

Knowledge of Language

Required reading: Ch. 1 of *Aspects*

1 Some Central Questions

- How are we able to comprehend a potentially infinite number of novel sentences? The problem of *discrete infinity*.
- What does linguistic knowledge consist of? We know things that we were never taught. How did this knowledge arise? Specifically, how do children succeed in acquiring language on the basis of an input that is underspecified and impoverished?
- How do we account for 'language universals'?

2 Implicit Knowledge

2.1 Errors and Non-errors in Child Language

Yes-No Question Formation

- (1) a. Has John eaten a cake?
(John has eaten a cake.)
- b. Will Lila come to the party?
(Lila will come to the party.)

Any number of rules can be devised to derive the interrogative Y/N questions from their declarative counterparts.

- (2) a. Swap the first two words around
- b. Swap the first verb with the first noun phrase
- c. Swap the subject and the verbal element after it

Test Cases:

- (3) a. The man has eaten a cake.
- b. The woman who is singing is happy.
- c. The book that John is reading is on sale.

While child language differs in interesting ways from the target adult language, errors of the sort predicted by (2a, b) are never made by children. This suggests that children are predisposed towards postulating rules of a particular kind.

2.2 Pronominal Reference: a case of implicit knowledge

- (4) a. John likes him.
b. He likes John.
c. He likes him.
- (5) a. Liina introduced John to him.
b. Liina introduced him to John.
c. Liina introduced him to him.
- (6) a. 1. John likes his brother.
2. He likes John's brother.
3. He likes his brother.
b. 1. John's brother likes him.
2. His brother likes John.
3. His brother likes him.
- (7) a. 1. Liina introduced John's (long lost) sister to him.
2. Liina introduced his (long lost) sister to John.
3. Liina introduced his (long lost) sister to him.
b. 1. Liina introduced John to his (long lost) sister.
2. Liina introduced him to John's (long lost) sister.
3. Liina introduced him to his (long lost) sister.
- (8) a. John thinks that he is smart.
b. He thinks that John is smart.
c. He thinks that he is smart.
- (9) a. 1. John thinks that Hafdis believes that he is smart.
2. He thinks that Hafdis believes that John is smart.
3. He thinks that Hafdis believes that he is smart.
b. 1. John thinks that he believes that Hafdis is smart.
2. He thinks that John believes that Hafdis is smart.
3. He thinks that he believes that Hafdis is smart.
c. 1. Hafdis thinks that John believes that he is smart.
2. Hafdis thinks that he believes that John is smart.
3. Hafdis thinks that he believes that he is smart.
- (10) a. 1. The fact that Liina admires John pleases him.
2. The fact that Liina admires him pleases John.
3. The fact that Liina admires him pleases him.
b. 1. John is pleased by the fact that Chunghye admires him.
2. He is pleased by the fact that Chunghye admires John.
3. He is pleased by the fact that Chunghye admires him.
- (11) a. 1. Liina gave a book to the boy who admires her.
2. She gave a book to the boy who admires Liina.
3. She gave a book to the boy who admires her.
b. 1. The boy who admires Liina gave a book to her.
2. The boy who admires her gave a book to Liina.
3. The boy who admires her gave a book to her.
- (12) a. 1. When John left the room, he was smiling.
2. When he left the room, John was smiling.
3. When he left the room, he was smiling.
b. 1. John was smiling when he left the room.
2. He was smiling when John left the room.
3. He was smiling when he left the room.

Tools for discovering structure: Tests for Constituency

3 Movement

If a group of words can undergo *movement* i.e. preposing, postposing, or fronting for question formation, they constitute a phrase of some sort.¹

3.1 Preposing

Constituents can often be preposed. Non-constituents can never be preposed.

Noun Phrase (NP) preposing:

- (13) a. I can't stand your younger brother.
b. [Your younger brother], I can't stand [___] (though your elder brother's OK).
c. * Your younger, I can't stand [___ brother].
d. * Younger brother, I can't stand [your ___].
e. * Brother, I can't stand [your younger ___].
f. * Your, I can't stand [___ younger brother].
g. * Your brother, I can't stand [___ younger ___].

Prepositional Phrase preposing:

- (14) a. Peter gave a book to your brother.
b. [To your brother], Peter gave a book [___] (but not to mine).
c. * To your , Peter gave a book [___ brother].
d. * To, Peter gave a book [___ your brother].
e. [Your brother], Peter gave a book [to ___] (but not to mine).
f. * Your, Peter gave a book [to ___ brother].
g. * To brother, Peter gave a book [___ your ___].

Why is (14e) ok?

Preposing of Adjective Phrases and Verb Phrases is more restricted but still possible.

- (15) a. Bill said that the new Almodovar was exciting and [very exciting], it was [_{AP} ___]. (Adjective Phrase)
b. [Give in to blackmail], I never will [_{VP} ___]. (Verb Phrase)
c. Patrick said that he would win the prize, and [win the prize], he did [_{VP} ___]. (Verb Phrase)
- (16) a. They said that Bill would read the book somewhere, and [read the book] he *did* in the library.
b. They said that Bill would read the book in the library, and read the book in the library he *did*.

¹Remember that the reverse is not always true i.e. if something cannot be moved around, it does not mean that it is not a constituent. There could be independent reasons for why it cannot move around.

Tensed VPs (and VPs + modals) cannot be preposed.

- (17) a. John ate the apple.
b. * [Ate the apple], John.
c. Kelly must visit the doctor.
d. * Must visit the doctor, Kelly.

Adverbial phrases can be preposed much more freely.

