boy), or the proximity of the person or object to the context (*this boy* versus *that boy*). Auxiliaries provide the verb with a time frame, whether ongoing (*John* is *dancing*), completed in the past (*John* has *danced*), or occurring in the future (*John* will *dance*). Auxiliaries may also express notions such as possibility (*John* may *dance*), necessity (*John* must *dance*), ability (*John can dance*), and so on.

Lexical categories typically have particular kinds of meanings associated with them. For example, verbs usually refer to actions, events, and states (*kick*, *marry*, *love*); adjectives to qualities or properties (*lucky*, *old*); common nouns to general entities (*dog*, *elephant*, *house*); and proper nouns to particular individuals (*Noam Chomsky*) or places (*Dodger Stadium*) or other things that people give names to, such as commercial products (*Coca-Cola*, *Viagra*). But the relationship between grammatical categories and meaning is more complex than these few examples suggest. For example, some nouns refer to events (*marriage* and *destruction*) and others to states (*happiness*, *loneliness*). We can use abstract nouns such as *honor* and *beauty*, rather than adjectives, to refer to properties and qualities. In the sentence "Seeing is believing," *seeing* and *believing* are nouns but are not entities. Prepositions are usually used to express relationships between two entities involving a location (e.g., *the boy is in the room*, *the cat is under the bed*), but this is not always the case; the prepositions *of*, *by*, *about*, and *with* are not locational. Because of the difficulties involved in specifying the precise meaning of lexical categories, we do not usually define categories in terms of their meanings, but rather on the basis of their syntactic distribution (where they occur in a sentence) and morphological characteristics. For example, we define a noun as a word that can occur with a determiner (*the boy*) and that can take a plural marker (*boys*), among other properties.

All languages have syntactic categories such as N, V, and NP. Speakers know the syntactic categories of their language, even if they do not know the technical terms. Our knowledge of the syntactic classes is revealed when we substitute equivalent phrases, as we just did in examples (1) and (2), and when we use the various syntactic tests that we have discussed.

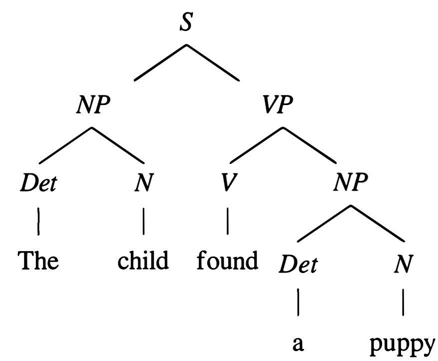
Phrase Structure Trees and Rules

Who climbs the Grammar-Tree distinctly knows
Where Noun and Verb and Participle grows.

JOHN DRYDEN, "The Sixth Satyr of Juvenal," 1693

Now that you know something about constituent structure and grammatical categories, you are ready to learn how the sentences of a language are constructed. We will begin by building trees for simple sentences and then proceed to more complex structures. The trees that we will build here are more detailed than those we saw in the previous sections, because the branches of the tree will have category labels identifying each constituent. In this section we will also introduce the syntactic rules that **generate** (a technical term for describe or specify) the different kinds of structures.

The following tree diagram provides labels for each of the constituents of the sentence "The child found a puppy." These labels show that the entire sentence belongs to the syntactic category of S (because the S-node encompasses all the words). It also reveals that *the child* and *a puppy* belong to the category NP, that is, they are noun phrases, and that *found a puppy* belongs to the category VP or is a verb phrase, consisting of a verb and an NP. It also reveals the syntactic category of each of the words in the sentence.



A tree diagram with syntactic category information is called a **phrase structure tree** or a **constituent structure tree.** This tree shows that a sentence is both a linear string of words and a hierarchical structure with phrases nested in phrases. Phrase structure trees (PS trees, for short) are explicit graphic representations of a speaker's knowledge of the structure of the sentences of his language.

PS trees represent three aspects of a speaker's syntactic knowledge:

1. The linear order of the words in the sentence
2. The identification of the syntactic categories of words and groups of words
3. The hierarchical structure of the syntactic categories (e.g., an S is composed of an NP followed by a VP, a VP is composed of a V that may be followed by an NP, and so on)

In chapter 3 we discussed the fact that the syntactic category of each word is listed in our mental dictionaries. We now see how this information is used by the syntax of the language. Words appear in trees under labels that correspond to their syntactic category. Nouns are under N, determiners under Det, verbs under V, and so on.

The larger syntactic categories, such as VP, consist of all the syntactic categories and words below that point, or **node**, in the tree. The VP in the PS tree above consists of syntactic category nodes V and NP and the words *found*, *a*, and *puppy*. Because *a puppy* can be traced up the tree to the node NP, this constituent is a noun phrase. Because *found* and *a puppy* can be traced up to the node VP, this constituent is a verb phrase. The PS tree reflects the speaker's intuitions about the natural groupings of words in a sentence. In discussing trees, every higher node is said to **dominate** all the categories beneath it. S dominates every node. A node is said to **immediately dominate** the categories one level below it. VP immediately dominates V and NP, the categories of which it is composed. Categories that are immediately dominated by the same node are **sisters.** V and NP are sisters in the phrase structure tree of "the child found a puppy."

A PS tree is a formal device for representing the speaker's knowledge of the structure of sentences in his language, as revealed by our linguistic intuitions. When we speak, we are not aware that we are producing sentences with such structures, but controlled experiments, such as the click experiments described earlier, show that we use them in speech production and comprehension. We will discuss these experiments further in chapter 9.

