Constituency, Trees and Rules

Carnie, 2013, chapter 3

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Learning objectives

- After this lecture, you should walk away having mastered the following ideas and skills:

1. Be able to explain what a constituent is.
2. Show whether a string of words is a constituent or not.
3. Using phrase structure rules, draw the trees for English sentences.

Learning objectives

4. Explain and apply the Principle of Modification.
5. Produce paraphrases for ambiguous sentences and draw trees for each meaning.
6. Using data, be able to extract a set of phrase structure rules for another language.
7. Define recursion and give an example.

Structure

- Syntax is about the study of sentence *structure*.
- So what is "structure"?

Consider the sentence in (1):

1) The student loved his syntax assignments.

- If we say that sentence (1) consists of a linear string of words, we will miss several important generalizations about the internal structure of sentences and how these structures are represented in our minds.

- Rather, we are going to claim that the words in sentence (1) are grouped into units (called ***constituents***) and that these constituents are grouped into larger constituents, and so on until you get a sentence.

- Certain words seem to be closely related to one another in the sentence .
- For example, the word *the* seems to be tied more to the meaning of *student* than it is to *loved* or *syntax*. A related intuition can be seen by looking at the sentences in (2).

2) a) The student loved his phonology readings.

b) The student hated his morphology professor.

- The relationship between *the student* and *his syntax assignments* in (1) and *the student* and *his phonology readings* in (2a) is the same.
- Similarly, the relation between *the student* and *his morphology professor* in (2b), while of a different kind (hating instead of loving), is similar:

- There is one entity (*the student*) who is either hating or loving another entity (*his syntax assignments, his phonology readings* or *his morphology professor*).
- To capture these intuitions that certain words are more closely connected than others, and the intuitions about relationships between words in the sentence), we need a more complex notion.

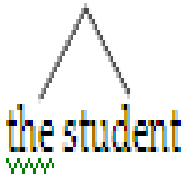
- The notions we use to capture these intuitions are ***constituency*** and ***hierarchical structure***.
- The idea that *the* and *student* are closely related to one another is captured by the fact that we treat them as part of a bigger unit that contains them, but not other words.

- There are two different ways of representing this bigger unit.
- One of them is to put square brackets around units:

3) [the student]

The other is to represent the units with a group of lines in what is called a tree structure:

4)



- These bigger units are called ***constituents***. An informal definition for a constituent is given in (5):

5) ***Constituent*: A group of words that function together as a unit.**

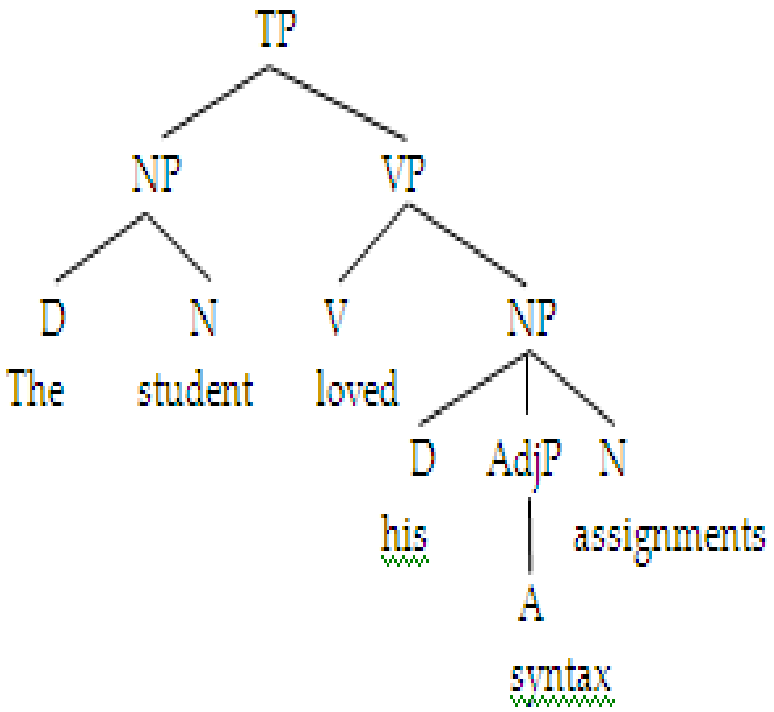
- Constituency is the most important and basic notion in syntactic theory.
- They capture the intuitions mentioned above. The “relatedness” is captured by membership in a constituent.
- As we will see it also allows us to capture the relationships between constituents exemplified in (1).

- Constituents are embedded one inside another to form larger and larger constituents. This is ***hierarchical structure.***
- This hierarchical structure can be demonstrated with the one given for sentence (1) below:

- This is a typical hierarchical ***tree structure***. The sentence constituent (represented by the symbol TP) consists of two constituents: a subject ***noun phrase*** (NP) *[the student]* and a predicate phrase or ***verb phrase*** (VP) *[loved his syntax assignments]*. The subject NP in turn contains a ***noun*** (N) *student* and a ***determiner*** (or article) (D) *the*. Similarly the VP contains a ***verb*** (V), and an object NP *[his syntax assignments]*.

- The object NP is further broken down into three bits: a determiner *his*, an adjective *syntax*, and a noun *assignments*. As you can see this tree has constituents (each represented by the point where lines come together) that are inside other constituents. This is hierarchical structure. Hierarchical constituent structure can also be represented with brackets.

6)


TP
NP
VP
D
N
V
NP
The
student
loved
D
AdjP
N
his
assignments
A
syntax

- Each pair of brackets ([ ]) represents a constituent. We normally put the label of the constituent on the left member of the pair. The ***bracketed diagram*** for (6) is given in (7):

7) $[_{TP}[_{NP}[_{D}$The$][_{N}$student$]][_{VP}[_{V}$loved$][_{NP}[_{D}$his$]$ $[_{AdjP}[_{Adj}$syntax$]][_{N}$assignments$]]]]$.

- Bracketed diagrams, as you can see, are much harder to read, so we will use tree diagrams most of the time. However, sometimes bracketed diagrams have their uses, so you should be able to translate back and forth between trees and bracketed diagrams.

Trees and rules

- In generative grammar, generalizations about structure are represented by rules. These rules are said to "generate" the tree. So if we draw a tree a particular way, we need a rule to generate that tree.
- The rules are called ***phrase structure rules*** (PSRs) because they generate the phrase structure tree of a sentence.

Noun Phrases (NPs)

- We can explore the range of material that can appear in NPs.
- The simplest NPs contain only a noun (usually a proper noun [+proper], pronoun [+pron], mass noun [count] or a plural noun [+plural]):

8) a) John b) water

c) cats

- Our rule must minimally generate NPs that contain only an N. The format for PSRs is shown in (9a); we use X, Y, and Z here as variables to stand for any category. (9b) shows our first pass at an NP rule:

9) a) XP → X Y Z

the label for the constituent *"consists of"* *the elements that make up the constituent*

b) NP → N

- This rule says that an NP is composed of (written as) an N. This rule would generate a tree like (10):

10)

- There are many NPs (e.g., those that are [+count]) that are more complex than this of course:

11) a) the box

b) his binder

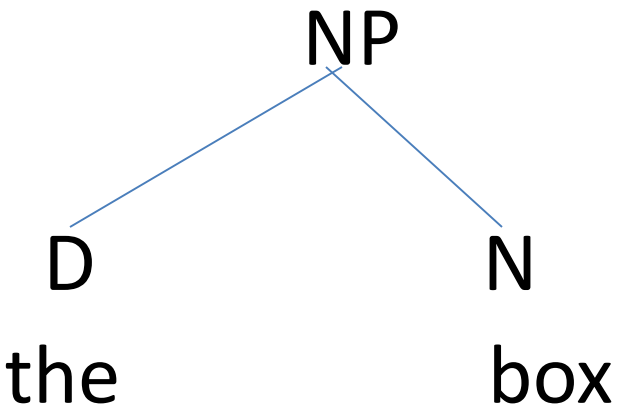
c) that pink fluffy cushion

- We must revise our rule to account for the presence of determiners:

12) a) NP⟶D N

This generates a tree like:

b)



- Determiners are optional. We indicate their optionality in the rule by using parentheses ( ) around the optional elements:

13) NP $\rightarrow$ (D) N

- Nouns can also be optionally modified by adjectives, so we will need to revise our rule as in (14):

14) a) the big box

b) his yellow binder

15) NP $\longrightarrow$ (D) (AdjP) N

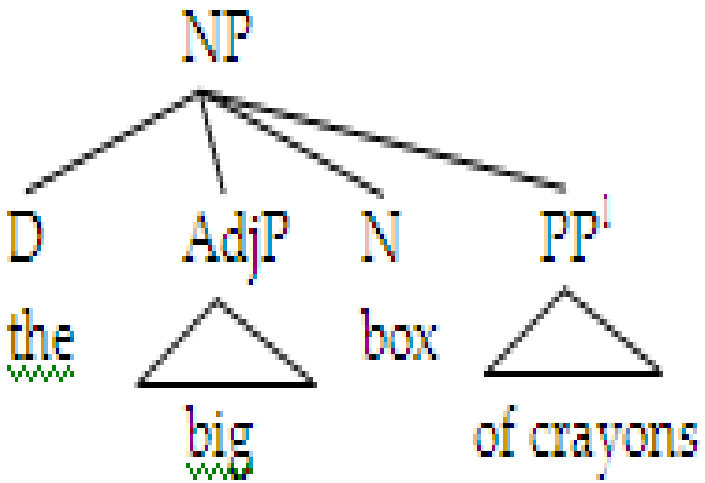
- Nouns can also take prepositional phrase (PP) modifiers as in (16), so once again we'll have to revise our rule:

16) a) the big box of crayons

b) his yellow binder with the red stripe

17) NP→(D) (AdjP) N (PP)

18)



- The NP constituent in (18) consists of four subconstituents: D, AdjP, N and PP.
- We can have more than one adjective and more than one PP in an English NP:

19) The $[_{AdjP}$ big] $[_{AdjP}$ yellow] box $[_{PP}$ of cookies] $[_{PP}$ with the pink lid].