- (18) a. She's going to be leaving for Poughkeepsie [very shortly].
b. [Very shortly], she's going to be leaving for Poughkeepsie [*AdvP* —].

3.2 Postposing

Only constituents can be postposed. Typically this test is only applicable to NP objects.

- (19) a. He explained [all of the terrible problems that he had encountered] to her.
b. He explained [*NP* —] to her [all of the terrible problems that he had encountered].
c. * He explained [*NP* all of —] to her the terrible problems that he had encountered.
d. * He explained [*NP* all —] to her of the terrible problems that he had encountered.

3.3 Questions

If it is possible to ask a question about a set of consecutive words in a sentence, they form a constituent.

- (20) a. He gave a book to Michael hurriedly.
b. Who gave a book to Michael hurriedly?
c. Who did he give a book [*PP* to [*NP* —]] hurriedly?
d. How did he give a book to Michael [*AdvP* —]?
e. To whom did he give a book [*PP* —] hurriedly?
f. What did he give [*NP* —] to Michael hurriedly?
g. What did he do [*VP* —]?

4 Adverbs

If adverbs can be positioned inside a constituent, it is either an S or a VP, and not an NP or a PP.

If S-adverbs such as *certainly*, *obviously* etc. can be positioned inside a constituent, it is an S. If VP-adverbs such as *completely* can be positioned inside a constituent, it is a VP.

- (21) a. Possible positions for S-adverbs like *certainly*
[*S* * The team * can * [*VP* rely on my support]*VP* *]*S*
b. Possible positions for VP-adverbs like *completely*
[*S* The team can * [*VP* rely * [*PP* on my support]*PP* *]*VP*]*S*

5 Sentence fragments

Only phrasal constituents i.e. full phrases can serve as sentence fragments (in an appropriate context).

- (22) a. A: Where did he go?
B1: Up the hill
B2: *Up hill
B3: He went up the hill
- b. A: Where are you going to?
B1: To the cinema
B2: The cinema
B3: I am going to the cinema
- c. A: Who were you ringing up?
B1: My sister
B2: *Up my sister
B3: I was ringing up my sister.

Up my sister in (22c) is not a possible sentence fragment because *up* and *my sister* do not form a constituent in 'I was ringing up my sister'. This is in contrast with 'I am going to the cinema' where *to* and *the cinema* do form a constituent.

6 Coordination

Only constituents can be coordinated.

- (23) a. He has [_{NP} a cat] and [_{NP} a dog].
b. I met your [_N mother] and [_N father].
c. Is she [_{PP} in the kitchen] or [_{PP} in the bathroom]?
d. He speaks [_{AdvP} very slowly] but [_{AdvP} very articulately].
e. [_S Wynona likes Maui] and [_S Kelly likes Cancun].
f. *John rang *up his mother* and *up his sister*.

Only identical constituents can be coordinated.

- (24) a. John wrote *to Mary* and *to Fred*. (= PP and PP)
b. John wrote *a letter* and *a postcard*. (= NP and NP)
c. *John wrote *to Mary* and *a letter*. (= PP and NP)
d. *John wrote *a letter* and *to Fred*. (= NP and PP)

6.1 Shared Constituent Coordination

Another kind of coordination is exemplified below.

- (25) a. John walked and Bill ran [*up the hill*].
b. Tamara denied but Fred admitted [*complicity in the crime*].
c. Kelly must, and Jason may, [*go to the party*].

The italicized sequence in the sentences in (25) is shared between the two conjuncts. Only constituents can be shared.

- (26) *Martha rang and Paul picked up *Martin's sister*.

6.2 Ellipsis

Under certain discourse conditions, it is possible to omit certain parts of a sentence. This phenomenon is known as Ellipsis.

- (27) A: Jay won't wash *the dishes*.
B: I bet he will (wash the dishes) if you're nice to him.
(the bracketed words need not be pronounced)

Typically, in English, only VPs can undergo Ellipsis (i.e. be omitted)

- (28) a. Vivian won't put soda water into scotch, but her brother will put soda water into scotch.
b. * Vivian won't put soda water into scotch, but her brother will put soda water into (scotch).
c. * Vivian won't put soda water into scotch, but her brother will put soda water (into scotch).
d. * Vivian won't put soda water into scotch, but her brother will put (soda water into scotch).
e. Vivian won't put soda water into scotch, but her brother will (put soda water into scotch).

7 Replaceability

If a sequence of words can be replaced by another sequence of words which you know forms a constituent, then the original sequence also forms a constituent.

So suppose you know that *eat the apple* is a Verb Phrase, then you can show that *drink scotch* is also a verb phrase by a simple replacement test.

- (29) Mimi didn't [drink scotch] → Mimi didn't [eat the apple].

7.1 Proforms

The replacement test can be used more generally with help of words which can stand for full phrases. These are words like *him*, *it*, *so*, *as*, *which* etc. These words are called proforms - to generalize over pronouns (actually pro-NPs), pro-VPs, pro-APs etc.

If we can replace a sequence of words by a pro-XP, then we can claim that the sequence is an XP.

Pronouns, (*him*, *her*, *it*), replace NPs and not Ns.

- (30) a. A: What do you think of the woman who wrote that incredibly pretentious book on shamanistic chants?
B: I can't stand *her*.
b. * What do you think of the *her* who wrote that incredibly pretentious *it* on shamanistic *it*?

there functions as pro-PP.

- (31) A: Have you ever been to Paris?
B: No, I have never been *there*.

so, *as*, *which* function as pro-VPs.

