جامعة نيويورك أبوظبي
NYU | ABU DHABI

PSYCH-UH 2218: Language Science

Class 16: X-bar Theory and movement

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Psychology

Hypothesizing phrase structure rules from constituency tests, phrasal category, and headedness

You now have the tools you need to start finding possible rules in your language

Step 1: Generate several sentences that potentially contain the phrase that you want to write rules for.

Step 2: Write the syntactic category over the words (you can check the category using frames to test category).

N V
Mary slept.

N V D N
Mary wrote the paper.

Step 3: Use constituency tests to prove that the sequences you care about are constituents (that they form either phrase or bar-level units).

Here I will use the standalone test (but you could also use others):

What did Mary do yesterday?

Slept.

Wrote the paper.

Are they the same type of constituent?

Step 4: Determine if they are the same type of constituent. We have two ways to do this: we can use the coordination test, or we can ask if the strings can show up in the same syntactic position.

Coordination:

Tonight, Mary will either <u>sleep</u> or <u>write the paper.</u>

Syntactic position:

Tonight, Mary will ____________________

sleep.

write the paper.

So we can see that they are both the same type of constituent. (I knew this going in, but I wanted you to see it. These are both VPs.)

What is the head?

Step 5: We need to determine the head of the constituent. To do this, we look to see which syntactic category is required in the string.

The only category that shows up in both example is V. The others can be absent. This tells us that V is the head.

N V
Mary slept.

N V D N
Mary wrote the paper.

(There may be examples where there are appears to be two required categories, but this is rare, so we won't worry about it for this brief introduction to syntax.)

Let’s hypothesize some rules

Step 6: The final step is to propose some rules for each of these. This is an iterative process. It requires us to figure out the rules for any smaller constituents in the strings using more constituency tests.

Here I will just show us the rules that we might find if we did constituency tests for all of them. But in a complete investigation, you would have to do constituency tests on the NP and DP as well!

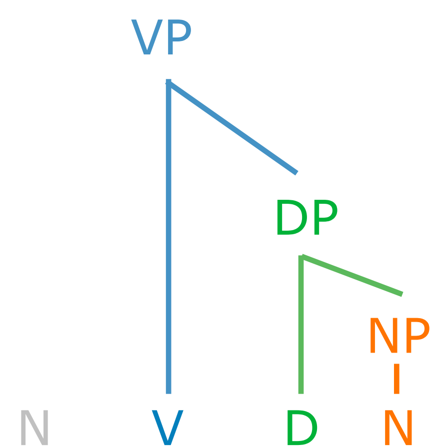
VP → V

Mary slept.

VP → V DP

DP → D NP

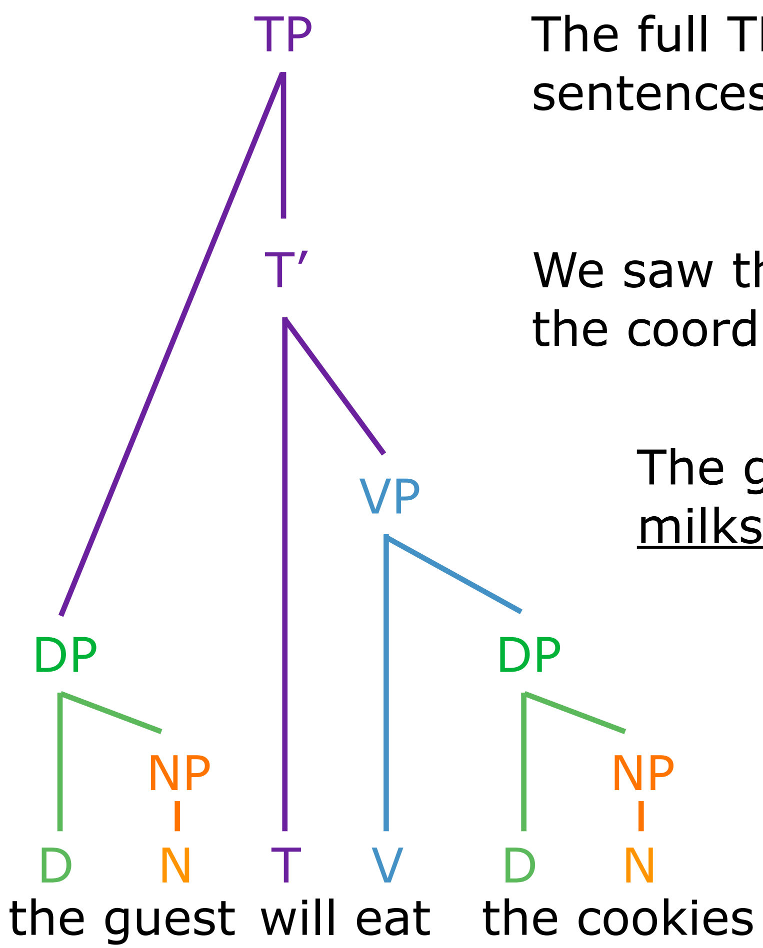
NP → N



Mary wrote the paper.

Theory expansion 1: For all phrases, we nee heads (X) and phrases (XP). For some phrases, we need an intermediate level: X’. So it must be part of our theory!

We have already seen that T requires 3 levels



The full TP is of course a constituent — because sentences are constituents.

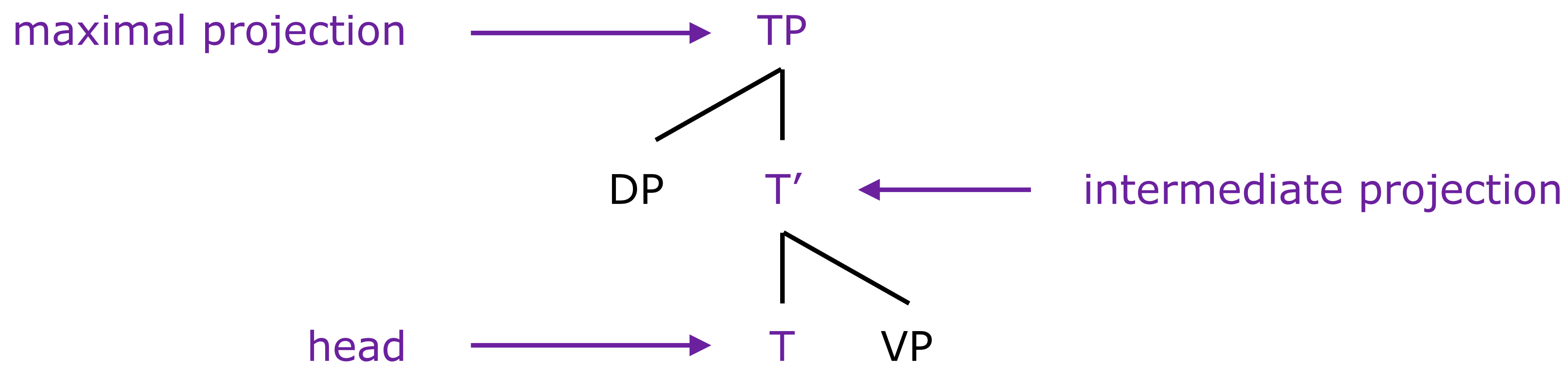
We saw that "will eat the cookies" is a constituent by the coordination test, so it must have a node!

> The guest will eat the cookies and might drink the milkshake.

This tells us that our psychological theory must have 3 levels available for any phrase! Some will use it, some may not. But it must be possible!

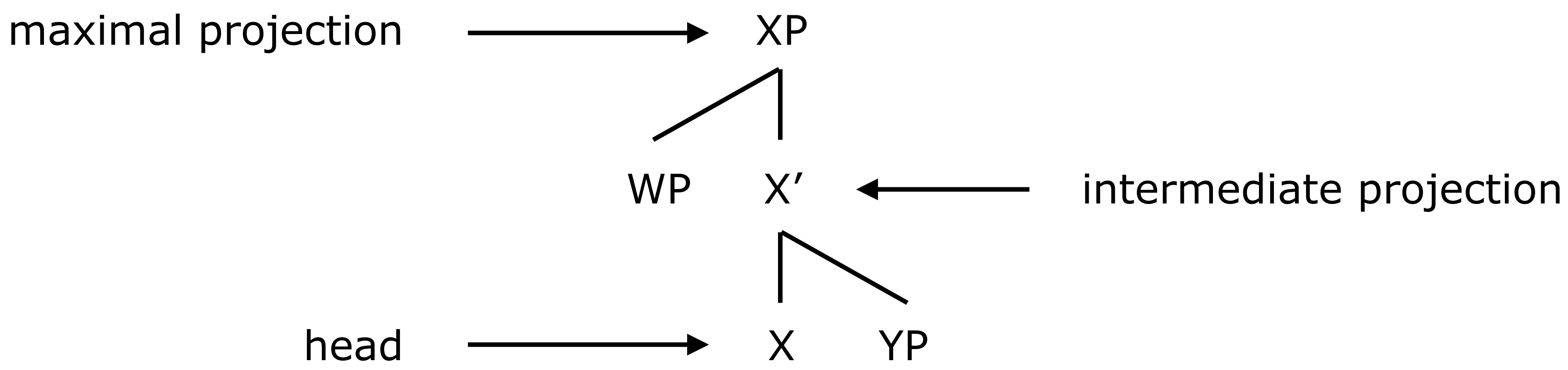
The three levels in TP in tree form

Here are the three levels for TP. What we see is that it is made of a head, an intermediate projection (indicated by the bar), and a maximal projection (indicated by a P):



