

The Algebra of Language an Introduction to Syntax

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Ver. 2

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Introduction

This is a script designed to assist students who are taking an introduction to syntax class as part of the theoretical linguistics curriculum. It is not really designed as a stand alone text and is best used in conjunction with class lectures. The framework adopted in this textbook is Generative Grammar. There is no historical preview of the field. You will not find in here discussion of phrase structure rules, which were part of early research in the field, but you will also not find more recent versions of Minimalism. This is an introduction text and as such its aim is to assist in training you to think like an empirical scientist and a linguist. For some, this might be a surprise that linguistics is aiming for the empirical-scientific method, as opposed to some other more nebulous approach that is, often mistakenly, associated with the humanities. This stems from the very nature of the Chomsky revolution of the 1950's that gave rise to Generative Grammar. Linguistics is the study of what a speaker knows when she/he is said to speak a given language. It is a way to model the computational properties of the human mind. In fact, it is one of the easiest ways to carry out empirical research on the architecture of the human mind. All you need is speakers of a given language, pencil and paper, and, the hardest part, a theory to test. Data can come in a variety of forms. However, in Theoretical Linguistics it usually takes the form of speaker intuitions. We ask a native speaker about a contrast between two or more structures. For example:

- *1. Who did John say *that* photographed Mary
- 2. Who did John say ____ photographed Mary

The two clauses above differ in one word and yet are perceived by a lot of speakers of English as differing in status. Clause number (1) is deemed by many speakers as ungrammatical (hence the asterisk). There is evidence that such data gathering is very stable and robust. You might think that getting a few speakers to give you their intuitions is very meager compared to getting data from tens, if not hundreds, of speakers. After all, we

are living in the age of big data. It turns out that this is not the case. We quickly achieve what psychologists call a ceiling effect. The data does not become more accurate. Obviously, if you cast a wide enough net you will find that there is speaker variation, but once you identify the different dialects for groups of speakers, or idiolects for individuals, the judgments themselves remain stable. In fact, there has been research where data obtained from just small groups of speakers was tested on much larger populations. It turns out, grammaticality judgments provided by small groups of speakers are just as reliable as those of large groups of speakers.

How about experiments involving brain imaging, or asking speakers to parse sentences on-line on a computer screen? All these research paradigms are effective, just not for the types of questions we are going to ask. Simply put, they are not sensitive enough. Experiments with imagining can only test the most rudimentary linguistic tasks and asking people to parse sentences on-line in real time tells us, you guessed it, how people parse, that is how they use a language. This at first might appear a false distinction: language use vs. language knowledge. However, we know that other cognate abilities fluctuate. That is why pilots need to sleep. It is not that their knowledge how to fly disappears when they are tired, it is their ability to use it. Furthermore, we see from studies on human aphasia that there are patients who have better comprehension than production, and vice versa. This suggests that what is damaged in such cases is the ability to use language, not the knowledge of language itself. What we will study is how to model one specific aspect of that knowledge: sentence structure.

Generative Grammar aims not only to establish the unique algorithm that generates our knowledge of language. It also aims at incorporating that model with how language is acquired. One aspect of the Generative revolution was the observation that there is an innate component to language acquisition. We are born pre-programmed to acquire a human language. That pre-programming leaves vestiges in the structures of all the languages of the world. It defines what they cannot be since any finite pre-programming will limit the types of grammars a child can grow. The analogies here are used on purpose. Acquiring a language is like growing an organ. In this case, a cognitive organ, but

nevertheless an organ. The pre-programming we are born with, sometimes called Universal Grammar, is the equivalent of our genes providing the pre-programming allowing us to grow a liver. The genes determine what a liver is not. For example, a lung or a finger, or a boat. The same happens with UG. It is not the case that children exposed to different communication systems will acquire them. No child has mistaken the pictographic system of road signs in the US with language. The kid's brain will not allow it. Having said that, there is obviously language variation. The theory is that such variation is limited mostly to lexical items. At the level of syntax, languages vary very little. Most of the variation is lexical: how words are pronounced, what endings they take, etc. In that sense the study of syntax has to be also the study of UG. Our models have to reflect the ease with which children acquire their target language. After all, they develop the ability to produce and comprehend an infinite set of sentences. Furthermore, that infinite set of grammatical sentences is only a subset of a much larger set of infinite sentences that we can generate by just randomly putting words together. It is true that given enough time by randomly typing words you will reproduce the works of Shakespeare!

Imagine that the set of grammatical sentences in our languages is the numbers between 1 and 2.

1.....2

That is infinity. One that cannot be even counted. If you take a number like $6/5$, which is between 1 and 2, it has an infinite set of numbers before it, and an infinite set of numbers after it. Unlike the well known infinity generated by using a rule $n=n+1$, this type of infinity is not only hard to generate but also has the property that we cannot establish the neighborhood of the elements that belong to that set. The set of grammatical sentences is such a set, an uncountable infinity. UG limits it, just like the numbers 1 and 2 limit the infinity between them. We will try to see if instead of counting or cataloguing the set of grammatical sentences in a given language we can establish the generative procedure (just

like $n=n+1$ for the countable infinity) that defines or closes the set of grammatical structures. In establishing this generative procedure, which we will call a grammar, we need to take into account that it has to be acquired from the available input based on our pre-programming. The input children receive is very impoverished compared to the skills they develop. Most of you can distinguish the example in (1) from the one in (2), but you were never coached in this data. Moreover, you probably never heard (1), or (1) being described as bad. Yet you know it is (unless you speak a specific dialect). You might say this is analogy at work. Not really, let us examine the examples below:

3. Who did John say **that** John photographed
4. Who did John say ____ John photographed

Sentences (3) and (4) are very close to (1) and (2) and yet there is no contrast for most speakers. Analogy would actually make the wrong prediction. Furthermore, it is hard to see how we can learn via analogy an uncountable and infinite set of sentences. After all, we would have to be exposed to an uncountable and infinite set of examples. Yet kids acquire syntax by puberty.

That is why we will pursue the idea that the human mind comes pre-programmed to acquire language and that this pre-programming limits the types of algorithms a child entertains when deciding on a grammar. Studying the end product of such acquisition will thus shed light of those preliminary hypotheses and predict similarities between languages.

§1 Sentence structure

When we discuss syntax of a given sentence, for example:

1. The cat likes salty fish

We in part refer to the way words are ordered in that sentence. The order could be for instance a simple linear numeration:

2. The cat likes salty fish
 1 2 3 4 5

Such a list like (2) just shows that: $n=1$ ='the', and $n=1$ precedes $n=2$ ='cat', and $n=2$ precedes $n=3$ ='likes' (which implies that 'the' precedes 'likes'), etc. This is a syntax of (2). It is not much. For example, the syntax of (2) cannot be easily applied to any other sentence. We cannot claim the word 'the' is always, or even frequently, assigned $n=1$. Why? Because there is an infinite set of sentences in English that do not start with 'the'. Actually, there is an infinite set of sentences that do not have the word 'the' in them at all! If you do not believe me try counting them, you will quickly notice that expressions like: "a cat that chased a mouse that ran into a house" can be re-iterated indefinitely. Meaning there is an infinite amount of such clauses. They do not contain the word 'the'.

A bigger problem with the syntax in (2) is that it does not capture any relationships between words other than their linear order. What we would like to capture is that some words lump together to form meaningful units. After all, there is this intuition about (2) where 'salty' modifies 'fish'. I use the term modify to mean that when the word 'salty' is combined with 'fish' it narrows the set of 'fish' that we are talking about (not all fish are salty). Note that the relationship between 'salty' and 'fish' is not symmetrical in (2). The combined meaning of the two words cannot give us the meaning 'fishy salt'!

One possible hypothesis on how we get salty+fish to mean ‘salty fish’ is to claim that a word indexed with a number [n] modifies a word of number [n+1] (informally a given word is modified by the word preceding it). Let us test that.

Hypothesis: word with number n modifies word with number n+1

3.
 - a. n=2, n+1 = 3 Prediction ‘cat’ modifies ‘likes’ ✗
 - b. n=3, n+1= 4 Prediction ‘likes’ modifies ‘salty’ ✗
 - c. n=1, n+1= 2 Prediction ‘the’ modifies ‘cat’ ✓
 - d. n=4, n+1 =5 Prediction ‘salty’ modifies ‘fish’ ✓

The list in (3) shows that we obtain 50% accuracy in our predictions, where (a) and (b) are incorrect, and (c) and (d) are correct. The predictive power of our system applied to example (2) is equivalent to tossing a coin. This is not very impressive! And yet, there is feeling that when we talk about one word modifying another, most of the time they will be next to each other. I will return to this intuition because it is a correct one, it just cannot be captured in a system where we assign linear order to words in a sentence.

Let me return to the issue of grouping words. It is obvious that a linear ordering is not sufficient. The question we need to ask is what other possible relationships can hold between words? More often than not, the best way to solve a difficult problem, like the one above, is to solve an easier one. For example, let us tackle the question: do groups of words behave like units? To say yes we need just one example. Fortunately, there are many. For now, I list just two:

4.
 - a. I think [the cat] likes [salty fish], and I think [she] eats [them] often.
 - b. I think the cat [likes salty fish], and the dog [does] too.

In (4a) ‘she’ refers to ‘the cat’ and ‘them’ refers to ‘salty fish’. In (4b) ‘does’ refers to ‘likes

salty fish'. The term *refer* will be used informally for now. When x *refers* to y, I mean that x has the same *denotation* as y. In a given expression, x and y have the same *denotation* when they can be used interchangeably without impacting the truth or falseness of that expression. If y is more than one word, as is in both examples in (4), then the meaning of x is expressed by more than one word.

- 5.
- | | | | |
|----|--|----|----|
| y1 | y2 | x1 | x2 |
| a. | I think [the cat] likes [salty fish], and I think [she] eats [them] often. | | |
| | y3 | x3 | |
| b. | I think the cat [likes salty fish], and the dog [does] too. | | |

The conclusion we can draw from the examples in (5) is that certain groups of words behave as a unit as far as reference is concerned. These groups of words can be replaced by a single word which we will call an *anaphor*. Anaphors need refer to something in the discourse in order to have a full meaning. We will discuss anaphors later; for now think of them as markers in a clause that point to a string of words that was uttered at some point in the conversation. In our examples, 'she', 'them' and 'does' are anaphors.

- 6.
- | | |
|----|---------------------------------------|
| a. | [the cat] = y1=x1=[she] |
| b. | [salty fish] = y2 = x2 = [them] |
| c. | [likes salty fish] = y3 = x3 = [does] |

Using an anaphor to replace a given string of words is often called a replacement *constituency test*. For now, a *constituent* will be defined as a string of words behaving as unit. When a given string of words [...a b c...] can be referred to by an anaphor x, that string [...a b c...] is considered to be a constituent (informally we can say the pronoun 'she' replaces the constituent 'the cat'). In other words, [the cat], [salty fish] and [likes salty fish] behave as a unit in that they can be targeted by anaphors. The standard way of showing what an anaphor refers to is to use matching indices on both the anaphor and the string it

refers to (this is more practical than using color coding). The subscript letter ‘i’ and ‘k’ match the anaphors with the strings that they refer to. A string of words that an anaphor refers to is called an *antecedent*.

7 I think [*the cat*]_i likes [*salty fish*]_k, and I think [*she*]_i eats [*them*]_k often.

Note that a constituent can have internal structure. Take (6c) [likes salty fish], in the light of (6b) where [salty fish] is also a constituent, we can say that (6c) is a constituent that has other constituents inside it. Syntactic structure is *recursive* - it exhibits a repetition of structural relationships. When we combine (6b) and (6c) the result is (7) below.

8 [likes[salty fish]] = y3

What (8) says is that [likes salty fish] is a constituent consisting of [likes] and [salty fish]. The expression [salty fish] is a constituent by virtue of (6b); the question is what is the status of “likes”? We can say it is a one word but not a constituent, or it is also a constituent consisting of one word. This brings us to another property of constituents, they can be coordinated:

- 9. a. The cat [*likes*] and [*eats*] salty fish
- b. The cat [*often likes*] and [*sometimes eats*] salty fish
- c. The cat [*likes*] and [*sometimes eats*] salty fish

Coordination takes two constituents and conjoins them with the help of the words like: *and, or, but*. The first thing that one can notice is that co-ordination does not require that two words mean the same thing or have the same referent. In (9a) we see ‘likes’ being coordinated with ‘eats’. In (9b) we have ‘often likes’ coordinated with ‘sometimes eats’. These are strings of words, so example (9b) shows that coordination is something that functions on more than one word, i.e., a constituent. Example (9a) shows that two words

can also be coordinated. What about example (9c)? Do we want to say that a word and constituent can be coordinated? The truth is there is no easy answer, but parsimony would suggest that we treat words as constituents since they behave like ones. Every word is a constituent, strings of words can be constituents too, but they do not have to be. To show that not every string of words is a constituent, take our two tests coordination and anaphora (an asterisk means the sentence is judged ungrammatical) and apply them to other strings in the clause:

10. a. I think the cat [likes salty fish], and the dog [does] too
b. I think the cat [likes salty fish] but [eats dried chicken]
- *c. I think the [cat likes] salty fish, and dried chicken [does] too
(meaning the cat likes salty fish and the cat likes dried chicken too)
- *d. Salty fish, I think [the cat likes] but [the dog eats]
(meaning: Salty fish, the cat likes but the dog eats them=salty fish)

In the above example (10a) shows again that [likes salty fish] can behave as a constituent because it can be referred to by 'does'. In example (10b) we see that coordination confirms our suspicion that [likes salty fish] is a constituent because it can be coordinated with another string [eats dried chicken]. What I did in (10c) is I tried to use constituency tests to see if [cat likes] is also a constituent. It is not. The anaphor 'does' cannot refer to it, nor as (10d) shows, can [cat likes] be coordinated with [dog eats]. Not every string of words is a constituent - even if you can assign some degree of meaning to that string.

Constituency Tests

Below is a summary of some tell-tale signs that a string of words behaves as a unit. These ‘tests’ should never be used in isolation. Use caution in using them. If a given string X fails

any of these tests that does not mean it is a constituent. Like in any empirical science a negative result does not prove much. Only positive outcomes tell us that X is a constituent.

I. Cleft constructions

Take a sentence:

A. He photographed the store on Fifth Avenue

You can use a cleft construction

It was X that did Y

To make A into B

B. It was the store on Fifth Avenue that he photographed

II. Ellipsis:

Take a sentence:

John photographed the store on Fifth Avenue and Mary photographed the store on Fifth Avenue

You can elide certain strings if they are similar enough to a preceding antecedent after factoring out something that has contrast. X=John and Y=Mary are that contrast, the similar part is photographed the store on Fifth Avenue

X photographed the store on Fifth Avenue and so did Y [~~photograph the store on Fifth~~

Avenue]

John photographed the store on Fifth Avenue and Mary ~~photographed the store on Fifth Avenue~~ did so too

III Coordination:

Take a clause:

John photographed the store on Fifth Avenue and a town in the Rocky Mountains

If a string X can be coordinated with a string Y then X and Y are constituents. Coordination can be tricky, you need to know what the length of the string is before 'and'. How do we know the store on Fifth Avenue is that string in the above clause? We need to use other constituency tests. For example, clefting:

It was the store on Fifth Avenue that John photographed

IV Pronoun replacement

We already mentioned this test. Take our sentence:

John photographed the store on Fifth Avenue and I painted it

The pronoun 'it' refers to the store on Fifth Avenue. In general, a string X is a constituent if it can be a referent to a pronominal, or more generally a pro-form (replacing other things that just nominals).

V. Fragments

Take our clause:

John photographed the store on Fifth Avenue

Turn it into a wh-question (ones using words like who, what, which, where, how)

What did John photograph

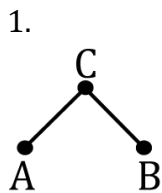
Answer it:

- The store on Fifth Avenue

You might ask why would meaning play a role in grouping words, while at the same time it does not determine what is a constituent? The answer lies in the architecture of the grammar that we are going to adopt. Syntax creates relationships between words. These relationships are used to compute meaning. In essence, syntax determines how meaning is computed, but is not necessarily part of the computation itself. The next chapter discusses the architecture of the grammar.

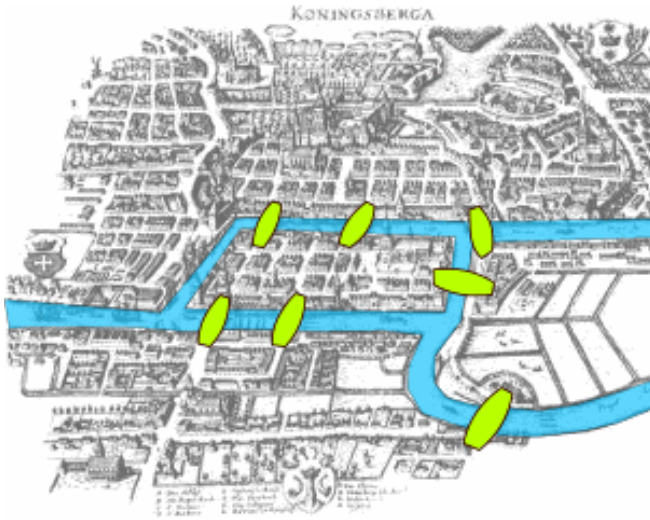
§ 2 Graphs

Relationships between items can be modeled via the use of graphs. Graph theory has grown to be its own field of mathematics (for nice introduction, see: Chartrand & Ping 2012, A first Course in Graph Theory, GT). The two main components of a graph are its branches (in GT: edges) and nodes (in GT: vertices). Below is a graph with three nodes and two branches:



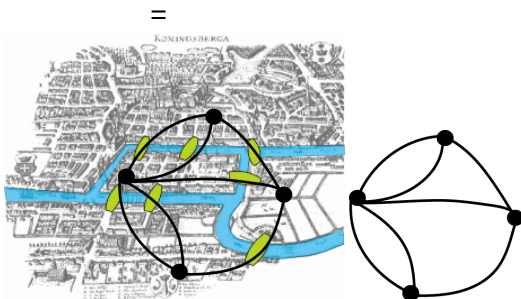
The diagram in (1) encodes certain relations and excludes others. For example, it says that node A is related to node B, but only indirectly via node C. Diagrams like these can be applied to any relation. For example, the above graph could be a diagram of the certain relations in a single parent household, A and B are sisters and C is the mother. A and B are related to each other because they share a mother: C. Node C is a mother because it has kids, namely: A, B. All that the diagram in (1) says is that node A is related to node B via node C, and node B is related to node A via node C. Furthermore, it captures the fact node C is the set that contains node A and node B. In our family example, motherhood - C, is defined by having kids: A and B. Graph theory is useful in mapping all sorts of relations. Euler used it in 1735 to solve a puzzle concerning the puzzle of 7 bridges at Königsberg a city in Prussia.

The map of the bridges is below, taken from Wikipedia:



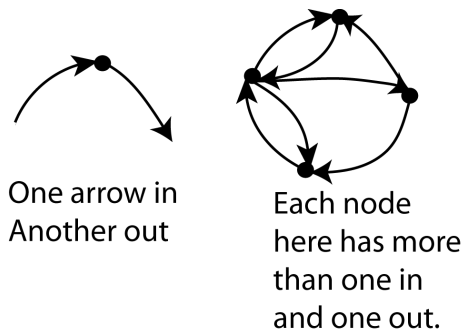
Euler's problem required a person to walk through each land mass by crossing each bridge once but only once. No other route other than the bridges is allowed to reach the islands. Each bridge had to be crossed completely and only once, once you are on it you need to finish crossing it. Crucially for the puzzle you should start and end your walk in the same spot. Euler using Graph theory proved that the problem has no solution.

Let us draw a graph of the bridges:



We can then abstract away from the map and just have a graph, where each node depicts a land mass, and each branch is a bridge. Each node has to be accessed via a branch, but only once. This means that if we enter a node it is via one branch, and if we

leave a node then it is via a different branch. In order to achieve the goal of walking the graph by using each branch once, each node must have an even amount of branches.



We can cross a branch only once, so in order not to get 'stuck' in a node, for each branch that lets us in there needs to be a branch that lets us out. It is clear that this is not the case. In the graph, one node has 5 branches, the other there have three branches. It cannot be done.

This shows that after abstracting away from the actual physical information, we can rephrase a problem and find a solution independent of the actual physical data (to be precise, in our case Euler showed that in order to walk a graph there must be zero nodes with odd connections, or precisely two and no more. For a more detailed discussion, see Barnett, Janet Heine [Early Writings on Graph Theory: Euler Circuits and The Königsberg Bridge Problem](#)). The above example shows the power of graph theory. It also highlights a crucial aspect of scientific thinking. In order to address a specific empirical question, we gather the data, abstract the data using theoretical tools, in our case math, so it becomes a theoretical question. Then we solve it. In the case of the bridge problem the issue was ultimately solved using a mathematical proof. Rarely are we so lucky. In most cases the ability to incorporate data into a working theoretical model that makes testable predictions is sufficient.