- (32) a. John might [_{VP} go home], and *so* might Bill.
b. John might [_{VP} resign his post], *as* might Bill.
c. If John can [_{VP} speak French fluently] - *which* we all know he can - why is he so shy with the French?

do so is another pro-VP.

- (33) a. Bill [**read the book**] in the library, and Mary *did so* (in the museum).
b. Bill [**fixed the faucet**] with a screwdriver in fifteen minutes with great difficulty, and Mary *did so* (with a hammer) (in twenty minutes) (with no problem at all).

(34) the boldfaced sequence is the (intended) antecedent for *do so*.
a. Maia [**gave a present to me**] yesterday and Sally *did so* the day before yesterday.
b. *Maia [**gave a present to me**], and Mary *did so* to my brother.
c. Maia [**put some money on the table**] yesterday and Sally *did so* the day before yesterday.
d. *Maia [**put some money on the table**], and Mary *did so* on the shelf.
e. Maia [**gave Mary a book**] yesterday, and Sally *did so* the day before yesterday.
f. *Maia [**gave Mary a book**], and Sally *did so* a magazine.

so can also replace APs i.e. it is a pro-AP also.

- (35) Many people consider John [_{AP} extremely rude], but I've never found him *so*.

Similarly *it* can be a pro-S also. However *it* can only occur in NP positions.

- (36) a. A: Mary has finished her assignment.
B: I don't believe it. (I don't believe that Mary has finished her assignment)
b. A: I believe that John will win.
B: * I hope it. (I hope that John will win)

Note that all the proforms that we have discussed so far replace phrases and not word-level constituent.

7.2 Words used as phrases

Consider the following sentence:

- (37) Cats can be useful.

Is *Cats* in (37) an NP or an N or both?

We know that *cats* is a Noun. Is it also an NP?

Similarly is *useful* just an A or is it an AP also?

We can show that *cats* is also an NP and that *useful* is also an AP.

For one thing, they can be replaced by the relevant proforms.

- (38) a. Cats can be useful, but *they* can also be dangerous.
 b. Cats can be useful, but I have never found them *so*.

Also *cats* can be replaced by phrases which we are sure are noun phrases.

- (39) Those brown cats can be very useful.

cats can be coordinated with NPs.

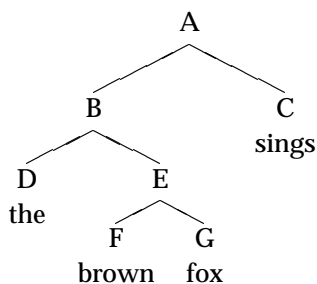
- (40) Cats and other mice hunting animals can be very useful.

These facts suggest that words can function as phrases. The absence of extra words should not lead us to conclude that something is just a word-level category.

8 Tree Definitions

Required reading: Chs. 1 and 2 of *Origins of Phrase Structure* by Tim Stowell

- (41) a tree for 'the brown fox sings'



- Linguistic trees have **nodes**. The nodes in (41) are A, B, C, D, E, F, and G.
- There are two kinds of nodes: internal nodes and terminal nodes. The internal nodes in (41) are A, B, and E. The terminal nodes are C, D, F, and G. Terminal nodes are so called because they are not expanded into anything further. The tree ends there. Terminal nodes are also called **leaf nodes**. The leaves of (41) are really the words that constitute the sentence 'the brown fox sings' i.e. 'the', 'brown', 'fox', and 'sings'.

- (42) a. A set of nodes form a **constituent** iff they are exhaustively dominated by a common node.
 b. X is a **constituent** of Y iff X is dominated by Y.
 c. X is an **immediate constituent** of Y iff X is immediately dominated by Y.

Notions such as subject, object, prepositional object etc. can be defined structurally. So a subject is the NP immediately dominated by S and an object is an NP immediately dominated by VP etc.

- (43) a. If a node X immediately dominates a node Y, then X is the **mother** of Y, and Y is the **daughter** of X.
 b. A set of nodes are sisters if they are all immediately dominated by the same (mother) node.

We can now define a host of relationships on trees - grandmother, granddaughter, descendant, ancestor etc.

Another important relationship that is defined in purely structural terms is c-command.

(44) A c-commands B:

if and only if A does not dominate B and the node that immediately dominates A dominates B.

if and only if B is either a sister of A or dominated by a sister of A.

c-command is used in the formulation of **Condition C**, a principle used to determine what a pronoun may not refer to.

- **CONDITION C**

(45) A pronoun cannot refer to a proper name it c-commands.

Note that Condition C is a negative condition. It never tells you what a particular pronoun must refer to. It only tells you what it cannot refer to.

In general, if a pronoun cannot refer to a proper name (despite agreeing in gender and number), you can conclude that the pronoun c-commands the proper name.

- **THE NO CROSSING BRANCHES CONSTRAINT**

(46) If one node X precedes another node Y, then all descendants of X must also precede Y and all descendants of Y.

9 How to grow trees

Where do the trees that we use to analyze linguistic structure come from?

In a way, they are just representations of facts that exist out in the world - the facts that we can discover using constituency test. So one way to make trees is by doing empirical work - taking a sentence, applying various constituency tests to the words in the sentence, and then drawing a tree based on the results of our tests.

This empirical method is ultimately the only correct way to deduce 'tree structure'. However, in most cases, we can simplify things considerably by using **Phrase Structure Rules**.