Generalizing to all phrases: **X-bar theory**

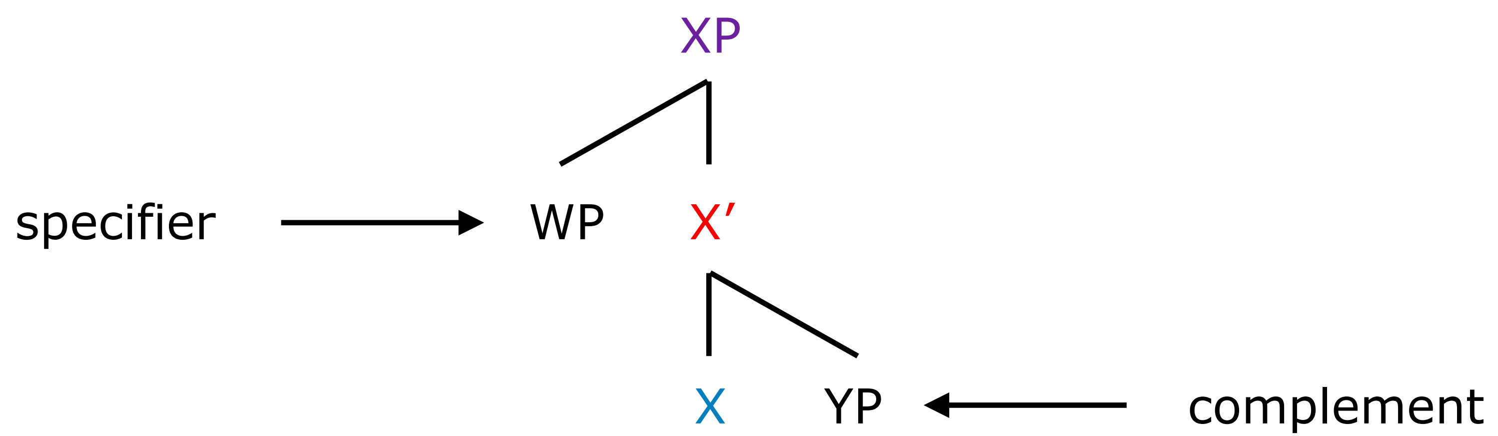
The big idea is that all phrases have this structure! So, we can replace the T with a variable "X". We call this **X-bar theory** after the variable X and the idea that there is a bar level!



Notice that we also replaced the other phrases with variables - WP and YP. The idea is that for different head types (T, V, D, N, P), these will be different!

Structural positions in XP

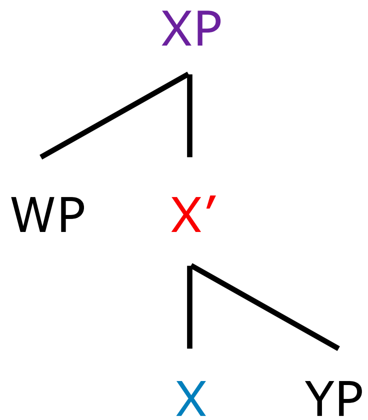
The structure given by X-bar theory makes it possible to uniquely define two syntactic positions within the XP. (And there is a third we will see a bit later.) We give these positions names to make it easier to refer to them.



Complement: A sister of an X (head) and a daughter of an X′

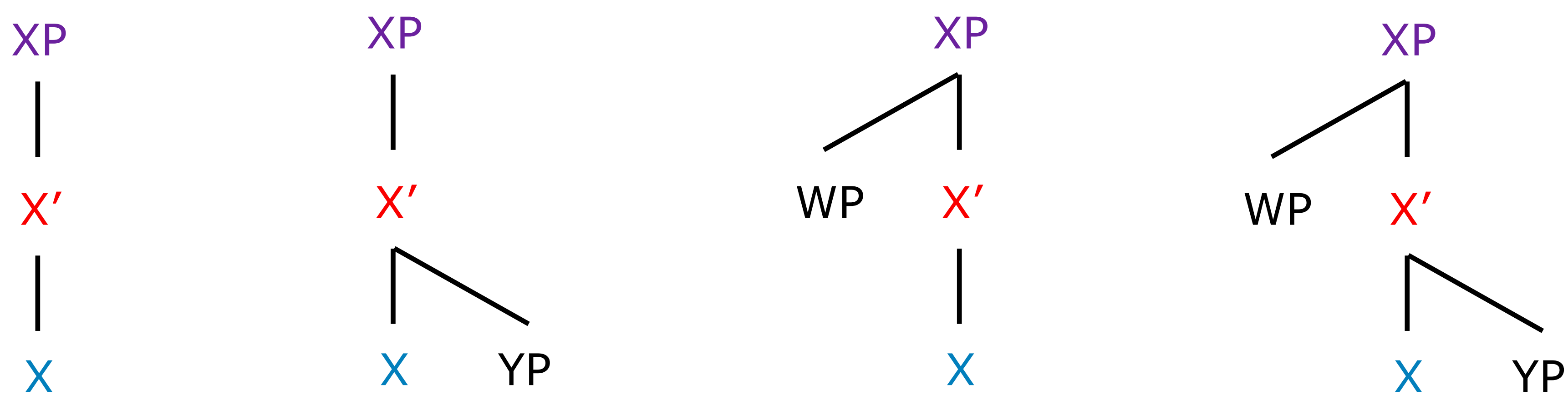
Specifier: A sister of an X′ and a daughter of an XP (phrase)

The big idea!



The biggest of big ideas in syntax is that **every phrase in all human languages will follow this pattern!** The idea is that this is the way the human mind woks for language!

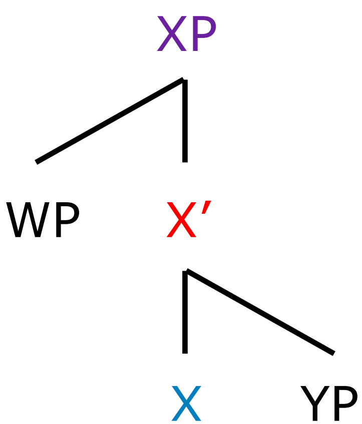
We are not saying every phrase will have all of these pieces. But we are saying that every phrase will be a subset of this. Here are some possible phrases:



Notice that I did put the X' level in each of them. This is not strictly necessary from an empirical point of view. (For example, I can't give you evidence that proves there is an X' in the first one.) But it is generally helpful at this stage for keeping everything regular and easy to analyze!

Converting these into rules, for completeness

The X-bar schema is our theory for the structure of all possible phrases in human language.



XP → WP X′

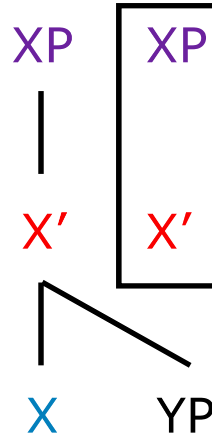
X′ → X YP

But we can also, equivalently, write **phrase structure rules** that match this schema. It only takes two. The big idea is that all rules in human language will be of this form!

To get all of the subsets, we simply remove WP or YP from the rule:

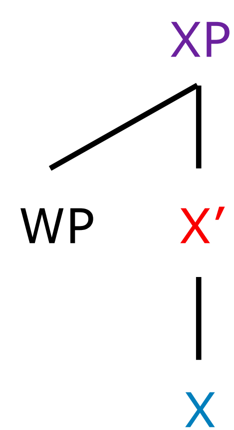
XP → X′

X′ → X



XP → X′

X′ → X YP



XP → WP X′

X′ → X

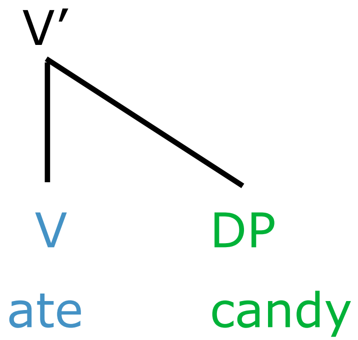
Theory expansion 2: Word order differences!

The order of the heads and complements

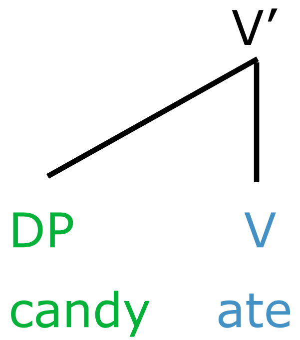
X-bar theory does not say anything about the order of heads and complements. This may seem like an oversight, **but it is intentional**. This is one of the major ways to capture cross-linguistic variation in word order using X-bar theory!

The (strong) hypothesis is that the phrase structure of languages only varies in one dimension: the order of the head and complement in a phrase:

Head initial: John ate candy



Head final: John candy ate

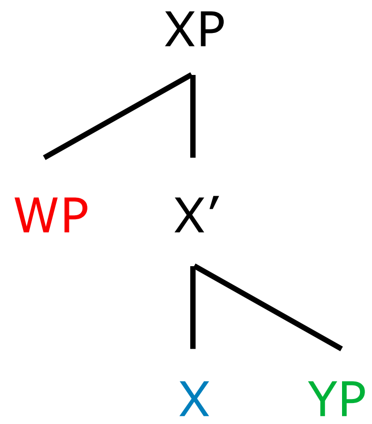


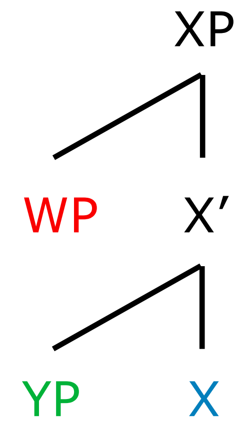
Wait, only one dimension? Yes.

In principle, X-bar theory should allow four orders of specifiers, heads, and complements:

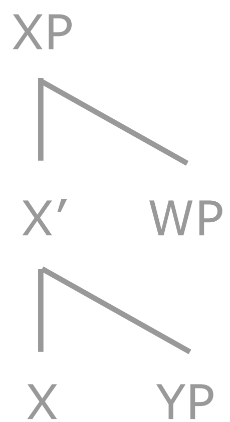
But, in practice, specifiers always appear **before** the head.