- In this NP, the noun *box* is modified by *big*, *yellow*, *of cookies*, and *with the pink lid*. The rule must be changed then to account for this. It must allow more than one adjective and more than one PP modifier. We indicate this with a +, which means “repeat this category as many times as needed”:

- 20) NP $\longrightarrow$ (D) (AdjP+) N (PP+)
- We will have cause to slightly revise this rule later, but for now we can use it as a working hypothesis.

Adjective Phrases (AdjPs) and Adverb Phrases (AdvPs)

- Consider the following two NPs:

21)a) the big yellow book

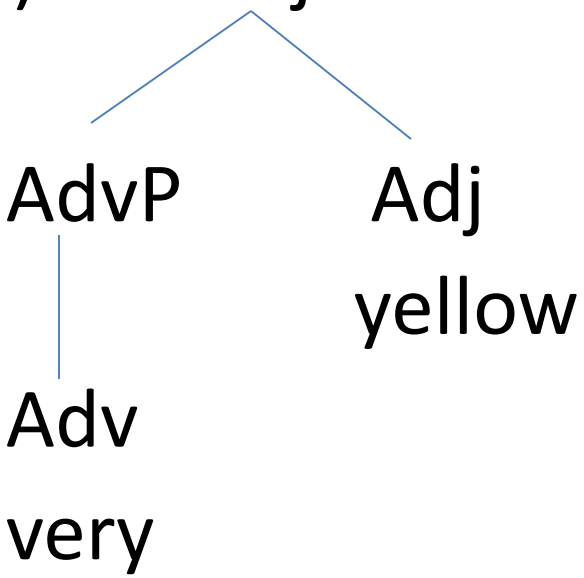
b) the very yellow book

- In (21a) *big* modifies *book*, as does *yellow*. In (21b) on the other hand, only *yellow* modifies book; *very* does not modify *book* (**very book*) – it modifies *yellow*.
- The structures of these two phrases are actually quite different. (21a) has two adjective constituents that modify the N, whereas (21b) has only one *[very yellow].*

- This constituent is called an adjective phrase (AdjP). The rule for the adjective phrase is given in (22a):

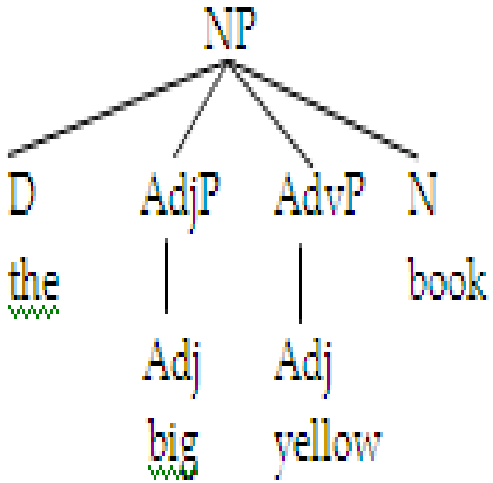
22)a) AdjP⟶(AdvP) Adj

b)

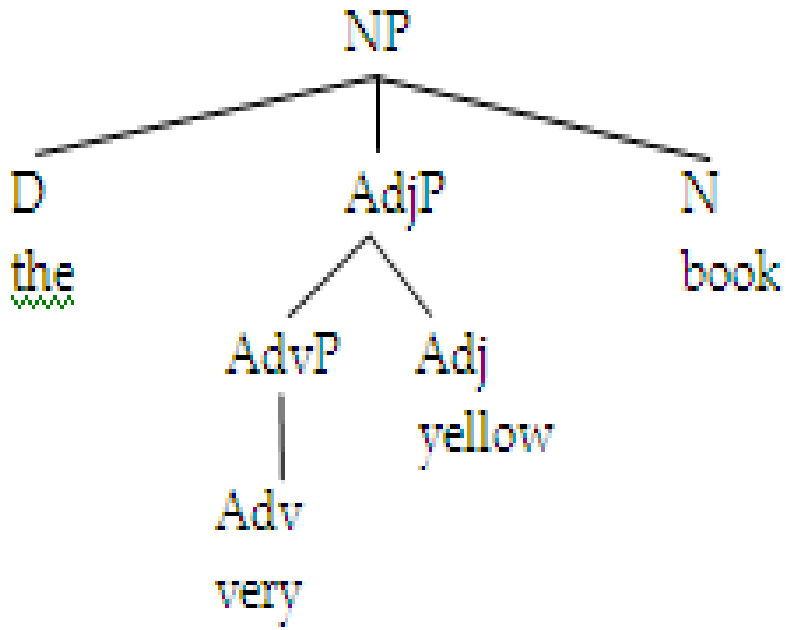


This will give us the following structures for the two NPs in (21):

23) a)



b)



- Despite their surface similarity, these two NPs have radically different structures. In (23a) the N is modified by two AdjPs, in (23b) by only one.
- This leads us to an important restriction on tree structures*:*

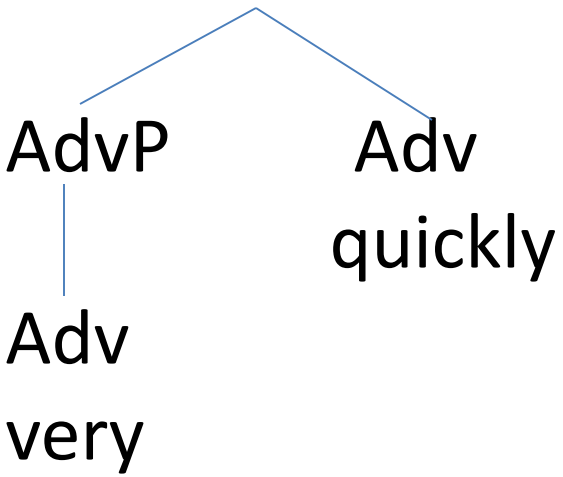
24) *Principle of Modification (informal):* Modifiers are always attached within the phrase they modify.

- The adverb *very* modifies *yellow*, so it is part of the *yellow* AdjP in (23b). In (23a) by contrast, *big* doesn't modify *yellow*, it modifies *book*, so it is attached directly to the NP containing *book*.
- A very similar rule is used to introduce AdvPs:

25) AdvP $\rightarrow$(AdvP) Adv

26) very quickly

27)

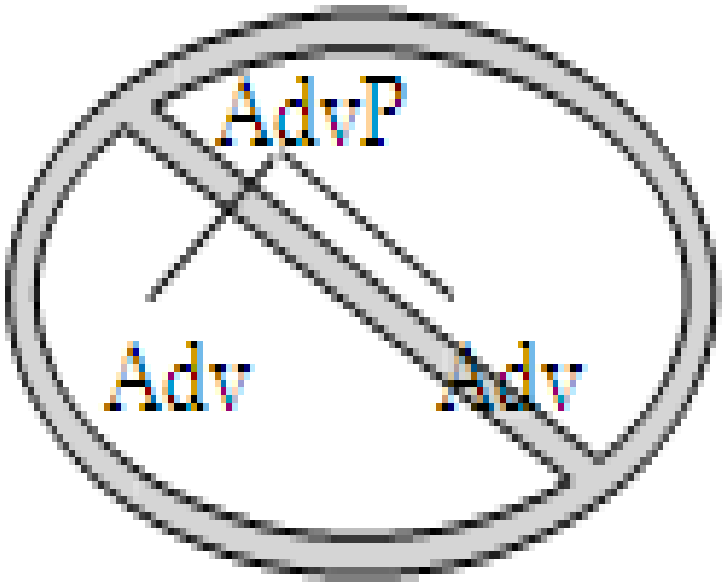


- A common mistake to avoid:
- Notice that the AdvP rule specifies that its modifier is another AdvP:

  AdvP $\rightarrow$ (AdvP) Adv.