Phrase Structure Rules are rules of the sort

$X \rightarrow YZ$

This rule says 'take the node X and expand it into the nodes Y and Z'. Alternately, going from right to left (or from below), it says 'if you have a Y and a Z next to each other, you can combine them to make an X'.²

Phrase structure rules can be categorial i.e. rules that expand categories into other categories, or they can also be lexical i.e. rules that expand category labels by word (lexical items).³

- A grammar can then be thought of as a set of phrase structure rules (categorial rules plus lexical rules).

The categorial rules can be thought of as (part of) the syntax and the lexical rules as (part of) the lexicon.

²Such phrase structure rules are called Context Free Grammars (CFG) and were invented by Noam Chomsky in 1956. A closely related model was used by Pāṇini to describe the grammar of Sanskrit in around 500 B.C.

³Why must we have at least some lexical rules?

9.1 Some Phrase Structure Rules for English

(47) Categorical Rules

- a. $S \rightarrow NP \text{ Modal VP}$
- b. $VP \rightarrow V \text{ AP PP}$
- c. $AP \rightarrow \text{ADVP A}$
- d. $\text{ADVP} \rightarrow \text{ADV}$
- e. $PP \rightarrow P \text{ NP}$
- f. $NP \rightarrow D \text{ N}$

(48) Lexical Rules

- a. $N \rightarrow \text{girl}$
- b. $N \rightarrow \text{boy}$
- c. $\text{Adv} \rightarrow \text{incredibly}$
- d. $A \rightarrow \text{conceited}$
- e. $V \rightarrow \text{seem}$
- f. $\text{Modal} \rightarrow \text{must}$
- g. $P \rightarrow \text{to}$
- h. $D \rightarrow \text{that}$
- i. $D \rightarrow \text{this}$

Some sentences these rules will **generate**:

- (49)
- a. This boy must seem incredibly conceited to that girl.
 - b. This boy must seem incredibly conceited to this girl.
 - c. This boy must seem incredibly conceited to that boy.
 - d. This boy must seem incredibly conceited to this boy.
 - e. This girl must seem incredibly conceited to that girl.
 - f. This girl must seem incredibly conceited to this girl.
 - g. This girl must seem incredibly conceited to that boy.
 - h. This girl must seem incredibly conceited to this boy.

How many more sentences will these rules generate?

• Optional constituents

How do we handle cases like:

- (50) This boy must seem incredibly stupid.

9.2 Introducing infinity

We know that human languages can contain sentences of arbitrary length. Consider (51) which stands for an infinite number of sentences.

- (51) He believes that he believes that he believes that he believes that ... he ate pizza.

So if all of human language is to be generated by a set of phrase structure rules, the relevant set of phrase structure rules should generate an infinite number of sentences.

How can that be done?

Let us try to analyze (51), starting with a more manageable (52).

(52) He believes that he ate pizza.

We start with the following categorial rules:

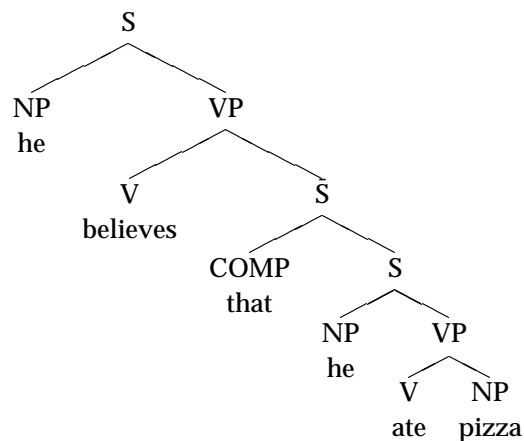
- (53) a. $S \rightarrow NP VP$
 b. $VP \rightarrow V \bar{S}$
 c. $\bar{S} \rightarrow COMP S$
 d. $VP \rightarrow V NP$

We need the following lexical rules:

- (54) a. $NP \rightarrow \text{he}$
 b. $NP \rightarrow \text{pizza}$
 c. $V \rightarrow \text{ate}$
 d. $V \rightarrow \text{believes}$
 e. $COMP \rightarrow \text{that}$

Now we can generate (52). This is shown in (55).

(55)



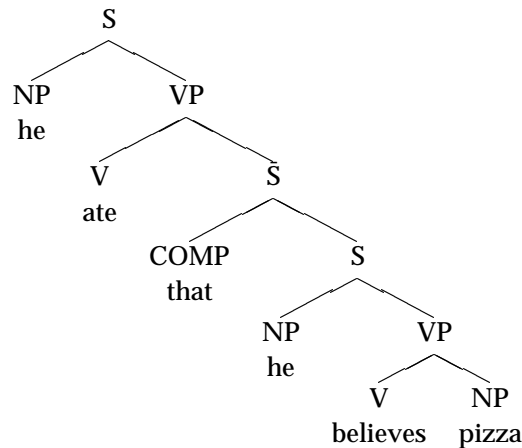
But is (52) all that the rules in (53) and (54) will generate?

How many sentences will (53) and (54) generate?

9.2.1 Overgeneration

The rules in (53) and (54) will also generate sentences (see the structure below) like:

(56) *He ate that he believes pizza.



How can we constrain phrase structure rules so that such overgeneration does not take place?

10 Noun Phrases

So far, we have seen two kinds of categories:

word-level categories such as N, V, A, P etc. (somewhat imprecisely, words) and phrase-level categories such as NP, VP, AP, PP etc. (somewhat imprecisely, sequences of words which can 'stand on their own').

We will now investigate if these two kinds of categories are all we need a third category which lies in between words and full phrases.