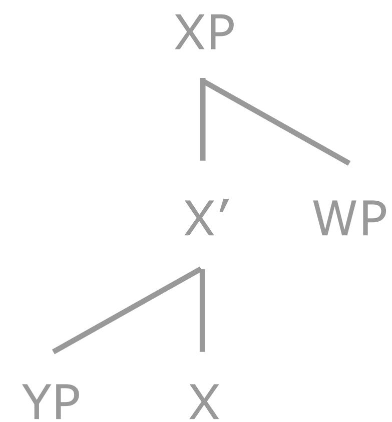
Whereas the head can either be **initial** (before the complement) or **final** (after the complement).





Specifiers never appear after the head (as far as we can tell).





I can’t show you this without looking at every language! But let’s take it on faith right now, and see what happens when you look at your languages!

An extreme example: English vs Japanese

Here is a sentence in Japanese, with the word-by-word translation in the second line (called a gloss in linguistics) and an equivalent English sentence below it in quotes to show you what the sentence means (called the translation in linguistics):

	Taro-ga	Hiro-ga	Hanako-ni	neko-no	syasino	miseta	to	omotte	iru
gl:	Taro	Hiro	Hanako-to	cats-of	pictures	showed	that	thinking	is

tr: ‘Taro is thinking that Hiro showed pictures of cats to Hanako.’

Most English speakers feel as though Japanese word order is very different from English. In fact, when given glosses, many English speakers have no idea what the sentence means. It comes across as gibberish.

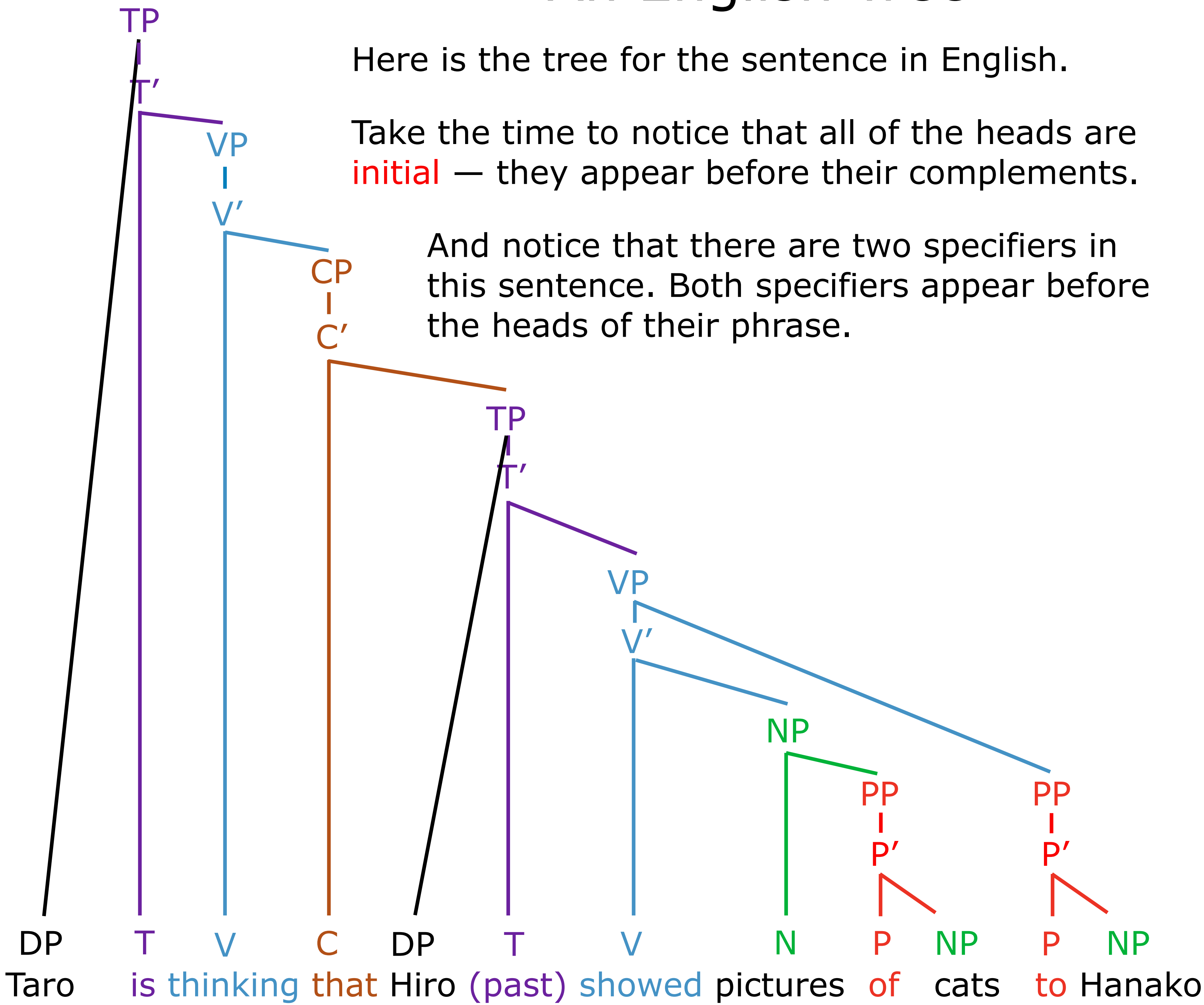
What I want to show you now is pretty amazing. All of the differences can be captured by a single difference between English and Japanese: English sets the head direction to head initial, and Japanese sets it to head final.

An English Tree

Here is the tree for the sentence in English.

Take the time to notice that all of the heads are initial — they appear before their complements.

And notice that there are two specifiers in this sentence. Both specifiers appear before the heads of their phrase.

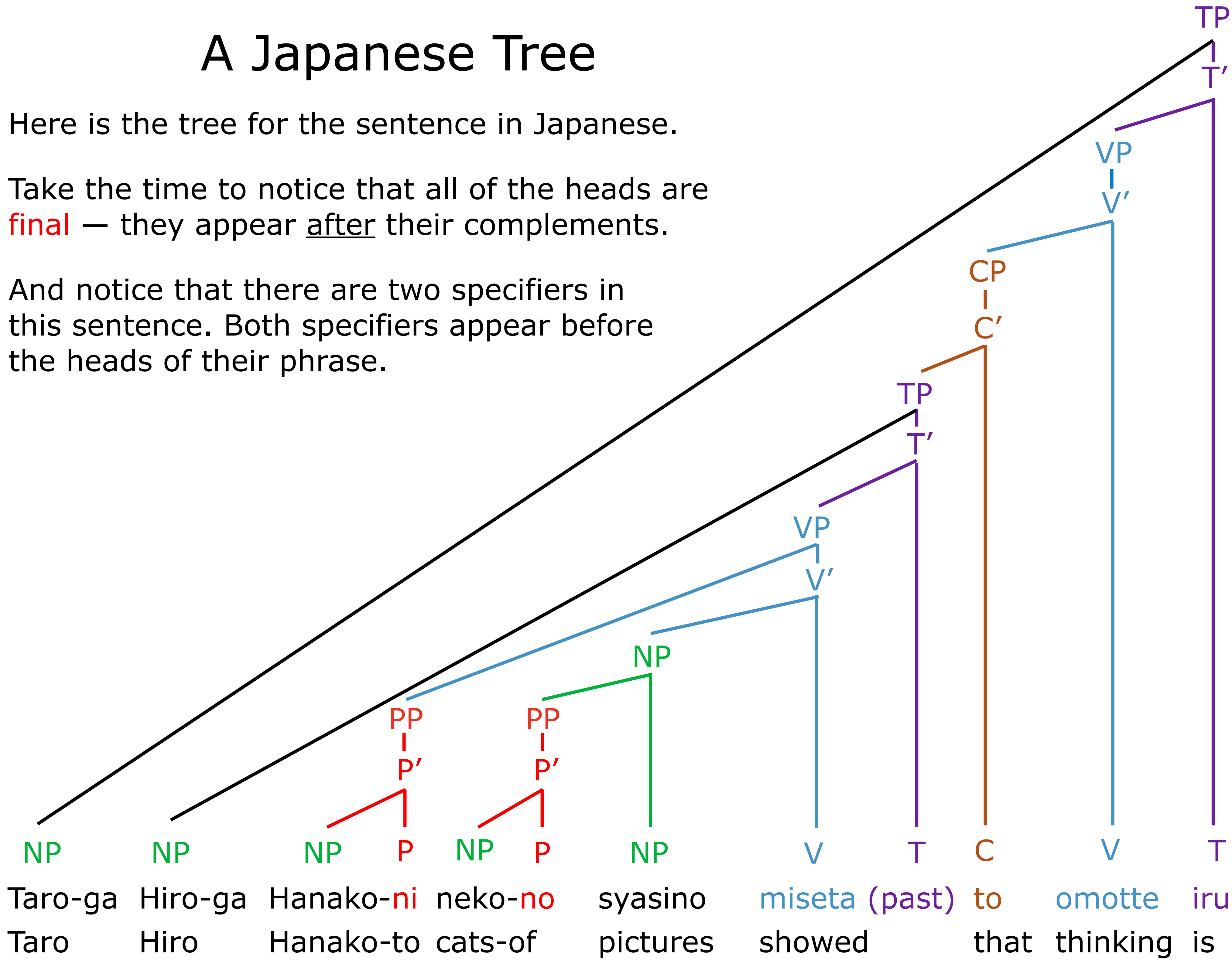


A Japanese Tree

Here is the tree for the sentence in Japanese.

Take the time to notice that all of the heads are final — they appear after their complements.

And notice that there are two specifiers in this sentence. Both specifiers appear before the heads of their phrase.



English/Japanese: head-initial vs head-final

From these trees we see two things:

1. Specifiers are always to the left. There is no variability in specifiers.

2. English heads appear before their complements, while Japanese heads appear after their complements:

	T	V	C		T	V	N	P	N	P	N
Taro	is	thinking	that	Hiro	(past)	showed	pictures	of	cats	to	Hanako

			N	P	N	P	N	V	T	C	V	T
Taro-ga	Hiro-ga		Hanako-	ni	neko-	no	syasino	miseta	(past)	to	omotte	iru
Taro	Hiro		Hanako-	to	cats-	of	pictures	showed		that	thinking	is

When you look at your own language!