It is obvious that graph theory is a very powerful tool in establishing connections between all sorts of things. However, we need it to capture the connections between words,

as well as sets of words that form larger sets, and that these sets function as units in syntax. Just like in the Euler problem, in order to make graphs more concrete, we need make the nodes more concrete and define what is the relationship that is encoded by our branches. The most obvious thing to do is to substitute individual words for nodes A, B, C, and define branches as simple concatenation of words. But this clearly will not work. If A= “the”, and B = “cat”, then, since branches indicate addition, C= “the cat”. Such a grouping predicts that the string “the cat” is a word, since we assume that nodes are stand-ins for words. This is incorrect - node C is not a word since ‘the cat’ is two words. We need a mechanism to differentiate nodes that consist of one word from nodes which are combinations of words, or what we will call **phrases**. In our diagram (1), nodes A and B are words, node C is a phrase. For us it is easy to identify what is what by inspecting the diagram. However that is insufficient, we need to know the algorithm that identifies which is which. Why? Because we are developing a theory of how our mind works and not a grammar of a language in the classical descriptive sense. We cannot rely on the fact that a person looking at a diagram will be able to clearly identify words from non-words. The process has to be autonomous and clearly defined since a speaker or a child acquiring the language does not have a grammarian in her head who can inspect various mental computations or representations. This is a frequent issue in cognitive science. Human cognitive capacities like language have to be modeled in such a way as to capture that they are not subject to conscious monitoring. A speaker is not aware of the mechanisms she uses, for example, in language, or vision.

Our goal of delineating words from phrases can be achieved by incorporating the intuition that graphs like the one in (1) are not only representations of relationships between nodes, but also encode the type of relationships between nodes. Let me describe the units in graph 1. The graph in (1) can be said to be a two membered set G consisting of the set of nodes N, and the set of branches B. $G = (N, B)$, where $N = (A, B, C)$ and $C = (AC, BC)$. Crucially, there is no BA branch, the nodes A and B are not connected directly. The fact that A and B are not connected can be captured if we make use of the observation that a Graph like (1) can represent set relationships. One such relationship is that nodes form sets made up of other nodes. The lack of a connection between A and B can be translated into set

theory by stating that A and B form the set C. In other words, the graph in (1) says that there is a set C, whose members are A and B: $C=(A,B)$. Why is thinking in terms of sets more useful? Now we can define which nodes are words and which are not. Nodes that are words are called **terminal nodes**. A terminal node is a set T which contains itself. If you are uncomfortable with the notion that a set contains itself, you are not alone. Up until the 1980's one of the axioms of standard set theory was the well-formedness axiom which prohibits sets containing themselves. Since then work has been carried out showing, primarily using Graph theory, that we can have a mathematically coherent set theory that does not have the well-formedness axiom. Non- well-formed sets since then have been used in linguistics, primarily semantics. Unfortunately, discussion of non-well-formedness would take us too far afield. Another way to look at a non-well-formed set is to say they are atomic. A terminal node is not decomposable, there is nothing we can say about its membership. Note that it is not the same as saying T is an empty set $T=(0)$, because then we would be actually decomposing T. **Terminal nodes are words and for syntax are not decomposable, whereas non-terminal nodes are sets of nodes and are decomposable.** Both types of nodes are considered constituents, i.e. groups of words behaving as a unit. A Terminal node is also a constituent, to be precise a word that behaves like a unit. The trick will be to map non-terminal nodes in such a way as to capture what sets of nodes behave as one unit. In order to do that we need to examine the nature of non-terminal nodes.

Are all non-terminal nodes the same? In the previous chapter we discovered that a sentence like (2) had distinguishable grouping of words. They behaved differently. A natural assumption would be to propose that some of those differences in behavior can be encoded as differences in the type of set that a given non-terminal node stands for (remember, non-terminal nodes are sets of other nodes). Let us return to the example from chapter 1. We identified three distinct constituents listed in 2a,b,c. We also know that words are terminal nodes and are constituents, the list is given in d. We are missing one more constituent - the whole clause, which is given in (e). It also behaves as a unit. For example it can be replaced by what appears to be a pronominal, but is in fact a pro-clausal, anaphor, as shown in (3).

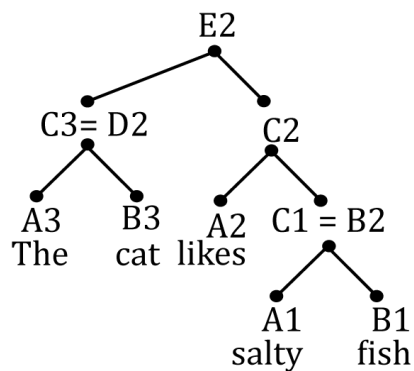
2. The cat likes salty fish

- a. [the cat]
- b. [salty fish]
- c. [likes salty fish]
- d. [the], [cat], [likes], [salty], [fish]
- e. [the cat likes salty fish]

3. The cat likes salty fish, I don't believe it!

The question is how do we graph (2) so that we combine the information in 2 (a-e) into one diagram? Let me suggest one way of doing it, consider the diagram in (4):

4.



In (4) I have used a simple rule: node A adds to node B, giving node C. Node C, when being added to another A node, becomes B. Otherwise, node C can add to node D, giving node E. If you think this is confusing, you are right. There must be a better way of doing things. The diagram in (4) is a simple sentence and yet its relationships between nodes are

already complex and hard to describe. However, it is not the procedure of putting nodes together that is at fault. Anyone who has looked at computer code recognizes the procedure to build (4) as a simple recursive rule with some ‘if’ functions.

Computationally, generating (4) is not hard. The source of the problem is the arbitrary values of the nodes that do not correspond or capture the nature of the words that constitute those nodes. We need a theory of word categories and categories that word combinations form. This will be the next section.

Ambiguity.

There is sometimes more than one way to draw a graph.

Consider the following sentence:

5. Deep blue ocean

It can mean two things:

- A. The ocean has a deep blue color
- B. The deep ocean has a blue color

The ambiguity is not from the words used, but must come from the relations between the words themselves. This is similar to some optical illusions like Rubin’s vase:

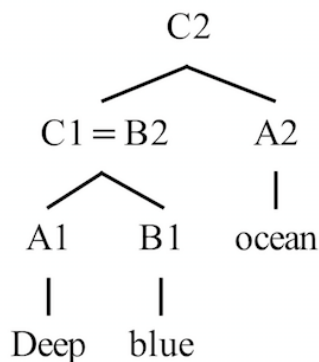


You see a vase or you see two faces. The same is with example (5). Moreover, you cannot

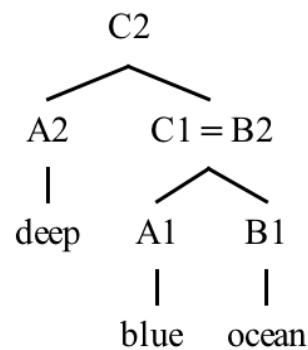
see both at the same time. Try looking at the picture of the vase/faces and see both the vase and the two faces at the same time. You cannot. The same with (5), try understanding the sentences as both A and B at the same time: that is the color is deep blue and the ocean is deep. You cannot.

The ambiguity of (5) must lie in the fact that there are two graphs connected with the string in (5). Let me propose the two structures:

A=



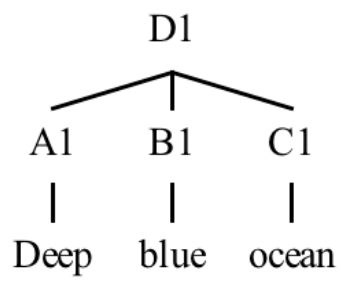
B=



The string cannot have both representations at the same time. The structure also makes a prediction. In cases like:

6. Deep blue and very salty ocean

The meaning can only be that the color is deep, not necessarily the ocean. That is because we need to coordinate constituents, and only the A structure has Deep+Blue= C1. In structure B, blue and ocean are not a unit. This shows that a flat structure like:



Is not possible since deep+blue is never a unit here.

§3 Word categories

If you want to make a linguist feel uncomfortable, ask her or him what is the definition of a word. The truth is there is no satisfactory definition. Moreover, every subfield of linguistics has its own pet description. Phonologists will give you one definition, morphologists will give you another and semanticists another. Syntacticians will say it is complicated and start talking for an hour. Well, dear reader you are in luck, this is a syntax textbook so the answer is – it's complicated.

Words are considered to be arbitrary signs, i.e. combinations of sound and meaning. However, that definition is fairly useless for us since clapping can be a word - the sound plus the meaning that I approve. Furthermore, we will quickly discover that not every word has sound. This might look surprising but in many instances silence has meaning. Consider the following sentence in Polish:

- | | | |
|----|-------------------|--------------------------------|
| 1. | Poszedłem spać | {this is the actual example} |
| | went sleep | {this is a word by word gloss} |
| | 'I went to sleep' | {this is a translation} |

The meaning of (1) for every speaker of Polish is clear. The last line in the quotes is the translation. However, if you examine the word by word gloss (line 2 below the example itself) you see that the sentence lacks the word 'I'. Silence can carry meaning. In the case of (1) that meaning is reconstructed from the endings on the verb itself. However, sometimes there is no obvious source from which we can recover the meaning of silence. For example, in example (2a) the meaning of the sentence is clear. It expresses two thoughts. John wants something. That something that John wants is for John to have a swim. But in (2a) there is only one instance of John next to verb want, there is no clear indication about who is the swimmer. One possible explanation is that if no one else is mentioned we just re-use John,

this would be supported by example (2b) where there is another person mentioned, namely Mary.

2. a. John wanted to swim.
- b. John wanted Mary to swim

We will return to such examples. At this stage, the important message is that silence shown as the shaded gap in (2a) is meaningful. We know it is because that position in the sentence can be filled by a word like 'Mary' in (b) and it changes the meaning of the expression.

Why am I stressing that silence can carry meaning and play a part in the interpretation of an expression? The reason is that we need to define words, which are, after all, the basic units of syntactic composition. [The typical definition is that a word is an arbitrary pairing of sound and meaning.](#) We can obviously define the lack of sound as also being a form of sound and thus argue that the gap in (2a) and the lack of any word for the person arriving in (1) are words, whose meaning is paired with an arbitrary sound - silence. In other words, [a word can have no pronunciation.](#) Obviously, this is not enough. If we assume the existence of silent words, what prevents us from postulating an infinite amount of silent words in every sentence. There has to be a mechanism, one that a child who is figuring out her/his first language can tap into, in order to clearly identify the words that have no sound associated with them. Part of this course will be to figure out this mechanism. We shall start by first establishing the dimensions according to which words are identified. I will follow standard practice and, instead of using the colloquial term 'word', use the term Lexical Item (LI). [Lexical Items are syntactically indivisible units that play a role in syntactic computation.](#) The definition is much broader now, and does not say anything about the composition of LI's but stresses their role in the grammar. The switch is not that unusual. When children are taught math early on, the concept of a number is associated with counting things. However, fairly quickly you need to advance and define numbers as amounts, but as roots of an equation. The number 4 is no longer the amount of oranges on

the table, but a solution to the equation $x+1=5$. Such a shift in the definition of number allows us to have numbers which are not possible to count or even list. For example π is a number, it even has its own day (3/14). Its first digits are

$\pi=3.14159265358979323846264338327950288419716939937510.....$

π is computed by dividing a circles' circumference by its diameter. $\pi=C/d$. The number is constant, but cannot be defined in any other way.

What does this have to do with Lexical Items? They are going to be defined in the same way as numbers, by looking at their role in the equations of grammar and not just how they are listed in a dictionary.

3. Dimensions of LI classification

Lexical Items can be shown to have clusters of unique properties along three crucial dimensions: morphology, semantics, syntax. The dimension of morphology allows us to look at how a given lexical item behaves in changing its individual form by taking on endings, affixes and prefixes. This is the most classical approach to classifying words. Anyone learning a grammar of a foreign language has been exposed to conjugations, declensions, etc. It is also the most idiosyncratic part of a lexical item.

3.1 Dimension of Morphology:

There are two subdivisions of morphological markers. Inflectional - these do not change a category, and Derivational - these change the category turning a lexical item into another lexical item.

Nouns

The **cat** likes **fish**

- A given LI is called a Noun (N) if it can take Inflectional endings that indicate:

Number: book vs book+s

I bought *a book* vs I bought *books*

Person: he, I we

Case: who vs whom

Who saw me? vs Whom did you see

Gender

actor vs actress

A Noun can take derivational endings turn a Noun into other Lexical Categories:

- Noun into an Adjective

book vs book+ish

I read a book vs He is a very bookish person

president vs president+ial

I met the president vs I like to act very presidential

- Noun into a Verb

club vs clubb+ing

We were clubb+ing at a club

Verbs

The cat *likes* fish

- A given LI is called Verb if it can take Inflectional endings that indicate:

Tense

walk vs walk+ed

I walk a lot, but I never walk+ed to work

Progressive

walk vs walk+ing

I walk vs He is walk+ing

Perfective

I walk vs I have walk+ed

Passive vs active

The cat chased the mouse vs The mouse was chased by the cat

Person agreement

walk vs walk+s

I walk vs he walk+s

-A Verb can take derivational endings turn a Verb into other Lexical Categories: Categories:

Verb into a Noun:

perform vs perform+ance

I performed the perform+ance

Adjectives

The **small** cat likes fish

- A given LI is called an Adjective (A), if it can take Inflectional endings that indicate gradation:

tall vs tall+er vs tall+est

- An Adjective can take derivational endings turn a Adjective into other Lexical Categories:

Adjective into an Adverb:

quick vs quick+ly

John can run quick+ly but Mary is quicker

Adverbs

The cat ran **quickly** out of the house

- Adverbs usually have No inflection
- Can be derived from adjective

The above four categories: Noun, Verb, Adjective and Adverb are considered by many as the major classes of words as far as morphology is concerned. However, this classification is very poor, we do not differentiate between words like 'has' 'been' and 'dancing' in sentences like

3. John has been dancing

Do we want to say that example (3) has three verbs: *has*, *been* and *dancing*? There are reasons not to assume that. For one, the meaning of each Lexical Item is different. The word 'dance' has a specific denotation to an action, but 'been' does not carry a denotation of existence, nor does 'have' carry a denotation of possession. We know this because the meaning of (3) is not:

- 4
- a. John possesses something +
 - b. John existed+
 - c. John danced

Rather the meaning of (3) is that in the past John completed a continuous activity that involved dancing. In other words, 'has' and 'been' indicate progressive and perfective (together with the ending +ing). Our analysis of (3) means that we need to take into account two additional dimensions that determine the category of a LI: semantic compositionality and function within a sentence. Let me start with semantic compositionality.

2.2 Semantic and syntactic dimension for categories of words

Nouns (N)

- Nouns denote entities/individuals: Boston, Mary, cat, boy, love, infinity...

Not necessarily real ones:

Unicorn, Goblin

The semantics of nouns seems simple, but that is superficial. Consider words like:

- Everything

- Nothing

- Something

Also words like 'London' in: Arsenal is a London football club. Is it a noun? Then how come it modifies another noun 'football' which modifies another noun 'club'?

Nouns are often arguments of verbs. The term argument is used here technically. [For now, we will call an argument of a verb that part which is required for the verb to have full meaning.](#) For example, the verb 'arrive' requires a noun like 'John' to complete the meaning: "John arrived." Syntactically, arguments of verbs are close to the verb.

Verbs (V)

- Verbs denote actions, states, occurrence:

jump, suspect, love, request, ...

However, again things are not so clear cut. Take the word 'assassination'. Morphologically, it is a noun. For example, it can become plural. But it denotes an action.

- Verb Composition and meaning

Verbs form predicates that can turn into propositions. A predicate is a verb plus its argument(s). It is a mapping of the relation of an argument to a certain function that can assign that argument a property, state or relate it to another argument. For example,

5. John sneezed

maps the noun 'John' to the set of individuals who have the property: x sneezed.

6. John photographed Mary

maps the relationship between the arguments 'John' and 'Mary' as that of x photographed y.

The formation of a predicate is one reflex of compositionality. We can compose a verb with a noun to produce a predicate. Note that the semantic dimension excludes words like 'have' and 'been' from being verbs in sentences like (7), but makes them into verbs in sentences like (8), (9).

7. John **has** **been** dancing

8. John **has** a book

9. John **is** a doctor

At first, this looks like a terrible result. The same word is sometimes a verb and sometimes not! But this is the intuition that native speakers of English have. In fact, that is one argument against associating the form of a word with its category. Many words seem to have identical forms but different categories. Take the word 'bank':

10. He went to the **bank**

11. The airplane **banked** a lot

In (10) it is a noun, in (11) it is a verb.

The conclusion is that verbs and nouns cannot be defined only morphologically, i.e. by the types of endings they take, they need to be also defined by their semantic denotation and composition properties as far as meaning.

Verbs can be further divided into classes depending on how many arguments they need. Note that arguments of a verb are usually obligatory, not optional. For example,

12. Three sub-types of verbs

a. Intransitive: 1 Argument

x arrive -> John arrived

b. Transitive: 2 Arguments

x photographed y -> x photographed Mary -> John Photographed Mary

c. Ditransitive: 3 Arguments

x gave y z -> x gave y books -> x gave Mary books -> John gave Mary books

In the above, only the last expression is a well-formed one. Previous versions where there is a variable feel incomplete. One has to be careful in establishing how many arguments a given verb requires since confounds like context can get in the way. For example, an answer to a question can omit an argument:

13. Q What were John and Mary doing?

A. dancing

Also, English can turn any type of verb into a habitual:

14. John used to give, but then he became poor and stopped.

It is an interesting observation that there is no language in the world where a verb requires more than three arguments. We will return to this later.

We will see that some Lexical Items, like verbs, require additional elements for composition, while others have the option of having additional elements compose with them. Such optional composition is called modification. Note that I am using optional not in the sense that composition is optional, but rather that the presence of an additional item is optional and depends on the intension of the speaker. Composition when possible is always obligatory. We cannot say 'green book' and not mean that the book has the color green. What we can do is not use the word green. In that sense, modification is optional.

Adjectives (A)

Adjectives denote state, quantity, and quality. They are modifiers but also predicates. A modifier narrows the denotation of the element it modifies. In the case of adjectives it is usually a noun. For example, 'rice' has a denotation of a certain type of grain. Anything fitting the definition of rice will do. However, if we add the modifier 'brown' we narrow the denotation of the expression.

15. Rice -> any grain with the right genetic makeup (denotation is according to some philosophers the scientific definition)

16. Brown rice - > any rice that has the color brown.

Example (16) shows compositionality at work. We took the noun 'rice' and combined it with the adjective 'brown'. Note that compositionality can 'stack up'

17. fake brown rice

Example (17) is interesting. It has two meanings. The rice is fake and brown-colored. Or the brown color is fake, but the rice is real. How we achieve this will be discussed in later chapters. For now, we can just say that the order in which elements are composed matters. If we add brown+rice first and then add fake, we get fake+(brown+rice) = rice that is fake and brown colored. If we add (fake+brown)+ rice we get rice that is real but the color is fake. The sequence in which we compose items matters. Note that this also means that adjectives do not have to modify noun, they can modify nouns that have already combined with other adjectives. This will be syntax in action!

Adjectives can also be modified by degree expressions like ‘most’, ‘more’, ‘very’, ‘least’

18. More salty than sweet
 Most salty fish in town
 Very salty fish
 Least salty fish

Degree modifiers modify adjectives, in essence this is modification of modifiers. I will return to degree modifiers when talking about function words.

Adjectives can be part of complex predicates like in

19. John is smart

In (19) ‘John’ is the argument of ‘is smart’. ‘John’ cannot be the argument of just ‘is’ since the meaning of (19) is not that John exists and that this is smart. I will return to these structures later and the status of ‘is’ and ‘smart’.

Adverbs (Adv)

Adverbs are modifiers that denote manner, quality, place, time, degree, number, cause, opposition, affirmation, or denial. They appear to modify actions, states that are associated with verbs, or predicates.

20. cats snore loudly

In (20) the adverb 'loudly' is modifying the verb 'snore'

21 cats frequently snore loudly

In (21) the adverb frequently is modifying the composed string (snore+loudly). Again, we see that adverbs can modify verbs but also modify verbs modified by adverbs.

Adverbs can be modified.

22. a. Cats very frequently snore.
 b. Cats snore more loudly than dogs

Again, we see that degree modifiers can modify adverbs.

Prepositions (P)

The discussion of the semantic and compositional properties of Lexical Items has up to this point covered LI's that also are distinct from each other by virtue of their morphological properties. However, Nouns, Verbs, Adjectives and Adverbs do not close the list of LI's. I have already mentioned Degree modifiers. But before I discuss these, we need to take care of another important group, that has no distinct morphology, but plays an important role in language.

Prepositions denote place, location, origin, destination.

23. He sleeps **under** bridges

Prepositions take noun arguments. But there are exceptions. In (24) below, the construction is called a propositional verb. The difference between (23) and (24) is the way words are composed. In (23) we first compose 'under' with 'bridge' = (under+bridges), and then only add it to 'sleep' = sleep + (under+bridges) and last we compose 'He' with (sleeps+(under+bridges)). In (24) we compose 'give' with 'up' (give+up) creating in essence a new verb. The telltale sign is that the meaning of give+up is only remotely if at all connected to the denotations of 'give' and 'up'.

