(19) **Bolded elements cannot refer to the same individual**

a. **Alex** took **Alex**'s umbrella.

b. **She** hurt **her**.

- ***Notation: Indices***
  We use indices to represent what a referential DP refers to:[9]

(20) a. Let I be the set of indices.

b. Let g be a function that maps indices to entities.

c. DP_i refers to $g(i)$, where $i \in \text{I}$.

d. $\forall i, j \in \text{I}\,[g(i) = g(j) \leftrightarrow i = j]$ *(uniqueness)*

- ***Which elements bear indices?***
  - At least all maximal and minimal projections bear an index, because indices are important/necessary for movement, and these are the elements that can move.
  - However, not all elements that have an index have an *assignment-dependent* meaning:

(21) a. $[\![\text{cat}_i]\!]^g = \lambda x\,.\,x$ is a cat

b. $[\![\text{she}_i]\!]^g = g(i)$

  - Non-assignment-dependent elements can have their index freely changed without affecting their interpretation. Thus, the binding conditions can essentially be vacuously satisfied for them.

- ***Terminology***
  - α and β are COREFERENTIAL iff they refer to the same entity.
  - α and β are COINDEXED iff they bear the same index.[10]
  - α BINDS β (in domain Δ) iff α c–commands β and α and β are coindexed (and α and β are both in Δ).
  - α is FREE (in domain Δ) iff nothing binds it (in Δ).
  - The ANTECEDENT of a pronoun or an anaphor is what it refers to.

⁎ ***Binding Conditions***
Classical BT comprises three conditions (Chomsky 1981):

(22) **CONDITION A**
An anaphor must be bound in its binding domain.

(23) **CONDITION B**
A pronoun must be free in its binding domain.

(24) **CONDITION C**
An R-expression must be free.

- Also called: Principle A, Principle B, Principle C

[9] i, j, and k are also often used for indices.

[10] Under (20d), coreferentiality and coindexation are one and the same notion. This assumption is nonstandard, but it makes the vast majority of binding cases easier to deal with because it avoids "accidental coreference".

- ***Binding-theoretic types of DPs***[11]
  - ANAPHOR: *herself, himself, themself, themselves, each other, one another, . . .*
  - PRONOUN: *she, he, they, it . . .*
  - R-EXPRESSION: *Björk* (proper names), *the cat* (definite descriptions), . . .

[11] Technically, an anaphor is something that obeys Condition A, etc.

- ***Binding domain***
  One of the core questions about binding is how to define the locality domain. For simplicity, let us assume that the binding domain is the smallest containing clause.

- ***Illustration***[12]

[12] You should treat the indices more like 'variables over indices'.

(25) a. **Condition A**
Blanche$_1$ thought [that Rose$_2$ saw **herself**$_{*1/2/*3}$].

b. **Condition B**
Blanche$_1$ thought [that Rose$_2$ saw **her**$_{1/*2/3}$].

c. **Condition C**
She$_{*1/*2/3}$ thought [that **Rose**$_2$ saw **Blanche**$_1$].

- Note that with Condition C, its effects manifest on what higher DPs may refer to.
  - For example, in (25c), the fact that the R-expression *Blanche* must be free manifests as the pronoun *she* not being able to refer to the same entity as *Blanche*.

∗ ***Variable binding***
Another BT-related tool for diagnosing c–command relations is pronominal variable binding: the binder needs to c–command the pronoun, but not necessarily in its binding domain:[13]

[13] Put differently, anaphora are bound variables that are subject to Condition A.

(26) a. [**Every parent**]$_1$ hopes [that the teacher likes **their**$_1$ child].
⇝ For every parent x, x hopes that the teacher likes x's child

b. *__Their__$_1$ parent hopes [that the teacher likes [**every child**]$_1$].

∗ ***Discussion***
  - It is well-established that binding is more complicated than Conditions A, B, and C make it out to be—even though these conditions are, broadly speaking, true.
  - For this reason, BT as developed in Chomsky (1981) is sometimes (affectionately?) referred to as "Baby Binding Theory".
  - ⇒ Classical/Baby BT is (more than) good enough for diagnosing structure!
  - For example: You want to determine if α c–commands β. If β can be an anaphor anteceded by α, then you know that α c–commands β.

- ***Is Condition C pragmatics?***
  Condition C is complicated by the fact that there is pragmatic pressure to introduce the antecedent of a pronoun before using the pronoun itself.
  - However, reconstruction effects show that Condition C cannot be reduced to pragmatics. In the following cases with *wh*-movement, the pronoun linearly preceding the coreferential R-expression is allowed, but the reverse is not:

(27) a. [Which of **her**$_1$ pictures] does **Björk**$_1$ like ___ ?

b. *[Which of **Björk's**$_1$ pictures] does **she**$_1$ like ___ ?

– This would not follow on a purely pragmatic account, but follows from Condition C if the structures that get evaluated are something like the following:

(28) a. ~~[Which of her pictures]~~ does **Björk**$_1$ like [which of **her**$_1$ pictures]?

b. *~~[Which of Björk's pictures]~~ does **she**$_1$ like [which of **Björk's**$_1$ pictures]?

What to read if you want to learn more?

⇒ Büring (2005): Textbook about the syntax and semantics of binding

- Chomsky (1981): Classical Binding Theory (BT is part of everything in *LGB*, so you have to read from start to finish)
- Reinhart (1983): Influential theory of the syntax and semantics of anaphoric relations
- Pollard and Sag (1992); Reinhart and Reuland (1993): Predicate-based theories of Condition A
- Sundaresan (2012): Interesting deep dive into anaphora and logophoricity, data mainly from Tamil
- Charnavel (2019): On so-called 'exempt' anaphora
- ***Condition C connectivity***
  - Stockwell et al. (to appear): Experimental investigation of Condition C connectivity under *wh*-movement
  - I have uploaded a handout (from my Spring 2020 proseminar) about the experiments reported in Adger et al. (2017) and Bruening and Al Khalaf (2019).

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