If we set aside the rule that builds phrases with or and and in them, our phrase structure rules are (1).

(1) $S \rightarrow \text{DP VP}$
$\text{DP} \rightarrow \text{D}$
$\text{DP} \rightarrow \text{D NP}$
$\text{DP} \rightarrow \text{DP D NP}$
$\text{NP} \rightarrow \text{N}$
$\text{NP} \rightarrow \text{NP PP}$
$\text{NP} \rightarrow \text{AP NP}$
$\text{NP} \rightarrow \text{NP CP}$

$\text{VP} \rightarrow \text{V}$
$\text{VP} \rightarrow \text{V AP}$
$\text{VP} \rightarrow \text{V DP}$
$\text{VP} \rightarrow \text{V VP}$

$\text{PP} \rightarrow \text{P}$
$\text{PP} \rightarrow \text{P DP}$
$\text{PP} \rightarrow \text{P VP}$
$\text{PP} \rightarrow \text{P CP}$

$\text{CP} \rightarrow \text{C S}$
$\text{CP} \rightarrow \text{C}$
$\text{CP} \rightarrow \text{A}$
$\text{CP} \rightarrow \text{AP}$

$\text{S}$
$\text{DP}$
$\text{VP}$
$\text{V}$
$\text{VP}$
$\text{PP}$
$\text{P}$

These rules are all context free, have just non-terminals on the right-hand side of the arrow and are Endocentric.

These rules are the complete set for English, of course. There are many more, and we won’t learn them all. But we will learn a few additional ones. For instance, we’ll need a new rule to produce the sentences in (2).

(2) a. She is singing the Macarena.
   b. She has sung the Macarena.

The expressions is and has are morphological forms of the verbs be and have. Their morphological form expresses, among other things, that these verbs are in the so-called “present tense.” What we see in these examples, then, is that there can be more than two verbs in a sentence. This can be achieved by adding the rule in (3), which will give (2a) the parse in (4).

(3) $\text{VP} \rightarrow \text{V VP}$

From (5) we can see that a preposition, like before, can combine with a S to form a larger PP.

(5) She sang before Sam arrived.

We’ll need the rule in (6), which will give (5) the parse in (7).

(6) $\text{PP} \rightarrow \text{P S}$
From (8), we can see that an adjectives, like happy, can combine with a CP to form an AP.

(8) She is happy that bolts roll.

We should add (9), which will give (8) the parse in (10).

(9) AP → A CP

(10) S → DP VP

And finally we can see from (11) that sentences can start with CPs as well as DPs.

(11) That snow stings is obvious.

We should allow Ss to be fit the rule in (12), which will give (11) the parse in (13).

(12) S → CP VP

(13) S → CP VP

We these additions, our phrase structures now look like (14).

(14) S → DP VP VP → V PP → P S

DP → D VP → V DP PP → P

DP → DP D NP VP → V VP CP → C S

DP → DP D NP VP → VP PP CP → C

VP → VP CP AP → A

NP → N AP → AP PP

NP → NP PP AP → A CP

NP → AP NP

NP → NP CP

Recall that all these rules, except the ones that make sentences, are Endocentric. A rule is Endocentric if it is a “projection” in the sense defined by (15).

A non-terminal $\alpha$ is a projection of $\beta$ if $\alpha$ introduces $\beta$ and:

a. $\beta$ is $\alpha$’s head, or

b. $\alpha$ doesn’t introduce a head but $\beta$ could.

A head is the X on the righthand side of “$\rightarrow$” in the rule $XP \rightarrow X$, where the “X”’s in this rule are the same symbol.

Our PP, CP, AP and DP rules are Endocentric, as every PP, AP, CP or DP is a projection of P, A, C or D, respectively. And our VP and NP rules are Endocentric.
because every VP is either a projection of V or of another VP, and every NP is either a projection of N or of another NP. The rules for S, however, do not make them projections of anything.

That is because our rules for S are wrong. We’ve hit on these wrong rules for S because finding the head for S is more difficult than finding the heads for another other phrase. Recall that a head is that terminal which a phrase is either a projection of, or is the projection of a projection of. There doesn’t seem to be a terminal that S is a projection of; there isn’t a kind of word, in other words, that has the same distribution in sentences that sentences themselves do.

The reason we cannot find the head of S is because we have made a mistake in our definition of syntax. We have assumed that syntax is (one.oldstyle/six.oldstyle).

Syntax is the set of laws that determine which strings of words are semantically compositional.