24. John gave up

Nouns, Verbs, Adjectives, Adverbs are Open Class words, meaning there are new items being added to each category on a regular basis. 20 years ago there was no verb 'to Google', the word 'selfie' did not exist. However, Prepositions seem to be more fixed in each language. In English, there have not been any new additions for centuries. The freedom of adding new tokens to a category seems to be correlated with the degree to which that category plays a role in establishing the structure and to what degree it contributes to the meaning of the sentence. **Categories that are biased towards the role of grammar markers are called Function Words. Function Words are usually Closed Class.** The divisions in categories have been studied extensively not only in linguistics but also psychology. There are cases of people suffering from brain disorders that target specific categories. Different types of Aphasia (Broca's vs Wernicke's) target different types of Lexical Items usually along the dimension **Function words vs. Content Words** (Nouns, Verbs, Adjectives).

Pronouns (N)

One might think that words like 'I', 'he', 'she', 'we', 'they', 'it', 'himself', 'herself', 'one' are Nouns since they can be used instead of noun.

25. Jay likes syntax - he likes syntax

But unlike nouns, pronouns are closed class. Also they differ in their denotation. Nouns refer to entities, whereas pronouns refer to nouns. They are what we call Anaphors, words that get their meaning from other words. The question is do we establish a separate category for pronouns, or do we treat them as nouns? Their semantics suggests that they are different from nouns, their morphology suggests that they are similar to nouns. English here being an exception because pronouns have a richer morphology than nouns in English, but in other languages pronouns and nouns are inflected for person, number, gender, case, etc.

There is another criterion we need to introduce, namely distribution within a sentence.

In essence, that is what we do in saying that in (25) a pronoun can replace a noun. Distribution criterion tells us that, since pronouns can be used in the same position and function as noun, then they are nouns. They have to be nouns that are special as far as semantics is concerned, since they do not have independent denotation. They are also closed class. The conclusion is that within a category there might be sub-divisions which identify specific subgroups. The question is when do we establish that a given subgroup is distinct enough to warrant its own category. That is difficult to establish and there is a lot of debate on the topic. In this text I will try to be conservative and minimize the amount of categories. More fine-grained divisions can be introduced later once we develop a theory of syntactic structure. But, at this point, we do not have a theory of what a category is, all we do have is different dimensions along which groups of words behave like one.

Syntactic Distribution as a criterion case of:

Determiners: [Articles, Demonstratives, Quantifiers, Numerals, Possessive Pronouns] (D)

In languages like English many singular Nouns cannot be without an article: 'the' or 'a' denoting definiteness, or lack thereof. Example (26) shows that many bare nouns are ungrammatical in English. [Star next to the example means the sentence is considered ungrammatical.](#)

*26. boy went home

We can add different types of determiners to the noun:

- **Articles**, sometimes called determiners. Denote +/- definite

27. **A/the** boy went home

- **Quantifiers** are functions on denotation of the noun. In the example 'boy' denotes a set of all male humans under a certain age. 'Every' forces, via compositionality with 'boy' an interpretation that the sentence is true if the proposition applies to every member of the set denoted by the word boy. The quantifier 'some' forces an interpretation where the proposition is true if there is at least one member of the set of boys to which this proposition applies. *Quantifiers are complex semantic objects; the story proposed here, where they group with determiners, is a simplification. There are good reasons to assume that they form their own category. But, for simplification, we will ignore those reasons for now.*

28. **Every/some** boy went home

- **Demonstrative pronouns**, distinguish a member of the set the noun denotes.

29. **that/this** boy went home

- **Numerals** combine with nouns to provide denotation of quantity, or a measurable scale.

30. **One** boy went home

- **Possessive** pronouns denote possession and combine with the noun that denotes the entity that is possessed.

29. **Her/ his/ my** boy went home

We can now introduce a a more formal definition of what we mean by distribution:

30. Criterion of distribution. X and Y are the same category if:

a. We can replace X with Y without

- changing the structure of the sentence, or

- changing that part of meaning of the sentence that is independent of X or Y

b. X and Y compete for the same position in a given sentence.

The criterion in (30) is an approximation and not a very well defined one, for the simple reason that we have not developed a theory of what sentence structure looks like, nor what it means to have the same position in the sentence. We also have not really established what it means when we talk about the meaning of sentence that is independent of some variable. Intuitively, we know that when we say: *John danced* and then replace *John* with *Mary* to have *Mary danced* there is shared part for both expressions, namely: *x danced*. Defining the basis of that intuition however is more difficult. But we will get there... For now, we can rely on linear relationships, the notion of an argument, and our intuitions. Examples (27) to (29) show that articles, quantifiers, demonstrative pronouns, numerals, and possessive pronouns are of the same category since they can be used interchangeably without disrupting the argument/ verb relations and they are positioned in the same slot relative to the noun. Furthermore, none of the above can co-occur with each other. Strings like (31) are ungrammatical:

31. *a. the every boy went home

- *b. her this boy went home
- *c. a my boy went home

The idea is that the category of determiners has one dedicated slot in front of the noun. When we have two determiners, one is not in its slot.

The distribution criterion is very powerful and has to be used in tandem with other dimensions in establishing the category of a word. For functional words the crucial connection is their distribution and their semantic/grammar contribution. Here are some other categories.

Auxiliary verb (v) <- Note the 'v' is small compared to capital V used for verbs. Some used underlined v in order to avoid confusion. The terms are called little v and big V.

Auxiliary verbs are distributed in tandem with a main verb or Adjective. The aid in the formation of a predicate or indicate perfectiveness, progressiveness, voice (passive vs. active).

32. John **has** danced

Perfective (action completed)

33. John **is** dancing

Progressive (action in progress)

34. John **has been** dancing

Perfective Progressive (completed past action in progress)

35. Cats **are** chased by dogs

Passive (order of verb arguments is writhed relative to each other - compare with Dogs chase cats)

36. John **is** smart

Copula (composed with adjective creates a predicate that can take an argument)

Note that auxiliaries can co-occur with each other, unlike determiners. This might lead us to think that they should be labeled as separate categories and some linguists do.

37. Cats **had been** chased **ed** by dogs (combination of Perfective+Progressive+Passive indicated by +ed on verb)

However, there are also similarities that should not be ignored. For example, negation is always on the topmost auxiliary

38. John **hasn't** danced

39. John **isn't** dancing

40. John **hasn't been** dancing

41. Cats **aren't** chased **ed** by dogs

42. John **isn't** smart

43. Cats **hadn't been** chased **ed** by dogs

Auxiliaries share similar role vis-a-vis the main verb (V) - they express additional information as to how the action denoted by the verb is carried out; whether it is continuous, complete, which argument is more prominent.

Tense/Modal (T)

The category Tense/Modal is differentiated from Auxiliary because, although Tense/Modals can co-occur with Auxiliaries, there is always one of them and it is always the first of the verbal elements.

44. John will/may/should/would/could/might/shall dance
 John may have been dancing
 John should have been dancing
 John will be dancing
 Cats will be chased by dogs

Negation can optionally be with Tense/Modal, or on the Auxiliary

45. John couldn't have been dancing
46. John could have not been dancing

The meanings of (45) and (46) are different. In (45) there is no possibility of dancing, in (46) there is possibility of not dancing.

Auxiliaries and Tense are not obligatory elements in the clause. They are needed only if we want to express a certain modality, or aspect of the verb. In many languages, these markers are actually endings on the verb. English also has that in past tense:

47. John danced

The obvious question for a syntactician is what is the structure of (47) as compared to (48) which expresses future tense

48. John will dance

We will see that there is evidence that (48) tells us more about the structure of (47) than the other way around. One giveaway is Negation. When we negate a past tense verb in English, an auxiliary suddenly has to be present:

49. John **did not** dance

Special mention must be given to structures that do not have Tense. It turns out that lack of Tense is also marked:

50. John likes **to** swim 'to' is an infinitival marker in English. It denotes that a given verb is not finite. In simplified terms, non-finite verbs do not have an obvious temporal anchor. Finiteness and lack of tense are not identical concepts, but for now I will conflate the two.

Complementizer (C)

Complementizers indicate whether a given clause is a question, or an assertion. They appear to be sensitive to finiteness.

51. John said **that** he likes Mary
Indicative subordinate clause complementizer
52. **That** John likes Mary is obvious
Indicative complementizer
53. John wonders **whether** he likes Mary
Question
54. John wonders **if**he likes Mary
Question
55. It is important **for** John to like Mary
Indicative, non-finite subordinate clause

Complementizers are at the beginning of what will be called a clause. There cannot be more than one complementizer per clause.

Negation (Neg)

Negation has been mentioned already. Its denotation is negating the element it takes as its argument. Arguments of negation seem to be the verb or noun. When negating a verb negation attaches to the leftmost Auxiliary, or Tense; when not present, 'do' is used.

- 55. John will **not** go home
- 56. John has **not** been dancing
- 57. John did **not** dance

When negating a Noun, negation precedes it.

- 58. Roger likes semantics, not syntax. (He loves syntax...)

Degree (Deg)

Degree modifiers modify expressions that indicate a scale. Typically these are Adverbs and Adjectives. Adjectives can take degree expressions like 'most', 'more', 'very' 'least'

- 59. **More** salty than sweet
- Most** salty fish in town
- Very** salty fish
- Least** salty fish

Degree modifiers modify adjectives, in essence this is modification of modifiers. They appear before the modified element.

Conjunctions (Conj)

Conjunctions like 'and', 'or', 'but' are syncategorematic in that their meaning is only established within an expression.

- 60. John and Mary went home

- 61. John bought and read a book
- 62. Susan danced but Mary jumped

Conjunctions take two expressions and form a unit. Note that the expressions have to be of the same category:

- 63. John [will] and [can] dance
- *64. John [will] and [has] dance
- 65. John lives [in Boston] and [in Philadelphia]
- 66. John inhabits [Boston] and [Philadelphia]
- *67. John inhabits [Boston] and [in Philadelphia]

Coordination cannot coordinate Tense with an auxiliary in (64), but it can coordinate two Tense/Modals. Examples (65) (66) and (67) show that coordination can target strings of words. This leads us back to the notion of a constituent. Somehow in (67) the string 'Boston' and the string 'in Philadelphia' are not the same for coordination. We know now that Boston is a Noun. The string 'in Philadelphia' is a Preposition taking a Noun as its argument. If we want to maintain that coordination takes two identical categories, we need to establish what is the category of a string? For that, we need to return to Graphs and incorporate Lexical Category information.

Before we move on, let me just mention two things.

A. Distribution of open class categories.

Nouns, Verbs Adjectives, Prepositions and Adverbs in English are also associated with specific positions relative to other words. I have used the distribution criterion for function words, but it can also be applied to other categories. Here are some distribution criteria for the major lexical categories:

Verbs - follow auxiliaries

Nouns - arguments of verbs, arguments of prepositions, modified by adjectives, have determiners,

Adjectives - modify nouns, between noun and determiner, modified

Adverbs - cannot appear between a determiner and a noun

Note that the last statement involves not where a given element occurs, but where it cannot occur. This is also part of the criterion of distribution.

Appendix. Other languages. Universality.

The list of Lexical Categories is based on English. However, this class is not aimed at providing you a grammar of English. Rather it uses English as an example of how language system is organized. The choice is obvious, we all have intimate knowledge of the language. However, if we are serious about developing a theory that not only provides an account of what we know when we know a language, but also how we obtained that knowledge, we need to look at other languages. Up to this point our discussion has not been very theoretical, but rather more descriptive. However, we will adopt a theory of Generative Grammar and the assumption that there is a universal component to language called Universal Grammar. The idea was proposed by Noam Chomsky in the late 1950's. Chomsky argues that language acquisition taps into our universal cognitive ability to grow a language, like we grow any other organ. The idea that cognitive capacities are organs that develop might seem radical. However, that is what our visual system appears to be. The ability to establish perspective, parallel lines, etc. is not part of our eyesight, but our cognitive capacity to process visual information. As such, it has to be developed after we are born. This is not only in humans, other species like cats need to develop their visual processing skills. Kittens that are blindfolded never develop the visual abilities of adult cats, even after the blindfolds are taken off.

Humans have a species-specific organ that allows them to acquire any human language up to the age when they reach sexual maturation. This experiment goes on every day in the US. Kids are born of parents who do not speak English and yet they acquire not only English, but also become often bilingual by acquiring the languages of the parents. However, this means that human languages share a set of common properties that distinguish them from other forms of human and animal communication. This core set is what I will call Universal Grammar.

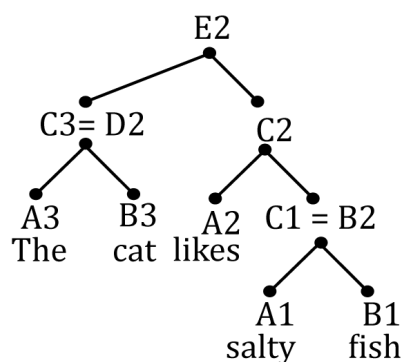
The question remains whether the categories that I have listed are universal? Or do they differ from language to language? The major categories seem to be pretty universal. No language lacks verbs or nouns. Lack of adjectives or adverbs is debated, but the cases are rare. Things become more tricky when we talk about functional words. Some determiners like quantifiers appear to be present in most languages, but many languages lack articles. On the other hand, many languages in Asia have classifiers which, for many linguists, are a distinct category. Universality on the lexical level is very hard to establish. After all, languages spectacularly differ as far as words are concerned. Yet many linguists feel that there is a universal aspect to lexical information. I will not dwell on this. It is a topic for a more advanced course. The working hypothesis will be that the categories that I just listed are a reflection of more universal mechanisms that apply to every human language. The nature of these mechanisms is a fruitful topic of research, unfortunately beyond the scope of this text.

§4 X-bar

Part 1

Let me now connect the information in Chapter 2 and 3. In chapter 2 we have used graphs to map the relationships between Lexical items into the expression:

1. The cat likes salty fish

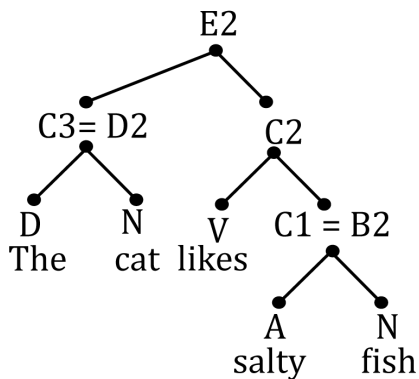


We have shown that 'the cat', 'salty fish' 'likes salty fish' all behave like units at some level, and we called them constituents.

In section 3 I have shown that Lexical Items can be grouped into categories

2. a. The - determiner (D) = A3
- b. cat - Noun (N) = B3
- c. likes - Verb (V) = A2
- d. salty - Adjective (A) = A1
- e. fish - Noun (N) = B1

Now we can make the association between the labels the terminal nodes of the graph and the categories of words that these nodes represent. The simplest association is that the label of the terminal node is the category of the Lexical Item that is represented by that terminal node.

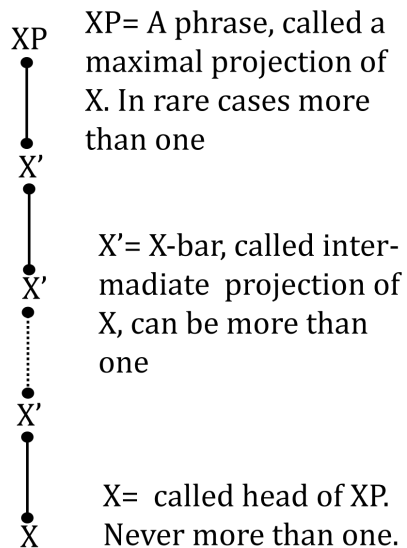


The question we want to answer is what is the nature of the non-terminal nodes that indicate constituents and are the product of composing other nodes. Part of that question is how do we compute the label of these non-terminal nodes. Again, one possible and simplest answer is that the labels of non-terminal nodes are computed based on the labels of the terminal nodes, which are in turn computed as identical to the category labels of the lexical items. The issue is how do we determine the labels of non-terminal nodes based on the labels of terminal nodes. It cannot be identity, because we will end up with a bunch of nodes having the same labels.

The answer is X-bar, a universal algorithm how graphs are built from individual lexical items. The idea is that every language of the world has sentence structure that has to conform to X-bar. In other words, this would be part of our Universal Grammar, a species specific endowment that allows us to easily acquire any language up the age of puberty.

X-bar is essentially an algebra on graphs that tells us what we can do and what we cannot. It introduces three types of nodes. A head X is what we called a terminal node. An X-bar is an intermediate node and an XP is the terminal node. There is one head X for every XP, but there can be many X-bars

3. X-bar (dashed line means iteration of X' projections)



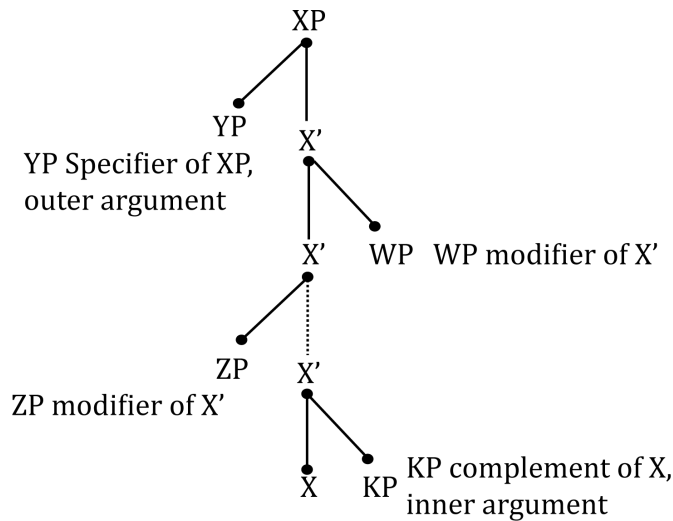
X-bar applies to every category because we treat X as a variable. In other words, X stands for: N, V, A, Ad, P, D, T, C, Deg., Conj. **Crucially every X projects to XP. that is why we have on X for each XP. The only variable is how many X' projection there are. That depends on the amount of modifiers.**

4. Principles of X-bar:

- A. Each X projects an XP of the category that X has.
- B. For any X projecting an XP, you can attach a full phrase YP once (binary branching) to any X' or XP node.

Positions of attachment matter. Attachment to position to XP is a Specifier. Attachment to the first X' is a complement. Attachment to any X' above the first X' is a Modifier.

5.



X-bar provides the necessary requirements that phrase structure has to conform to in order to be grammatical. It has to be stressed that necessary requirements is not the same as sufficient requirements. In other words, satisfying X-bar does not guarantee that the structure is fine, but violating X-bar, does guarantee the structure is not grammatical.

In our diagram, there are only two branches coming out of any node. Only YP's that have their own head can attach to an existing XP that is being built. These two principles are very important. Binary Branching means that a given node will only have at most two branches. Binary branching can be argued to follow from principles of compositionality.

6. Compositionality

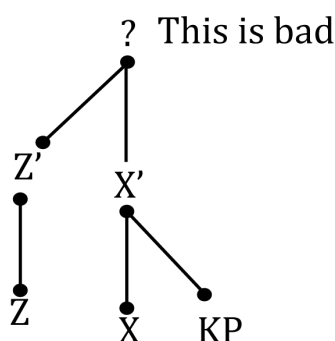
Syntactic structure is input to semantic composition. Meaning is computed via composition of two nodes at a time. Hence, at any given stage of the derivation syntax combines maximally two nodes

Binary branching can also be seen as the most constrained hypothesis on structure formation. The minimal amount of Lexical Items that is needed to create what we will call a phrase is two. It could be that 23 is the actual number, but it is easier to disprove that no more than 2 nodes can be combined at a time, than that no more than 23 nodes can be combined at a time.

We will see that there are also other arguments for binary branching that are independent of compositionality.

The fact that only maximal projections (XP) can be attached to an existing structure being built follows partially from endocentricity which requires that any XP have only one head. Attaching a maximal projection to a phrase under construction guarantees that there is no confusion as to which head is to project an XP. Otherwise we can have a construction like:

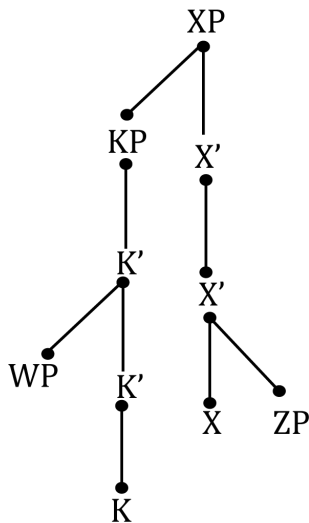
7.



The above graph would permit to have the top phrase be neither ZP or XP, in fact it appears it would have to both a ZP and XP at the same time. However, if Z and X stand for word categories then this will lead to fusion of categories, which is basically word formation. There is evidence that we do not want syntax to be where word formation takes place. At least for languages like English, where a noun and a preposition do not form a noun+preposition.