Consider the following NP:

(57) the king of England

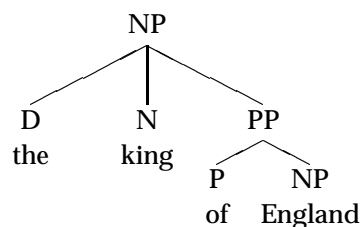
We feel quite confident saying that 'the king of England' is an NP. What else can we say about its structure?

There seems to be a lot of evidence that **of England** is a PP. It can be co-ordinated, shared in **shared constituent** co-ordination. It can also function as a sentence fragment and be preposed.

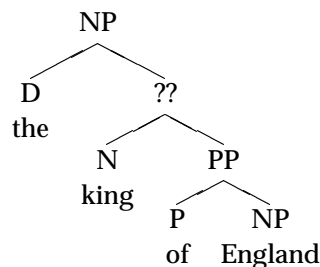
- (58) a. the king [_{PP} of England] and [_{PP} of the empire]. (coordination)
- b. He is the king, and she is the queen, [_{PP} of England]. (shared constituent coordination)
- c. A: Was he the king of Livonia?
B: No, [_{PP} of England]. (sentence fragment)
- d. [_{PP} Of which country] was he the king?

At this point we have two options:

(59)



(60)



There is evidence from constituency tests that the sequence of words ‘king of England’ forms a constituent.

- ‘king of England’ can undergo co-ordination with another similar sequence.

(61) Vivian dared defy the [king of England] and [ruler of the Empire]?

- ‘king of England’ can serve as the **shared constituent in shared constituent co-ordination**.

(62) Edward was the last, and some people say the best, [king of England].

- There is a proform that replaces sequences like ‘king of England’.

(63) The present [king of England] is more popular than the last **one**.

So ‘king of England’ forms a constituent that excludes *the*. Thus we have evidence for the tree in (60).

This evidence doesn’t actually rule out the tree in (59). It is not easy to rule out (59) on the basis of the discussion so far. However, an assumption that natural language structures only involve binary branching could be used to block structures like (59).

10.1 What kind of constituent is ‘king of England’?

In other words, what is the name of the node labeled ?? in (60)?

Let us assume that it is an NP.

We find that this assumption is problematic in many ways.

- ‘king of England’ does not have the distribution of ‘normal’/‘full’ noun phrases. Normal NPs can occur in subject position, in object position, and as a prepositional object. ‘king of England’ cannot appear in any of these positions.

(64) a. subject:

- [The king of England] invaded several countries.
- * [King of England] invaded several countries.

b. object:

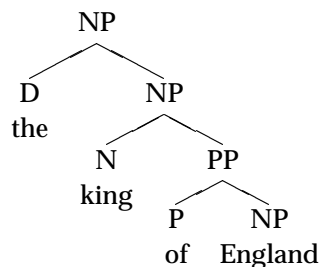
- I saw [the king of England] on the T yesterday.
- * I saw [king of England] on the T yesterday.

c. prepositional object:

- I didn’t give any money to [the king of England].
- * I didn’t give any money to [king of England].

- Consider the tree for ‘the king of England’ under the assumption that ‘king of England’ is also an NP.

(65)



From this tree, we can read of the phrase structure rules involved in building it. They are shown in (66).

- (66) a. Categorical Rules:
- i. $NP \rightarrow D NP$
 - ii. $NP \rightarrow N PP$
 - iii. $PP \rightarrow P NP$
- b. Lexical Rules:
- i. $D \rightarrow \text{the}$
 - ii. $N \rightarrow \text{king}$
 - iii. $P \rightarrow \text{of}$
 - iv. $NP \rightarrow \text{England}$

Note in particular the categorical rule (66a.i). It has the unusual property that it expands a node label into itself. Such rules are called **recursive** and this phenomena is called **recursion**.⁴

So we can go from NP to [D NP] to [D D NP] to [D D D NP] and so on. In principle, using the rules in (66), we can generate NPs like those in (67).

- (67) a. * the the king of England
 b. * the the the king of England
 c. * the ... the the the king of England

Now, it is very clear that none of the NPs in (67) are good noun phrases in English. From this we can conclude that the categorical rule (66a.i), which is the source of the recursion, cannot be correct.

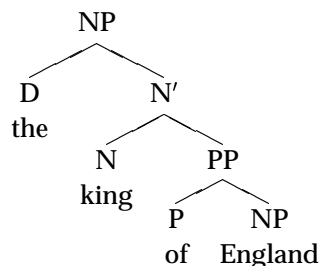
So:

- 'king of England' cannot be an NP
- and yet
- 'king of England' is a constituent of some sort.

Let us call nominal constituents that are bigger than words but still not full phrases \bar{N} (or N' or $N\text{-bar}$).

Our tree now becomes:

(68)



NPs are sometimes called N-double bars or N'' . N are sometimes called N^0 .

11 Complements and Adjuncts

Consider the phrase-structure rules responsible for generating (68)⁵:

⁴We have already seen a case of recursion, though there the recursion was in two steps.

⁵From now on, we will only consider the categorical rules. The lexical rules are straightforward.

- (69) a. $NP \rightarrow D N'$
 b. $N' \rightarrow N PP$
 c. $PP \rightarrow P NP$

We see that D combines with an N' to its left and forms an NP. Similarly P combines with an NP to its left and forms a PP.

Likewise, (69) says that an N combines with any PP that follows it (i.e. any **postnominal** NP) and forms an N' .

But is this really the case? Do the PPs in (70a, b) have the same relation to the N?