The information represented in a PS tree can also be represented by another formal device: phrase structure (PS) rules. PS rules capture the knowledge that speakers have about the possible structures of a language. Just as a speaker cannot have an infinite list of sentences in her head, so she cannot have an infinite set of PS trees in her head. Rather, a speaker's knowledge of the permissible and impermissible structures must exist as a finite set of rules that generate a tree for any sentence in the language. To express the structure given above, we need the following PS rules:

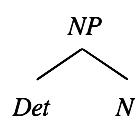
1. S → NP VP
2. NP → Det N
3. VP → V NP

Phrase structure rules specify the well-formed structures of a language precisely and concisely. They express the regularities of the language and make explicit a speaker's knowledge of the order of words and the grouping of words into syntactic categories. For example, in English an NP may contain a determiner followed by a noun. This is represented by rule 2. This rule conveys two facts:

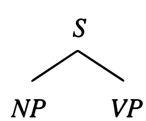
A noun phrase can contain a determiner followed by a noun in that order.

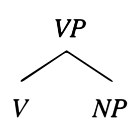
A determiner followed by a noun is a noun phrase.

You can think of PS rules as templates that a tree must match to be grammatical. To the left of the arrow is the dominating category, in this case NP, and the categories that it immediately dominates—that comprise it—appear on the right side, in this case Det and N. The right side of the arrow also shows the linear order of these components. Thus, one subtree for the English NP looks like this:



Rule 1 says that a sentence (S) contains (immediately dominates) an NP and a VP in that order. Rule 3 says that a verb phrase consists of a verb (V) followed by an NP. These rules are general statements and do not refer to any specific VP, V, or NP. The subtrees represented by rules 1 and 3 are as follows:

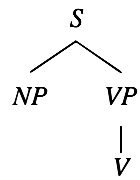




A VP need not contain an NP object, however. It may include a verb alone, as in the following sentences:

The woman laughed.
The man danced.
The horse galloped.

These sentences have the structure:



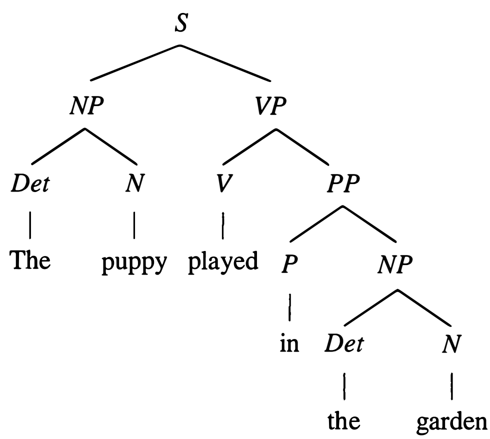
Thus a tree must have a VP that immediately dominates V, as specified by rule 4, which is therefore added to the grammar:

4. VP → V

The following sentences contain prepositional phrases following the verb:

The puppy played in the garden.
The boat sailed up the river.
A girl laughed at the monkey.
The sheepdog rolled in the mud.

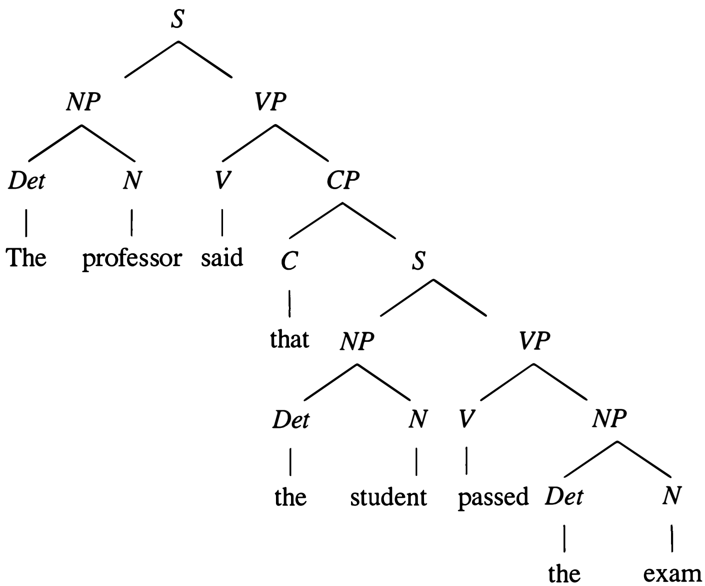
The PS tree for such sentences is



To permit structures of this type, we need two additional PS rules, as in 5 and 6.

5. VP → V PP
6. PP → P NP

Another option open to the VP is to contain or *embed* a sentence. For example, the sentence "The professor said that the student passed the exam" contains the sentence "the student passed the exam." Preceding the **embedded sentence** is the word *that*, which is a **complementizer** (C). C is a functional category, like Aux and Det. Here is the structure of such sentence types:



To allow such embedded sentences, we need to add these two new rules to our set of phrase structure rules.

7. VP → V CP
8. CP → C S

CP stands for complementizer phrase. Rule 8 says that CP contains a complementizer such as *that* followed by the embedded sentence. Other complementizers are *if* and *whether* in sentences like

I don't know whether I should talk about this.
The teacher asked if the students understood the syntax lesson.

that have structures similar to the one above.

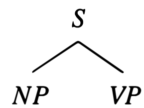
Here are the PS rules we have discussed so far. A few other rules will be considered later.