When you analyze your own language for PS 3, you will see:

1. Specifiers are always to the left. There is no variability in specifiers.

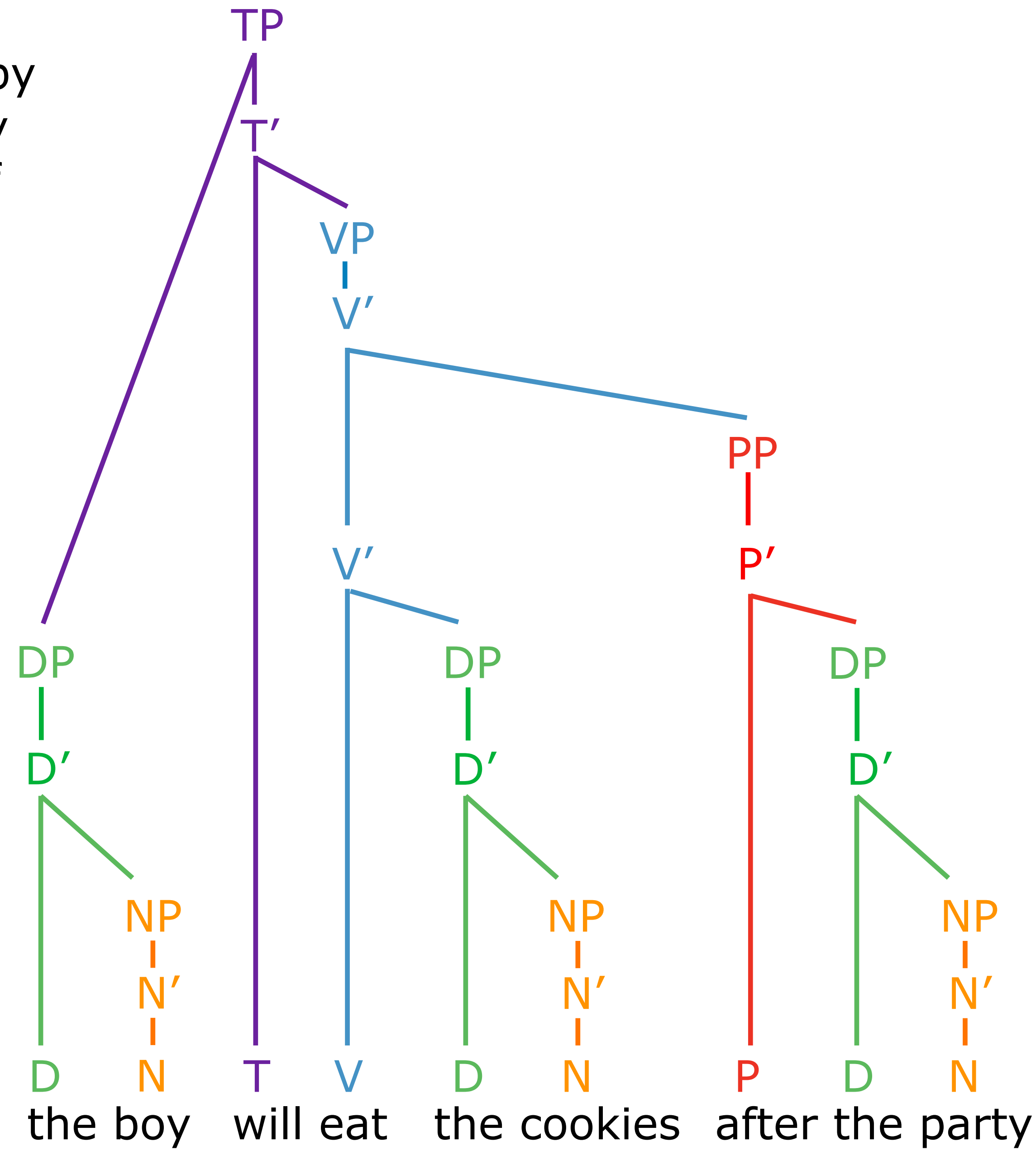
2. Some phrases may be head-initial, others may be head-final. English and Japanese are extreme in that they are both uniformly head-initial or head-final. Some languages (like German!) have both types. So you will have to look at each phrase type (TP, VP, DP/NP, CP) to see!

Theory expansion 3: Matrix sentences and Embedded sentences (and infinity!)

Matrix sentences are Tense Phrases (TPs)

We started the syntax section by saying that we wanted a theory of the mental representation of sentences. And now we have started to build one:

The representation of sentences is a hierarchical structure that we call phrase structure. Each phrase has a head. And **the head of the sentence is T**. That means a sentence is a TP.



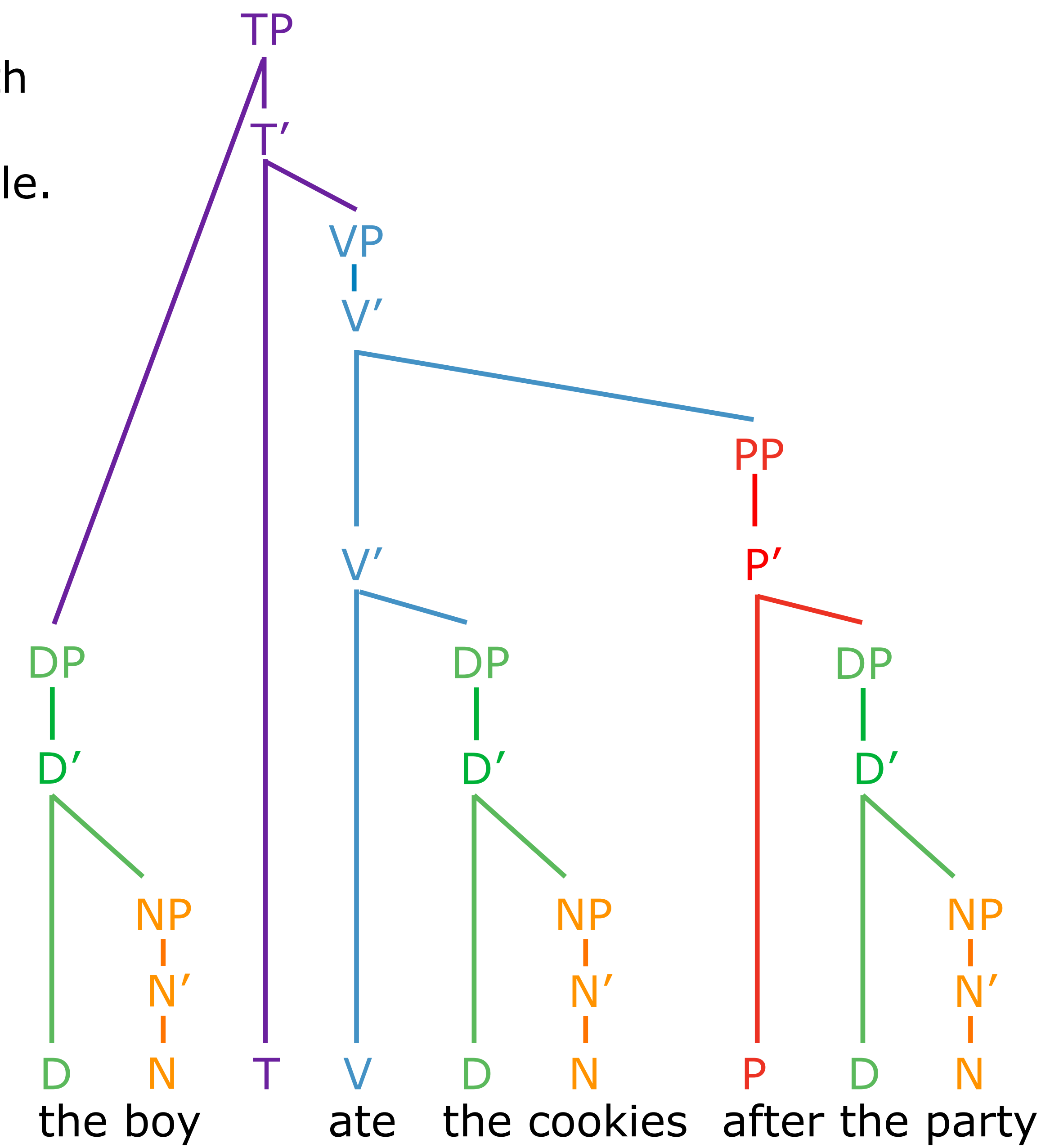
What if there is no word to go in T?

Here is an immediate issue with making T the head of the sentence: it is not always visible.

In this sentence (in English), there is no distinct item for T. T is in someway incorporated into the verb “ate” - which has past tense.

And, as you will recall from the lecture on language and thought, some languages don’t express Tense much at all - like Mandarin.

So what should we do?



Our options are either variability or a null T

One option is to say that sentences have different heads depending on the items in the sentence:

The boy ate cookies	head: V
The boy eats cookies	head: V
The boy is eating cookies	head: T
The boy will eat cookies	head: T
The boy can eat cookies	head: T
The boy did eat cookies	head: T
The body did not eat cookies	head: T

This is obviously **unsatisfying**. It would create a lot of duplication in the grammar, like subjects would sometimes be the specifier of TP and sometimes the specifier of VP. So we'd need to double every rule that is relevant for subjects (which is quite a few, even if we won't review them all here).