In diagram (5) I have marked the positions of modifiers and positions of arguments. In syntax an argument is called a complement. I will use those terms interchangeably. There are two unique positions in the graph and those are connected with the role of being an argument. Attachment of a phrase when a structure has just commenced to be built (first X') this is the inner argument position of X, and attachment when the phrase is to be completed (attachment to XP) this is the external, outer argument position. Note that there is no prohibition of attaching a KP that contains a WP to an XP as shown below. This means that you can attach a phrase that contains a phrase to another phrase. This is recursion.

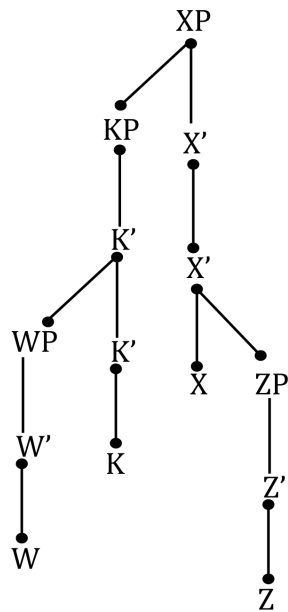
8.



The intuition is that syntactic structure is built bottom-up starting with a terminal node that is a Lexical Item and moving up in accordance with X-bar principles. This process can run in parallel and fully formed XP's can be attached to other phrases that are being built.

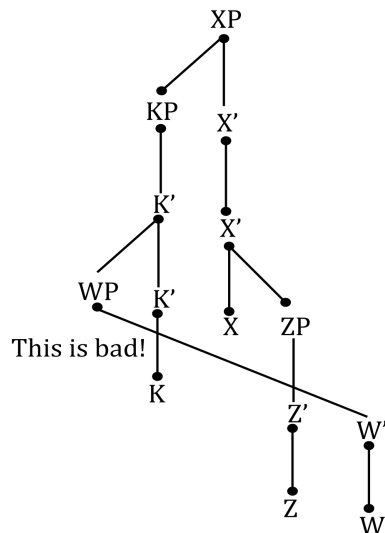
Syntactic structure is not only input to semantic computations, it also needs to provide input for pronunciation. Sentence structure might be hierarchical but pronunciation is linear. There needs to be a way to translate a syntactic representation to a linear one. The way we will do this is to assume that syntactic representations are read left to right from the top. Take our syntactic tree (that is how these representations are called) from the previous example. Let me draw it with all the heads present.

9.



The linear realization of the relations in (8) is W K X Z. Note that reading off the terminal nodes left to right allows a person to map most of the hierarchical structure based on the linear input provided they use X-bar. In other words, the structural information is recoverable from the linear input. Otherwise, children would not be able to acquire sentence structure from speech around them. This will work provided we adhere to one crucial principle. No crossing of branches. A well formed syntactic structure cannot have branches crossing. Once we allow that the relationship between linear order and hierarchical structure is lost. Consider (8) but with branches crossed.

10.



The linear order is now KXZW, although the hierarchical structure of (10) is not any different from (9). This means a child would be able to map different hierarchical structures to the same linear output. An acquisition nightmare - since kids would end up with different grammars for the same sentences. Something that does not appear to happen.

How do we know that (9) and (10) have the same structure? Well let me introduce a few relationships within the syntactic tree that will let us help navigate it.

Connection

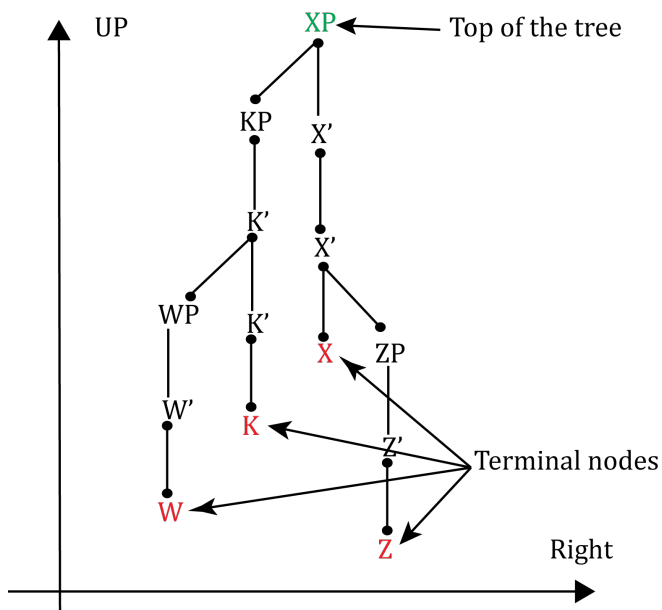
Nodes [A] and [B] are connected if you can draw a line between them (going through other nodes is fine). For us every syntactic tree has to have all the nodes connected.

Top and Bottom of the tree

We will distinguish two dimensions in the tree. One is up/down. This is anchored to terminal nodes in the tree which we call the bottom of the tree. Moving along connections away from terminal nodes will be called moving up the tree. Top of the tree is reached when you cannot move up anymore.

Left-Right

The other dimension to distinguish is Left-Right. Pronunciation is achieved by reading off the information in the terminal nodes from left to Right.

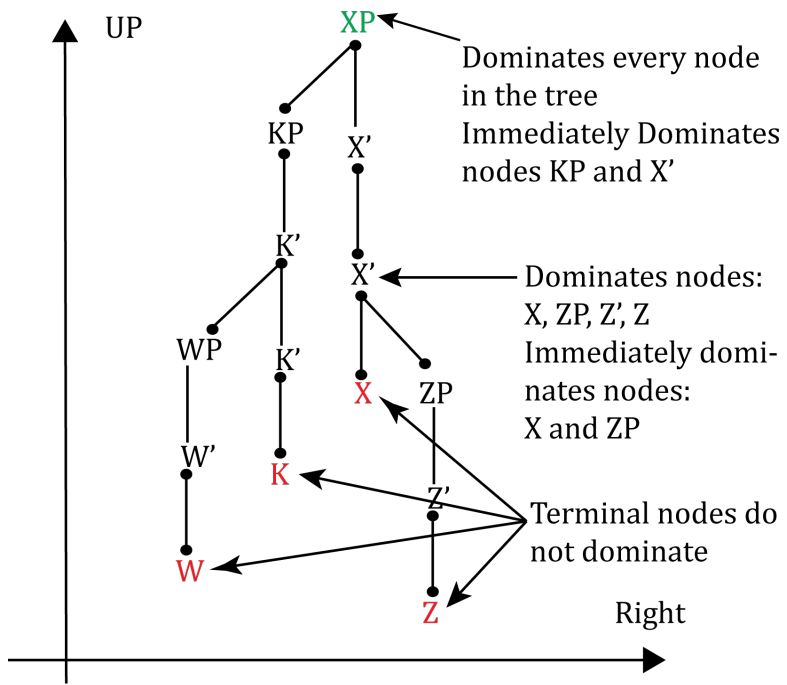


11. Dominance

A node [A] dominates a node [B] if and only if [A] is higher up in the tree and you can trace a line from [A] to [B] without going upwards.

12. Immediate Dominance

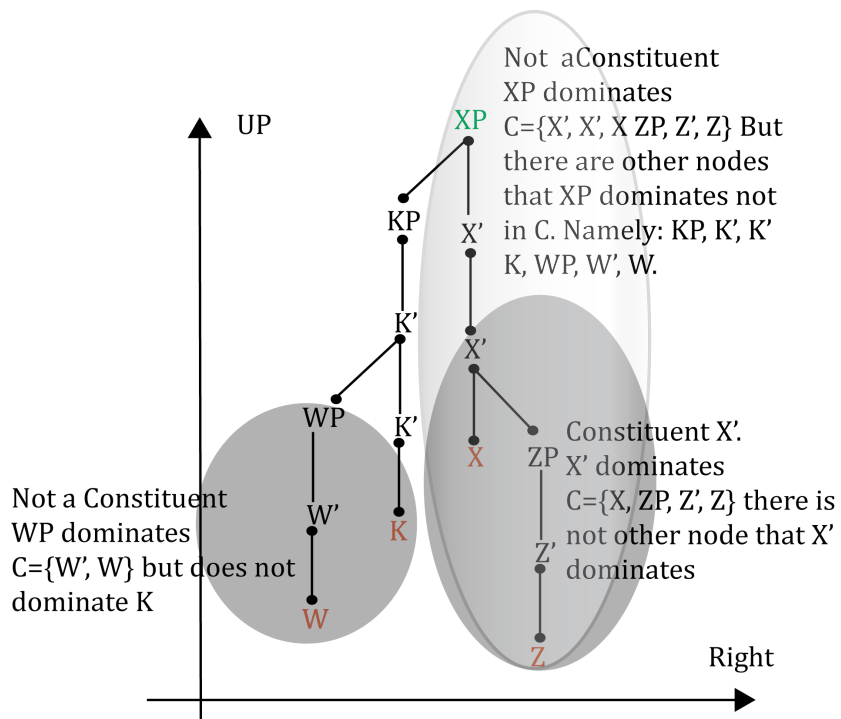
A node [A] immediately dominates node [B] if and only if [A] dominates [B] and there is no other node [C] that dominates [B] and is also dominated by [A]



We are now ready to define what a constituent is.

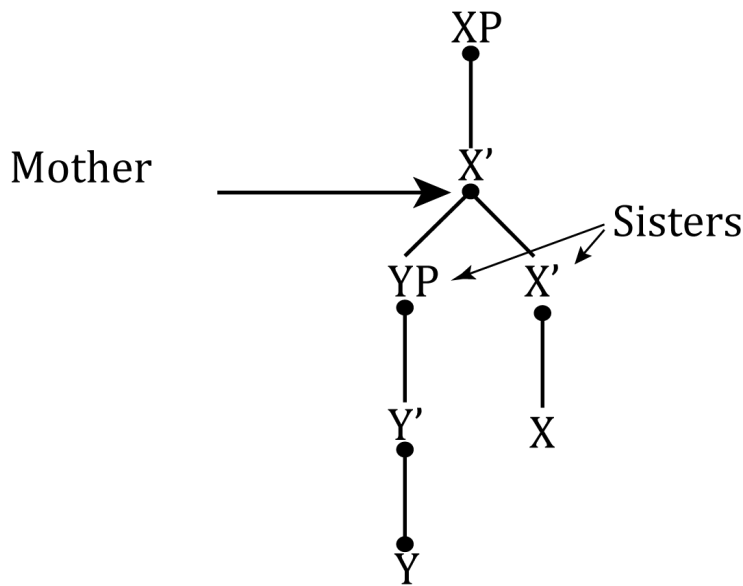
13. Constituent

Take a set C consisting of a string of nodes $C=\{B,C,D,E\}$ if and only if there is a Node A that dominates every member of C and there is no node F that is dominated by A but does not belong to C , then C is a constituent with an assigned value of A .



14. Sisterhood

An important type of relationship between nodes will be called sisterhood.



Sisterhood plays an important role in syntactic representations since it encodes the closest relationship two nodes can have, namely forming a set/constituent. Modification is accomplished via sisterhood, internal arguments are formed via the first sisterhood relationship within a given XP and become sisters of the head X, whereas external arguments are the last sisterhood relationship within a given XP. Syntactic relationships that will be discussed later, like agreement, selection are encoded via sisterhood relationships. The importance of sisterhood underscores the fact that the theory that we will adopt puts emphasis on local relations within a phrase. Sisterhood is the most local relation that there can be.

4.1 Node 'Flavors'

We can now combine our knowledge of Categories with our X-bar schema and notion of constituent and propose that syntactic structure is built in phrases which are inherently constituents. However, we need to distinguish types of constituents. This was evident in Chapter 1. Some strings can be replaced by pronouns others can be deleted. It is not the case that every constituent behaves identically to another. That is where the notion of a Head of a phrase is important. Heads are terminal nodes that are filled by Lexical Items (many believe that heads are Lexical Items). Every lexical item contains category

information, which means that every head, since it is always filled by a lexical item also contains category information. In other words, X has to have the value taken from the set $Cat = \{N, V, A, Ad, C, P, D, Deg, Conj\}$. The assumption that we will pursue is that the category information of the head impacts the phrase that it builds. If X is N that means X' is N', and XP is NP. If X is V, then X' is V' and XP is VP, and so on. A VP will differ in behavior from an NP, so will a CP from a DP, etc. Note a XP is not identical to X, VP is not V (a verb phrase is not a verb) but the theory is that a Verb Phrase (VP) will behave in way that is a function of the properties of the type of verb that is its head, and that a verb phrase will behave differently from a Noun Phrase, since some core properties of Nouns and Verbs are different. Let us examine some phrases.

- Noun Phrase

Take the string 'salty fish' in our example 'The cat likes salty fish'. We have argued that [salty fish] behaves like a unit.

It can be replaced by a Pronoun:

15. I think the cat likes [salty fish]_k, and I think she eats [them]_k often.

It can be coordinated with another Noun:

16. The cat likes salty fish and chicken

Other properties include Topicalization, a process where the word order is changed in order to emphasize one string over another:

17. Salty fish, the cat likes (its chicken that she hates)

Another way of emphasizing is called focus cleft formation:

18. It is salty fish what the cat likes

It is not important how these processes are encoded in the grammar. We will discover those mechanisms later. For now, they are empirical evidence that 'salty fish' can behave as

unit, meaning it is a constituent, meaning it is a phrase, an XP of sorts. But what type of XP? There are two obvious candidates for the head of [salty fish], the lexical item 'salty' and the lexical item 'fish'. The first observation is that if we drop 'salty' the sentence is fine, if we drop 'fish' it is not.

19. The cat likes fish

*20. The cat likes salty

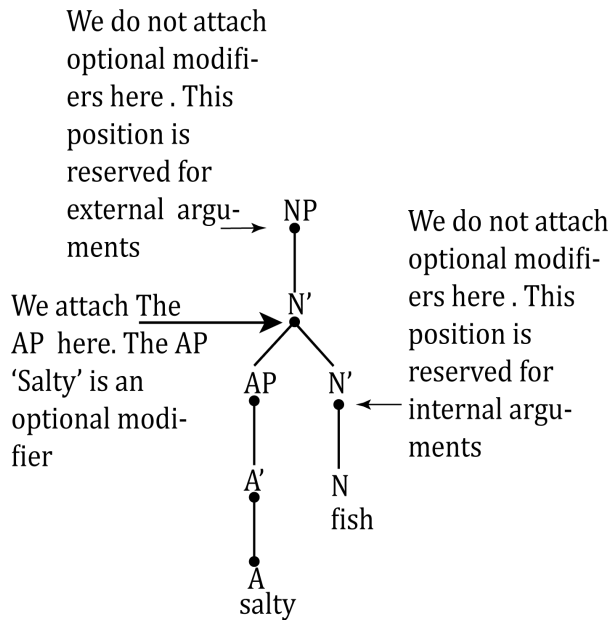
Why? The suspicion is on the properties of the verb 'like'. There is some requirement that can only be satisfied when a noun is present. We will see what that requirement is later. What is clear is that it can be fulfilled by the string [salty fish], meaning that [salty fish] retains some crucial property that 'fish' has, and that 'salty' by itself does not.

The idea that 'salty fish' is Noun Phrase is supported but the fact that it does not behave like an adjective. You cannot use it to modify other nouns:

*21. salty fish dog

There is also the intuition that a 'salty fish' is still a fish and not a type of salt. There is an asymmetry in the composition. In fact X-bar requires that there be such an asymmetry any given X can only be modified by an already completed Phrase YP, which means that the output of modification will be an XP modified by a YP and not vice versa. The data strongly suggests that the noun 'fish' is being modified by the AP 'salty'. The way to diagram this in X-bar is the following. Note that when I draw the AP it contains one unmodified LI, salty. But it is still a phrase that projects an X-bar and XP. The underlying assumption is that even a single word can be an XP.

22.



The diagram above shows that we attached the AP next to the N' dominated by another N'. The AP node is the sister of the N' node. As such it modifies that N'. One might ask why is the AP not in the Specifier of NP (topmost position)? That would make it the external argument. It is not clear the the noun 'fish' requires any arguments. More importantly, putting the AP in Spec-NP would mean that it is the sister of the topmost N'. That is a privileged position and unique position. This raises the question what if there is more than one modifier?

23. Salty expensive fish

24. Imported salty expensive fish

etc.

We can multiply modifiers, which means we need more than one position for them. Furthermore the sequence of modifiers is often quite free, Remember, we can have as many X' in a phrase as we need.

25. Expensive salty fish

26. Expensive salty imported fish

etc.

An recursive position that is both the sister of an $X'=N'$ and a daughter of $X'=N'$ is the most likely attachment site for adjectival modifiers.

- Agreement

Evidence that the AP is part of the NP and not vice-versa comes from agreement phenomena. In many languages Nouns are inflected for case/number/person/gender. In English you only see that on pronouns. In this languages the inflection of the noun determines the inflection on the adjective. This suggests that the pivot of the the phrase is the nominal element. In Spanish for example we can see number and gender agreement on the adjective.

27.

la muchacha alta
the tall girl

el muchacho alto
the tall boy

las muchachas altas
the tall girls

los muchachos altos
the tall boys

At this point it is not important how agreement is implemented. It has to be a syntactic phenomena since it involves more than one Lexical Item. Crucially, it is the properties of the noun that determine the endings of the adjective suggesting that the properties of the noun impose the form of the adjective. However, the argument from agreement is tricky since the determiner in the above examples also agrees with the Noun and Adjective and it will be far from clear if Determiners actually modify Nouns.

Processing

Another argument for assuming that expression like 'salty fish' are Noun Phrases and

not Adjectival Phrases comes from processing (Miozzo, M. & Caramazza, A. (1999). *The selection of lexical-syntactic features in noun phrase production: Evidence from the picture-word interference paradigm*. Journal of Experimental Psychology: Learning Memory and Cognition, 25, 907-922.). There is evidence that when asked to name a picture in a language like Italian subjects are already processing the noun when pronouncing the adjective. For example, faced with an image of a red car, at the moment of saying the word 'red' our brain has already processed the word 'car' although it is pronounced later. The idea is that we need to process 'car' first in order to establish the agreement on the adjective.

Based on the example of a Noun Phrase we have seen what modifiers look like. As an exercise try to diagram the following:

- A. brown water
- B. Very brown water
- C. Fake city policeman (as a challenge try to get the meaning that the city is fake but the cop real, you will find that an adjective phrase can modify another A')

Let me turn now to verbs, verb phrases and the notion of a complement. Returning to our example,

28. The cat likes salty fish

We have argued that [salty fish] is a Noun Phrase, what about [likes salty fish]? Is it also a Noun Phrase. Unlikely, since it does not behave like one. For one, there is no pronominal replacement:

*29. The cat likes salty fish and the dog it.

Again we look at the Lexical items in the string. [salty fish] is a Noun Phrase, 'like' is a verb. A plausible assumption is that [likes salty fish] is a Verb phrase whose head is 'likes'. The question that remains is where do we attach the Noun Phrase [salty fish]? Is it a modifier or an inner argument (complement)? X-bar does make a prediction as far as modifiers. We used it in the Noun Phrase example. There can be more than one modifier and they can have interchangeable word orders. Modifiers are also optional. These two properties are encoded in X-bar by the fact the X' nodes can be iterated- meaning we can generate as many modifier (sister of X' and daughter of X') positions as we need. This

means we can have many modifiers, and since modifier positions are essentially clones of each other, the order in which they are filled should not matter that much. Complements are predicted to be different. There is one unique inner argument position, sister of X. This means there should be just one unique inner argument and its linear order should be fixed relative to X. Let us test these predictions.

30. The cat likes salty fish on Tuesdays

Let us assume that [on Tuesdays] is a constituent. This will be argued to be the case later on. Furthermore, we can assume that it is a modifier since we can add more modifiers and interchange their order:

31. The cat likes salty fish [on Tuesdays] [in the afternoon]

32. The cat likes salty fish [in the afternoon] [on Tuesdays]

However, we cannot do the same with [salty fish]:

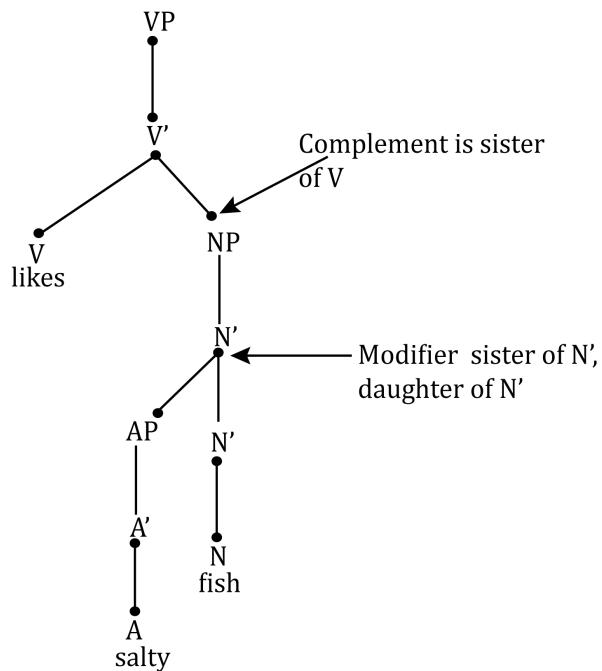
*33. The cat likes [on Tuesdays] [salty fish] [in the afternoon]

*34. The cat likes [on Tuesdays] [in the afternoon] [salty fish]

*35. The cat likes [on Tuesdays] [salty fish]

The above data strongly suggests that the NP [salty fish] is a complement of the verb 'like'. This is supported by the intuition that the meaning of the verb 'to like' entails that there is an object/activity that is being liked. The VP [like salty fish] is a predicate in that [salty fish] is assigned the property of being liked. This means that [salty fish] is the argument of the verb 'to like'. Let me draw the phrase:

36.