1. S → NP VP
2. NP → Det N
3. VP → V NP
4. VP → V
5. VP → V PP
6. PP → P NP
7. VP → V CP
8. CP → C S

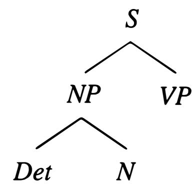
Some Conventions for Building Phrase Structure Trees

> Everyone who is master of the language he speaks . . . may form new . . . phrases, provided they coincide with the genius of the language.
>
> **JOHANN DAVID MICHAELIS,** *Dissertation,* 1769

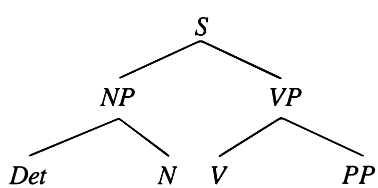
One can use the phrase structure rules as a guide for building trees that follow the structural constraints of the language. In so doing, certain conventions are followed. The S occurs at the top or "root" of the tree (it's upside down). Another convention specifies how the rules are applied: First, find the rule with S on the left side of the arrow, and put the categories on the right side below the S, as shown here:



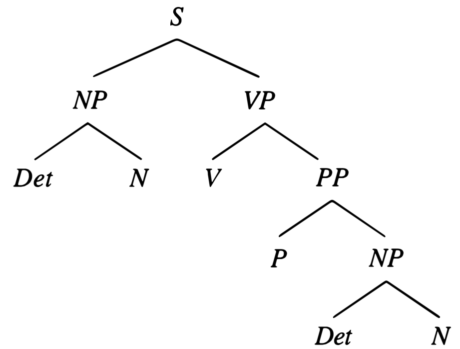
Continue by matching any syntactic category at the bottom of the partially constructed tree to a category on the left side of a rule, then expand the tree with the categories on the right side. For example, we may expand the tree by applying the NP rule to produce:



The categories at the bottom are Det, N, and VP, but only VP occurs to the left of an arrow in the set of rules and so needs to be expanded using one of the VP rules. Any one of the VP rules will work. The order in which the rules appear in the list of rules is irrelevant. (We could have begun by expanding the VP rather than the NP.) Suppose we use rule 5 next. Then the tree has grown to look like this:



Convention dictates that we continue in this way until none of the categories at the bottom of the tree appears on the left side of any rule (i.e., no phrasal categories may remain unexpanded). The PP must expand into a P and an NP (rule 6), and the NP into a Det and an N. We can use a rule as many times as it can apply. In this tree, we used the NP rule twice. After we have applied all the rules that can apply, the tree looks like this:



By following these conventions, we generate only trees specified by the PS rules, and hence only trees that conform to the syntax of the language. By implication, any tree not so specified will be ungrammatical, that is, not permitted by the syntax. At any point during the construction of a tree, any rule may be used as long as its left-side category occurs somewhere at the bottom of the tree. By choosing different VP rules, we could specify different structures corresponding to sentences such as:

The boys left. (VP → V)
The wind blew the kite. (VP → V NP)
The senator hopes that the bill passes. (VP → V CP)

Because the number of possible sentences in every language is infinite, there are also an infinite number of trees. However, all trees are built out of the finite set of substructures allowed by the grammar of the language, and these substructures are specified by the finite set of phrase structure rules.

The Infinity of Language: Recursive Rules

So, naturalists observe, a flea
Hath smaller fleas that on him prey;
And these have smaller still to bite 'em,
And so proceed ad infinitum.

JONATHAN SWIFT, "On Poetry, a Rhapsody," 1733

We noted at the beginning of the chapter that the number of sentences in a language is infinite and that languages have various means of creating longer and longer sentences, such as adding an adjective or a prepositional phrase. Even children know how to produce and understand very long sentences and know how to make them even longer, as illustrated by the children's rhyme about the house that Jack built.

This is the farmer sowing the corn,
that kept the cock that crowed in the morn,
that waked the priest all shaven and shorn,
that married the man all tattered and torn,
that kissed the maiden all forlorn,
that milked the cow with the crumpled horn,
that tossed the dog,

that worried the cat,
that killed the rat,
that ate the malt,
that lay in the house that Jack built.

The child begins the rhyme with *This is the house that Jack built*, continues by lengthening it to *This is the malt that lay in the house that Jack built*, and so on.

You can add any of the following to the beginning of the rhyme and still have a grammatical sentence:

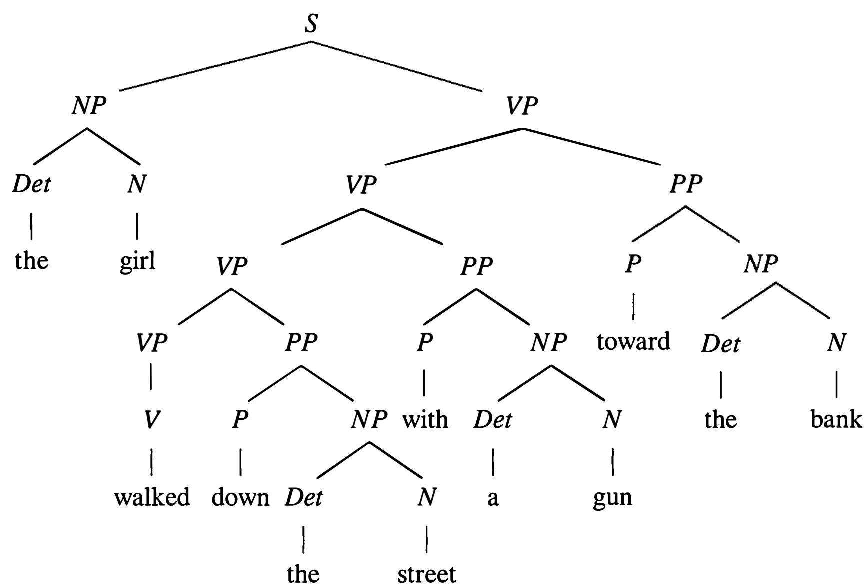
I think that . . .
What is the name of the unicorn that noticed that . . .
Ask someone if . . .
Do you know whether . . .

Once we acknowledge the unboundedness of sentences, we need a formal device to capture that crucial aspect of speakers' syntactic knowledge. It is no longer possible to specify each legal structure; there are infinitely many.