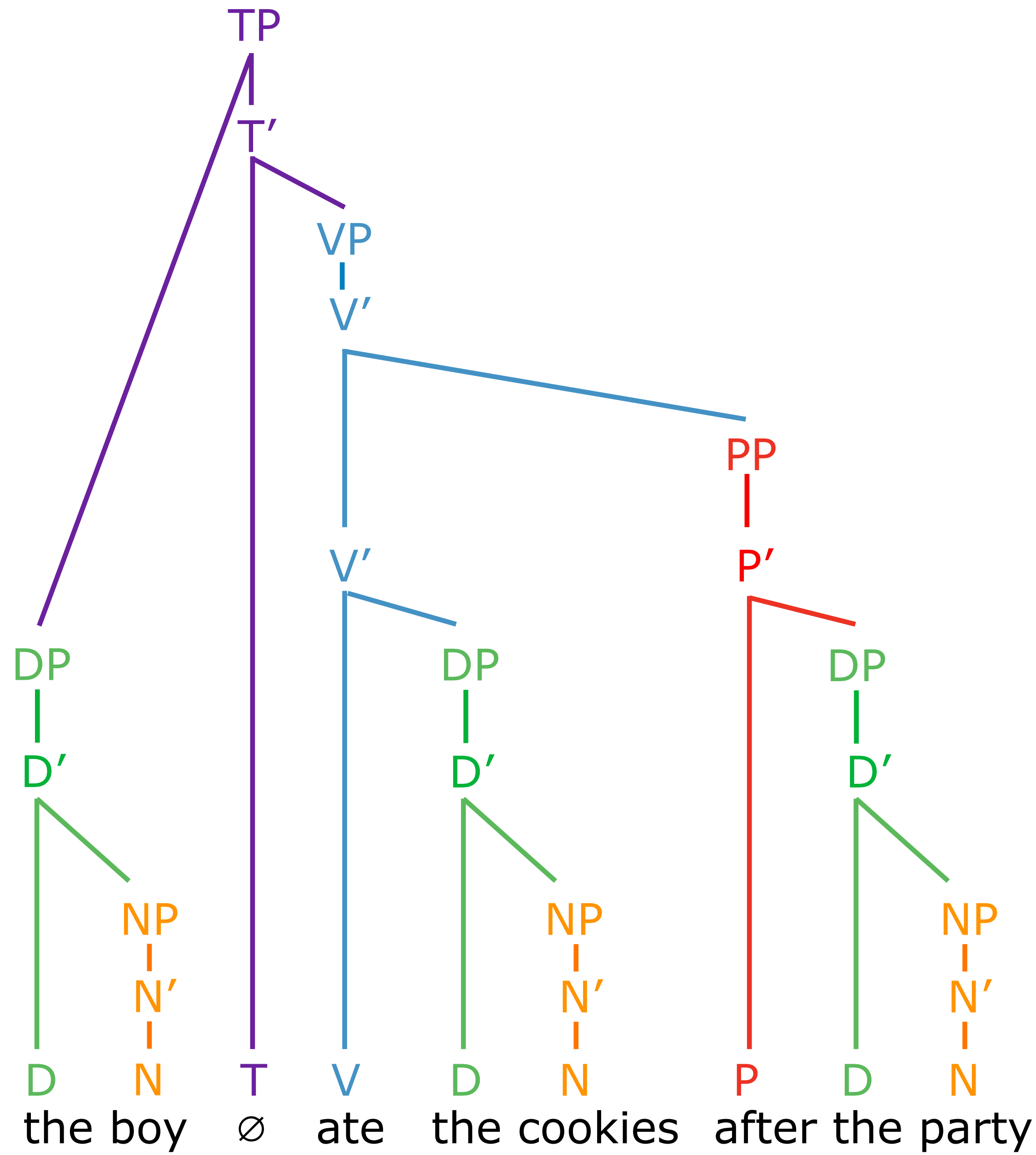
The other option is to say that all sentences have a T, we just can't see it sometimes. In morphology we postulated morphemes without phonetic content. T could be another example of that:

The boy ∅ ate cookies.

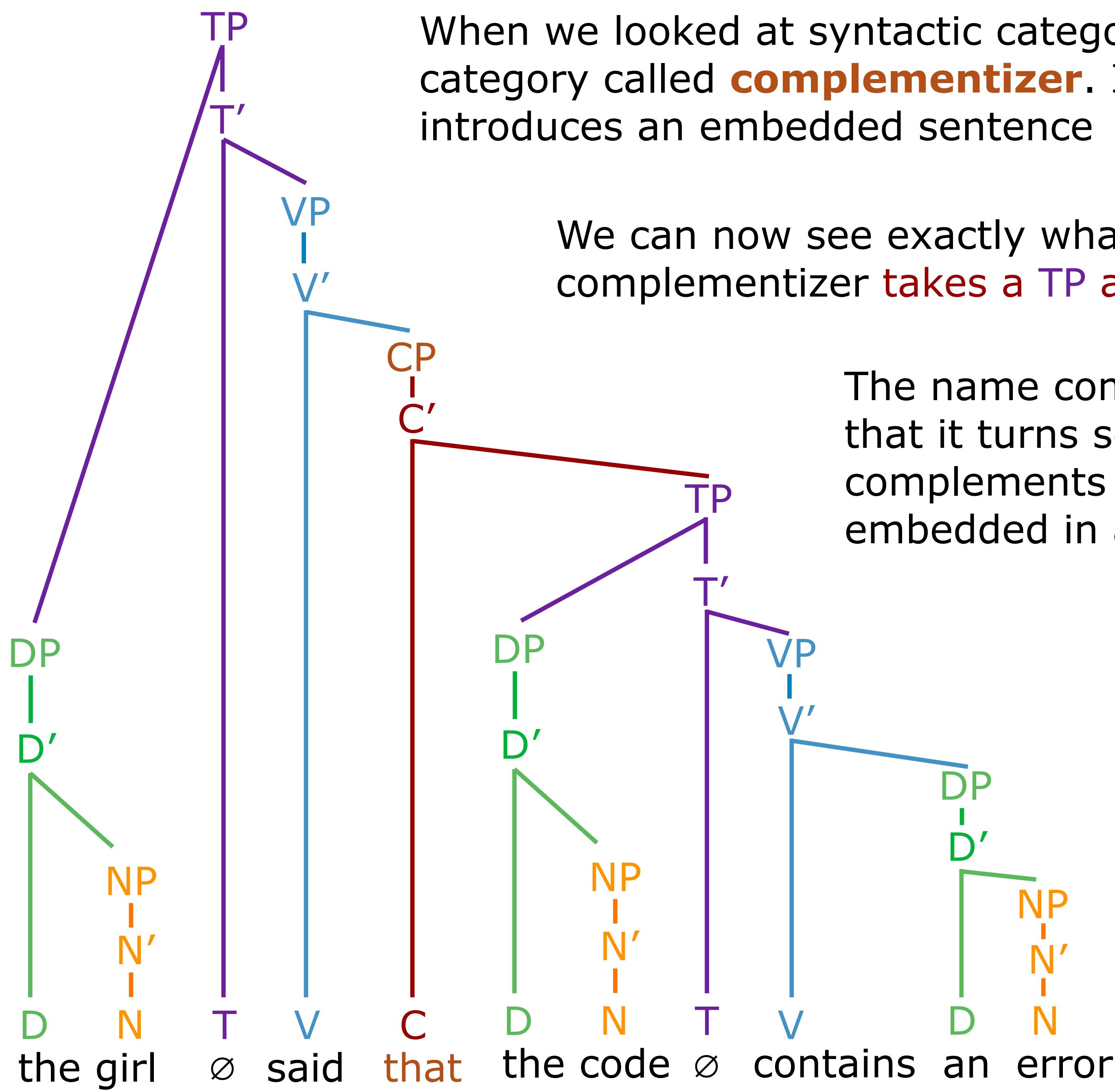
Phonetically null morpheme T

The general consensus in the field is that it would be better to have a phonetically null T than to have the head of the sentence vary from construction to construction.

(In some languages, the verb shows up in the T position! But to analyze that, we need to go further and learn about movement. We will do that later today!)



Complementizer Phrases (CPs) and embedded sentences



When we looked at syntactic category, we learned about a category called **complementizer**. It is a word that introduces an embedded sentence

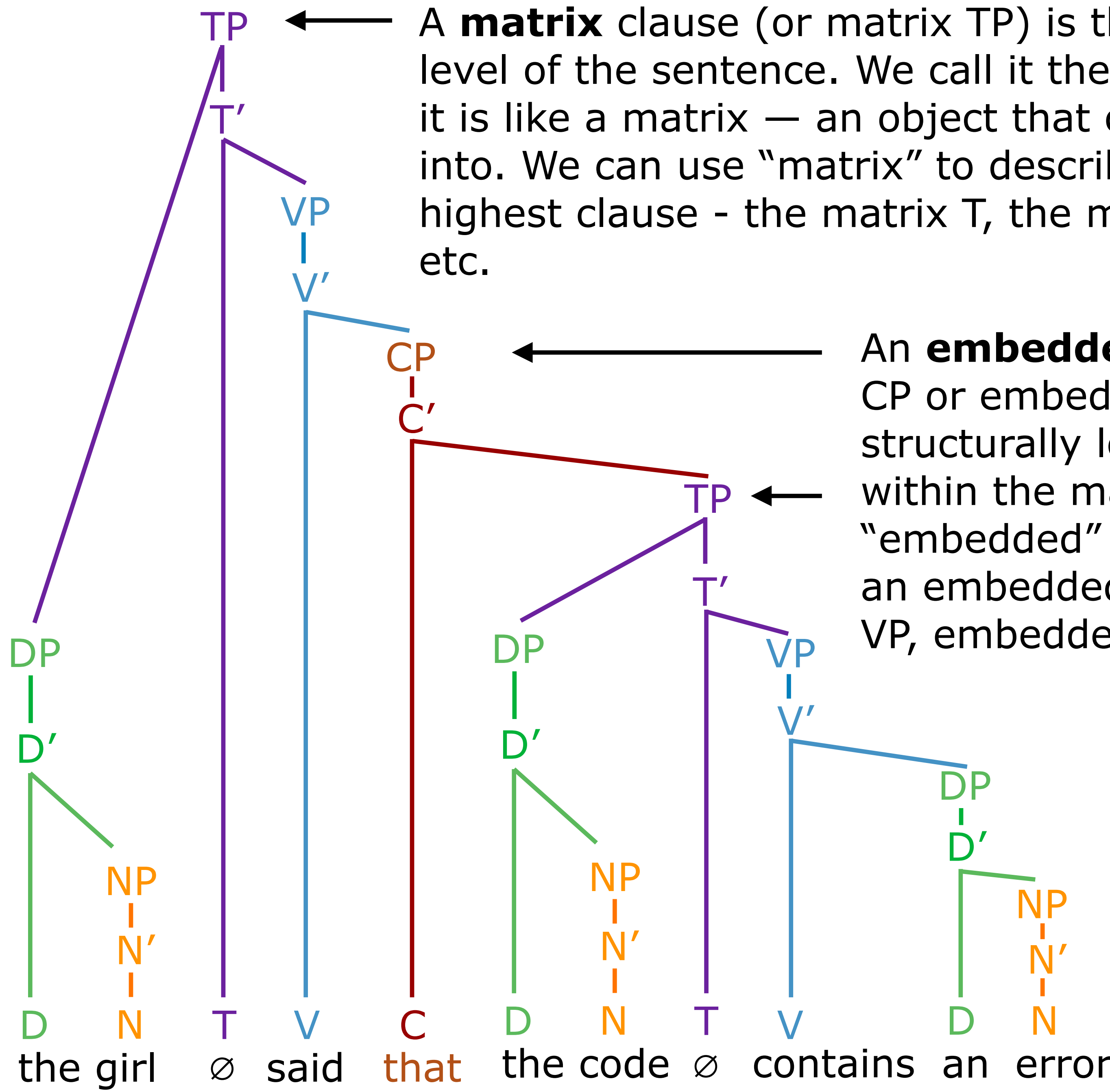
We can now see exactly what this means. A complementizer takes a TP as its complement!