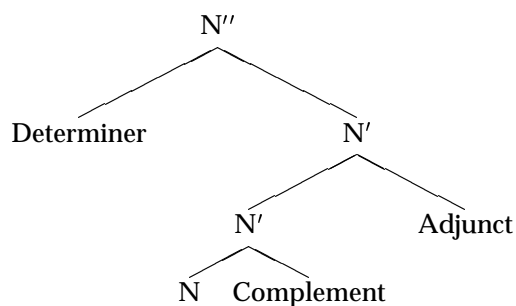
- (70) a. a student [of Physics]
 b. a student [with long hair]

It seems not. Consider the following pattern:

- (71) a. i. He is [a student of Physics].
 ii. = He is [studying Physics].
 b. i. He is [a student with long hair].
 ii. \neq He is [studying long hair].

PPs like 'of Physics' are called **complements**, while PPs like 'with long hair' are called **adjuncts**. Corresponding to this difference in terminology, a structural difference is also proposed. This is shown in (72).

(72)



In terms of phrase structure rules this is:

- (73) a. $N'' \rightarrow D N'$ (Determiner Rule)
 b. $N' \rightarrow N' PP$ (Adjunct Rule)
 c. $N' \rightarrow N PP$ (Complement Rule)

The rules in (73) make a prediction - if an NP contains both a complement PP and an adjunct PP, the complement PP should precede the adjunct PP. This prediction turns out to be true.

- (74) a. the student [of Physics] [with long hair]
 b. * the student [with long hair] [of Physics]

11.1 Optional Constituents of the Noun Phrase

Do all NPs have to contain a determiner, a noun, a complement PP, and an adjunct PP?

Well, they have to contain an N, otherwise they wouldn't be NPs. What about the others?

Consider the rules in (73). If you wanted to make an NP, would it be necessary to apply the Adjunct rule?

You could take an N and a complement PP and make an N'. Then you **could** combine the N' with an adjunct PP to make another N'.

You could, but you don't have to. You can now just combine your adjunct-less N' with a D on its left to make an NP.

So, NPs don't have to contain adjuncts. In other words, the adjunct rule is an **optional** rule.

Still, the rules in (73) insist that every NP must have a determiner (the Determiner rule) and a complement PP (the Complement rule). This is, however, just false.

- (75) a. the student
- b. the student with long hair

(75a) is an NP without a complement PP, (75a) show that an NP without a complement PP can still take an adjunct PP. How can we modify our phrase structure rules to handle these case?

For this purpose, we will introduce new terminology: **(A)** means that A is optional. So we can now change our complement rule from (76a) to (76b).

- (76) a. $N' \rightarrow N \text{ PP}$ (Old Complement Rule)
- b. $N' \rightarrow N \text{ (PP)}$ (New Complement Rule)

We also find optionality of determiners cf. (77a-e).

- (77) a. cheese from Greece
- b. students
- c. students with long hair
- d. students of physics
- e. students of physics with long hair

However, this optionality is **lexically determined** i.e. it only works for certain nouns - noncount nouns and plural count nouns but not singular count nouns.⁶

- (78) a. * Student likes pizza
- b. * Student with long hair likes pizza

For such nouns, we can modify the determiner rule in the way we modified the complement rule in (76).

- (79) a. $NP \rightarrow D \text{ N'}$ (Old Determiner Rule)
- b. $NP \rightarrow (D) \text{ N'}$ (New Determiner Rule)

However, we have to think of a way to block the NPs in (78) from being generated.

⁶How can we be sure that the word sequences in (77) are NPs?

11.2 Non-branching Phrases

Consider the new complement rule:

- (80) $N' \rightarrow N \text{ (PP)}$ (New Complement Rule)

This rule is really equivalent to the following two rules:

- (81) a. $N' \rightarrow N \text{ PP}$
b. $N' \rightarrow N$

(81a) is nothing new. (81b) is definitely new. It tells us something unexpected. According to (81b), **student** in 'the student' is both an N' as well as an N , while **student** in **the student of Physics** is only an N , not an N' . Similarly, **student** in 'the student with long hair' should be both an N' as well as an N . We can check to see if these predictions are true.

The test we will use is substitution by the N' pro-form **one**.

- (82) a. The [student] with long hair is dating the **one** with short hair.
b. This [student] works harder than that **one**.
c. * The [student] of chemistry was older than the **one** of Physics.

What can co-ordination tell us here?

11.3 A bit more on N'

Both (83a, b) are responsible for the creation of N' 's.

- (83) a. $N' \rightarrow N' \text{ PP}$ (Adjunct Rule)
b. $N' \rightarrow N \text{ PP}$ (Complement Rule)

How can we be sure that the node created by the complement rule isn't $N\text{-bar}1$ and the node created by the adjunct rule $N\text{-bar}2$?

Again by a constituency test: we know that only like categories can be co-ordinated and we find that N' created by the two different rules can be co-ordinated.

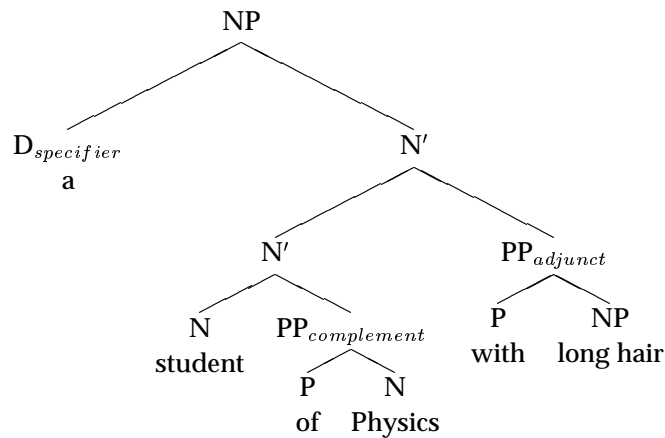
- (84) the [[students of Chemistry with long hair] and [professors of Physics]]

In addition, the pro- N' **one** can refer to N' 's created by either rule.