To see how this works, let us first look at the case of multiple prepositional phrases such as [The girl walked [down the street] [over the hill] [through the woods] . . .]. VP substructures currently allow only one PP per sentence (VP → V PP—rule 5). We can rectify this problem by revising rule 5:

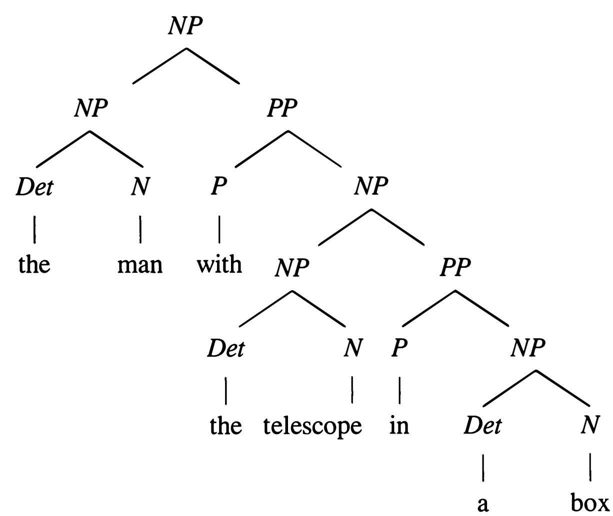
5. VP → VP PP

Rule 5 is different from the previous rules because it repeats its own category (VP) inside itself. This is an instance of a **recursive rule**. Recursive rules are of critical importance because they allow the grammar to generate an infinite set of sentences. Reapplying rule 5 shows how the syntax permits structures with multiple PPs, such as in the sentence "The girl walked down the street with a gun toward the bank."



In this structure the VP rule 5 has applied three times and so there are three PPs: [down the street] [with a gun] [toward the bank]. It is easy to see that the rule could have applied four or more times, for example by adding a PP like *for no good purpose.*

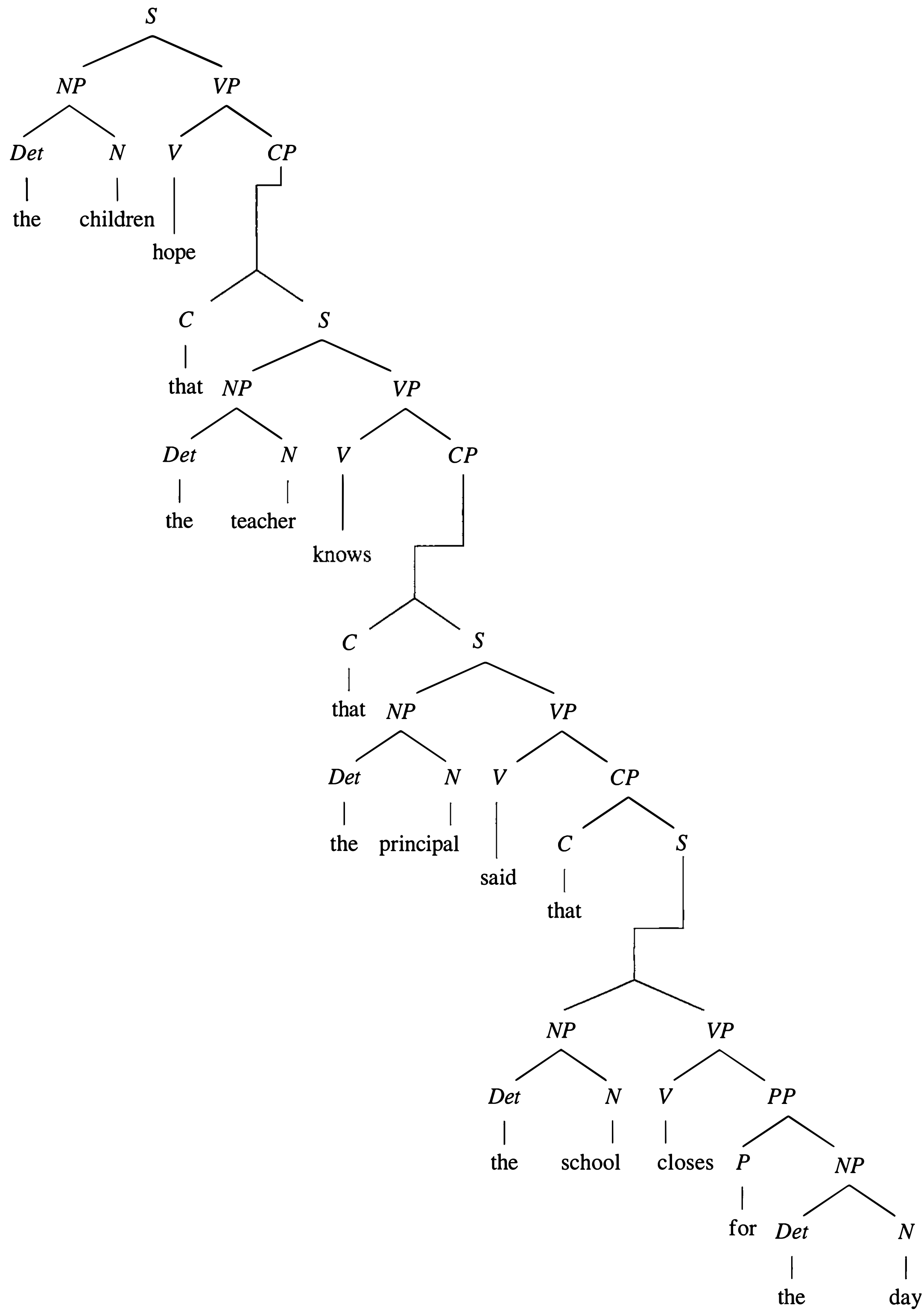
NPs can also contain PPs recursively. An example of this is shown by the phrase *the man with the telescope in a box.*



To show that speakers permit recursive NP structures of this sort, we need to include the following PS rule, which is like the recursive VP rule 5.