  The rule does NOT say

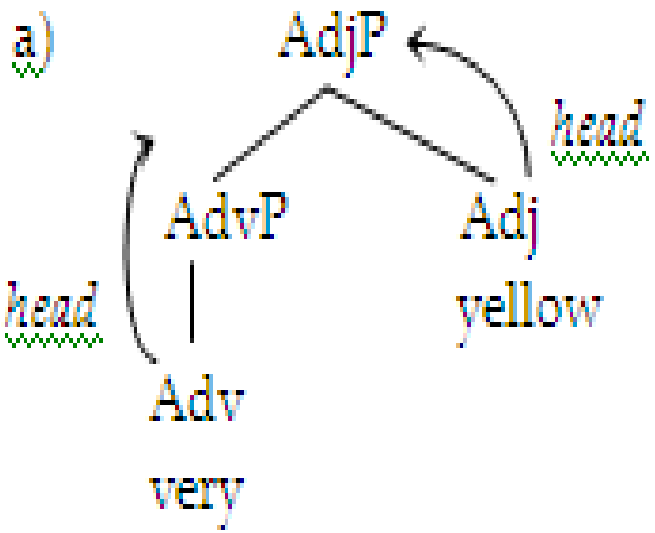
  *AdvP $\rightarrow$ (Adv) Adv, so you will never get trees of the form shown in (28):

28) 

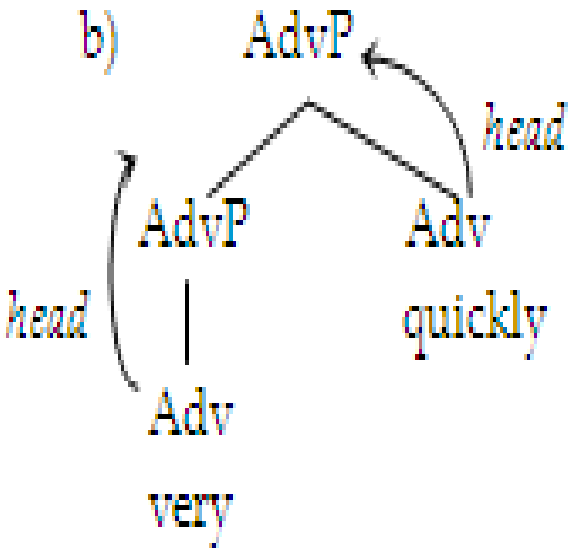
- You might find the tree in (27) a little confusing. There are two Advs and two AdvPs.
- In order to understand that tree a little better, let's introduce a new concept: ***heads***.
- The head of a phrase is the word that gives the phrase its category.

- For example, the head of the NP is the N, the head of a PP is the P, the head of the AdjP is Adj and the head of an AdvP is Adv.

29) a)



- In (29a), the heads should be clear. The adverb *very* is the head of the adverb phrase and the adjective *yellow* is the head of AdjP.

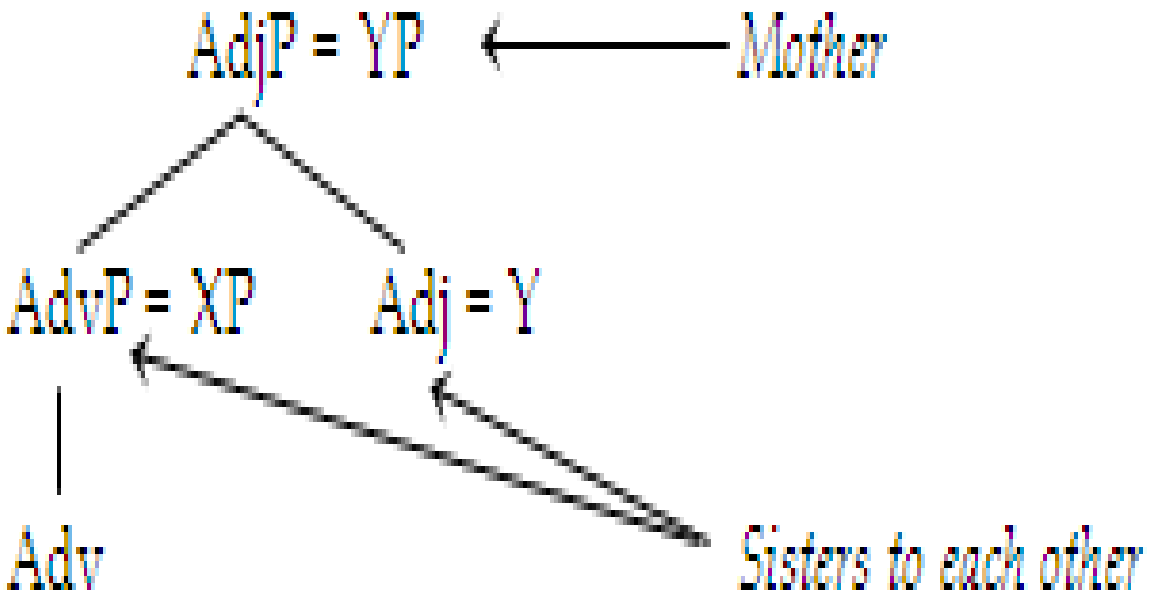

b)
AdvP
head
AdvP
Adv
quickly
head
Adv
very

- In (29b) we have the same kind of headedness, except both elements are adverbs. *Very* is the head of the lower AdvP, and *quickly* is the head of the higher one. We have two adverbs, so we have two AdvPs – **each has its own head**.

- With this in mind, we can explain why the "very" AdvP is embedded in the AdjP.
- We'll give a more precise version of the Principle of Modification here:

30) ***Principle of Modification*** (revised): If an XP (that is, a phrase with some category X) modifies some head Y, then XP must be a sister to Y (i.e., a daughter of YP).

31)



- The diagram in (31) shows you the relations mentioned in the definition in (30). If we take the AdjP to be the ***mother,*** then its ***daughters*** are the AdvP and the head Adj. Since AdvP and Adj are both daughters of the same mother, then we say they are ***sisters.***

- In (30) X and Y are variables that stand for any category. If one XP (AdvP) modifies some head Y (Adj), then the XP must be a sister to Y (i.e., the AdvP must be a sister to the head Adj), meaning they must share a mother.
- This relationship is asymmetric: AdvP modifies Adj, but Adj does *not* modify AdvP.

Prepositional Phrases (PPs)

- Most PPs take the form of a preposition (the head) followed by an NP:

32) a) $[_{PP}$ to $[_{NP}$ the store]]

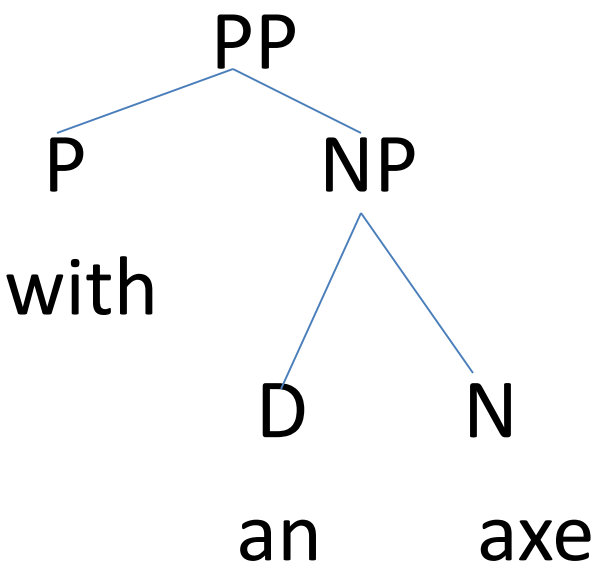
b) $[_{PP}$ with $[_{NP}$ an axe]]

c) $[_{PP}$ behind $[_{NP}$ the rubber tree]]

- The PP rule appears to be:

33) a) PP → P NP

b)



- In the rule we've given here, the NP in the PP is obligatory. There may actually be some evidence for treating the NP in PPs as optional. There is a class of prepositions, traditionally called particles, that don't require a following NP:

34) a) I haven't seen him *before.*

b) I blew it *up.*

c) I threw the garbage *out*.

- If these are prepositions, then it appears as if the NP in the PP rule is optional:

35)PP $\longrightarrow$ P (NP)

We will not concern ourselves on the debate on this issue here.