Note how the diagram does not align the lines in a neat fashion. It is irrelevant. Sisterhood and motherhood are defined structurally, you need to follow the connections to see the relationships. V and NP are sisters because they have a common mother V', a node that immediately dominates them and only them.

Prepositional Phrase

I mentioned that a verb phrase can have a complement (inner argument) and modifiers. The examples above involve strings like [on Tuesdays]. The obvious question to ask is what is the status of that string. There is evidence that it is a constituent. For one it can be coordinated:

37. The cat likes salty fish on Tuesdays and on Fridays

Moreover it does appear to be able to change position within a clause:

38. On Tuesdays the cat likes salty fish.

The question that remains is what is the status of the constituent. Again, we have to possibilities the proposition [on] and the noun [Tuesdays]. If the phrase is headed by a noun then it should behave like a Noun Phrase.

*39. The cat like salty fish [on tuesdays] and the dog likes beef [it]

We cannot replace it with a pronoun, so that seems to suggest that it is not a noun phrase. How about coordination

40. The cat likes salty fish on Tuesdays and Mondays

??41. The cat like salty fish Mondays and on Tuesdays

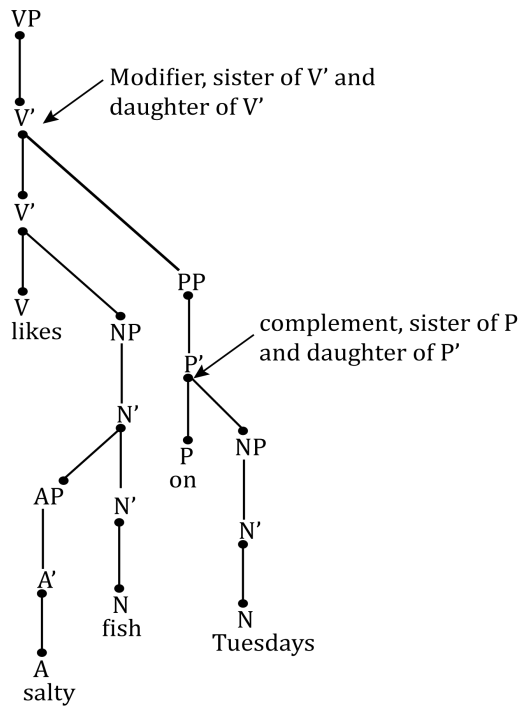
The first example above seems to indicate that [on Tuesdays] can be coordinated with [Mondays] which would suggest that [on Tuesdays] is a noun phrase. But we need to be careful and control for what we are coordinating. The string [on Tuesdays] definitely contains a noun phrase [Tuesdays], the question is whether the NP contains the prepositional phrase PP, or is it the PP that contains the NP. When we coordinate strings like [on Tuesday] with [Monday] we might actually be just coordinating two NP's [Tuesdays] and [Mondays]. The way to establish that is to flip the order of the strings and see if coordination is symmetrical. It should be. But it is not. Why? Because when we put [Mondays] first then we cannot coordinate it with [Tuesdays] in the expression: [Mondays] and [on Tuesdays] the proposition is in the way.

The above data suggests that strings like [on Tuesdays] are PP not NP. The second question is whether the NP [Tuesdays] is a modifier or complement (inner argument) of the Preposition. The giveaway is that we cannot drop the Noun.

*42. The cat like salty fish on

Complements of verbs and prepositions are obligatory. We are ready now to draw the VP:

43. [[likes [salty fish]] [on Tuesdays]]

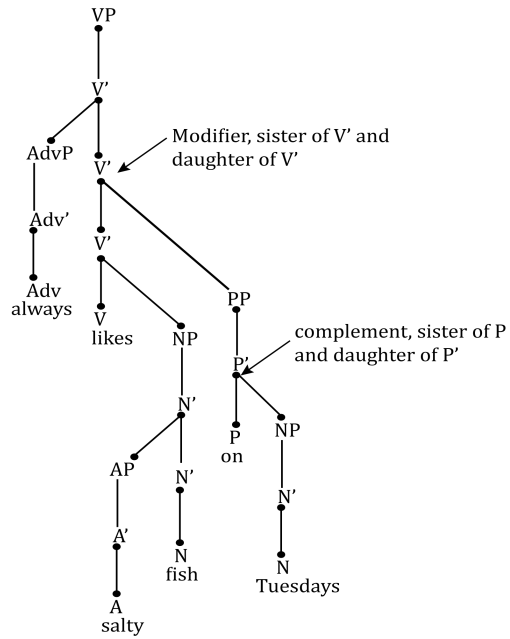


We can also have adverbial modifiers on the VP. For example the structure for

44. always likes salty fish on Tuesdays

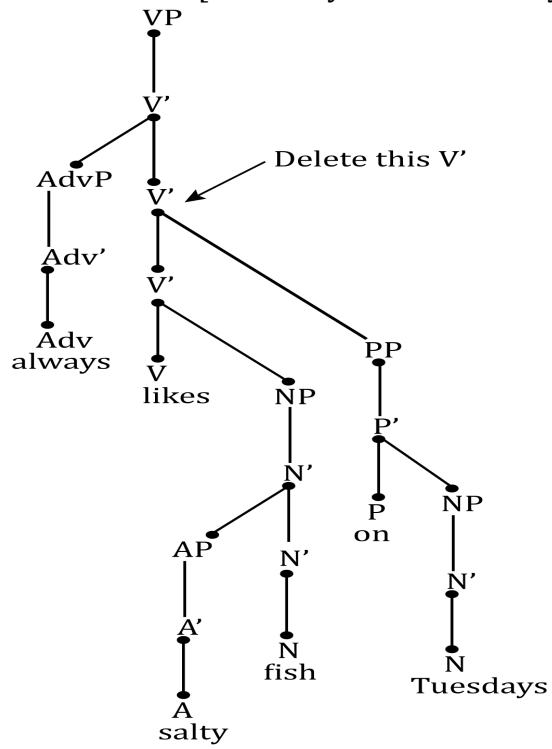
will be the diagram below. Note now we have three iterations of V' to accommodate two modifiers and one complement.

45

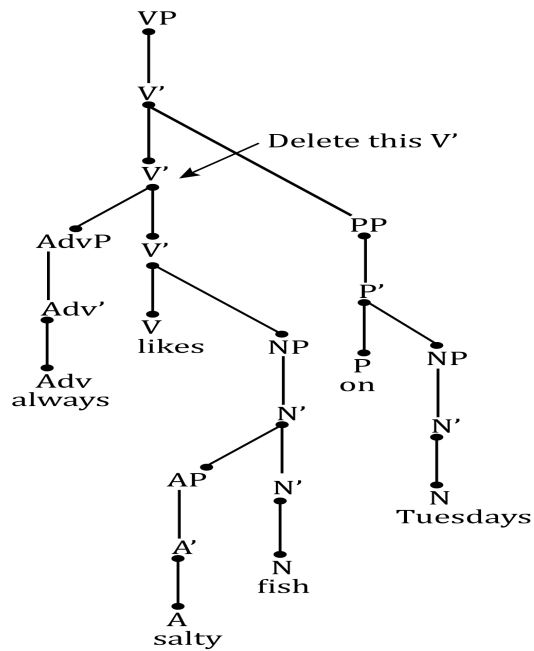


Such a structure predicts that each V' is a constituent. We can test this by looking at ellipsis, an operation which deletes constituents under the right identity conditions.

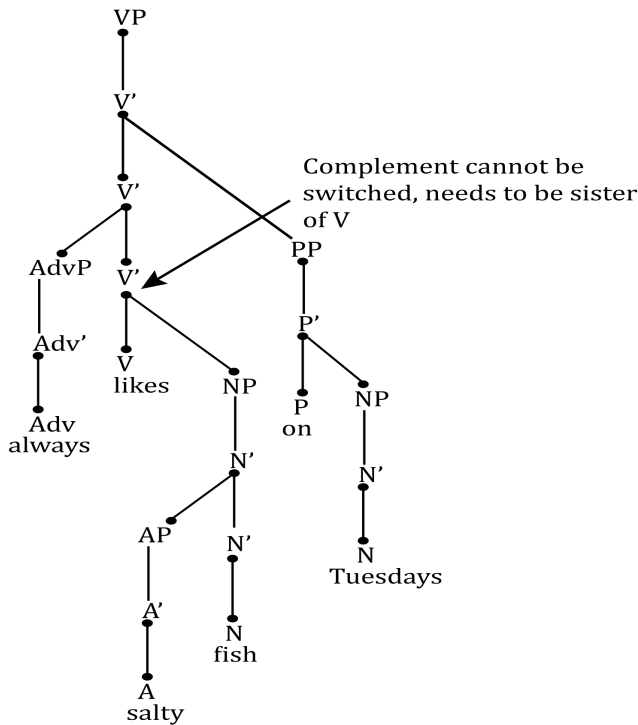
46. The dog never **likes salty fish on Tuesdays** but the cat always does so
 -> deletion of [likes salty fish on Tuesdays]



47. The dog **always likes salty** fish on Wednesdays but the cat does so on Tuesdays.
 -> deletion of [always likes salty fish]



*48. The dog **always likes** spicy beef **on Tuesdays** but the cat does so salty fish.
 -> cannot delete of [always likes on Tuesdays]



The behavior of ellipsis suggests that modifiers are defined as sisters of X' and daughters of X'. That is why if we switch them around, as we did above, they're still modifiers. Note that it is not important whether the modifier is to the left or right of the head. The definition does not require direction. Crucially, we cannot switch the complement with a modifier, since then neither would then occupy the required structurally defined position.

Internal and external arguments why are they special? Theta roles

As we have seen the complement of a verb (internal argument) occupies a specific structural position. Not only is it different from the positions modifiers occupy, it is also unique in that it cannot be iterated. The theory behind such a close relationship between complements and their heads involves the assumption that heads like verbs have a set of features/properties that require them to compose with other elements. These features are idiosyncratic for each verb, or to be more precise each class of verbs. The mechanism

responsible for verbs needing a complement is called thematic role marking. Theta roles are that part of the meaning of a verb that can only be expressed by combining it with another Lexical Item. Let me give you some examples:

Theta Role Agent - initiator of an action

49. John photographed Mary

John is the Agent.

Theta Role Theme/Patient - undergoing the action, moved, perceived

50. John photographed Mary

Mary is the patient of photographed

Theta Role Experiencer - only as part of verbs denoting experience, emotion, cognition.

51. John loves Syntax

John is the experiencer.

There are many more theta roles: Goal, Recipient, Location, Source, etc. However, what is more important to note is that the mechanism that we are adopting here involves the verb requiring another XP to complete its own meaning. The mechanism adopted here will be that a given verb discharges its theta role to its argument in a local relationship.

52. Local relationship:

For a given head X a local relationship is its complement position and its Specifier position. These positions will be called **inner and outer arguments**. Other positions will be called **adjunct** or **modifier** positions (we will discuss later if every adjunct is a modifier and if every modifier is an adjunct)

Theta roles are discharged to arguments depending on the type of verb. Each verb will have idiosyncratic properties that characterize it as far as what theta roles it has to discharge.

These have to be learned by a child when acquiring a language. Note that when we learn verbs we need to be provided by speakers with whole utterances. Unlike with Nouns, where in many cases we can just point at the object or describe its characteristics. It remains to be discovered if there is a more fundamental system at play which governs what theta roles are. At this point we do not know.

Theta roles are not enough to differentiate the two examples below:

53. I live in New York

54. I inhabit New York

In the first case we need a PP as an argument, whereas in the second case we need an NP. However, the theta roles are the same. It appears verbs on top of having theta roles have what we will call category-selection properties, c-selection for short. **C-selection is exactly what its name says. The verb selects certain syntactic categories as possible arguments.** The verb 'live' needs a PP, the verb 'inhabit' needs an NP. C-selection will be very important for us since it will be the 'glue' that binds our syntactic trees.

55. C-selection.

A given head X selects the category of its complement.

We have discussed c-selection on verbs, however, there is no reason to believe that c-selection is not a general property of heads. Unlike theta roles, c-selection does not infer that meaning of a head requires another constituent. C-selection might be considered screening the XP as potential complement for category information. Theta roles are discharged after c-selection has taken place and are based on whether the semantics of a verb requires it. Note that it is not clear if other categories have theta roles. One that does appear to have them is PP's.

56. Theta role criterion

A. P and V must assign theta roles to their nominal arguments if they have one.

B. Every nominal (NP) has to have one and only one theta role.

The theta role criterion prohibits verbs and prepositions from not assigning a theta role

if they have one. That seems simple. You cannot say

57. John photographed Mary

and not mean that Mary is the patient of the action of photographing. Try it, it is impossible.

The idea that every NP requires a theta role is harder to show. But there seems to be a strong indication that no language that we know has non-theta marked NP's in grammatical sentences. If it was possible that NP's should be possible as adjuncts/modifiers (sister of X' and daughter of X').

*58. John photographed Mary his photo-album

Could mean that

59. John photographed Mary for his photo-album

But it does not. It seems we need a PP. Why? Because they discharge theta roles and the NP [photo-album] needs a theta role. Evidence that only one theta role can be assigned to each noun comes from reflexive pronouns like 'herself'

60. Susan hit herself

*61. Susan hit

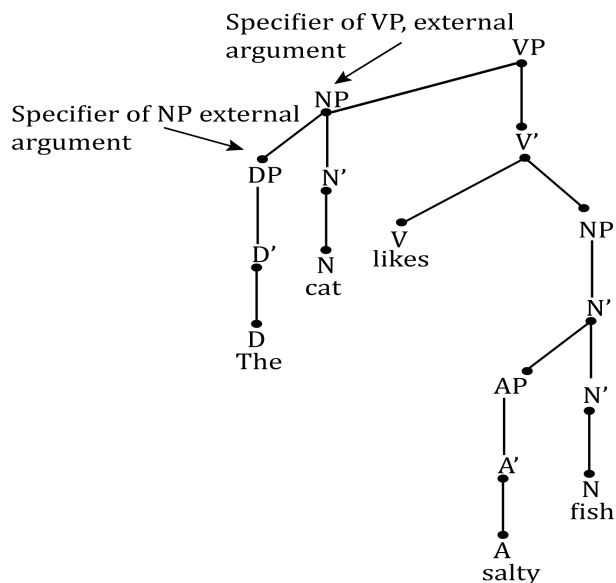
The latter cannot mean the former. In fact it is ungrammatical. Why? Because Susan cannot receive two theta roles: one as an agent, and the other as a patient. We need two nominals for that. It is irrelevant that the reflexive has identical denotation as its antecedent: Susan. The grammar requires that: if a verb like 'hit' has two theta roles, it requires two nominal arguments.

We will examine theta-role criterion more closely later and revise it. But for now it will be sufficient.

Subjects - Functional projections

How about outer agreements, is the Spec-XP position ever filled? The likely candidates for that would be determiners like 'the' in [the cat] and [the cat] in the phrase 'the cat likes salty fish'.

62.



Drawing a tree is equivalent to making a hypothesis. The graph theory underpinning our analysis based on X-bar provides an algebraic backbone to model what a given speaker knows when they know English, or in this specific case know the structure, meaning, etc of the clause 'the cat likes salty fish'. The above diagram in that sense is a nice hypothesis. It captures not only the status of each constituent: [the cat] is a NP, [likes salty fish] is a V', [salty fish] is an NP, and the whole structure is a VP. It also captures that [salty fish] is the complement of [like], that [salty] is a modifier of [fish]. Finally, it captures that determiners are in a unique relationship with nouns, they are their external arguments, and that the verb like needs an external argument, after all the meaning of like is: x likes y. It is a two place predicate, meaning it requires two arguments that it relates with each other and assigns a property to each. In this case [the cat] is the liker, [salty fish] is being liked, and as a result there is a relationship between [the cat] and [salty fish].

Unfortunately, this hypothesis is most likely wrong. However, there is wrong and there is wrong. In our case, discovering that the structure above is incorrect will yield interesting revisions and additions to the graph based X-bar model but not its refutation. In fact it, will allow us to extend the theory to other facts. Such an approach is standard practice. You develop a hypothesis using a formalism that forces you to be explicit. Make predictions and tests them. If the predictions are correct, great. If they are not then you analyze why. It is important always to check your proposal for inherent contradictions. If there are contradictions, there is nothing more to do but develop a new proposal that avoids them. If there are no contradictions, then one is free to play with the model and see if it can be modified to not only accommodate the problematic data, but also account for new phenomena. If that is achievable, then you have made progress. And that is what we will try to achieve here. First we will show that the hypothesis in the diagram above is problematic and then modify it so that it covers new finding in addition to existing data.

An analysis of specifier positions requires us to look closely at functional heads and their role in syntactic structure. This is the next chapter.

Exercises:

1.

Draw the structure for the following underlined expressions

John frequently danced with Mary until morning

I often swim under large brown bridges

Identify the sisterhood, motherhood relationships. Mark what is a modifier and what is a complement.

2. Consider the following pair of sentences:

A. John photographed Mary

B. Mary was photographed by John

Mark the theta roles of the above arguments. example B is called a passive sentence of clause A. What does passivation do to Theta Role Assignment. Note the answer is complex. Especially if you consider that you can say:

C. Mary was photographed yesterday by John.

§5 X-bar, Part 2 Functional Heads

Let me start with the Determiner position. The issue of an external argument of VP will require more analysis, and will not be fully resolved until we discuss movement later in the course.

Determiners are unlikely modifiers. If we use tests for modifiers and arguments we quickly notice that determiners cannot be iterated and their position is fixed.

- *1. The a cat
- *2. The small cat
- *3. Small the cat

So it would seem that placing a Determiner Phrase in Spec-NP is a good idea. Remember, a phrase can have just one Lexical Item - the head; a determiner phrase would be such an example, where there is only one element, a determiner. In fact, for quite a while, this was the assumed structure. However, a few facts are problematic. These facts involve possessive constructions, as in the examples below:

- *4. the her crown
- 5. her crown
- 6. Elizabeth's crown
- 7. The Queen of England's crown

In example (4) we have evidence that the possessive pronoun behaves like a determiner. The idea is that (4) is bad because there is one Specifier position in the NP 'crown'. It can be occupied by either 'the', or 'her' as can be seen in (5). But example (6) shows that whole NP's can also be possessives. It is a stretch to assume that [Elizabeth] is a determiner, but things get worse. In example (7) we have a whole complex Noun Phrase that would have to be a determiner. Why? Well, in D the possessor is [The Queen of England]. She owns the crown. Based on our previous analyses, we can draw the NP. Crucially [of England] is a Prepositional Phrase that takes an NP as its complement.

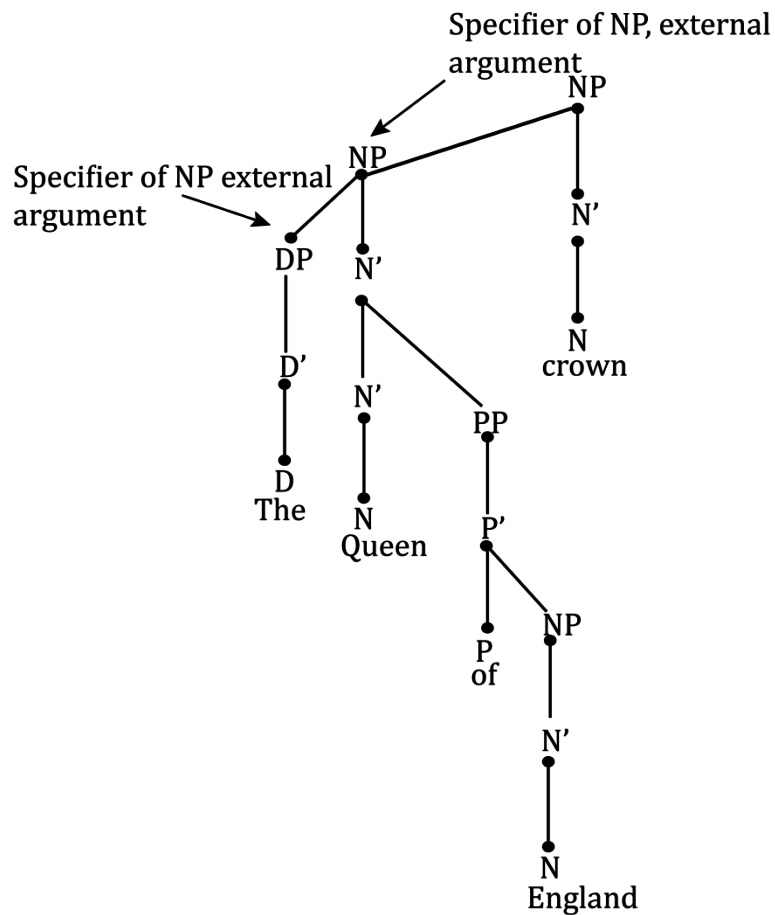
Another question is what is ['s]? It appears it can attach to a whole constituent. In fact it has to:

?8. The Queen's of England crown

The above sounds bad.