The head of S is not, it turns out, (always) a word. The head of S is (oftentimes) the morpheme that makes a verb tensed. That morpheme belongs to the class of inflectional morphemes that attach to verbs. There are two tense inflections in English: present and past. Their form depends on a number of factors, including the kind of verb they attach to and the kind of subject here is nearby. The verbs in (17) are inflected for the present tense, and those in (18) are inflected for the past tense.

(17)  a. She dances.  (18)  a. She danced.
    b. I dance.
    c. They dance.
    d. She sings.
    e. I sing.
    f. They sing.
    g. She is happy.
    h. I am happy
    i. They are happy
    j. She has a solution.
    k. I have a solution.
    l. They have a solution

The sentences in (17) have the same meaning (roughly) that the sentences in (18) do, with the difference only in when the state of affairs they describe is to hold. So, She sings and I am happy describe a state of affairs that holds at the same time that one utters those sentences, but She sang and I was happy describes the same set of affairs, but those state of affairs hold prior to the time the sentences are uttered.

Many sentences have this inflectional morpheme in them. Some, however, do not. But those sentences always have something else in them that we can imagine replaces the tense inflection. For instance, sentences that have a class of words that are sometimes called modals (will, shall, can, must, would, should, could) do not have past or present tense inflection in them.

(19)  a. She should sing.
    b. * She should sings.
    c. * She should sang.
    d. * She shoulds sing.

Sentences with modals in them are neither present tense nor past tense. They are sentences that describe a state of affairs in a timeless sort of way.

There are also sentences that have neither tense inflection nor modals in them, but have something else instead. These sentences are only found embedded in larger sentences. One example is in (20).

(20)  She wants [s you to sing].

In place of a modal or tense inflection is the word to. These sentences are sometimes called “to infinitives.” Sentences with a modal or tense inflection in them are sometimes called “finite” sentences.

We could capture these facts if we made up a category that includes tense inflection, modals and the infinitival to. Let’s call this category “I,” after “inflection.” We can now make our S rules Endocentric by changing them to (21).

(21)  S → DP I VP
      S → CP I VP

We’ve adopted the convention in all of our other phrase structure rules of naming the phrase on the left side of the arrow after the thing it is a projection of. So applying this convention here, we should change our rules to (22).

(22)  IP → DP I VP
      IP → CP I VP

And, of course, we should also change all of our other rules that make reference to “S” so that they make reference to “IP” instead. So, for instance, “PP → P S” should become “PP → P IP.”
We should also change our definition of syntax from (16) to (23).

(23) Syntax is the set of laws that determine which arrangement of morphemes are semantically compositional.

Unfortunately, (22) is still not quite right. These rules have two problems, only one of which we'll be able to fix today. The first problem, and the one we have to put off, is that they put modals in the right place but not tense inflection. Suppose, for instance, that we represent the past tense inflection with "ed." (22) would produce (24), which isn't grammatical.

(24) IP
    \[\Delta\]
    DP I VP
    She ed V
dance

The past tense morpheme needs to be part of the verb dance, but this isn't what (22) does. (22) does the right thing, however, for modals, as we can see in (25).

(25) IP
    \[\Delta\]
    DP I VP
    She can V
dance

Let's just tolerate this mistake for a while. Its solution requires a little bit of time to develop.

The other problem with (22) can be seen by considering (26).

(26) She can sing and should dance.

Recall that and brings together two phrases of the same kind on either side of it, and from them forms another phrase of that same type. In (26), the two phrases that are brought together are can sing and should dance. The rules in (22) don't provide for such phrases. We need to change these rules so that (26) can get a parse like that in (27).

(27) IP
    \[\Delta\]
    DP ??
    she ?? and ??
    I VP I VP
can V should V
    sing dance

Our rules should look something like (28).

(28) IP → DP ?
    IP → CP ??
    ?? → I VP

What are "??" in (28)? If we are to preserve Endocentricity, then "??" should be a projection of I. But it cannot be IP, since that would allow us to produce sentences like (29).

(29) IP
    \[\Delta\]
    DP IP I VP
    it I VP
    she I VP
    should V
    stay

We need a new kind of phrase. That phrase is called "I bar," and it is represented either as "I" or "I′." Our rules for sentences, then, will be (30).