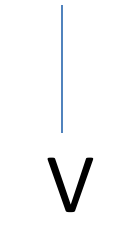
Verb Phrases (VPs)

- Minimally a VP consists of a single verb. This is the case of intransitives ($V_{[NP\ \_\ ]}$):

36) a) $VP \rightarrow V$

b) Ignacious [$_{VP}$ left].

c)

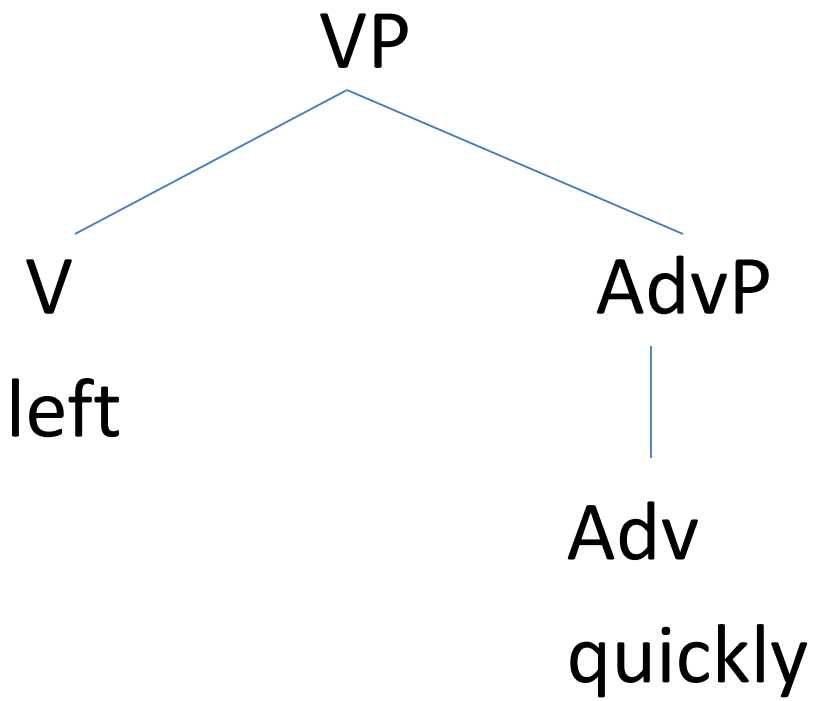


- Verbs may be modified by adverbs (AdvPs), which are, of course, optional:

37)a) Ignacious [VP left quickly].

b) VP $\rightarrow$ V (AdvP)

c)



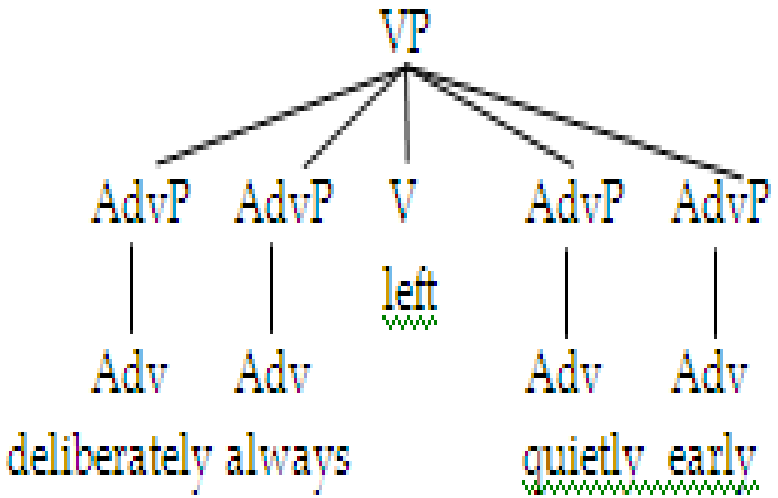
- Many of these adverbs can appear on either side of the V, and you can have as many AdvPs as you like:

38) a) Ignacious [$_{VP}$ quickly left].

b) Ignacious [$_{VP}$[$_{AdvP}$ deliberately] [$_{AdvP}$ always] left [$_{AdvP}$ quietly][$_{AdvP}$ early]].

c) VP (AdvP+) V (AdvP+)

39)


VP
AdvP
AdvP
V
AdvP
AdvP
left
Adv
Adv
Adv
Adv
deliberately always
quietly early

- You'll recall that there is a subcategory of verbs that can take an NP object (the transitive $V_{[NP\ \_\ NP]}$); these NPs appear immediately after the V and before any AdvPs:

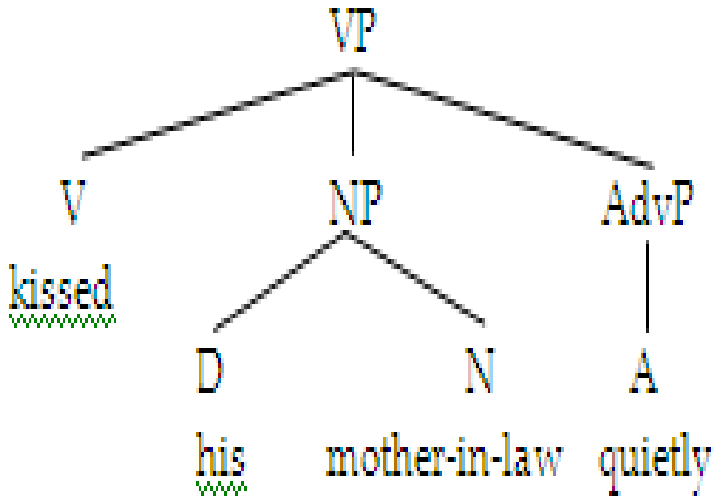
40) a) VP $\longrightarrow$ (AdvP+) V (NP) (AdvP+)

b) Bill [$_{VP}$frequently kissed *his mother-in-law*].

c) Bill [$_{VP}$ kissed *his mother-in-law* quietly].

(cf. *Bill [$_{VP}$ kissed quietly *his mother-in-law*].)

41)

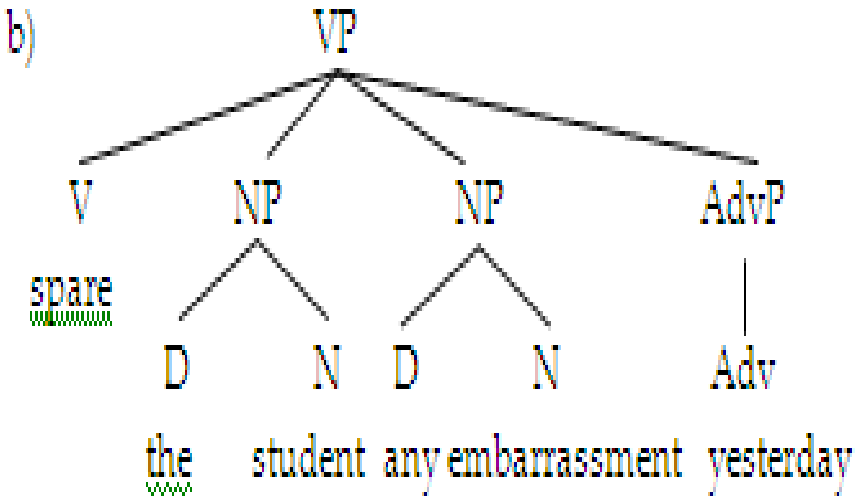


- It is also possible to have two NPs in a sentence, for example with a double object verb like *spare* (V[NP __ NP NP]). Both these NPs must come between the verb and any AdvPs:

42) I spared [$_{NP}$ the student] [$_{NP}$ any embarrassment] [$_{AdvP}$ yesterday].

- We will list both NPs in the rule:

43) a) VP $\rightarrow$ (AdvP+) V (NP) (NP) (AdvP+)

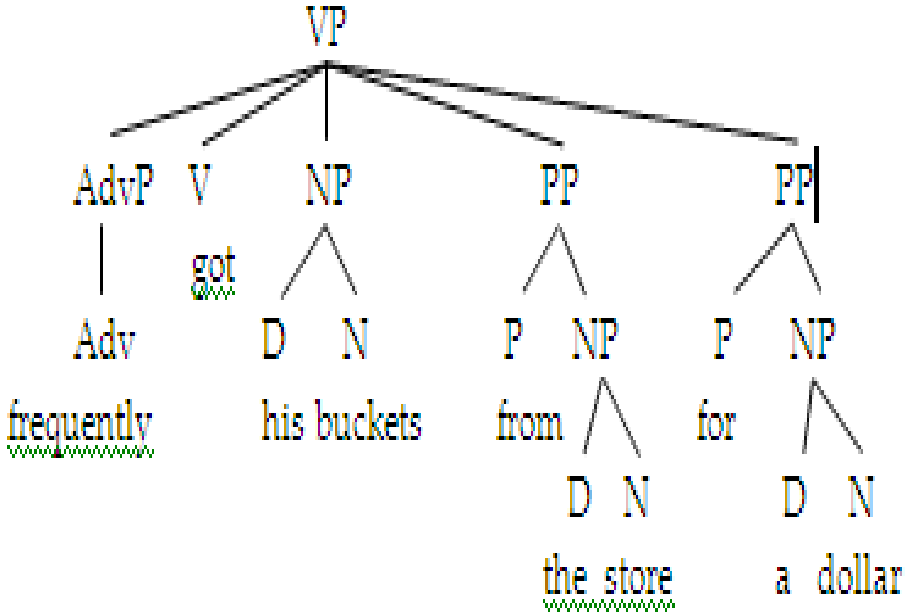

b)
VP
V
NP
NP
AdvP
spare
D
N
D
N
Adv
the
student
any
embarrassment
yesterday

- Verbs can be modified by PPs as well. These PPs can be arguments as in ditransitive verbs of the type V[$_{NP}$ _ NP PP] (e.g., the PP argument of the verb *put*) or they can be simple modifiers like *for a dollar* below.
- These PPs can appear either after an adverb or before it.