We could try to map possessives as NP's in Spec of NP's

9.



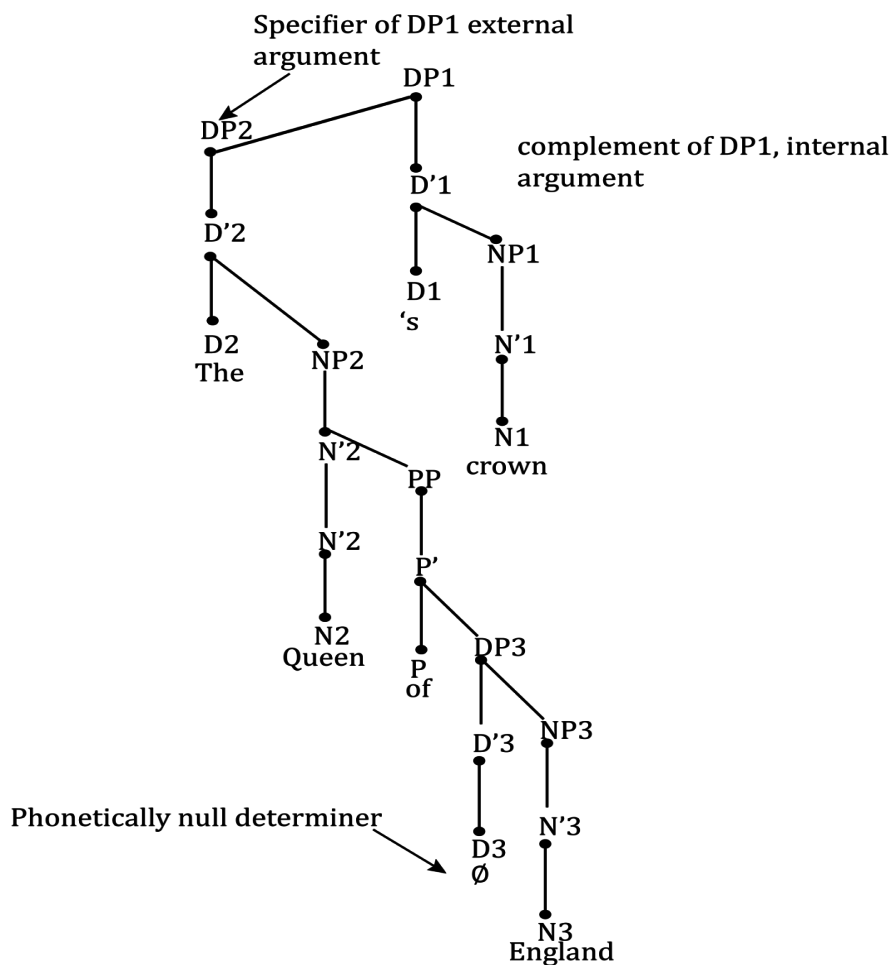
The above diagram will account for the fact that the Noun 'crown' cannot have a determiner:

*10. The Queen of England's the crown

But the mystery of where to attach ['s] remains. It is tied to another mystery, namely why is D the external argument of N? We have talked about internal arguments of V and mentioned that external arguments are in Spec-V. In most cases, it would appear that Nouns do not have an internal argument, but must have an external one. This would make them similar to verbs like 'die' in 'John died'. However, the semantics of possession is then wrong. The possessor would be the external argument of the possessee. But, if anything, the meaning of 'The queen of England's crown' is that the possessee 'crown' is the internal argument of the possessor 'The Queen of England's'. The intuition is that 'The Queen of England's' needs the Noun Phrase 'crown' to complete the meaning of possession. The string is otherwise completely ungrammatical, just like a bare verb. It would be a stretch to say that nominals like 'crown' require an external argument to complete their meaning.

In order to solve the problem of ['s] and the semantics of possession some linguists advocate a structure where DP takes the NP as its complement.

11. DP hypothesis- every nominal is a DP.



What the diagram above says is that possessive [’s] is a Determiner that takes two arguments: The external one - DP2 that has the Theta Role of possessor (the numeral is just a diacritic for bookkeeping) , and an internal argument NP1 [crown] which is the possessee. The obvious questions to ask are:

- Does NP1 get a theta role?
- Can we have a phonetically null determiner? Should not NP3 just not have a DP? In essence, what is the status of the zero determiner in D3?

Let's answer those questions. No, NP1 does not get a theta role. If it did get one from the possessive, then it would end up with two theta roles as in:

12. John photographed the Queen of England's crown

The understanding of the clause above is that a crown possessed by the Queen of England is what John photographed. There is an agent theta role to be assigned - if the NP [crown] gets a theta role from the possessive then what absorbs the patient theta role discharged by 'photograph'?

Instead, let us change the theta role criterion from the last section:

13. Theta role criterion

- A. D, P and V must assign theta roles to their nominal arguments if they have one to assign.
- B. Every DP has to have one and only one theta role.

D1 assigns a theta role to DP2 - possession, P assigns a theta role to DP3 - possession, and DP1 gets a theta role from the verb it becomes an argument of. Note, that such an approach requires that we assume that the NP [England] is a complement of a Determiner. This would seem to be easily disproven since we cannot use determiners with NP's like England:

*14. The/a England is my country

However there is evidence that there is a DP in expression like 'I like England'. For one they can be replaced by Pronouns:

15. I know England - I like it.

A pronoun cannot take a determiner:

*16. I like the it

but 'it' can be anaphor to a DP:

17. I like [John's coffee], I really like it!

The most obvious way to analyze pronouns is that they are anaphors for determiner phrases. But if that is the case then 'England' has to be a determiner phrase. Note, we cannot say that pronouns can replace a NP or DP since then we should be able to say:

*18. I like John's coffee but not Susan's it.

But we can't. Thus there is evidence that every Noun Phrase is really a complement of a determiner. That determiner is sometimes pronounced and sometimes not. We will assume that null determiners have specific c-selection properties they take: plurals, proper names, and mass nouns like 'rice'. In other languages we see determiners surface even in proper names. For example in Italian determiners occur with proper names

19. Il Gianni mi ha telefonato
The Gianni me has telephoned
'Gianni telephoned me'

The syntax of Italian DP's is more complex than we can discuss here. The above example aims to show that we can pursue a theory where D is a universal category that is present in many languages even when there is no overt phonological material associated with it. **In essence, we can have Lexical Items with no overt phonology.**

The reasoning goes back to what I suggested in section 3 when talking about the categories of Lexical Items. We should define Lexical Items as being terminal nodes of the syntactic graphs, just like we define numbers as roots of equations. This allows us in math to have numbers like $\sqrt[3]{2}$ as a solution to $X^3 - 2 = 0$. This was not so obvious, and for example for the Pythagoreans the existence of such numbers was considered a secret. To the point that legend has it, one of the Pythagoreans, Hippasus of Metapontum, was killed for divulging it.

Fortunately, the existence of null determiners does not lead to violence. However, it is contested in modern syntactic literature. This is especially pertinent to the analysis of Slavic languages, where there do not appear to be any overt determiners, calling into question if children can acquire their existence. The issue is important since it raises the question of how we curb the presence of phonetically null Lexical Items. We do not want to say they exist freely, since then we can postulate an infinite lexicon with phonetically null LI's.

The status of null determiners in English is clear - they alternate with overt ones in strictly defined environments. A null determiner is present with proper names, plurals, and mass nouns:

- 20. a. John likes swimming
- b. Boys like dancing
- c. Rice is nutritious

In the above, none of the NP's: "John", "boys" or "rice" can take "a/the". In cases where the alternation between a null LI and its overt counterparts is rule-determined we should have no problem in postulating a null LI. It is easily acquired since it is rule-governed and the environment in which null Determiners occur is well established. However, I must stress that such an approach is only possible if a child assumes LI's to be defined by their syntactic distribution, and possibly semantic and morphological effects. An LI is no longer defined as a pairing of sound and meaning.

Summing it up, in the previous section I mentioned that Lexical Items need to be defined not by their intrinsic properties but by the role they play within the structure of the sentence. The analogy was with numbers being defined as roots to equations. That allows us to say PI is a number, so is the square root of two. Null determiners are Lexical Items with a meaning and feature composition just like non-null determiners - except they do not have phonetic articulatory features. They are a solution to an equation in the grammar.

It would be suspicious if the only null heads that we have are determiners. Fortunately, there is evidence for null complementizers, null tense, null light verbs. Let us discuss those in sequence.

Complementizer Phrases

Consider the clauses:

- 21. John said that Mary sneezed
- 22. John said Mary sneezed

The first example has the verb 'say' take as its complement the constituent [that Mary sneezed]; in the second clause the verb 'say' takes as its complement the constituent [Mary

sneezed]. Does that mean the verb 'say' can c-select for two different constituents? This might be true. For example, we have verbs:

23. John likes Mary

24. John likes to dance

Here the verb 'like' c-selects for a DP [Mary] but also for an infinitival clause [to dance]. One feature of such constructions is that the two possible arguments [Mary] and [to dance] do not coordinate symmetrically:

25. John likes Mary and to dance

?26. John likes to dance and Mary

For many both sound weird, and the second one is worse than the first. However, there is no asymmetry in coordination in cases like:

27. John said [that Mary sneezed] and [Roger slipped]

28. John said [Roger slipped] and [Mary sneezed].

Could it be that the strings above without 'that' have a null complementizer? This would mean that verbs like 'say' c-select for CP. Which would mean that when we do not see a complementizer in a clause selected by 'say' there is a null one heading a CP anyway. We can also use our test with anaphors. English has an anaphor that can replace a CP:

29. I heard that John hates cats.

30. but I couldn't believe it!

In the above 'it' refers to [that John hates cats] because we cannot say:

*31. but I couldn't believe that it

Although 'believe' is fine with a complementizer:

32. I believe that John hates cats.

This means that 'it' needs to replace a CP and not something smaller than a CP like [John hates cats] in 'I believe that John hates cats'. If so, then what about:

33. I heard John hates cats.
34. but I couldn't believe it!

In the above there is no 'that' in the antecedent sentence. However, 'it' is possible. If we assume that there is a null complementizer in [John hates cats] as part of 'I heard John hates cats' then we can account for the distribution of 'it'. The Lexical Item 'it' replaces a CP. Note, English has more than one [it], we will return to the middle one. For now, we will assume that there are three separate Lexical Items associated with the sound 'it'

35. I saw your book, I like it, it=book
36. It is raining, It=????
37. I heard that John hates cats, but I don't believe it, it= that John hates cats.

The above discussion strongly suggests that the inventory of complementizers in English has to include a phonetically null indicative complementizer, a null version of 'that'.

What about tense/modal and various auxiliaries? Here, we also have evidence that there are phonetically null LI's. Consider the following examples.

38. John hated cats
39. John will hate cats
40. John [hated cats] and [will hate dogs]

We see that (38) and (39) have a verb in the past with no overt Tense LI and a verb in the future with an overt Tense LI= 'will'. Interestingly, we can coordinate the two clauses as shown in (40). We can coordinate a string with Tense with a string that has no overt Tense. The most obvious solution is to assume that there is a phonetically null Tense LI in (38). Its effects can be seen on the morphology of the verb since it needs to take a past tense affix -ed. We will assume that there can be phonetically null Lexical Item with Tense category in English. In fact, there need to be two tense LI's. Their feature composition differs in that one has a feature: [+past], and the other [+present]. This leads us to the conclusion that null Lexical Items can be identified by the way their semantic and syntactic features act on the structure. Even though there is no past tense overt equivalent of 'will' there is past tense

marking on the verb and the utterance is marked as past tense. Similarly for the habitual/present as in (41) below:

41. a. John reads books
 b. Does John read books?

Here, there is no confusion that the action was in the past or will be in the future. Tense is still established. It becomes visible when we want to ask a Yes/No question as in (41b) and surfaces as the light verb 'do' inverted with the subject John. The mechanism behind inversion and the surfacing of 'do' is not relevant for now. What is crucial is that we have an alternation between a zero form and overt tense marking even in cases like (41).

We can generalize our method of identifying phonetically null elements as following a set of principles:

42. Identifying phonologically null LI's

- alternation, in some controlled environments there is an overt LI, in others there is not.
- there is a common dimension between the null LI and its overt counterparts.

For example:

- null determiners share with the overt counterparts the fact that they specify definiteness,
- null complementizers share with their overt counterparts that they indicate indicative clauses or, as we will see later, relative clauses.
- null Tense shares with its overt counterpart that it indicates tense.

The idea is simple, null LI's have the same types of semantic and syntactic features as their overt counterparts, they just lack phonology.

Let us examine a more complex situation involving light verbs in English. We have two types - one is the verbs indicating perfective and progressive. It is not clear if they have null counterparts, since lack of 'have' or 'be' appears to have the effect of not marking the structure as perfective or progressive.

43. a. John **had** photographed cats
 b. John photographed cats
44. a. John **is** photographing cats
 b. John photographed cats

There does not appear to be any reason to suggest that in (43b) and (44b) there is a phonologically null perfective v or progressive v. However, the situation is different in the case of passive/active

45. a. John photographed cats
 b. Cats **are** photographed by John

The contrast between active in (45a) and passive in (45b) seems to suggest that in (45a) there is a null v that has the feature [+active], whereas in (45b) the overt light verb has the feature [+passive] = [-active].

The picture that we are getting from the above data is that Lexical Items that carry passive/active features alternate between a zero form for the active and an overt phonological one for the passive (identical to the verb 'be'). In contrast, the progressive and perfective LI's do not appear to have phonetically null counterparts, since the lack of overt 'have' or progressive 'be' does not signal features that can be considered minus progressive or minus perfective. The argument is not as strong as we would like, but I will assume that there is a distinction between passive/active and progressive and perfective. I have argued that all four light verbs: passive, active, perfective, and progressive are of the same category, little v. **Passive has an overt light verb in the form of the verb 'to be'. Active has a null light verb, perfective and progressive have only overt light verbs: 'have' and 'be' respectfully.**

Are there any other cases when we see phonetically null LI's? It appears languages are full of null LI's. Pronouns appear to be often null. Even in English:

46. a. John wants PRO to swim
 b. John wants her to swim

In the above example, I have marked as PRO a silent pronoun that refers back to John. We see that there must be pronoun if we want to express the thought that John wants someone else than him to swim. I will discuss these cases later. For now, it is important to note that pronoun can be null, even in English. Another example is relative clauses. These are clauses that modify nominals. In such constructions we see alternations between null and 'that' complementizers, which is not surprising since we already know that null complementizers

exist. But we also see alternations between null and overt relative pronouns like 'which' 'who' etc.

47. a. The man [that John met] is a linguist
 b. The man [____ John met] is a linguist

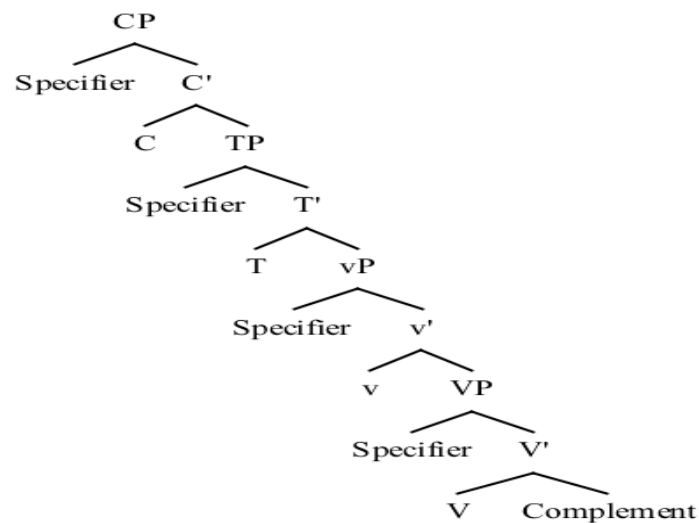
48. a. The man [who John met] is a linguist
 b. The man [____ John met] is a linguist

The bracketed string is a relative clause that modifies the expression 'the man'. We see in (47) that there is alternation between 'that' and a zero complementizer. We also see that there is alternation between 'who', which we will call a relative pronoun, and zero. This suggests that there are phonetically null relative pronouns and phonetically null complementizers in relative clauses. What we should not assume is that there is one zero category that is both relative pronoun and complementizer and that this null hybrid can alternate with both 'that' and 'who'. Why? Because we established that the categories of pronouns and complementizers are separate. Null lexical items cannot be hybrid categories.

The syntactic spine.

Adding phonetically null LI's to our inventory frees us to assume that the linear order of strings is not the only indicator of phrase structure. Presence of features like Tense, indicative, or definite also have to be taken into account. Such a model allows us to assume a common structure for clauses, because clauses share certain syntactic, semantic properties regardless whether these properties are signaled by a phonetically realized LI. This common structure will involve a Complementizer Phrase, Tense Phrase, an active/passive vP and VP.

49. Clause skeleton (specifiers shown just for illustration, there is no need to draw if nothing in them)



The vP phrases can be iterated, provided we need Progressive and Perfective. The order appears to be:

50. Perfective - Progressive - Passive/Active

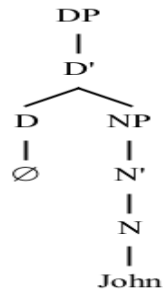
51. The fish had been being eaten

This might not be that obvious at first glance, but that is because information is redundantly repeated, perfective markings 'spill over' to the Progressive marker, and progressive markings spill over to the passive marker and passive spills over to the main verb. But the relative order is fixed.

Marking null phrases.

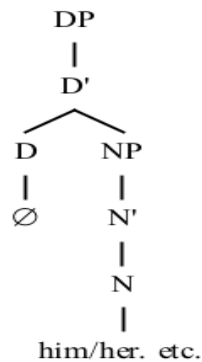
We can mark a phonetically null phrase with zero.

52. Null DP



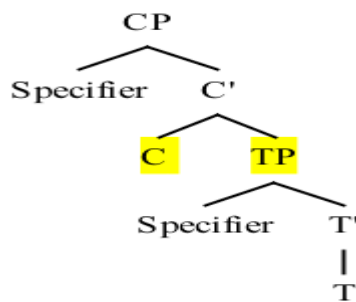
Pronouns, including possessives (note that in chapter 3 we assumed they are determiners, now we know that pronouns have a null D).

53. Pronouns:

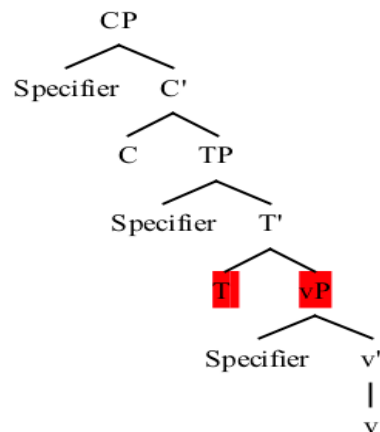


This shows that C-selection of D is almost always an NP. In fact functional heads are more picky than verbs in C-selection. They will only take very specific categories of phrases. That is how we arrive at the skeleton. Let me review the main trends in Category selection.

54. A complementizer (C) C-selects a TP. This can be more fine-grained, for example a 'for' complementizer only C-selects an infinitival TP as in: *It is important for Mary to swim*.