(30) IP → DP I
    IP → CP I
    I → I VP
Let’s take a look, now, at our rules.

\[
\begin{align*}
\text{IP} & \rightarrow \text{DP I} & \text{IP} & \rightarrow \text{CP I} & \text{IP} & \rightarrow \text{I VP} & \text{DP} & \rightarrow \text{D} & \text{DP} & \rightarrow \text{D NP} \\
\text{IP} & \rightarrow \text{CP I} & \text{IP} & \rightarrow \text{V DP} & \text{CP} & \rightarrow \text{C} & \text{IP} & \rightarrow \text{V AP} & \text{CP} & \rightarrow \text{P CP} \\
\text{I} & \rightarrow \text{I VP} & \text{I} & \rightarrow \text{V AP} & \text{PP} & \rightarrow \text{P VP} & \text{IP} & \rightarrow \text{V VP} & \text{IP} & \rightarrow \text{C IP} \\
\text{DP} & \rightarrow \text{D} & \text{DP} & \rightarrow \text{V VP} & \text{PP} & \rightarrow \text{P} & \text{VP} & \rightarrow \text{V VP} & \text{CP} & \rightarrow \text{C IP} \\
\text{DP} & \rightarrow \text{D NP} & \text{DP} & \rightarrow \text{V VP} & \text{PP} & \rightarrow \text{P IP} & \text{VP} & \rightarrow \text{VP CP} & \text{AP} & \rightarrow \text{A} \\
\text{DP} & \rightarrow \text{D NP} & \text{DP} & \rightarrow \text{V VP} & \text{PP} & \rightarrow \text{P} & \text{VP} & \rightarrow \text{VP PP} & \text{AP} & \rightarrow \text{AP PP} \\
\text{NP} & \rightarrow \text{N} & \text{NP} & \rightarrow \text{AP NP} & \text{NP} & \rightarrow \text{NP PP} & \text{AP} & \rightarrow \text{A CP} & \text{NP} & \rightarrow \text{NP CP} \\
n & n & n & n & n & n & n & n & n & n
\end{align*}
\]

Notice that all these rules, except one, have no more than two things on the right side of “→.” That is, with one exception, no phrase is made up of more than two other things.

The one exception is the rule “DP → DP D NP.” This rule is responsible for producing DPs of the sort in (32).

Now a funny thing about this rule is that the only time it is used is when the “D” position is occupied by the genitive s morpheme. DPs of the kind in (33) aren’t good.

This has the unfortunate effect of making difficult to tell whether “DP → DP D NP” is the right rule, or whether something like the rules in (34) are instead.

\[
\begin{align*}
\text{DP} & \rightarrow \text{DP D} & \text{D} & \rightarrow \text{D NP} \\
\text{DP} & \rightarrow \text{DP D NP} & \text{D} & \rightarrow \text{D NP} \\
\text{DP} & \rightarrow \text{DP D NP} & \text{D} & \rightarrow \text{D NP} \\
\end{align*}
\]

If we could replace “DP → DP D NP” with (34), we’d have managed to make every rule conform to the generalization that there are no more than two things on the right side of “→.” The rules in (34) would still allow us to parse things like Jill’s idea, though the parse would look a little different.

The difference between “DP → DP D NP” and the rules in (34) is that (34) says that “D NP” is a phrase, and “DP → DP D NP” says they aren’t. Evidence, then, that would tell us which view is right would be phenomena that tell us whether or not “D NP” is a phrase. We’ve got two things we could look to for this evidence. One is compositionality: does “D NP” have a compositional meaning? Unfortunately, it’s not clear what the meaning of the genitive s is, and since this is the only D that can fit into the schema we’re looking at, this is the D we must use. Until we know what the meaning of the genitive s is, we can’t tell if it plus a following NP together make a compositional meaning.

The other thing we can look to are how these DPs behave with and or or. Can and or or combine the D+NP sequence that (34) says exists? If it could, we should expect to find things like (36).
But, unfortunately, even if the parse in (36) is correct, we should still expect this to be ungrammatical. We should expect this because the genitive s is a suffix on a DP. Recall that this morpheme must be spoken at the end of a DP, which corresponds to the way we generally spell this morpheme. That requirement cannot be satisfied in (36) since the second genitive s isn’t in a position that would allow it to be spoken at the end of a DP.

It seems that we cannot tell whether the rule “DP → DP D NP” is correct, or if instead the rules in (34) are. Most syntacticians favor the rules in (34), because they obey the otherwise true generalization that there cannot be more than two things on the right side of “→.” We will join most syntacticians.

With this change, we now have the system of rules in (37).