44)a) Bill [$_{VP}$frequently got his buckets [$_{PP}$ *from the store*] [$_{PP}$ *for a dollar*]].

b) VP$\longrightarrow$ (AdvP+) V (NP) (NP) (AdvP+) (PP+) (AdvP+)

c)


VP
AdvP
V
NP
PP
PP
got
Adv
D
N
P
NP
P
NP
frequently
his buckets
from
for
D
N
D
N
the store
a dollar

Clauses

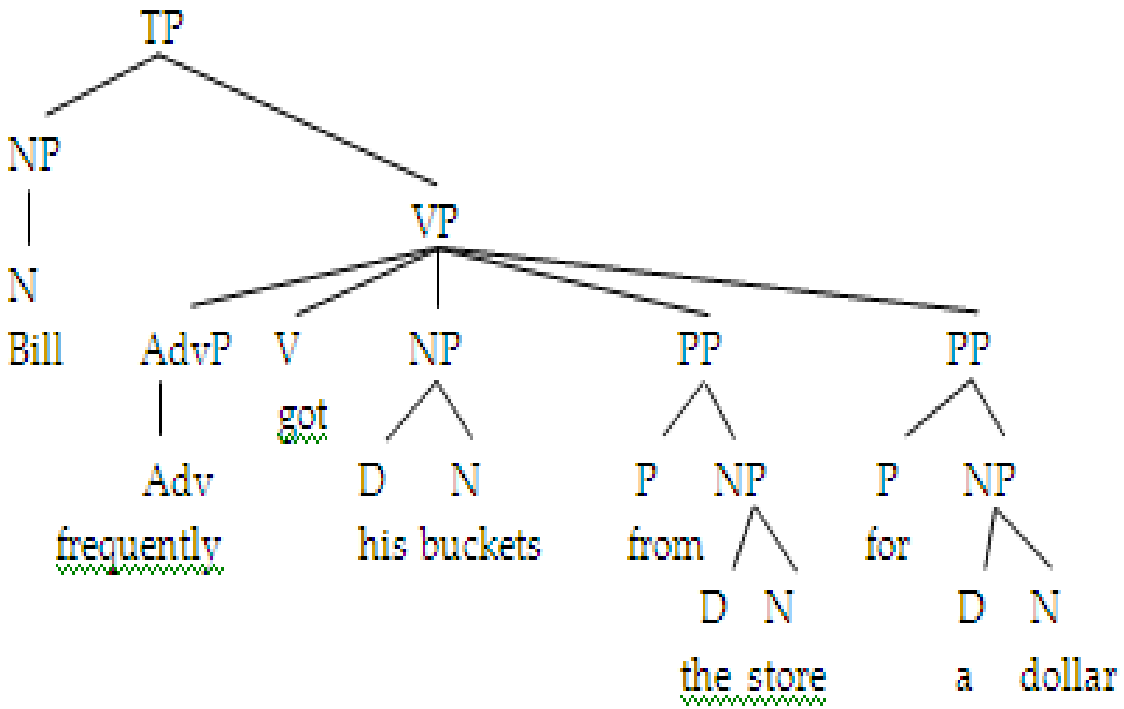
- A clause (or sentence) consists of a subject NP and a VP. The label we use for clause is TP (which stands for tense phrase).

45) $[_{TP}[_{NP}$ Bill] $[_{VP}$ frequently got his buckets from the store for a dollar]].

This can be represented by the rule in (46):

46) TP $\rightarrow$ NP VP

47)


TP
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frequently
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buckets
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D
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the
store
a
dollar

- TPs can also include other items, including elements of the category T, such as modal verbs and auxiliary verbs like those in (48):

48) a) Cedric *might* crash the longboat.

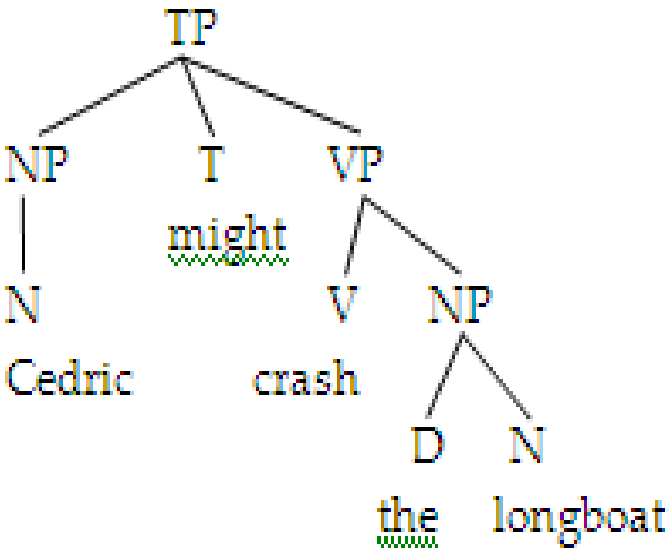
b) Gustaf *has* crashed the semi-truck.

- Note that the T in the TP is optional:

49) TP $\rightarrow$ NP (T) VP

A tree showing the application of this rule is given in (50):

50)



- There are times when one clause is embedded inside another:

51) [$_{TP}$ Shawn said [$_{TP}$ he decked the janitor]].

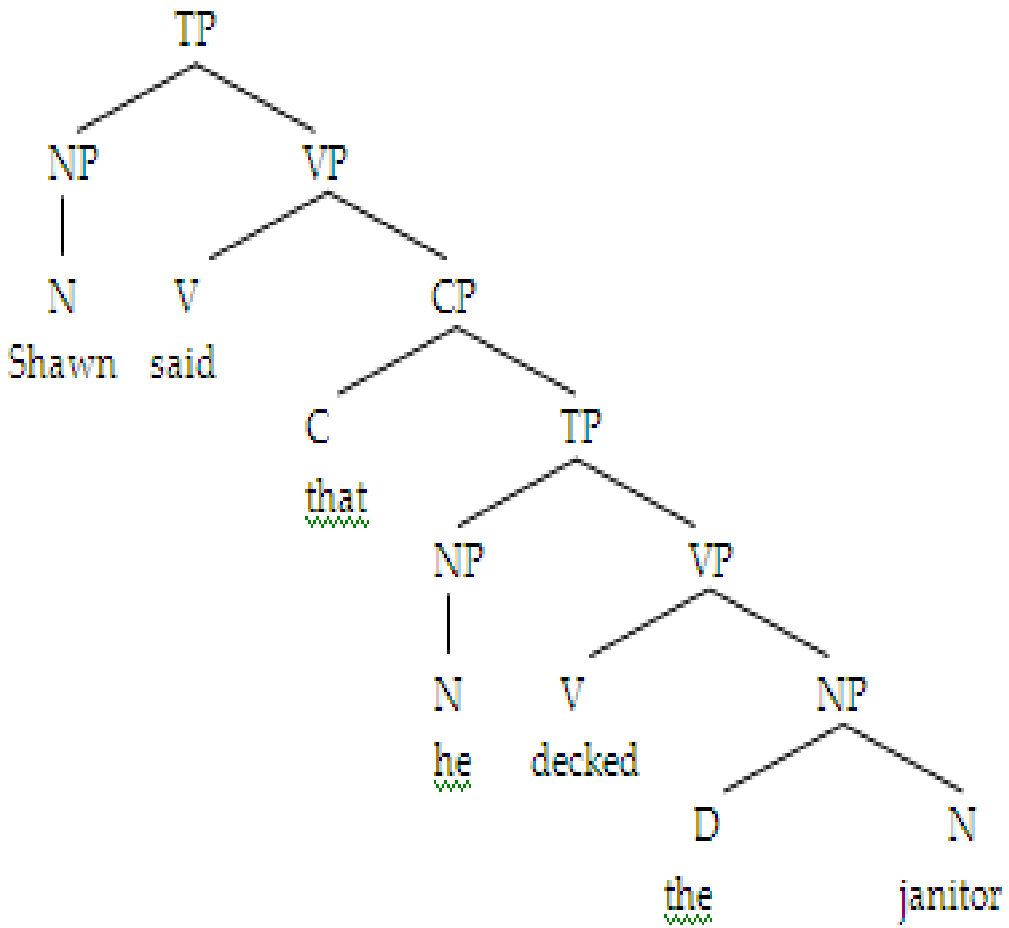
- In sentence (51) the clause *he decked the janitor* lies inside the larger main clause.
- Often embedded clauses are introduced by a complementizer like *that* or *if*:

52)[$_{TP}$ Shawn said [$_{CP}$ [$_{C}$ that] [$_{TP}$ he decked the janitor]]].