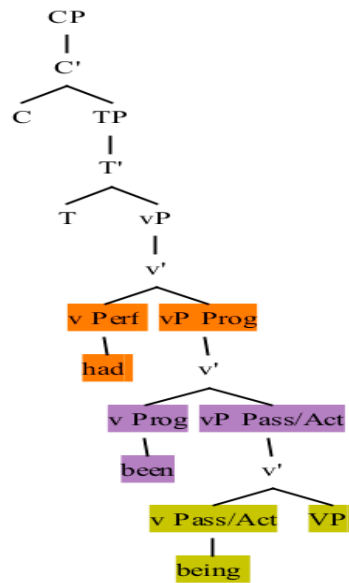


55. A Tense head will C-select a little \bar{v} (\bar{v}). Note that we assumed that \bar{v} comes in three flavors: Perfective when headed by 'have', Progressive when headed by 'be' and Passive/



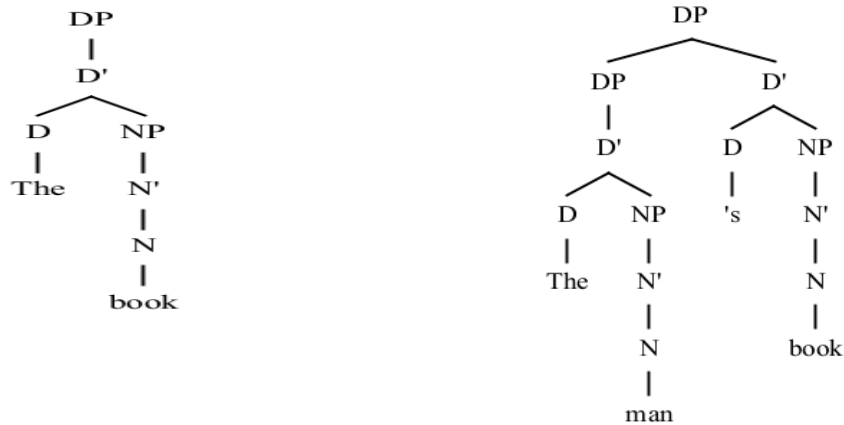
Active. T does not seem to care, it just takes a \bar{v} P, this could be headed by a Perfective \bar{v} , a Progressive \bar{v} , or a Passive/Active \bar{v} . This in fact is one of our main arguments for assuming that all three have something in common, they can all be C-selected by Tense.

56. Sequence of little v. When present, Perfective takes Progressive when it is present, or Passive /Active. When present, Progressive takes Passive/Active. Note that Passive/Active is always there, since otherwise Tense would not be able to select a v.

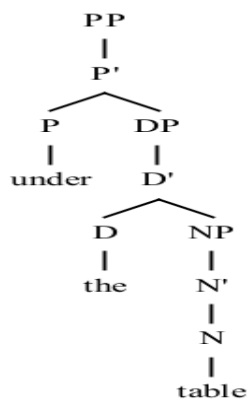


Finally, as we can see the vP Active/Passive C-selects the VP.

57. We have shown that Determiners C-select NP's. And, in the possessive case, C-select a DP in in their Specifier.

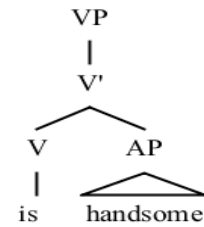
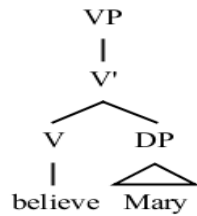
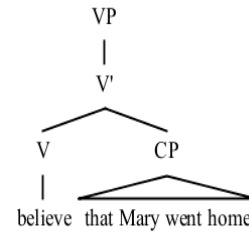
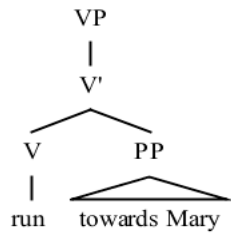


58. We have also shown that Prepositions C-select DP's



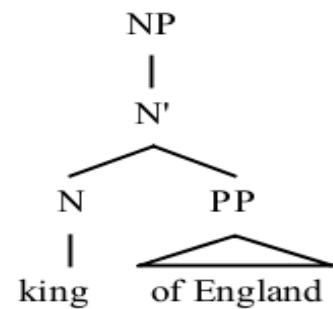
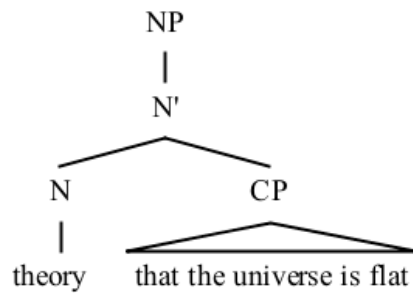
Unlike with functional categories, C-selection of major Lexical Categories like V and N is less strict.

55. Verbs can C-select PP's, DP's, CP's, AP's (do not draw triangles unless asked, I am doing



this for reasons of space)

56. The same with Nouns. They can C-select a PP or a CP.



Note that C-selection only applies to sisters of the head (complements). Restrictions on the category of modifiers appear to be less dependent of the head.

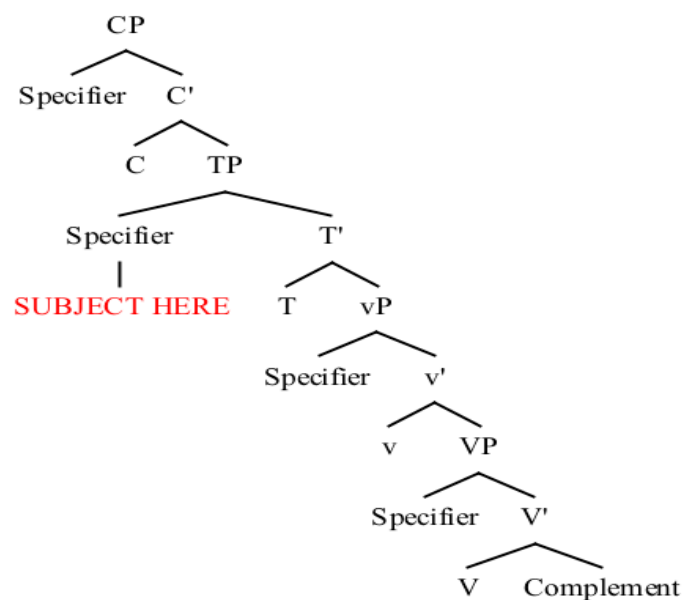
Subjects

We can now address the issue of the outer argument of the verb. The initial suggestion was that the specifier of the VP is a good place to have the external argument. However, assuming our clause skeleton in (49), this would give us the wrong word order since the subject/external argument precedes the Tense marker as in (54).

54. John will be dancing

It appears that Subjects/external arguments are in Spec-TP, at least when Tense is a non-null. Can we assume that when Tense is phonetically null, the external argument is in Spec-VP? Not really - for one, even when tense is null, we can still put the progressive and perfective Lexical Items and see that the external argument is above them. Parsimony would suggest that since Tense is above Perfective, and Perfective above Progressive, then Subjects are above Tense, Progressive and Perfective, which means they are above the highest element, Tense. The First highest position is Spec-TP.

55. a. John has danced
b. John is dancing



56.

This begs the question why the External Argument, which for now we identify with subject, is in Spec-TP and not Spec-VP? We will return to this problem when discussing movement. For now, let me suggest that there are some reasons to assume that subjects are in Spec-TP. For one, their behavior differs from Internal Arguments which, for now, we will equate with objects. Also, thematic roles and c-selection seems to be less stringent with subjects. Consider the examples below:

57. a. That John hates Mary annoyed Jim
 b. Mary annoyed Jim
 c. The idea annoyed Jim
 d. Swimming annoyed Jim

The external argument has a lot of leeway as far as category and semantic denotation. This is reflected in the fact that we have less Subject idioms: *The jig is up*, than object idioms: *The NSA keeps tabs on everyone*. The relationship between the verb and its internal arguments appears more connected. This is not precise, and we will return to the issue. Not only is the relationship between subject and verbs less close than between objects and verbs, subjects seem to be sensitive to Tense. For example, they tend to disappear, or become null as I have argued, when the clause is infinitival:

58. a. It seems that John swims a lot
 b. John seems ___ to swim a lot

In (58a) there are two subjects: 'it' and 'John'. I will return to 'it' in a moment. In (58b) there is just one subject, but two verbs. The difference is the lack of tense in the subordinate clause in (58b). Note, both sentences mean exactly the same thing. It is as if subjects are sensitive to lack of tense.

As far as 'it' in (58a), there is another interesting fact. The Lexical Item is meaningless, in that it does not have a denotation. It is semantically void. Yet, we cannot drop it. It is as if subjects become null when tense is infinitival, but when finite, there needs to be an overt subject, even if it does not mean anything. This connection between subjects and Tense can be captured if we assume that Tense always has to have a Lexical Item in its Specifier. In the

case of infinitival tense then Lexical Item is phonetically null, but in the case of finite Tense, it has to be overt. Why?

To answer the question we need to look at the morphology of subjects. One striking contrast with objects is that their endings can be different. In English this only surfaces with pronouns.

59. She [Nominative] saw her [Accusative]

The subject is marked with Nominative Case, whereas the object in Accusative. In infinitival clauses what appears to be a subject is not Nominative, suggesting its origin is elsewhere:

59. a. John wants **her** to swim
 b. It is important for **her** to swim

The status of the above pronouns will be discussed later. What is clear is that they do not have nominative morphology. Nominative appears to be associated with Finite Tense. This is clearly visible in languages like Polish, where we have more than just two case markings and they appear on nouns. The subject in most cases is Nominative.

60. a. Jan (Nominative) zobaczył **Marie** (Accusative) vs Maria (Nom)
Jan saw Mary
'Jan saw Mary'

b. Jan (Nominative) nie zobaczył **Marii** (Genitive)
Jan not see Mary
'Jan did not see Mary'

c. Jan (Nominative) dał **kotu** (Dative) vs kot (Nom) mleko (Accusative)
Jan gave cat milk
'Jan gave the cat milk'

d. Jan (Nominative) jedzie **samochodem** (Instrumental) vs samochód (Nom)
Jan drive car
'Jan is driving a car'

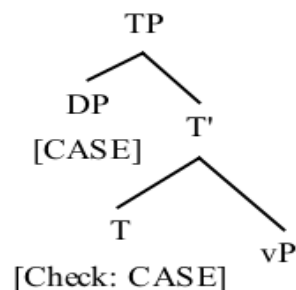
The examples above show that the inner arguments vary as to Case depending on the verb, and in Polish depending on whether the verb is negated or not. The subject stays

invariably Nominative. However, we have a verb in the infinitival, and what looks like the subject is in the Dative:

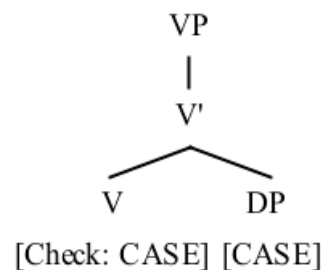
61. Jan kazał kotu (Dative) łapać (inf) myszy
 Jan ordered cat chase mice
 'Jan ordered the cat to chase mice'

This shows that in Polish Nominative is strongly associated with Finite Tense. This can be captured if we assume that the Subject is in Spec-TP. But we still need to have a theory of how Case is licensed. It cannot be just proximity. Case will be licensed under sisterhood. There are three case assigners. Tense for Nominative, Verbs for Accusative, Dative, Instrumental etc. and Prepositions usually for Locative. We will assume that Case is carried out via feature checking. Where a case licensing head will check the case of the DP if it carries the required features.

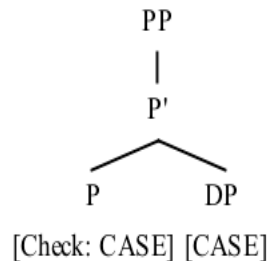
62. Nominative case assigned/checked by T



63. Case assigned/checked by verb (to be revised later)



64. Case assigned/checked by P



Note that in each instance Case is checked and assigned at the most local configuration. Tense does not have a free inner argument slot; it is taken by little v. Hence the Specifier is the next available argument slot.

The distribution of DP's is now governed by two principles. The Theta criterion discussed earlier, and now the Case Filter:

65. Case Filter: Each DP has to have its case checked once.

Note that the case filter requires that subjects be in Spec-TP to participate in Nominative case checking, but the Theta Criterion requires subjects to be in Spec-VP to get their Agent role. This tension shows the dual nature of XP's that are both External arguments of the verb and Subjects of a clause. We will not resolve the issue until we discuss DP movement. For now, we will assume that Subjects/Eternal Arguments are in Spec-TP since this is where they are pronounced.

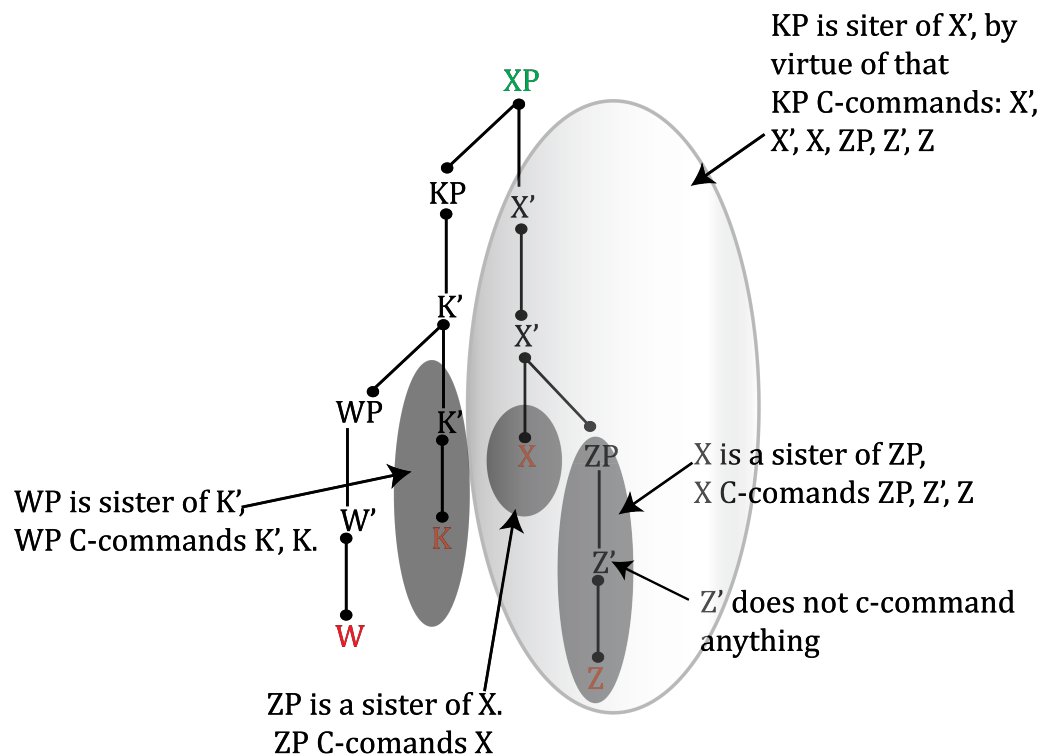
§6 C-Command and Binding

In this section we will explore relations within a syntactic tree and explore their impact on the interpretation of anaphors.

We have argued that sisterhood is a very important relationship between syntactic nodes. It is the basis of modification, head-complement relations, theta role assignment, case, etc. A special kind of relationship resulting from sisterhood is called C-command (from constituent command).

1. C-command

Node X c-commands node Y if every node dominating X also dominates Y, and X does not itself dominate Y.



C-command is connected to sisterhood and dominance. It allows us to capture the fact that sisterhood has repercussions on constituents contained inside the sister nodes. It is uncanny but C-command can account for the distribution of anaphors, that is elements like the pronouns: him, her, he, she, etc.; the reflexives: herself, himself, themselves, etc., and reciprocals like: each other. Before we discuss C-command restrictions, we need to establish a few principles of how we encode intuitions about anaphor interpretation. First, we use indices to show the co-reference of an anaphor:

2. John₁ said that he_{1/2} is smart

Indices are written in subscript under the Lexical Item we want to mark. In example (2) *John* is the **antecedent** of the **anaphor** pronoun *him* if their indices match. We can use numbers or letters as indices. Their value is irrelevant. What is crucial is that they match. When indices do not match, we assume the pronoun has an antecedent in the discourse, but not the sentence. Note that such an interpretation is possible for pronouns, but not anaphors like reflexives or reciprocals:

3. a. John₁ calls himself_{1/*2} smart
b. [John and Mary]₁ call [each other]_{1/*2} smart

When an interpretation is impossible, we place an asterisk next to the index that represents the impossible interpretation. Sometimes, there is no possible interpretation:

4. John₁ said that himself_{*1/*2} is smart

The question to ask here: is there a principled distribution of pronouns, reflexives, anaphors? The answer is: yes there is. Note that comparing 2 and 4, repeated as 5 below, we see that, when a pronoun is possible with an antecedent, a reflexive is usually not.

Furthermore, when a reflexive is possible with a certain antecedent, a pronoun is possible, but not with that antecedent as shown in 6:

Pronominal possible -> reflexive not

- 5. a. John₁ said that himself_{*1/*2} is smart
- b. John₁ said that he_{1/2} is smart

Reflexive possible -> pronominal not with same antecedent

- 6. a. John₁ calls himself_{1/*2} smart
- b. John₁ calls him_{*1/2} smart

There seems to be a kind of symmetry in the distribution of both anaphors. Note that there are other factors that have to be met in order to have an anaphor antecedent relationship.

The anaphor has to agree with the antecedent, usually in gender, number:

- 7. a. John₁ likes herself_{*1/*2}
- b. Susan₁ said that he_{*1/2} is smart

Agreement has to be controlled for, otherwise it will muddle figuring out anaphor distribution. Returning to our symmetry of distribution, we see that it appears to be sensitive to clause distance. In 5, the anaphor is in a different CP than the antecedent. In 6, the anaphor is in the same CP as the antecedent. One might speculate that this is the crucial factor distinguishing reflexives from pronouns. Reflexives have to be in the same CP as the antecedent, pronouns cannot. That is why a reflexive cannot have a discourse antecedent, because it would not be in the same CP, yet a pronoun can, but does not have to. This proposal seems to account for 5 and 6, but not for 8 below:

8. a. [Roger₂'s brother]₁ likes himself_{1/*2/*3}
 b. [Roger₂'s brother]₁ likes him _{*1/2/3}

In 8a, the reflexive is in the same CP as both DP's *Roger* and *brother*. And yet only one DP=*brother* can be the antecedent of the reflexive! Also, in 8b, both antecedents *Roger* and *brother* are in the same CP as the pronominal anaphor. Yet the pronoun *him* can refer to *Roger* in (8b)! This might be attributed to the intervening DP *brother*. The rule might be that pronoun cannot immediately follow the antecedent in the same CP. This does not seem to be the case:

9. Roger₂ from Jack₁'s apartment likes him _{1/*2/3}

In example 9, the antecedent has to be the DP *Jack*, which is immediately preceding the pronoun *him*.

This means that we cannot capture the difference between the distribution of pronouns and reflexives by just referring to CP containment and linear adjacency. We need something more. The answer is C-command.

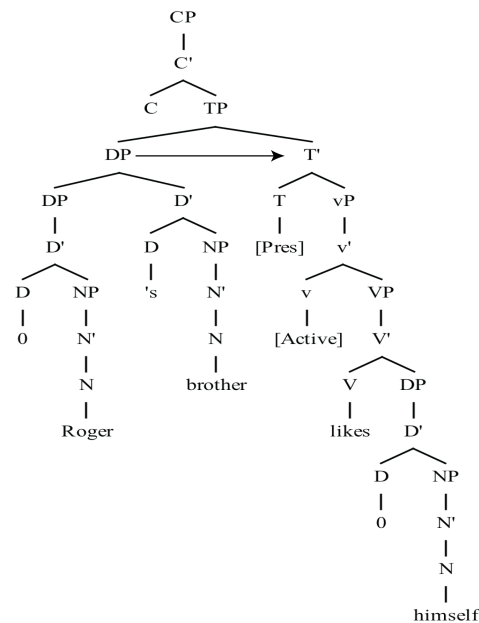
Binding Conditions.

Condition A

A reflexive, reciprocal requires a C-commanding antecedent within its Binding Domain (CP).

10. [Roger₂'s brother]₁ likes himself_{1/*2/*3}

The arrow indicates the sisterhood relationship that triggers C-command of the reflexive.

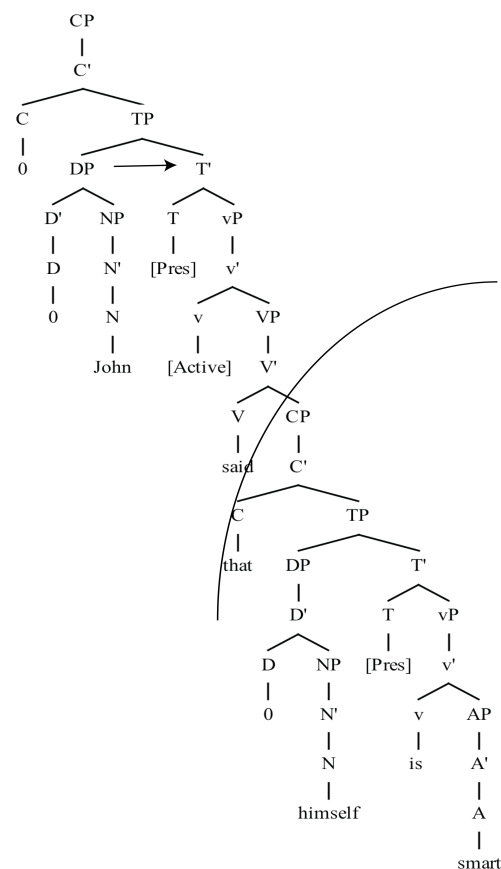


Note that the distribution of reflexives requires both a C-commanding antecedent and one that is in the same CP. The latter is needed to account for:

11. John₁ said [_{CP} that himself_{*1/*2} is smart]

The reflexive is impossible here, although *John* C-commands it.