The name complementizer means that it turns sentences (TPs) into complements so that they can be embedded in another TP!

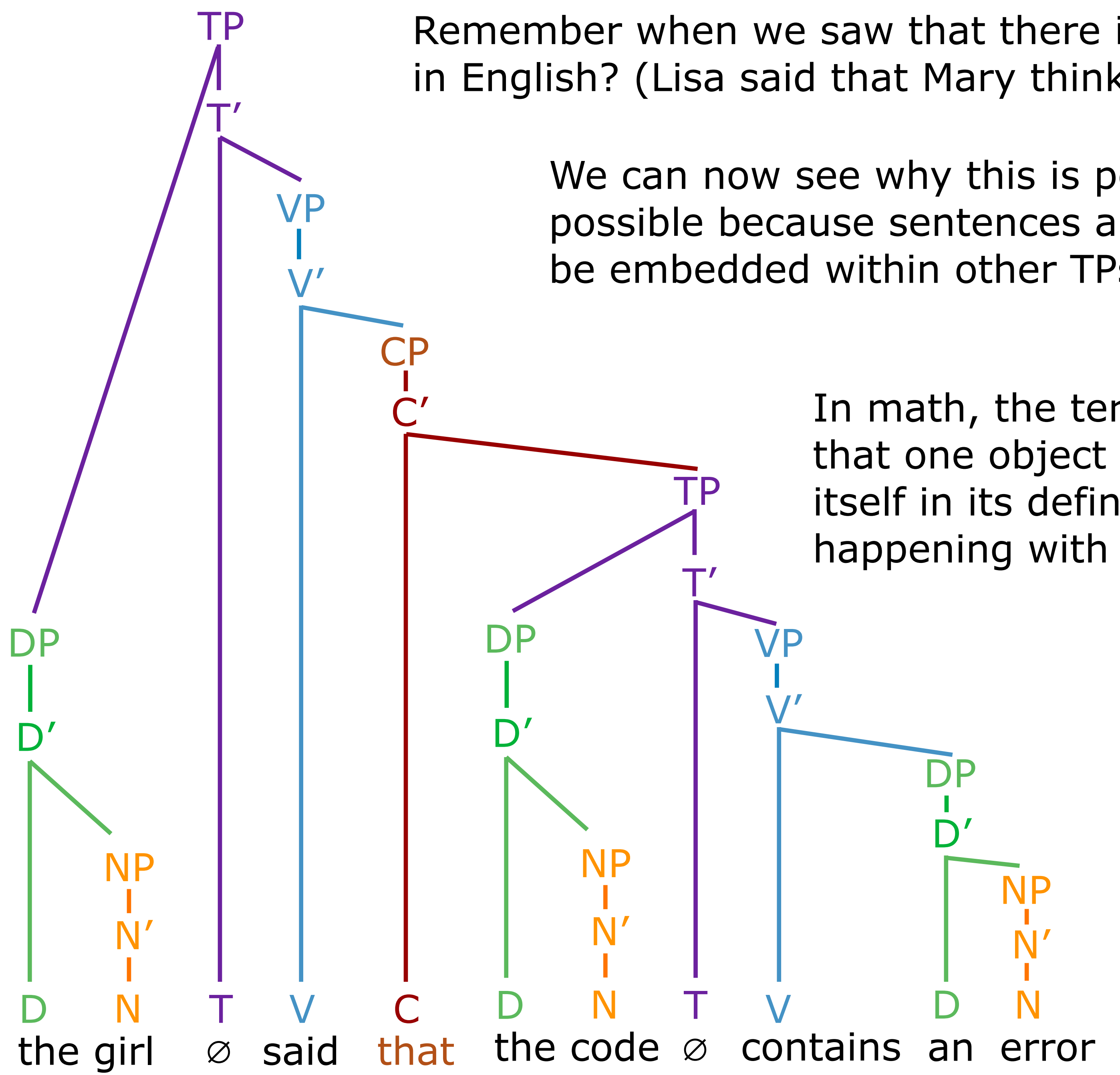
Two useful terms: matrix and embedded

A **matrix** clause (or matrix TP) is the highest structural level of the sentence. We call it the matrix clause because it is like a matrix — an object that other objects can fit into. We can use “matrix” to describe any item in the highest clause - the matrix T, the matrix V, the matrix DP, etc.

An **embedded** clause (or embedded CP or embedded TP) is one that is structurally lower — it is embedded within the matrix clause. We can use “embedded” to describe anything in an embedded clause - an embedded VP, embedded DP, etc.



Recursion of TP gives us infinity



Remember when we saw that there is no longest sentence in English? (Lisa said that Mary thinks that…)

We can now see why this is possible. It is possible because sentences are TPs, and TPs can be embedded within other TPs by using a CP!

In math, the term **recursion** means that one object (or function) contains itself in its definition. That is what is happening with TP. TP contains itself!

Recursion can give infinity - you can just keep looping through by defining the embedded TP as containing another TP… and on and on.