- We need a special rule to introduce complementizers (C):

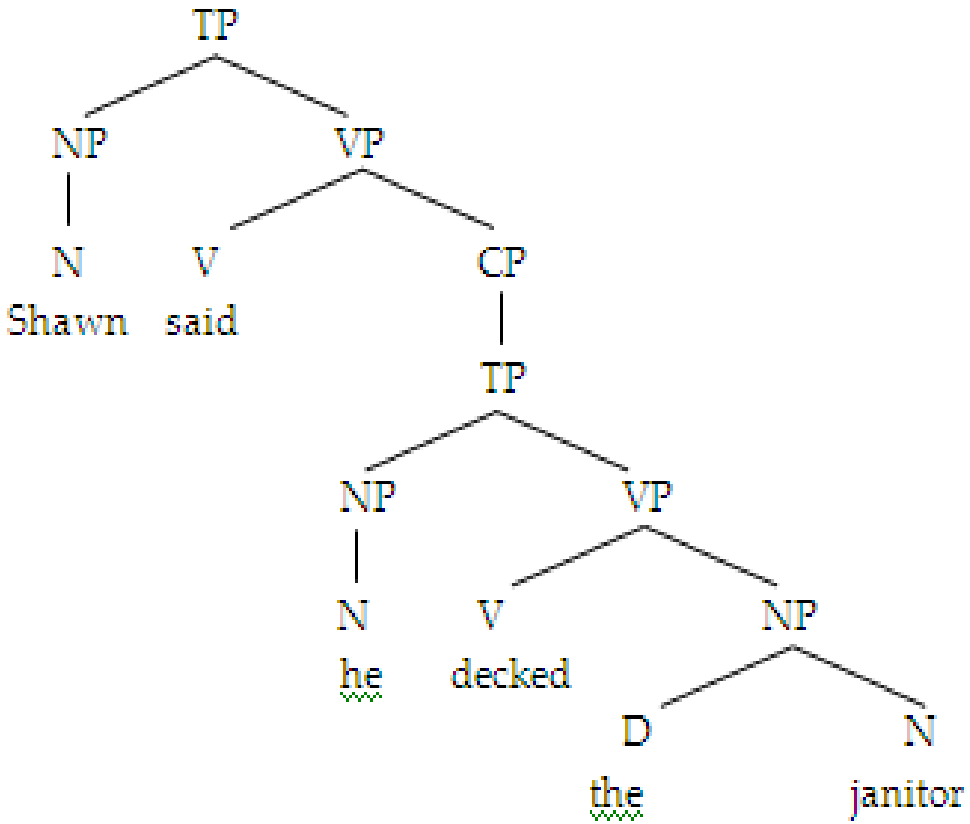
53) a) CP$\rightarrow$(C) TP

b)


TP
NP
VP
N
V
CP
Shawn
said
C
TP
that
NP
VP
N
V
NP
he
decked
D
N
the
janitor

- We will assume that *all* embedded clauses are CPs, whether or not they have a complementizer.
- This means that a sentence like *Shawn said he decked the janitor* will have a CP in it even though there is no complementizer *that*.

54)



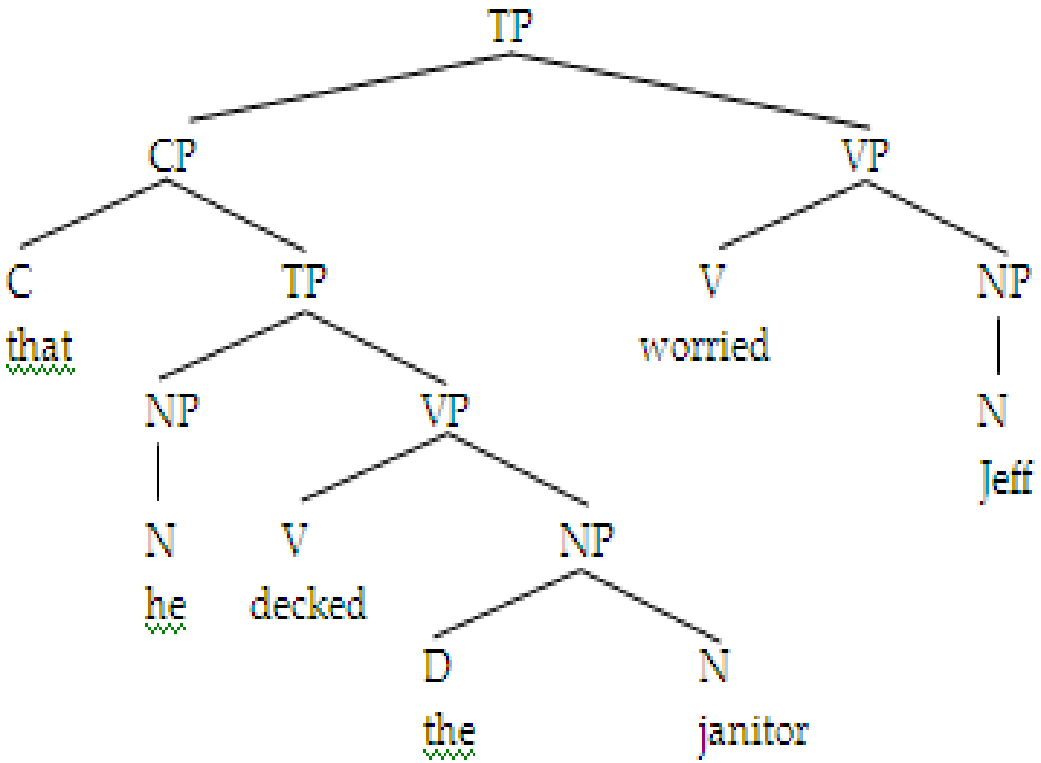
- Embedded clauses appear in a variety of positions. In (54), the embedded clause appears in essentially the same slot as the direct object.
- Embedded clauses can also appear in subject position:

  55) [$_{TP}$ [$_{CP}$ That he decked the janitor] worried Jeff].

- Because of this we are going to have to modify our TP and VP rules to allow embedded clauses.
- Syntacticians use curly brackets { } to indicate a choice. So {NP/CP} means that you are allowed *either* an NP or a CP but not both. The modification to the TP rule is relatively straightforward. We simply allow the choice between an NP and a CP in the initial NP:

- 56) a) TP $\longrightarrow$ VP

b)

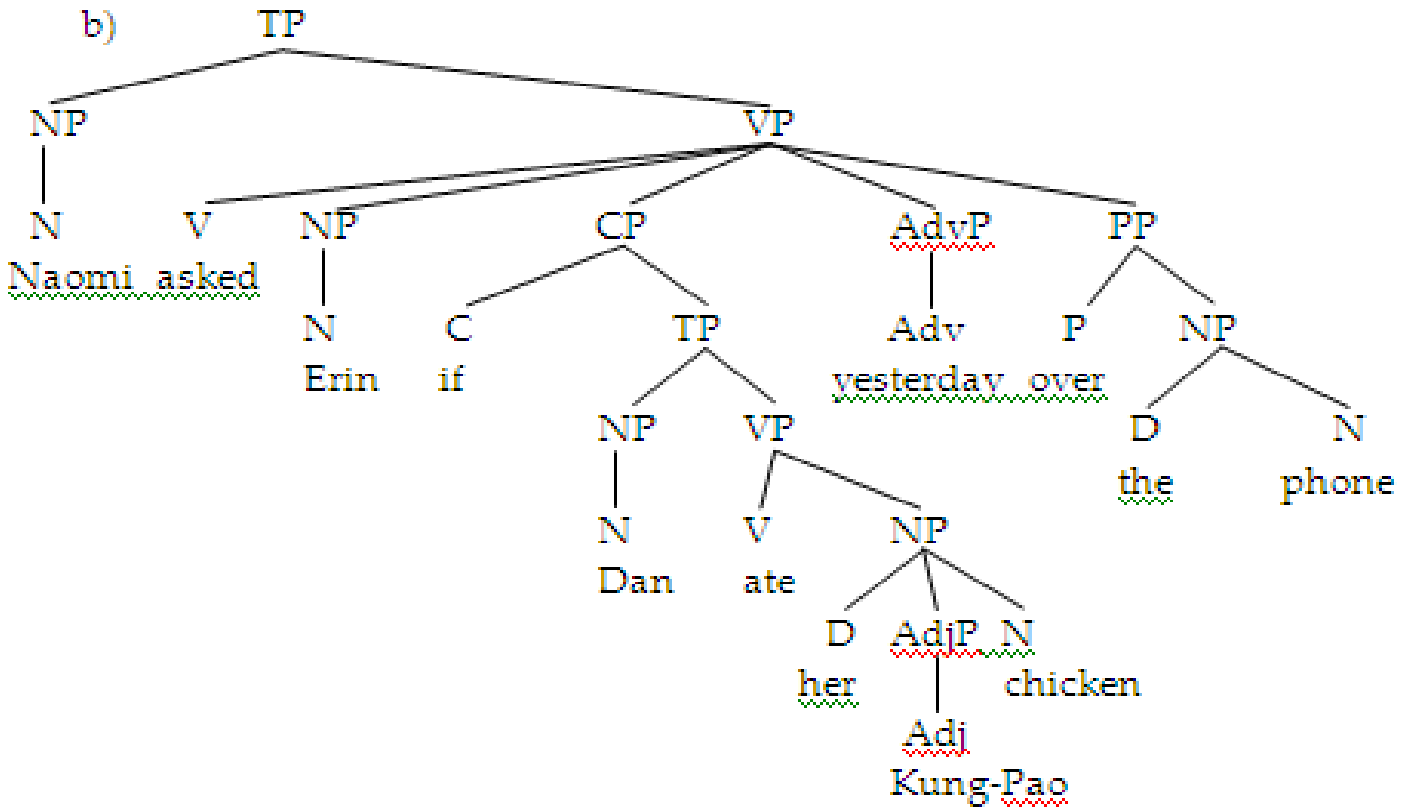

TP
CP
VP
C
that
TP
V
worried
NP
N
Jeff
NP
VP
N
he
V
decked
NP
D
the
N
janitor

- The revised VP rule requires a little more finesse. First observe that in verbs that allow both an NP and a CP ($V_{[NP\_\ N\ P\ \{NP/CP\}]}$ such as *ask*), the CP follows the $\overline{NP}$ but precedes the PP (in the following sentence *yesterday* and *over the phone* should be interpreted as modifying *ask*, not *ate*), essentially in the position of the second NP in the rule:

57) Naomi asked [$_{NP}$ Erin] [$_{CP}$ if [$_{TP}$ Dan ate her Kung-Pao chicken]] yesterday over the phone.