We’ve observed that all the rules we’ve encountered so far either meet the description in (39), or are not counter-examples to it.

We say about a set of rules that meet (39) that they are “binary branching.” This recognizes the fact that in the parse tree way of representing a sentence, no point on the graph will have more than two branches coming out of it. Perhaps it is not an accident that all our rules are binary branching. Perhaps this too is a reflection of the constraints posed by the acquisition sequence. Maybe, that is, that as a child is forming the syntax of the language she is to speak, she only posits rules that are binary branching. We might build this into our hypothesis about what a syntax can look like, like we did with Endocentricity. We could adopt (40).

Phrase Structure Grammars

The syntax of a language is a phrase structure grammar. A phrase structure grammar is a finite set of binary branching rules, each of which have the following form:

a. Each rule rewrites exactly one non-terminal. This is represented by “→.”

b. Terminals are category labels and non-terminals are phrases (i.e., XP or X).

c. Each rule is Endocentric.

If we look back at the rules in (38), we can see that there is a difference in the form that the rules in the first column have relative to the rules in the other columns. In the first column, but not the others, are rules that involve “bar”
phrases: \( \overline{D} \) and \( \overline{I} \). We can see a relationship between the bar phrases and the others that is expressed in (41)

(41) \( \text{XP is a projection of } \overline{X} \text{ and it contains at most one other phrase.} \)

Only \( \overline{X} \) is a projection of \( X \) and it contains at most one other phrase.

The “contains at most one other phrase” part of the formulation follows from binary branching. So (41) boils down to this:

(42) \( \text{XP only projects from } \overline{X}. \)

We could re-write the rules in the other columns so that they conform to (42) as well. That re-write would produce (43).

(43) \( \begin{align*}
\text{IP} & \to \text{DP} \overline{I} \\
\text{VP} & \to \overline{V} \\
\text{CP} & \to \overline{C} \\
\text{I} & \to \text{VP} \\
\overline{V} & \to \overline{V} \text{ DP} \\
\overline{C} & \to \overline{C} \\
\text{DP} & \to \overline{D} \\
\overline{V} & \to \overline{V} \text{ VP} \\
\overline{P} & \to \overline{P} \text{ DP} \\
\text{DP} & \to \overline{D} \overline{D} \\
\overline{V} & \to \overline{V} \text{ CP} \\
\overline{P} & \to \overline{P} \\
\text{D} & \to \overline{D} \overline{NP} \\
\overline{V} & \to \overline{V} \text{ PP} \\
\overline{A} & \to \overline{A} \\
\text{NP} & \to \overline{N} \\
\overline{A} & \to \overline{A} \text{ PP} \\
\text{N} & \to \overline{N} \text{ CP} \\
\overline{N} & \to \overline{N} \\
\end{align*} \)

Every one of these rules fits one of the following six forms.

(44) \( \begin{align*}
\text{XP} & \to \overline{X} \\
\text{XP} & \to \overline{X} \\
\text{ZP} & \to \overline{X} \\
\overline{X} & \to \overline{X} \\
\overline{X} & \to \overline{X} \\
\overline{X} & \to \overline{X} \\
\overline{X} & \to \overline{X} \\
\end{align*} \)

A working hypothesis is that the set of phrase structure rules that a syntax can use are from a small number like these. Indeed, it seems that every phrase structure rule that has been found in the world’s languages can be expressed in one of these six ways, plus one more that isn’t found in English. That seventh form is:

(45) \( \begin{array}{c}
\overline{X} \\
\overline{WP} \\
\overline{X}
\end{array} \)

These forms are called an “\( \overline{X} \) Skeleton.” A theory about what the phrase structure rules of a syntax have to look like is that they all conform to the \( \overline{X} \) Skeleton. That particular theory is called the “\( \overline{X} \) Theory.” (In fact, there are variations on this theory, so there are families of theories of this kind. The one I am showing you, then, is more properly called an \( \overline{X} \) Theory.)

There are names for the various parts of the forms in (44) and (45). The position that \( ZP \) is in is called the “Specifier position,” and the position that \( WP \) is in is called the “complement position.” Sometimes the positions that \( YP \) are in are called “adjunct positions.”

Adopting this \( \overline{X} \) theory makes the prediction that not just IP and DP will have things that show up in Specifier position, but that the other phrases will too. We will eventually see that this prediction is confirmed. In anticipation of that, I suggest that we adopt \( \overline{X} \) Theory.