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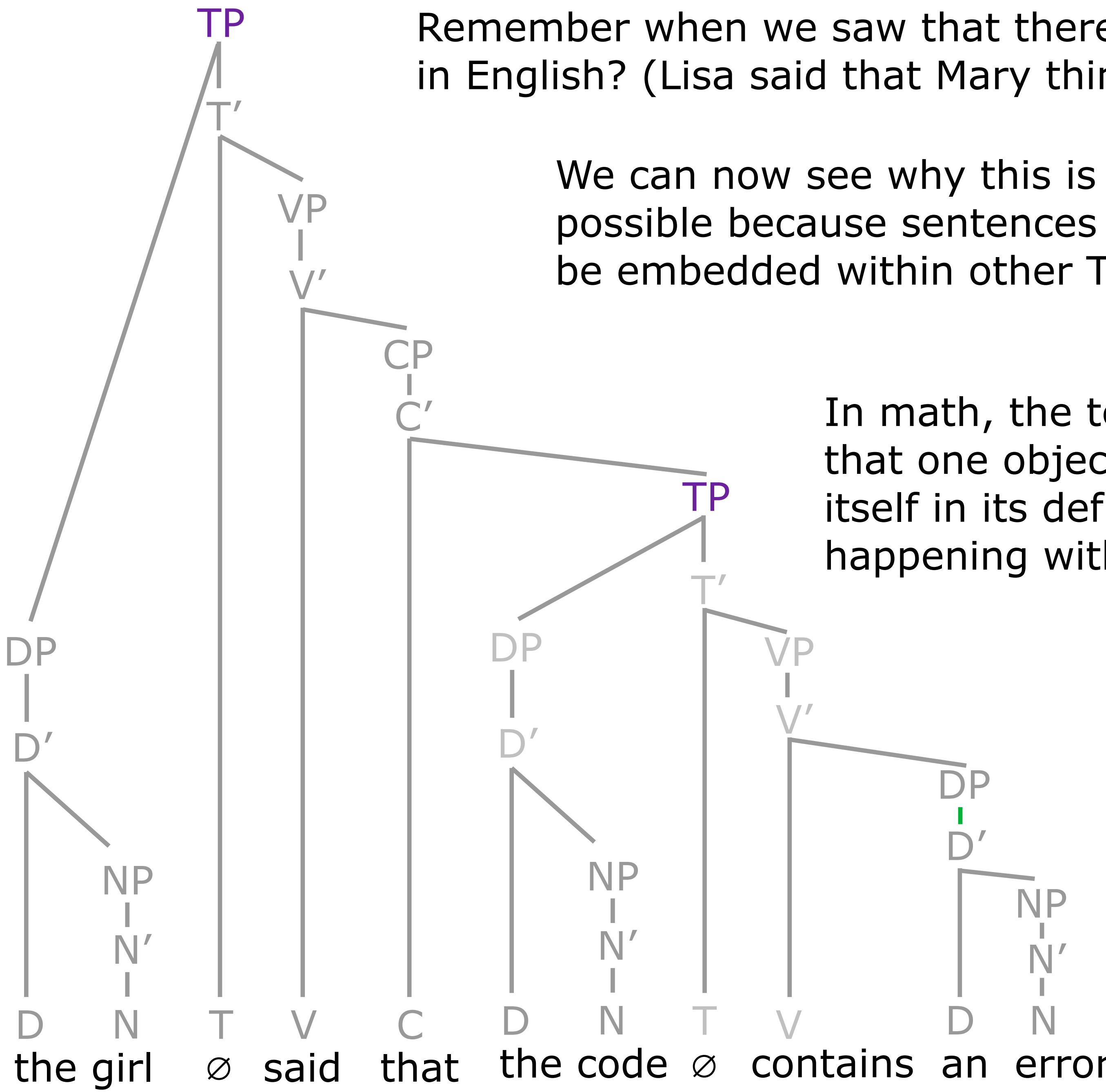
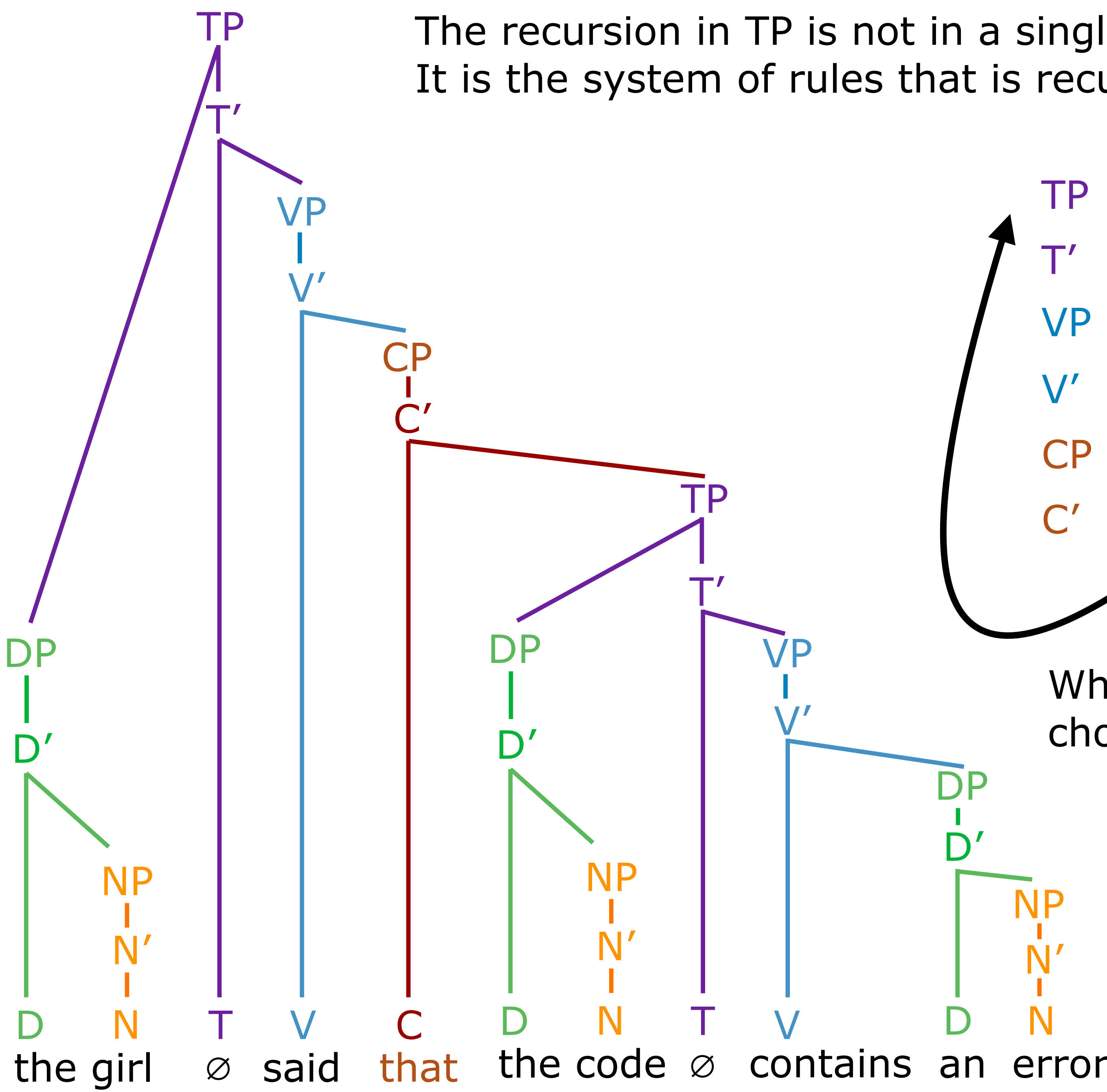


To see the recursion, you need to look at multiple rules:



The recursion in TP is not in a single phrase structure rule.
It is the system of rules that is recursive:

TP → DP T′
T′ → T VP
VP → V′
V′ → V′ CP
CP → C′
C′ → TP

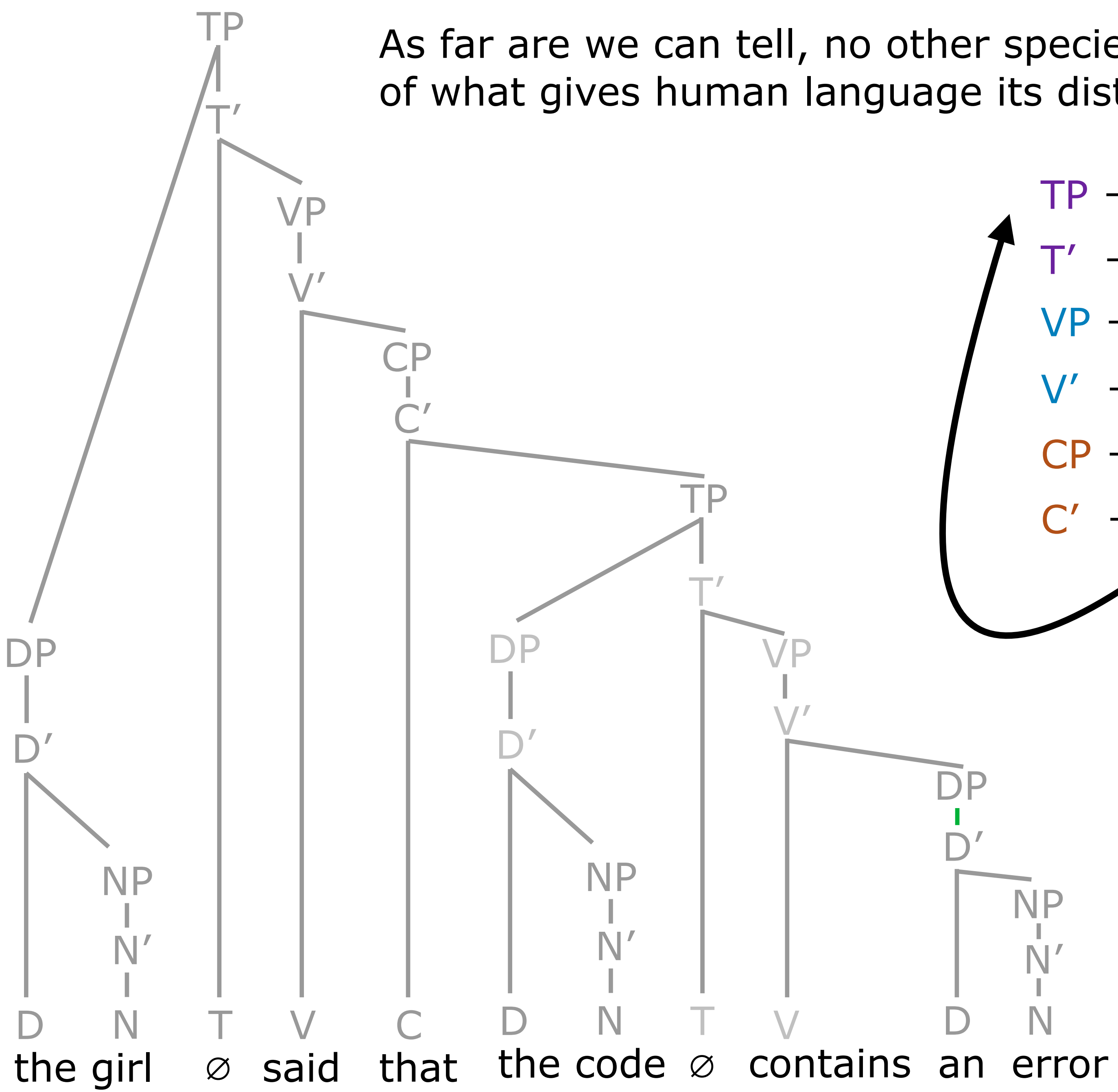
When you want to stop, you choose a different VP rule!

~~V′ → V′ CP~~

V′ → V′ DP

Recursion is a critical property of human language!

As far are we can tell, no other species has this. So it is part of what gives human language its distinctive complexity!



- TP → DP T′
- T′ → T VP
- VP → V′
- V′ → V′ CP
- CP → C′
- C′ → TP

Theory expansion 4: X-bar theory is really good for declarative sentences. But what about other sentence types?

Distortions of phrase structure

Our phrase structure rules do a lot of work for us. Once you have them, they will capture many of the sentences of your language. But some sentences might present problems:

Declarative: The customer did devour the pizza.

Yes/no question: Did the customer __ devour the pizza?

Wh-question: What did the customer __ devour _____?

While it is possible to write phrase structure rules that generate these questions, it gets a little complicated, because you now need rules that say devour can exist without an object in certain circumstances but not others:

The customer devoured the pizza.	V′ → V DP
*The customer devoured.	*V′ → V
*What did the customer devour the pie.	*V′ → V DP
What did the customer devour?	V′ → V

A new operation: Movement

One solution to this is to say that questions require an additional kind of rule, different from a phrase structure rule, called **movement**.

So, for a yes-no question, we would start with phrase structure rules, which would give us something that looks like the declarative:

1. output of phrase structure: The customer did devour the pizza.

And then we would add movement — we will move “did” from its position dictated by phrase structure rules to a new position:

2. movement of did: did the customer ___ devour the pizza?

The end result is the word order that we want!