9. NP → NP PP

The PS rules define the allowable structures of the language, and in so doing make predictions about structures that we may not have considered when formulating each rule individually. These predictions can be tested, and if they are not validated, the rules must be reformulated because they must generate all and only the allowable structures. For example, rule 7 (VP → V CP) in combination with rules 8 (CP → C S) and 1 (S → NP VP) form a recursive set. (The recursiveness comes from the fact that S and VP occur on both the left and right side of the rules.) Those rules allow S to contain VP, which in turn contains CP, which in turn contains S, which in turn again contains VP, and so on, potentially without end. These rules, formulated for different purposes, correctly predict the limitlessness of language in which sentences are embedded inside larger sentences, such as *The children hope that the teacher knows that the principal said that the school closes for the day* as illustrated on the following page.


S
NP
VP
Det
N
V
CP
the
children
hope
C
S
that
NP
VP
Det
N
V
CP
the
teacher
knows
C
S
that
NP
VP
Det
N
V
CP
the
principal
said
C
S
that
NP
VP
Det
N
V
PP
the
school
closes
P
NP
for
Det
N
the
day

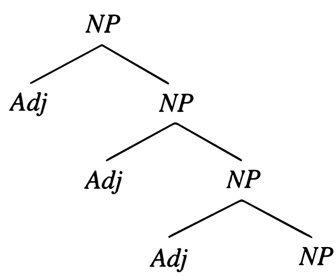
Recursive Adjectives and Possessives

"Very traditional. He's the noun. She's the adjective."

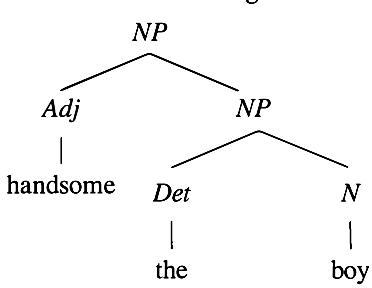
Now we consider the case of multiple adjectives, illustrated at the beginning of the chapter with sentences such as "The kindhearted, intelligent, handsome boy had many girlfriends." In English, adjectives occur before the noun. As a first approximation we might follow the system we have adopted thus far and introduce a recursive NP rule with a prenominal adjective:

NP → Adj NP

Repeated application of this rule would generate trees with multiple adjective positions, as desired.

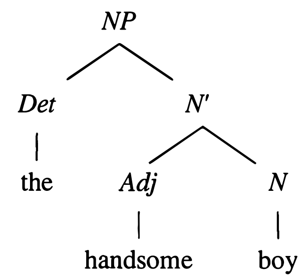


But there is something wrong in this tree, which is made apparent when we expand the lowest NP. The adjective can appear before the determiner, and this is not a possible word order in English NPs.



NOT POSSIBLE!

The problem is that although determiners and adjectives are both modifiers of the noun, they have a different status. First, an NP will never have more than one determiner in it, while it may contain many adjectives. Also, an adjective directly modifies the noun, while a determiner modifies the whole adjective(s) + noun complex. The expression "the big dog" refers to some specific dog that is big, and not just some dog of any size. In general, modification occurs between sisters. If the adjective modifies the noun, then it is sister to the noun. If the determiner modifies the adjective + noun complex, then the determiner is sister to this complex. We can represent these two sisterhood relations by introducing an additional level of structure between NP and N. We refer to this level as N-bar (written as N').



This structure provides the desired sisterhood relations. The adjective *handsome* is sister to the noun *boy*, which it therefore modifies, and the determiner is sister to the N' *handsome boy*. We must revise our NP rules to reflect this new structure, and add two rules for N'. Not all NPs have adjectives, of course. This is reflected in the second N' rule in which N' dominates only N.

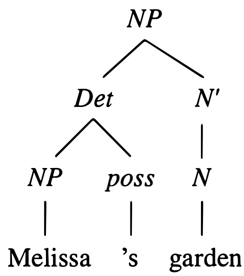
NP → Det N' (revised version of NP → Det N)
N' → Adj N'
N' → N

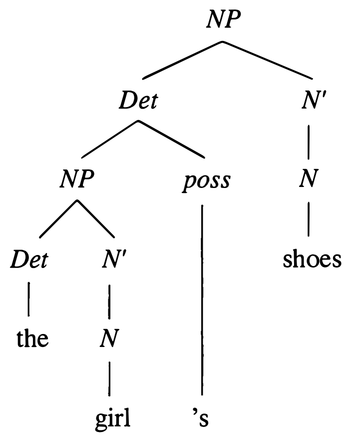
Let us now see how these revised rules generate NPs with multiple (potentially infinitely many) adjectives.

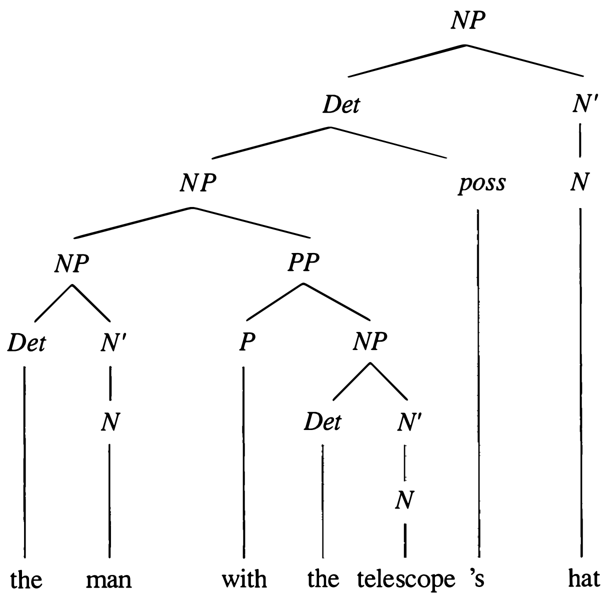
Thus far all the NPs we have looked at are common nouns with a simple definite or indefinite determiner (e.g., the cat, a boy), but NPs can consist of a simple pronoun (e.g., he, she, we, they) or a proper name (e.g., Robert, California, Prozac). To reflect determiner-less NP structures, we will need the rule