- This gives us the rule :

58) a) VP$\rightarrow$ (AdvP+) V (NP) ({NP/CP}) (AdvP+) (PP+) (AdvP+)


b)
TP
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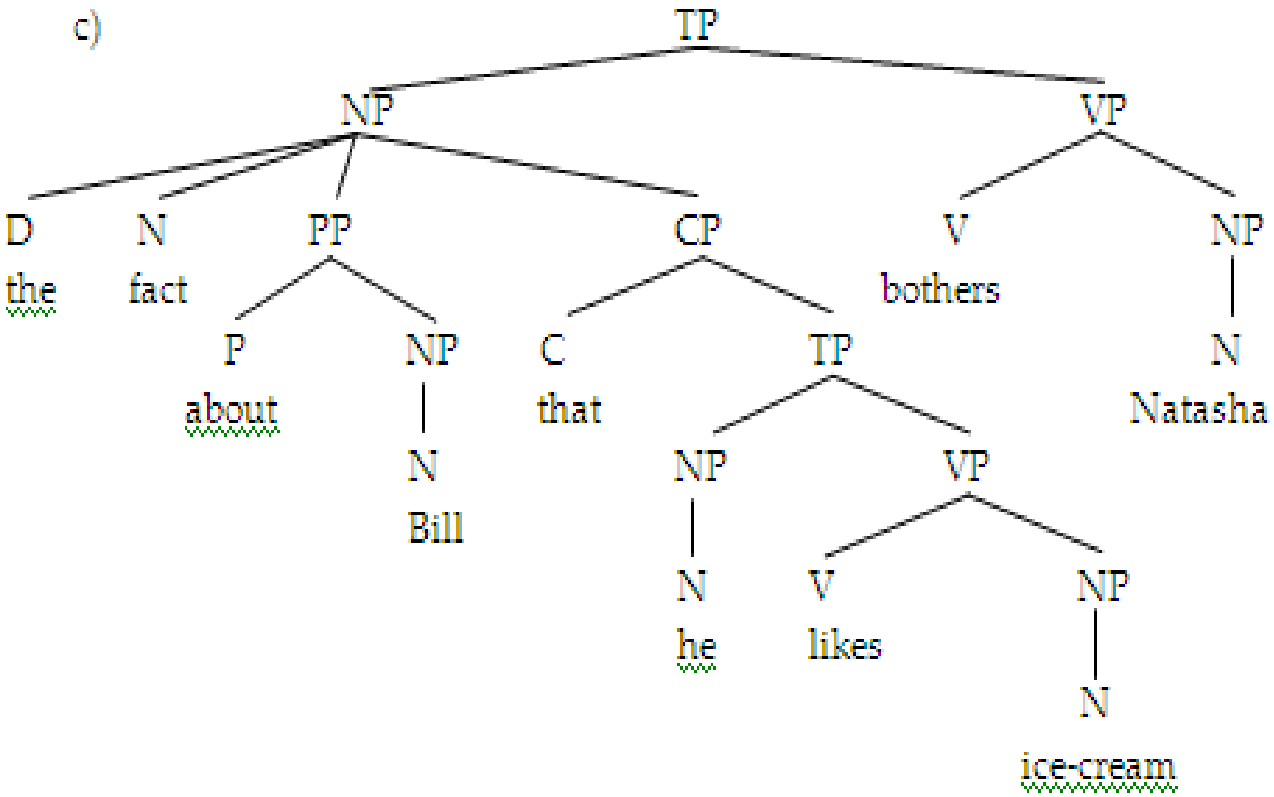
asked
NP
N
Erin
CP
C
if
TP
NP
N
Dan
VP
V
ate
NP
D
her
AdjP
Adj
Kung-Pao
N
chicken
AdvP
Adv
yesterday
PP
P
over
NP
D
the
N
phone

- The last revision we have to make to our PSRs is to add the CP as a modifier to NPs to account for cases like (59).

59) a) $[_{NP}$ The fact about Bill $[_{CP}$ that he likes ice-cream]] bothers Natasha.

b) NP $\rightarrow$ (D) (AdjP+) N (PP+) (CP)

c)


TP
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about
NP
C
that
TP
N
Natasha
N
Bill
NP
VP
N
he
V
likes
NP
N
ice-cream

Coordination (Conjunction)

- One type of constituent is the coordinated or conjoined constituent. This is a constituent that is joined together with words like *and*, *or*, *but*, *nor*, etc.

60) a) the [blue and red] station wagon

b) I saw [these dancers and those musicians] smoking something suspicious.

c) I am [drinking lemonade and eating a brownie].

d) [I’ve lost my wallet or I’ve lost my mind.]

e) We went [through the woods and over the bridge].

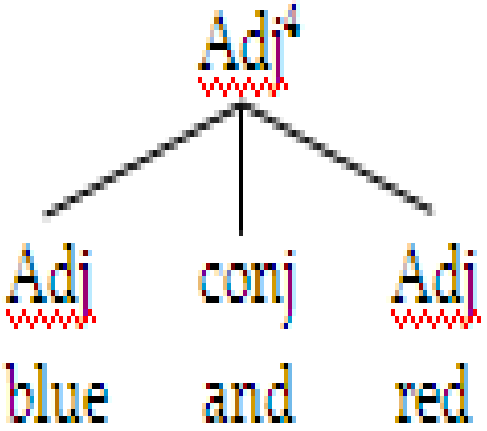
- Coordination seems to be able to join together two identical categories and create a new identical category out of them.
- In order to draw trees with conjunction in them, we need two more rules. These rules are slightly different than the ones we have looked at up to now. They are not category-specific.

- Instead they use a variable (X). This X can stand for N or V or A or P, etc. Just like in algebra, it is a variable that can stand for different categories. We need two rules, one to conjoin phrases (*[The Flintstones] and [the Rubbles]*) and one to conjoin words (*the [dancer] and [singer]*):

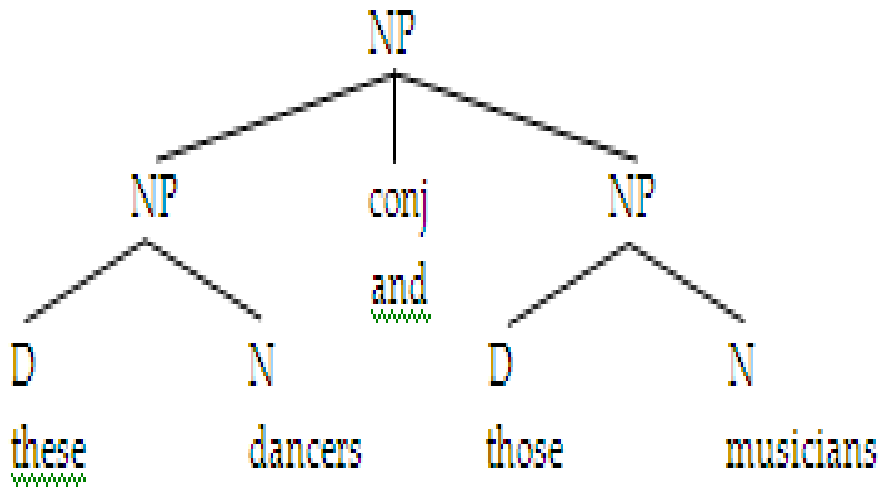
61) a) XP $\rightarrow$ XP conj XP

b) X $\rightarrow$ X conj X

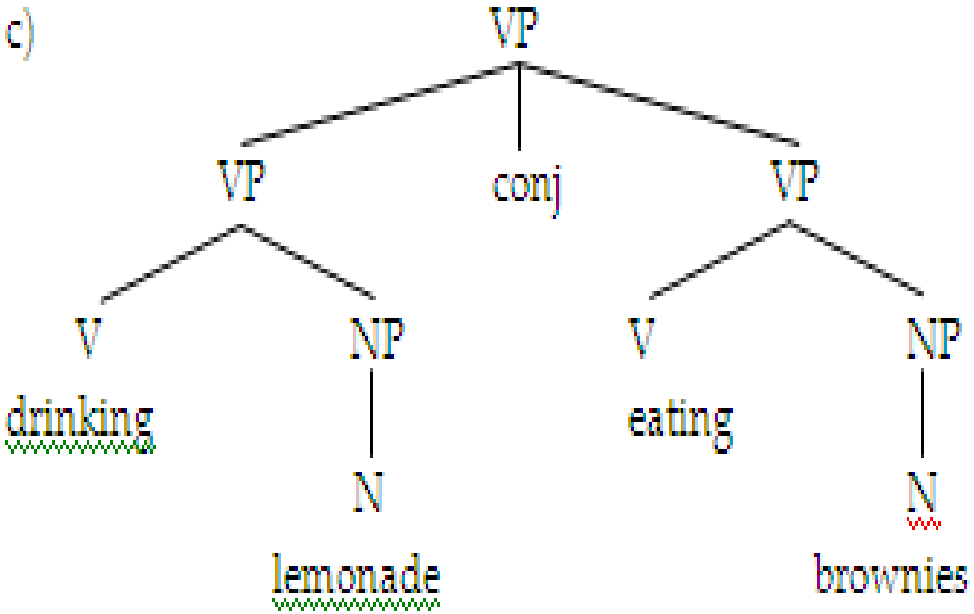
62) a)