A new operation: Movement

We can use the same process for wh-questions:

We start with phrase structure rules to get something that looks a bit like a declarative:

1. output of phrase structure: The customer did devour what.

Then we move did to its new position:

2. movement of did: did the customer ___ devour what?

Finally, we move what from the position dictated by phrase structure rules to its final position:

3. movement of what: What did the customer ___ devour _____?

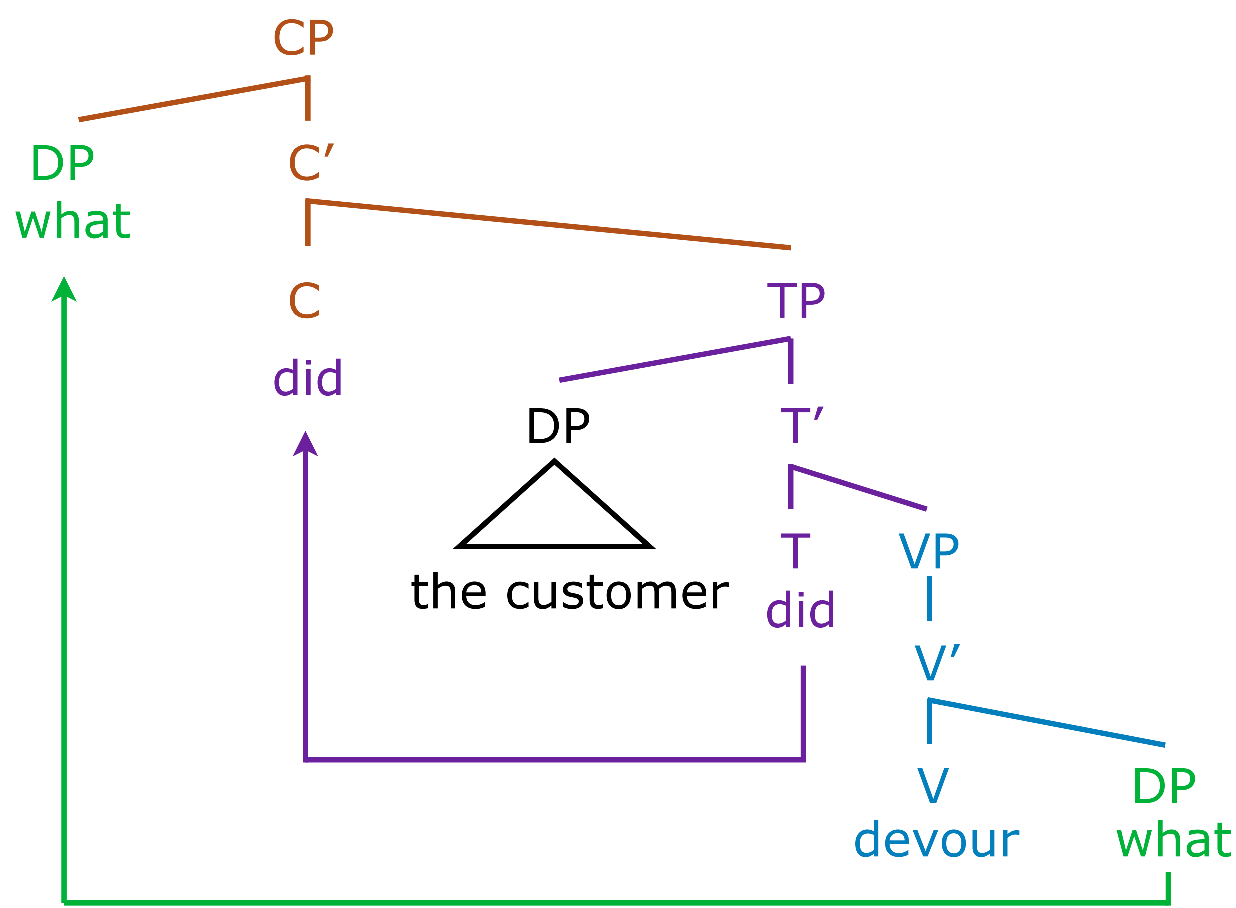
But what is the structure?

Movement is easy to grasp conceptually, but it raises an interesting question about what the structure looks like. Where are did and what moving to?

What did the customer __ devour _____?

We know that they are moving to positions to the left of TP? Well, what do our phrase structure rules tell us about what kind of structure can be to the left of TP?

Yes, CP! In our PS rules, CP takes TP as a complement. One proposal is that the same is true for structure created by movement.



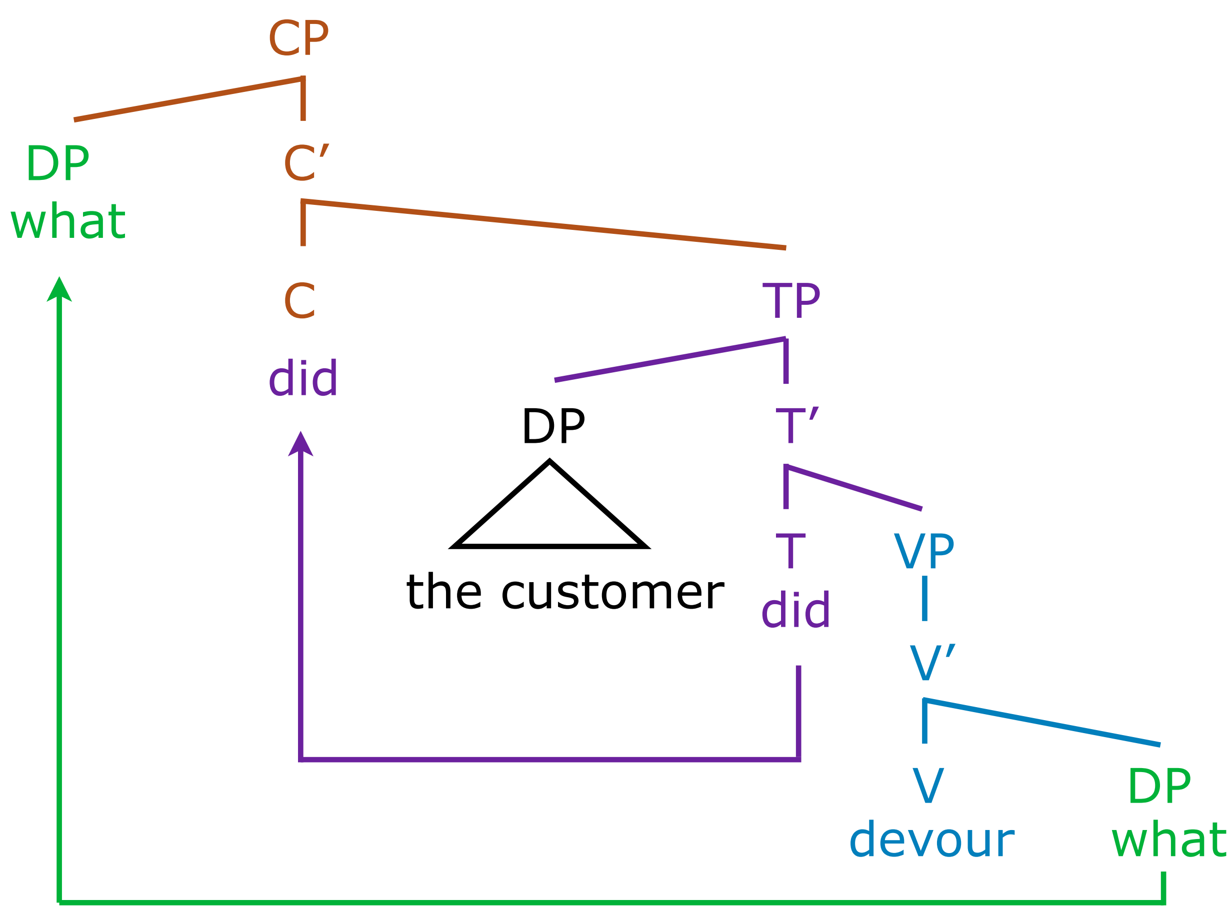
Notice that X moves to X, XP to XP

There are two instances of movement in this structure. Did moves from the T position to the C position, and what moves from the complement of VP to the specifier of CP.

This looks like a pattern.

What we see over and over is that words that are the heads of a phrase move to head positions (like T moving to C).

And words that are XPs move to positions that can host XPs (like the DP moving to the specifier of CP).



A number of sentence types involve movement!

Questions: What did the customer ___ devour _____?

Topicalization: I don’t like pepsi, but coke, I like _____.

Relative Clauses: I read the book that Lisa wrote _____.

Passive: The book was written _____ by Lisa.

This list is specific to English. And it is not exhaustive. In any given language, there may be more or fewer or different constructions that involve movement. The way to find them is to look for items that appear in a different location from where they would according to phrase structure rules (and the theta criterion).

Cross-linguistic variation in movement

As we already saw, questions in English (with one wh-word) involve movement of the wh-word to the specifier of CP:

What did the customer __ devour _____?

But some languages don't use movement at all. We call these **wh-in-situ** languages. Mandarin and Japanese are classic examples:

Mandarin: Lisi mai-le shenme?
Lisi bought what?
'What did Lisi buy?'

Japanese: Kengakusha-wa itsu tsuki-mashita ka?
vistor-topic when arrive-past Q
'When did visitors arrive?

> Notice that Japanese also has a question particle at the end of the sentence. That is something that can happen with wh-in-situ languages!

With multiple wh-words, we get three types of languages!

If we put two wh-words in a question, we see that there are actually three types of languages:

Mandarin:

Lisi weishenme mai-le shenme?

Lisi why bought what?

'Why did Lisi buy what?'

Mandarin leaves all wh-words in-situ! No movement. We call this **wh-in-situ**.

English:

What did Lisa give to who?

English moves one, and leaves the other in-situ. We call this **single wh-fronting**.

Bulgarian:

Koj kude mislìš če e otišul ___ ___?

who where think that has gone ___ ___?

'who do you think went where?'

Bulgarian moves both. We call this **multiple wh-fronting**.