- (85) a. Which [student of Physics]? The **one** with long hair?
b. Which [student of Physics with long hair]? That one?

Hence we can conclude that the 'output' of both the rules is indeed one kind of node, which we call N' .

- (86) a student of Physics with long hair



12 On differences between Complements and Adjuncts

12.1 Semantic Arguments

Each N' denotes a semantic property. To attribute (86) to someone is to attribute two properties to them - one of studying Physics and another of having long hair.

On the other hand, (87a, b) both involve only one property attribution: that of being a student in (87a) and that of studying Physics in (87b).

- (87) a. John is a student.
b. John is a student of Physics.

Note that the post-copular⁷ NPs contain only one N' each. On the other hand, (86) contains two N's and involves two property attributions.

• In some cases, PPs are quite unambiguously either adjuncts (*with long hair*) or complements (*of Physics*). In most cases, however, PPs don't so wear their complement/adjunct status on their sleeves. Consider the ambiguous (88).

- (88) a student [*of high moral principles*]
a. a person who studies high moral principles
b. a student who has high moral principles

This ambiguity can be characterized in structural terms: on the reading in (88a), the PP *of high moral principles* is a complement of *student*, while on the reading in (88b), the PP *of high moral principles* is an adjunct. A similar point is made by (89).

- (89) a. Arguments [with Tim] are often pointless. (complement)
b. Arguments [with few premises] are often pointless. (adjunct)

Evidence for the proposal that *with Tim* in (89a) is a complement and that *with few premises* in (89b) is an adjunct comes from the contrast in (90).

- (90) a. Arguments [with Tim] [with few premises] are often pointless.
b. *Arguments [with few premises] [with Tim] are often pointless.

⁷ *be* is also called the *copula*. a post-copular NP is an NP that follows the copula.

12.2 Syntactic Arguments

(91) Phrase Structure Rules for Noun Phrases

- a. $N'' \rightarrow D N'$ (Determiner Rule)
- b. $N' \rightarrow N' PP$ (Adjunct Rule)
- c. $N' \rightarrow N (PP)$ (Complement Rule)

One consequence of these rules that we have seen earlier is that a complement must precede an adjunct.

- (92) a. a student [of Physics] [with long hair]
b. * a student [with long hair] [of Physics]

These rules have other consequences too. Note that the adjunct rule is *recursive* i.e. in principle, it could apply an arbitrarily large number of times.

On the other hand, the complement rule is not recursive i.e. it can apply only once. These predictions are borne out:

- (93) a. a student [with long hair] [with short arms]
b. * a student [of Physics] [of Chemistry]

Further, unlike complements which have to precede adjuncts, adjuncts can be freely reordered with respect to each other.

- (94) a. a student [with long hair] [with short arms]
b. a student [with short arms] [with long hair]

12.2.1 Co-ordination

Complements can be co-ordinated with other complements.

- (95) a student [of Physics] and [of Chemistry]

Likewise, adjuncts can be co-ordinated with other adjuncts.

- (96) a student [with short arms] and [with long hair]

But adjunct PPs and complements PPs cannot be co-ordinated.

- (97) a. * a student [of Physics] and [with short arms]
b. * a student [with short arms] and [of Physics]

Since *a students of Physics* and *professors with long hair* are both N's, our analysis predicts that it should be possible to co-ordinate them.

- (98) the [[students of Physics] and [professors with long hair]]

12.2.2 Extraposition

Adjuncts are less tightly bound to the head noun than complements. This can be seen by the fact that it is possible to extrapose adjuncts PPs but not possible to extrapose complement PPs.

- (99) a. (?) A student came to see me yesterday [*with long hair*].
b. * A student came to see me yesterday [*of Physics*].

12.2.3 Preposing

Complements and Adjuncts behave differently with respect to preposing.

- (100) a. [What branch of Physics] is Jack a student of?
b. * [What kind of hair] is Paco a student with?

(Note that Complements and Adjuncts go in opposite directions with respect Extraposition and Preposing.)

12.3 Co-occurrence Restrictions

Heads place significant restrictions (i.e. *subcategorise*) on what can appear as their complement.

- (101) a. a student of Physics
b. * a boy of Physics
c. * a girl of Physics
d. * a teenager of Physics
e. * a goth of Physics

No similar restrictions are imposed on adjuncts.

- (102) a. a student with long hair
b. a boy with long hair
c. a girl with long hair
d. a teenager with long hair
e. a goth with long hair

Generalisation: heads are more closely related to their complements than to their adjuncts. Sub-categorisation restrictions hold only between a head and its complement, not between a head and its adjuncts.

12.4 Some more examples

Complements:

- (103) a. your reply [to my letter]
b. the attack [on Starr]
c. the loss [of the ship]
d. Joan's disgust [at Tamara's behavior]
e. his disillusionment [with life]

Adjuncts:

- (104) a. the book [on the table]
b. the advertisement [on the television]
c. the fight [after the match]
d. his resignation [because of the scandal]
e. a cup [with a broken handle]

12.5 Non-PP Complements and Adjuncts

So far we have only considered cases of PP complements and adjuncts. Can other kinds of phrases also be complements/adjuncts of nouns?

Complements: It seems that only PPs and full clauses (Ss) can be complements of nouns.