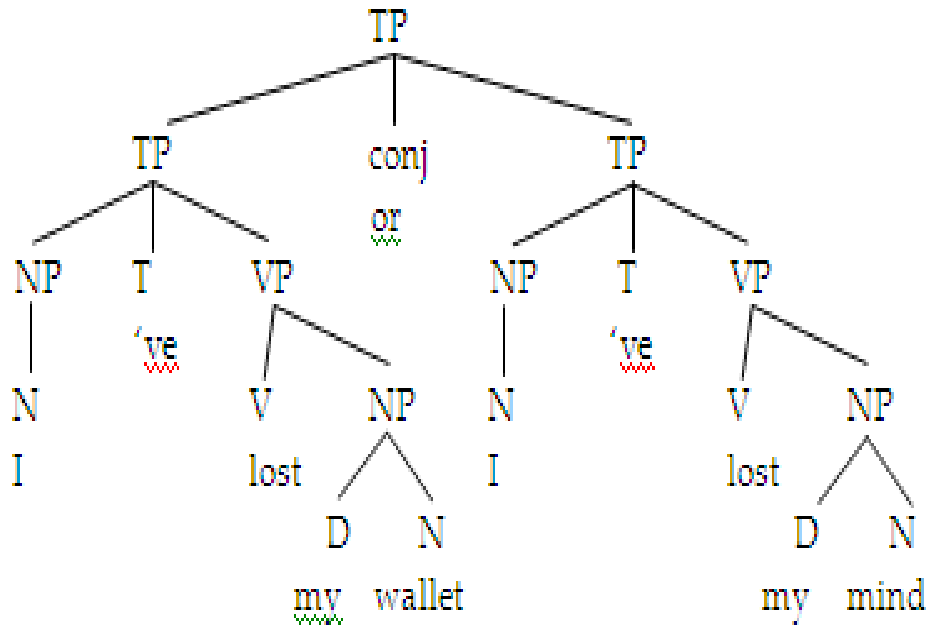
b)



c)



d)


TP
TP
conj
or
TP
NP
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NP
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VP
N
've
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've
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NP
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lost
I
lost
D
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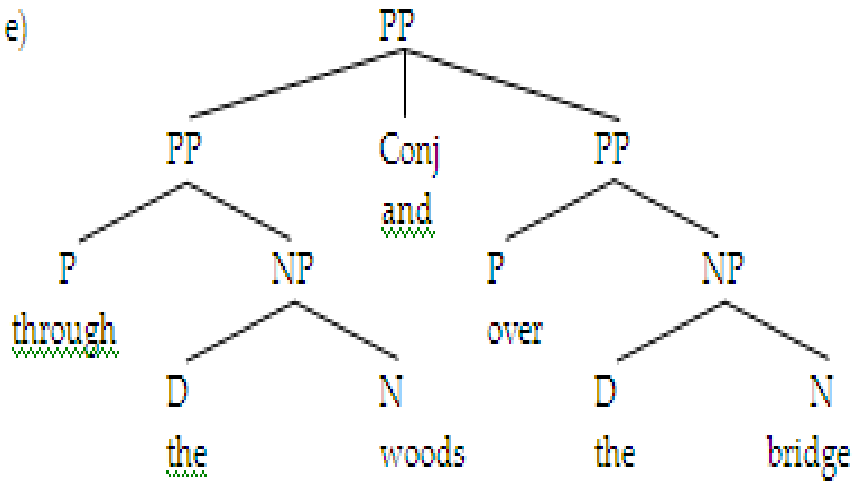
D
N
my
wallet
my
mind

e)


PP
PP
Conj
and
PP
P
NP
P
NP
through
over
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D
N
the
woods
the
bridge

Summary

- In this section we've been looking at the PSRs needed to generate trees that account for English sentences. As we'll see in later chapters, this is nothing but a first pass at a very complex set of data. It is probably worth repeating the final form of each of the rules here:

63) a) CP $\rightarrow$ (C) TP

b) TP $\rightarrow$ {NP/CP} (T) VP

c) VP $\rightarrow$ (AdvP+) V (NP)({NP/CP}) (AdvP+) (PP+) (AdvP+)

d) NP $\rightarrow$(D) (AdjP+) N (PP+) (CP)

e) PP $\rightarrow$ P (NP)

f) AdjP → (AdvP) Adj

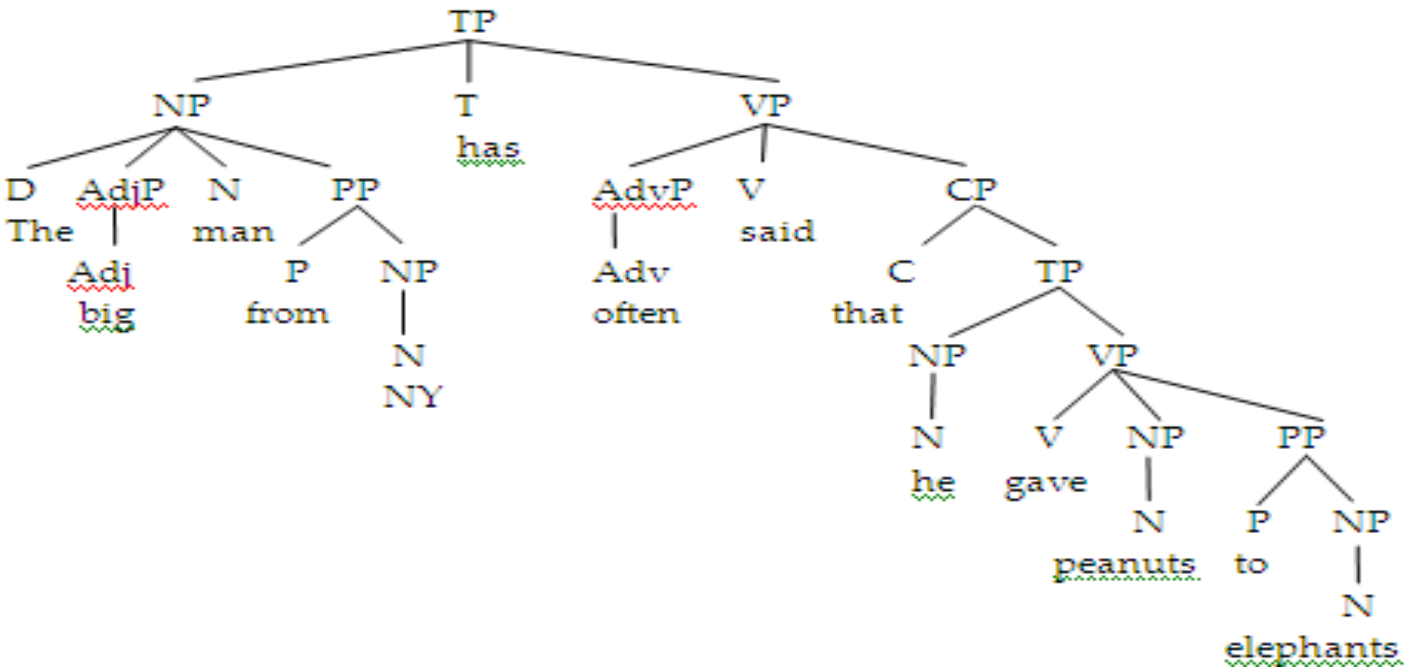
g) AdvP → (AdvP) Adv

h) XP → XP conj XP

i) X → X conj X

- These rules account for a wide variety of English sentences. It's quite a complicated set, but it captures the basic generalizations about the constituency of English. Later, we'll propose a simplified set of rules that isn't quite so stipulative. A sentence using each of the rules in (63) is shown in (64):

64) The big man from NY has often said that he gave peanuts to elephants.



Recursion

- Notice the following thing: The TP rule has a VP under it. Similarly, the VP rule can take a CP under it, and the CP takes a TP. This means that the three rules can form a loop and repeat endlessly:

i) Fred said that Mary believes that Susan wants that … etc.

- This property, called ***recursion***, accounts partially for the infinite nature of human language. Because you get these endless loops, it is possible to generate sentences that have never been heard before.

Source

Carnie, A. (2013). *Syntax: A Generative Introduction.* 3rd Edition. Oxford, UK & Cambridge, USA: Blackwell Publishing, chapter 3.