NP → N'

But that's not all. We have possessive noun phrases such as *Melissa's garden*, *the girl's shoes*, and *the man with the telescope's hat*. In these structures the possessor NP (e.g., *Melissa's*, *the girl's*, etc.) functions as a determiner in that it further specifies its sister noun. The *'s* is the phonological realization of the abstract element *poss*. The structures are illustrated in each of the following trees.







To accommodate the possessive structure we need an additional rule:

Det → NP poss

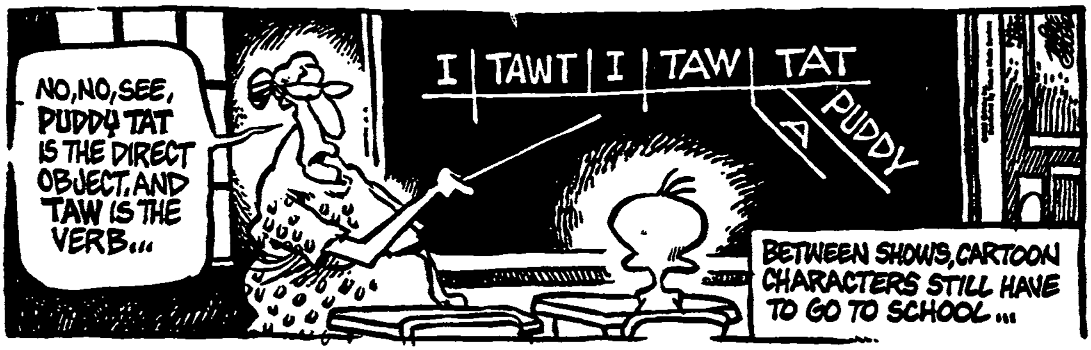
This rule forms a recursive set with the NP → Det N' rule. Together these rules allow an English speaker to have multiple possessives such as *The student's friend's cousin's book.*

The embedding of categories within categories is common to all languages. Our brain capacity is finite, able to store only a finite number of categories and rules for their combination. Yet this finite system places an infinite set of sentences at our disposal.

This linguistic property also illustrates the difference between competence and performance, discussed in chapter 1. All speakers of English (and other languages) have as part of their linguistic competence—their mental grammars—

the ability to embed phrases and sentences within each other ad infinitum. However, as the structures grow longer, they become increasingly more difficult to produce and understand. This could be due to short-term memory limitations, muscular fatigue, breathlessness, boredom, or any number of performance factors. (We will discuss performance factors more fully in chapter 9.) Nevertheless, these very long sentences would be well-formed according to the rules of the grammar.

Heads and Complements



Phrase structure trees also show relationships among elements in a sentence. For example, the *subject* and *direct object* of the sentence can be structurally defined. The subject is the NP that is closest to, or immediately dominated by, the root S. The direct object is the NP that is closest to, or immediately dominated by, VP.

Another kind of relationship is that between the **head** of a phrase and its sisters. The head of a phrase is the word whose lexical category defines the type of phrase: the noun in a noun phrase, the verb in a verb phrase, and so on. Reviewing the PS rules in the previous section, we see that every VP contains a verb, which is its head. The VP may also contain other categories, such as an NP or CP. Those sister categories are **complements**; they complete the meaning of the phrase. Loosely speaking, the entire phrase refers to whatever the head verb refers to. For example, the VP *find a puppy* refers to an event of "finding." The NP object in the VP that completes its meaning is a complement. The underscored CP (complementizer phrase) in the sentence "I thought that the child found the puppy" is also a complement. (Please do not confuse the terms *complementizer* and *complement.*)

Every phrasal category, then, has a head of its same syntactic type. NPs are headed by nouns, PPs are headed by prepositions, CPs by complementizers, and so on; and every phrasal head can have a complement, which provides further information about the head. In the sentence "The death of Lincoln shocked the nation," the PP *of Lincoln* is the complement to the head noun *death.* Other examples of complements are illustrated in the following examples, with the head in italics and the complement underlined:

an *argument* over jelly beans (PP complement to noun)
his *belief* that justice will prevail (CP complement to noun)
happy to be here (infinitive complement to adjective)
about the war in Iraq (NP complement to preposition)
wrote a long letter to his only sister (NP—PP complement to verb)
tell John that his mother is coming to dinner (NP CP complements to verb)

Each of these examples is a phrase (NP, AdjP, PP, VP) that contains a head (N, Adj, P, V), followed by a complement of varying composition such as CP in the case of *belief*, or NP PP in the case of *wrote*, and so on. The head-complement relation is universal. All languages have phrases that are headed and that contain complements.

However, the order of the head and complement may differ in different languages. In English, for example, we see that the head comes first, followed by the complement. In Japanese, complements precede the head, as shown in the following examples:

Taro-ga	inu-o	mitsuketa	
Taro-subject marker	dog-object marker	found	(Taro found a dog)

Inu-ga	niwa-de	asonde	iru	
dog-subject marker	garden-in	playing	is	(The dog is playing in the garden)

In the first sentence, the direct object complement *inu-o* "dog" precedes the head verb *mitsuketa* "found." In the second, the PP complement *niwa-de* "in the garden" also precedes the head verb phrase. English is a VO language, meaning that the verb ordinarily precedes its object. Japanese is an OV language, and this difference is also reflected in the head/complement word order.