- (105) a. the suggestion [that we should abandon ship]
b. the demand [for him to resign]
c. the question [whether euthanasia is ethical]

On the other hand, a much wider range of phrases can occur as adjuncts e.g. temporal NPs, APs, and Relative Clauses.

- (106) a. the [[_{N'} abolition of taxes] [_{NP} next year]]
b. the [[_{N'} students of Physics] [_{AP} absent from class]]
c. the [[_{N'} king of England] [_S who abdicated]]

The greater freedom found with adjuncts reflects the fact that fewer restrictions are imposed by a head on its adjuncts than on its complement.

12.6 Complex NPs

What happens when the PP complement or adjunct itself contains a non-trivial NP (i.e. an NP with internal structure)?

- (107) a. an advocate of the abolition of indirect taxation
b. a woman with an umbrella with a red handle
c. his dislike of men with big egos

How can we account for the ambiguity of (108)?

- (108) a woman with three children with ginger hair

13 Prenominal Modifiers

Nouns can have three different kinds of prenominal (i.e. preceding the noun) modifiers:

Determiners: *a*

Attributes (Prenominal Adjuncts): *Cambridge*

Complements: *Physics*

- (109) a [*Cambridge*] [*Physics*] student

We already have the following two phrase structure rules:

- (110) a. $N' \rightarrow D N'$ (Determiner Rule)
b. $N' \rightarrow N' PP$ (Adjunct Rule)
c. $N' \rightarrow N (PP)$ (Complement Rule)

In addition, we will add the following two rules:

- (111) a. $N' \rightarrow NP N'$ (Adjunct Rule)

- b. $N' \rightarrow (NP) N$ (Complement Rule)

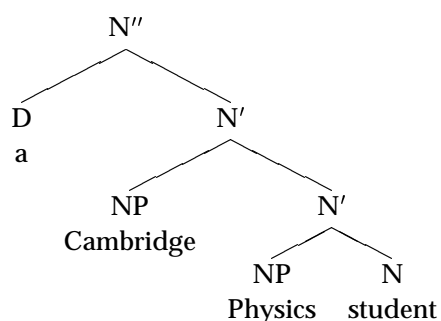
Consider the two readings of (109):

- (112) a. a student of Physics in Cambridge
b. a student of Cambridge Physics (as opposed to New York Physics)

The case of (112b) is somewhat straightforward so we can set it aside for now.

As for (112a), we know from our discussion on postnominal modifiers that in (112a), *of Physics* is a complement and *in Cambridge* is an adjunct. If we want to maintain maximal structural symmetry between (109) and its postnominal version in (112a), we are led to the following structure for the reading of (109) paraphrased by (112a).

(113)



13.1 Evidence for the above tree

- **Ordering:** We know that complements have to be closer to the head than adjuncts while adjuncts can be more freely reordered with respect to each other.

Note that *Cambridge* and *Physics* cannot be reordered. *Physics* has to be closer to the head noun.

- (114) a. a [Cambridge] [Physics] student
b. * a [Physics] [Cambridge] student

- **Co-ordination:** Prenominal adjuncts cannot be co-ordinated with prenominal complements.

- (115) a. * several [[Physics] and [Cambridge]] students
b. * several [[Cambridge] and [Physics]] students
c. several [[Physics] and [Chemistry]] students
d. several [[Cambridge] and [New York]] students

Also since both *Physics student* and *Cambridge Physics student* are N's, they can both be co-ordinated with another N'.

- (116) a. a Cambridge [hockey player and Physics student]
b. a [hockey player and Cambridge Physics student]

- **Recursion:** The attribute/adjunct rule is recursive, the complement rule is not. This means that we can have an arbitrarily large number of attribute/adjuncts but only one complement.

- (117) a. * a Physics Economics Agriculture student
b. a [Cambridge] [middle class] student
c. a [middle class] [Cambridge] student

13.2 The Prenominal/Postnominal Parallel

In general, for most postnominal structures, whether they involve complements or adjuncts, we can produce corresponding prenominal structures.

- (118) a. i. the ban [on controversial art] (Complement)
 ii. the [controversial art] ban
 b. i. recruitment [of personnel] (Complement)
 ii. [personnel] recruitment
 c. i. the shop [on the corner] (Adjunct)
 ii. the [corner] shop
 d. i. the lady [of iron] (Adjunct)
 ii. the iron lady

However, there is a difference - only nominals can occur in the preverbal position. Unlike postnominal modifiers which could be PPs, prenominal modifiers can only be NPs or adjectives⁸. Not all postnominal modifiers can be paraphrased by prenominal modifiers:

- (119) a. the carrot [on the pan]
 b. * the [on the carrot] pan
 c. * the [pan] carrot

Further the meaning of a prenominal modifier, esp. if it is an adjunct, can differ substantially from the postnominal PP version.

- (120) a. the book [on the coffee table]
 b. the [coffee table] book

A book kept on the coffee-table is not the same thing as a coffee-table book.

14 Adjectival Premodifiers

So far, we have only considered nominal attributes. Where do adjectives fit into the picture?

- (121) a. a [really excellent] book
 b. a [patently obvious] lie

For the most part, adjectival premodifiers are like NP premodifiers. We can handle them by adding the following rule:

- (122) $N' \rightarrow AP N'$ (Adjunct AP Rule)

Points to consider:

- recursiveness
- Ambiguity of cases like:

- (123) an English teacher
 a. someone who teaches English
 b. someone who teaches, and who is English

⁸Also participles as in 'the eaten apple'.