Selection

Whether a verb takes a complement or not depends on the properties of the verb. For example, the verb *find* is a transitive verb. A transitive verb requires an NP complement (direct object), as in *The boy found the ball*, but not **The boy found*, or **The boy found in the house*. Some verbs like *eat* are optionally transitive. *John ate* and *John ate a sandwich* are both grammatical.

Verbs select different kinds of complements. For example, verbs like *put* and *give* take both an NP and a PP complement, but cannot occur with either alone:

Sam put the milk in the refrigerator.
*Sam put the milk.
Robert gave the film to his client.
*Robert gave to his client.

Sleep is an **intransitive verb**; it cannot take an NP complement.

Michael slept.
*Michael slept a fish.

Some verbs, such as *think*, select a sentence complement, as in "I think that Sam won the race." Other verbs, like *tell*, select an NP and a sentence, as in "I told Sam that Michael was on his bicycle"; yet other verbs like *feel* select either an AdjP or a sentence complement. (Complements are italicized.)

Paul felt *strong as an ox.*
He feels *that he can win.*

As we will discuss later, sentences that are complements must often be preceded by a complementizer *that.*

Other categories besides verbs also select their complements. For example, the noun *belief* selects either a PP or a CP, while the noun *sympathy* selects a PP, but not a CP, as shown by the following examples:

the belief *in freedom of speech*
the belief *that freedom of speech is a basic right*
their sympathy *for the victims*
*their sympathy that the victims are so poor

Adjectives can also have complements. For example, the adjectives *tired* and *proud* select PPs:

tired *of stale sandwiches*
proud *of her children*

With noun selection, the complement is often optional. Thus sentences like "He respected their belief," "We appreciated their sympathy," "Elimelech was tired," and "All the mothers were proud" are syntactically well-formed with a meaning that might be conveyed by an explicit complement understood from context. Verb selection is often not optional, however, so that **He put the milk* is ungrammatical even if it is clear from context where the milk was put.

The information about the complement types selected by particular verbs and other lexical items is called **C-selection** or **subcategorization**, and is included in the lexical entry of the item in our mental lexicon. (Here C stands for "categorial" and is not to be confused with the C that stands for "complementizer"—we apologize for the "clash" of symbols, but that's what it's like in the linguistic literature.)

Verbs also include in their lexical entry a specification of certain intrinsic semantic properties of their subjects and complements, just as they select for syntactic categories. This kind of selection is called **S-selection** (S for semantic). For example, the verb *murder* requires its subject and object to be human, while the verb *drink* requires its subject to be animate and its object liquid. Verbs such as *like*, *hate*, and so on select animate subjects. The following sentences violate S-selection and can only be used in a metaphorical sense. (We will use the symbol "!" to indicate a semantic anomaly.)

!The rock murdered the man.
!The beer drank the student.
!The tree liked the boy.

The famous sentence *Colorless green ideas sleep furiously*, discussed earlier in this chapter, is anomalous because (among other things) S-selection is violated (e.g., the verb *sleep* requires an animate subject). In chapter 5 we will discuss the semantic relationships between a verb and its subject and objects in far more detail.

The well-formedness of a phrase depends then on at least two factors: whether the phrase conforms to the structural constraints of the language as expressed in the PS rules, and whether it obeys the selectional requirements of the head, both syntactic (C-selection) and semantic (S-selection).

What Heads the Sentence

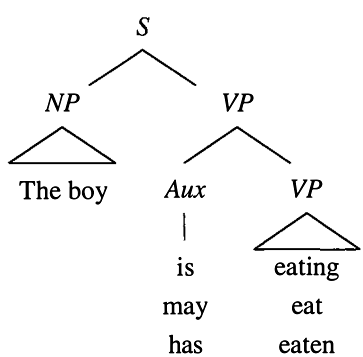
Might, could, would—they are contemptible auxiliaries.

GEORGE ELIOT (MARY ANN EVANS), *Middlemarch*, 1872

We said earlier that all phrases have heads. One category that we have not yet discussed in this regard is sentence (S). For uniformity's sake, we want all the categories to be headed, but what would the head of S be? To answer this question, let us consider sentences such as the following:

Sam will kick the soccer ball.
Sam has kicked the soccer ball.
Sam is kicking the soccer ball.
Sam may kick the soccer ball.

As noted earlier, words like *will*, *has*, *is*, and *may* are auxiliary verbs, belonging to the category Aux, which also includes modals such as *might*, *could*, *would*, *can*, and several others. They occur in structures such as the following one.



(From now on we will adopt the convention of using a triangle under a node when the content of a category is not crucial to the point under discussion.)

Auxiliary verbs specify a time frame for the event (or state) described by the verb, whether it will take place in the future, already took place in the past, or is taking place now. A modal such as *may* contains "possibility" as part of its meaning, and says it is possible that the event will occur at some future time. The category Aux is a natural category to head S. Just as the VP is about the situation described by the verb—*eat ice cream* is about "eating"—so a sentence is about a situation or state of affairs that occurs at some point in time.

The parallel with other categories extends further. In the previous PS tree, VP is the complement to Aux. The selectional relationship between Aux and VP is demonstrated by the fact that particular auxiliaries go with particular kinds of VPs. For example, the auxiliary *be* takes a progressive (-ing) form of the verb,

The boy **is** danc**ing.**

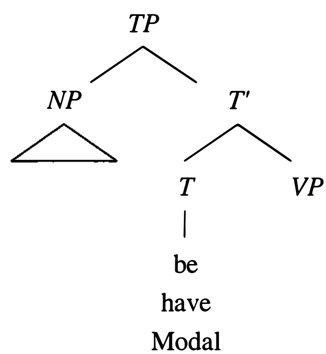
while the auxiliary *have* selects a past participle (-en) form of the verb,

The girl **has** eat**en.**

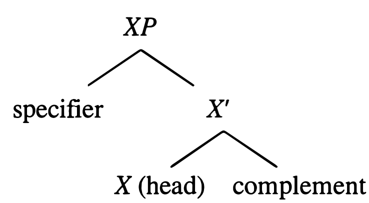
and the modals select the infinitival form of the verb (no affixes),

The child **must sleep**
The boy **may eat.**

To have a uniform notation, many linguists use the symbols **T** (**= tense**) and **TP** (**= tense phrase**) instead of Aux and S. Furthermore, just as the NP required the intermediate N-bar (N') category, the TP also has the intermediate T-bar (T') category, as in the phrase structure tree below.



Indeed, many linguists assume that all XPs, where XP stands for any of NP, PP, VP, TP, AdjP, or CP, have three levels of structure. This is referred to as **X-bar theory.** The basic three-level X-bar schema is as follows:



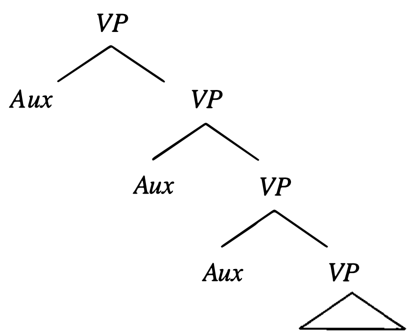
The first level is the XP itself. The second level consists of a **specifier**, which functions as a modifier (and which is generally an optional constituent), and an X' (i.e., "X-bar"). For example, an NP specifier is a determiner; a VP specifier is an adverb such as *never* or *often*; an AdjP specifier is a degree word such as *very* or *quite*. The third level is an expansion of X' and consists of a head X and a complement, which may itself be a phrasal category, thus giving rise to recursion. X-bar structure is thought to be universal, occurring in all the world's languages, though the order of the elements inside XP and X' may be reversed, as we saw in Japanese.

We will not use X-bar conventions in our description of syntax except on the few occasions where the notation provides an insight into the syntax of the language. For sentences we will generally use the more intuitive symbols S and Aux instead of TP and T, but you should think of Aux and S as having the same relationship to each other as V and VP, N and NP, and so on. To achieve this more straightforward approach, we will also ignore the T' category until it is needed later on in the description of the syntax of the main verb *be*.

Without the use of TP, T', and T, we need an additional PS rule to characterize structures containing Aux:

VP $\rightarrow$ Aux VP

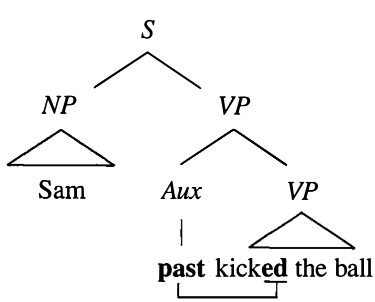
Like the other recursive VP rules, this rule will allow multiple Aux positions.



This is a desired consequence because English allows sentences with multiple auxiliaries such as:

The child may be sleeping.	(modal, be)
The dog has been barking all night.	(have, be)
The bird must have been flying home.	(modal, have, be)

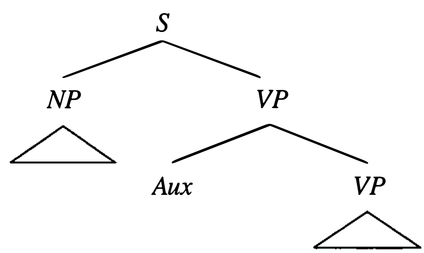
The introduction of Aux into the system raises a question. Not all sentences seem to have auxiliaries. For example, the sentence "Sam kicked the soccer ball" has no modal, *have* or *be*. There is, however, a time reference for this sentence, namely, the past tense on the verb *kicked*. In sentences without auxiliaries, the tense of the sentence is its head. Instead of having a word under the category Aux (or T), there is a tense specification, *present* or *past*, as in the following tree:



The inflection on the verb must match the tense in Aux. For example, if the tense of the sentence is *past*, then the verb must have an *-ed* affix (or must be an irregular past tense verb such as *ate*).

Thus, in English, and many other languages, the head of S may contain only an abstract tense specification and no actual word, as just illustrated. The actual morpheme, in this case *-ed* or an irregular past tense form such as *went*, is inserted into the tree after all the syntactic rules have applied. Most inflectional morphemes, which depend on elements of syntax, are represented in this way. Another example is the tense-bearing word *do* that is inserted into negative sentences such as *John did not go* and questions such as *Where did John go?* In these sentences *did* means "past tense." Later in this chapter we will see how *do*-insertion works.

In addition to specifying the time reference of the sentence, Aux specifies the agreement features of the subject. For example, if the subject is *we*, Aux contains the features first-person and plural; if the subject is *he* or *she*, Aux contains the features third-person and singular. So, another function of the syntactic rules is to use Aux as a "matchmaker" between the subject and the verb. When the subject and the verb bear the same features, Aux makes a match; when they have incompatible features, Aux cannot make a match and the sentence is ungrammatical. This matchmaker function of syntactic rules is more obvious in languages such as Italian, which have many different agreement morphemes, as discussed in chapter 3. Consider the Italian sentence for "I buy books."



Io	Present first person	compro i libri
*Io	Present second person	compri i libri

The verb *compro*, "buy," in the first sentence bears the first-person singular morpheme, *-o*, which matches the agreement feature in Aux, which in turn matches the subject *Io*, "I." The sentence is therefore grammatical. In the second sentence, there is a mismatch between the first-person subject and the second-person features in Aux (and on the verb), and so the sentence is ungrammatical.