In the tree below, the sisterhood relationship triggering C-command is indicated with an arrow. The arc is the Binding Domain. As you can see, the reflexive has no antecedent - its binding domain and C-command by the DP *John* is insufficient.



As a side note, notice that *is smart* is drawn as a vP and not VP. There is no verb here, just an auxiliary and Adjectival Phrase. The subordinate clause does not mean that *John exists* and *John has the property of being smart*. It only means the latter.

Condition B

A pronoun requires:

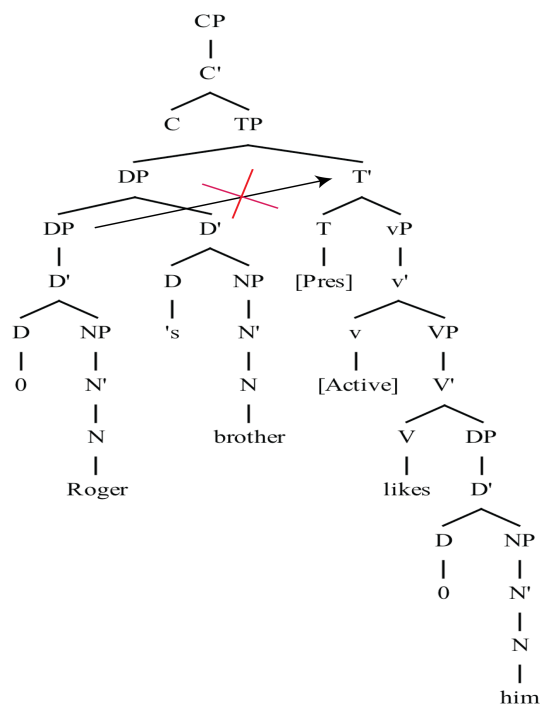
- **within** its Binding Domain (CP) a **non** C-commanding antecedent, and
- **outside** its Binding Domain (CP) **any** appropriate antecedent

We see that Binding Condition B has two disjoint subparts. Within CP, a pronoun cannot be C-commanded by its antecedent. But outside CP an antecedent can, but does not have to, C-command the pronoun. Note that a discourse antecedent is also outside CP.

That is why:

[Roger₂'s brother]₁ likes him ^{*1/2/3}

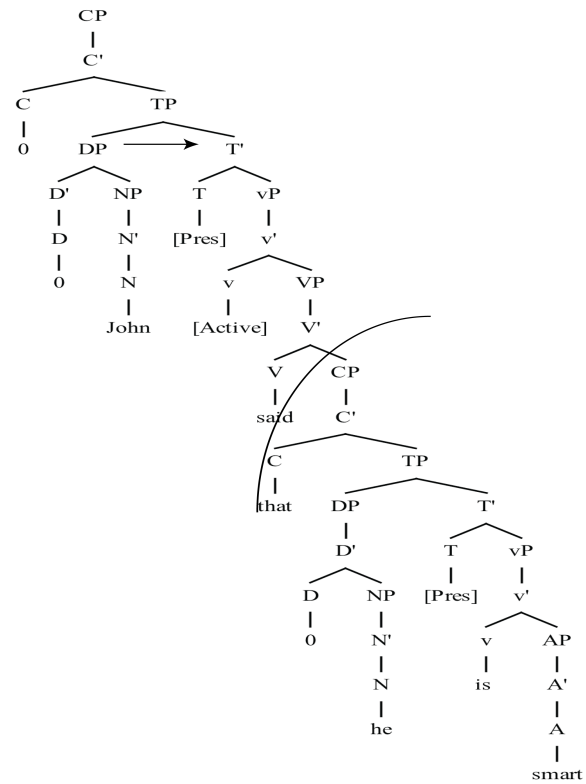
Since *Roger's brother* does C-command *him* but *Roger* does not (shown by the crossed out arrow):



The above is accounted for by the first part of Condition B.

The second part accounts for:

John₁ said that he_{1/2} is smart



In the above, the pronoun is in a different CP than the Antecedent DP (shown by the arc). And even though the DP does C-command the anaphor pronoun (shown by arrow indicating sisterhood that triggers C-command), because there is a CP which the anaphor pronoun does not share with the antecedent, co-indexation is possible.

Condition C

A referring expression must not have an antecedent.

Referring expressions are NP's that are not anaphors: John, Paris, Susan, Man, Dog, etc.

Condition C is required to account for examples like:

John₁ hates John_{*1/2}

where we see that a referring expression cannot have an antecedent.

§ 7 Movement preliminaries

This chapter is the first of three where we will tackle the question how does syntax manage contradictory requirements imposed on its computational system.

The intuition which we are going to explore is that syntactic relationships extend beyond those that involve building phrase structure and providing constituency. For one, we see that syntax combines phrases together to create a template for the computation of meaning relationships. These relationships do not span across many phrases, but rather are local - sometimes within one given phrase. For example, we cannot use the word 'green' to modify 'bridge' in the following expression:

1. John read a green book under a bridge

This might appear to be an obvious point, but sometimes it useful to ask the question, why is that impossible: why 'green' cannot modify 'bridge' in (1). The answer is, modification is not local enough between 'green' and 'bridge' in (1), but local enough between 'green' and 'book'.

We will argue that syntax can encode relationships between Lexical Items *only locally*. To be more precise let me define locality as:

2. Locality to a head X is:
 - a. Sister of X (most local)
 - b. Specifier of XP (less local than a)
 - c. Adjunct/Modifier of X' (less local than b)

Being an argument of X means being either in Spec-XP or sister of X. Being a modifier of X means being sister of X' and daughter X'. This is something we assumed in previous

chapters. Now we will extend this notion of locality to other relationships. For example theta-role assignment, case, agreement, question marking.

I. Theta role marking

We have argued that every DP requires a theta role. Arguments of the verb get theta roles from the appropriate verb, arguments of propositions get a theta from the proposition. We see that theta role assignment is local in that we cannot switch theta roles in the examples below.

3. John showed Mary that Simon hit Susan

–Cannot swap John-Simon

–Cannot swap Susan-Mary

Example 3 cannot mean: “Simon showed Susan that John hit Mary”. even when we are not swapping theta roles, long distance theta role assignment seems impossible. For example, we cannot swap ‘John’ with ‘it’ in (4a) to give us (4b).

4. a. It seems that John died

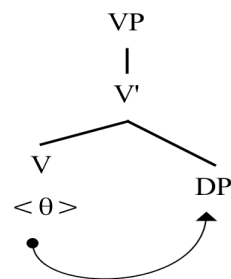
*b. John seems that it died

Again it begs the question why? Especially in (4b) why does ‘John’ need to be in the same clause as the verb assigning it a theta role? There is only one that needs to be assigned by the verb ‘die’, so there can be no confusion. And yet, there appears to be a closeness requirement for theta role assignment. Note, ‘it’ does not have a theta role, since ‘seems’ does not assign one. There is no meaning associated with ‘it’ as previously noted ‘it’ is a dummy placeholder for the subject position. We will return to the role of ‘it’ many times.

Let us assume that theta role assignment is local, just like input to compositional semantics.

For example, we will propose that inner arguments receive their theta roles under sisterhood with their main verb. This captures the close relationship that a verb has with its inner argument.

5. Inner argument theta-role assignment by a verb under sisterhood.



The theta role of the inner argument of the verb is more sensitive to the type of verb than the external argument theta role. For one, main verbs differ how many inner arguments they have (intransitive vs. transitive vs. ditransitive).

6.
 - a. I slept
 - b. I read a book
 - c. I gave Mary a book

But there is always one external argument.

Different theta roles their internal arguments are closely correlated with different main verbs. In other words, verb variation triggers variation of types of inner theta roles:

7.
 - a. John photographed Boston (theme)
 - b. John visited Boston (location)
 - c. John terrorized Boston (experiencer)

That is not to say that external arguments cannot vary in theta roles, just that the variation is more limited.

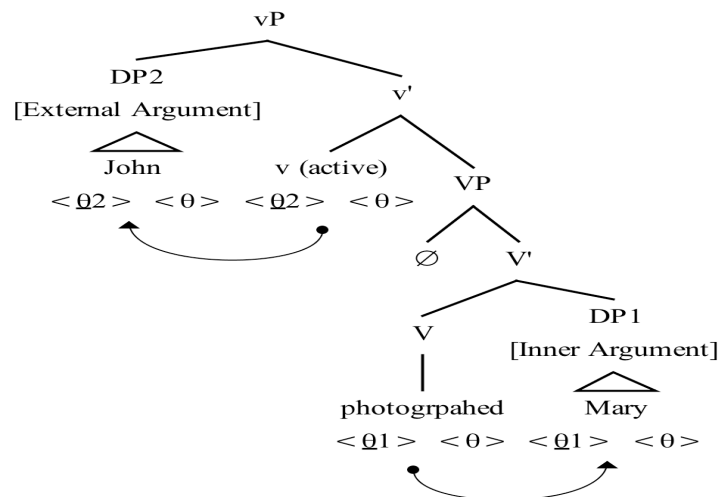
That begs the question where external arguments receive their theta role? One possible suspect is Spec-VP, but there are reasons to suspect that this is not the case. I will use just one. We have an active *v* head that selects the VP when the sentence has a subject. The arguments for a *v* head encoding active/passive were discussed in previous sections. Suffice to say, we have a verb 'to be' that shows up when we see have a passive counterpart of an active sentence:

- 8. a. John photographed Mary
- b. Mary **was** photographed

The form 'was' is assumed to be the *v* head selecting the VP with the verb 'photograph'. Note that passive formation involves getting rid of the External Agent theta role. This leads us to suspect that *v*(active/passive) is the verb that is involved in assigning a theta roles to the external argument. After all, when it changes the theta roles also changes from Active to none. This is the same logic that we used to argue that inner theta roles are intimately involved with the main Verb!

Thus let me suggest that the external Agent argument gets its theta role from little *v* (active). The complement position is taken by the VP, but Spec-*v* is free.

9. Theta role assignment



But if we put the subject in the specifier of one of the vP's or specifier of VP then we get the wrong word order:

*10. Will John photograph Mary

We know from previous sections that 'will' is in T. Example (10) is not the statement 'John photographed Mary' but rather question asking about that statement.

Moreover, we have argued that subjects have to be in Spec-TP for reasons which involve the Extended Projection Principle:

11. EPP

Every Tense phrase has to have a DP in its specifier.

EPP has to be independent of Theta roles. Why? Well we see it in action in cases where no theta role is assigned:

12. a. It will rain
c. It will seem that John is happy

In (12) the 'dummy' expletive 'it' has no theta role. And yet occupies a position that looks like Spec-T.

The nature of EPP is debated, one possibility is it is connected to case. Nouns which are in Spec-T are marked for Nominative case. In English this marking shows up on pronouns:

13. He will photograph her

Note that case can vary on the object in languages where there is more than two cases as in English. For example, in Polish we have:

14. a. Jola(nom) kupiła książkę (acc)
Jola bought book
b. Jola (nom) nie kupiła książki (gen)
Jola not bought book
c. Jola (nom) przyglądała się książce (dat)
Jola looked refl book

Note the case varies depending on the type of verb, on whether it is negated, etc. The case of the subject does not. It is constantly Nominative. We will use this as evidence that case of the inner argument/object is assigned within the verb phrase and case of the subject is assigned outside the verb phrase. The most natural candidate is Spec-T. There is also another argument that Nominative Case is associated with tense. Infinitival clauses do not assign Nominative case:

15. a. John expects **her** to read a book
 b. It is important for **her** to read a book

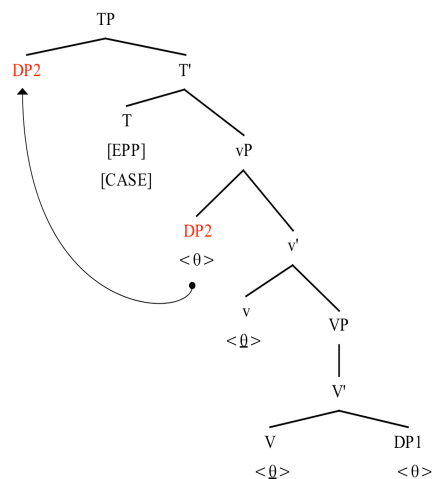
In (15a,b) the Agent of 'to read' is in Accusative case. But this is only because T is occupied by 'to' signaling an infinitival. Example like (15) indicate that Tense is crucial in assigning Nominative case. Note that case has to be assigned locally, otherwise we would not have nothing preventing from T assigning Nominative case to the object inside the verb phrase.

- *16. Her photographed **he**

This means that the subject needs to be in Specifier position of the verb phrase to get a theta role, and at the same time in the specifier position of TP for case EPP. It has to be in two local configurations at the same time.

II. Movement

17.



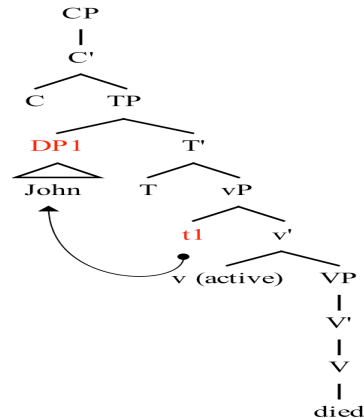
A relationship where a given constituent is in more than one local configuration will be called **Movement**. It has to be stressed that movement is not motivated by getting 'the right'

word order. It is always motivated by some trigger on a head that requires a local configuration. Examples of such requirements are:

18. v-> theta role
T -> EPP/Case

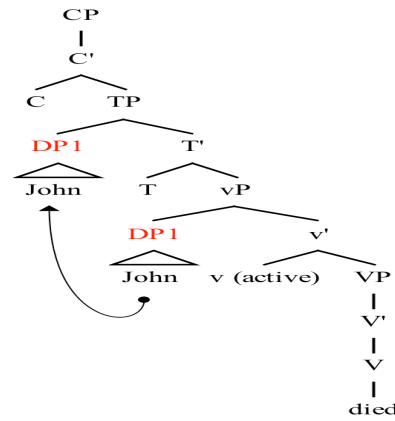
Movement leaves what is called a **trace**. Usually, that is marked by the letter 't' and co-indexed with the full representation of the moved item at its final destination. We will adopt this notation where using more complex examples. *For now, I will use arrows to depict movement and give the representation of the moved item either in its base position or where it ended up being moved.*

19. The usual way to draw movement.



The nature of the trace is debated. We will assume one school of thought where a trace is a copy of the moved item. The copy is not identical, they will differ in what feature licensing configurations they participate in. SO in (19) below the lower copy in Spec-v participates in theta role marking, whereas the upper copy participates in Case and EPP.

20. Copies



Movement should not be considered a real time operation. There is no time t_1 where DP is in Spec-v and a later time t_2 where DP is in Spec-T. Rather, movement is an encoding of a sequence of operations that culminate in being a position that allows for that item to be pronounced.

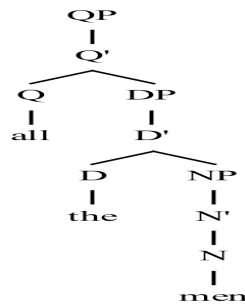
Movement can leave visible breadcrumbs. Consider the following expression.

21.
 - a. All the men must have been going home
 - b. The men must all have been going home
 - c. The men must have all been going home
 - d. The men must have been all going home

'All' is allowed to be below T and $v(\text{perf})$ and $v(\text{prog})$. But the meanings of (21) are the same! All modifies [the men]. If we are to maintain modification as a local process then we must say that in all the examples in (21) there was a point where 'All' was modifying [the men]. In order to do that we have to revise our notion of what quantifiers are. I mentioned in section (3) that we assume them to be determiners, but that we will revise this later.

Well this is the time to revise it. 'All' cannot be a D since it selects a DP, instead we assume that quantifiers have their own phrase, QP and that Q selects DP.

22. QP

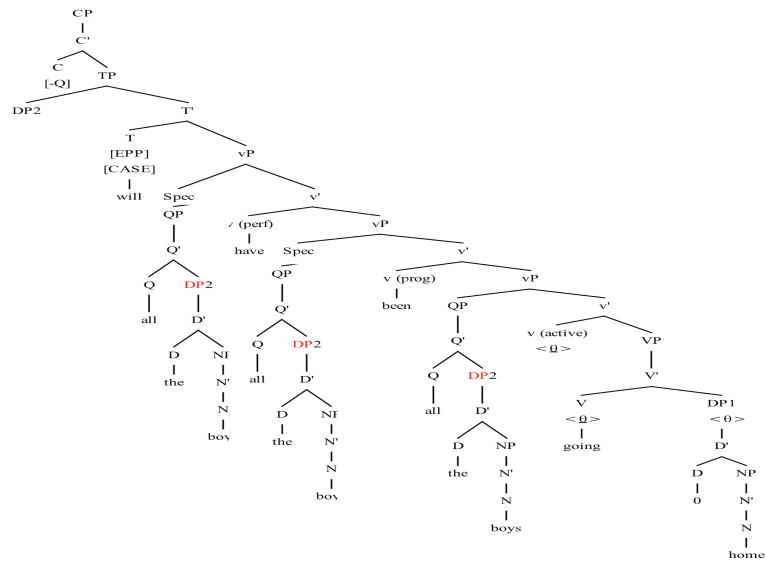


But how can QP be left behind by the DP, and why in different positions. We will return to this in later sections. For now notice, that we can account for (21) if we assume that QP is in Spec-v (active) and moves through every specifier on the way to Spec-T. At any point in that movement DP can separate from QP and move on its own. Why? because Nom Case and EPP requires a DP. It can also accommodate a QP with a Dp complement as seen in (21). But the presence of the DP is essential. 'All' on its own cannot satisfy EPP and get case for DP:

*23. All must have been the boys going home

So the derivation of the examples in (20) involves copies of the QP and at some point the DP separates from the QP. Below is a derivation of

24. The boys will all have been going home



I will return to DP movement. For now let us assume that there is always movement of the DP in Spec-v(active) to Spec-T. We will need this to discuss Head movement.

§7.1 Head movement

Let us outline the main assumption that we will pursue.

1. We can move

–X (a head)

–XP (a phrase)

2. Movement is triggered by Morphology Syntax semantics

–Case (Morphology)

–EPP (Syntax)

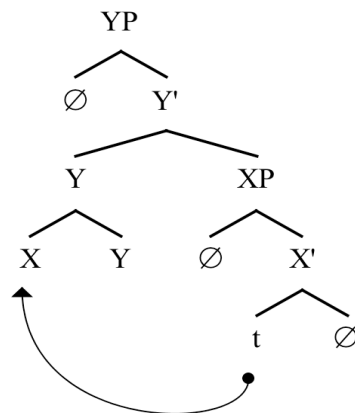
–+Q (Semantics)

3. Deep structure is the level of representation where theta role assignment is carried out – semantic encoding of arguments

4. Surface structure is where all movement operations have applied – all morphological, semantic and syntactic requirements are satisfied

Head Movement is movement of X to a position Y where there is no PF material in Y. It has to be stressed Movement is not word formation, rather Head movement adjoins head to a head.

5. Head adjunction



In the above the head X adjoins to head Y creating a new head Y. I know it is circular and non-well formed set. And yet Y is clearly defined in each position. First, as a sister of X, and then as a mother of X.

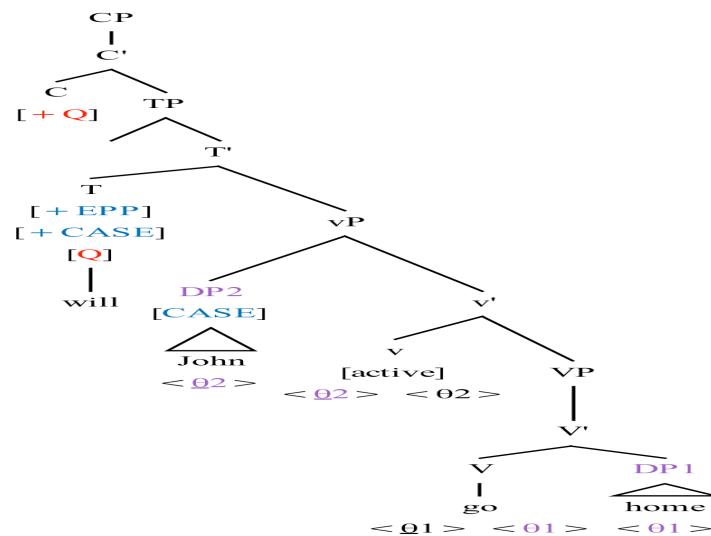
Head movement is triggered by the features of the destination position. Features include for example: +Q on C, Tense on T. Note we would not talk about head movement without phonetically null LI's. Since without null LI's there would be no position to move into.

One instance where we see head movement is Question formation. Consider the examples below:

6. Q. **Will** John go home?
 A. John **will** go home

The question in (6) is related to answer in (6). For one the that roles are the same. Also the truth conditions for (6Q) are determined by (6A). Let us assume that the structures have a common Deep Structure from which both constructions are derived.

7. Deep structure of: **Will** John go home?



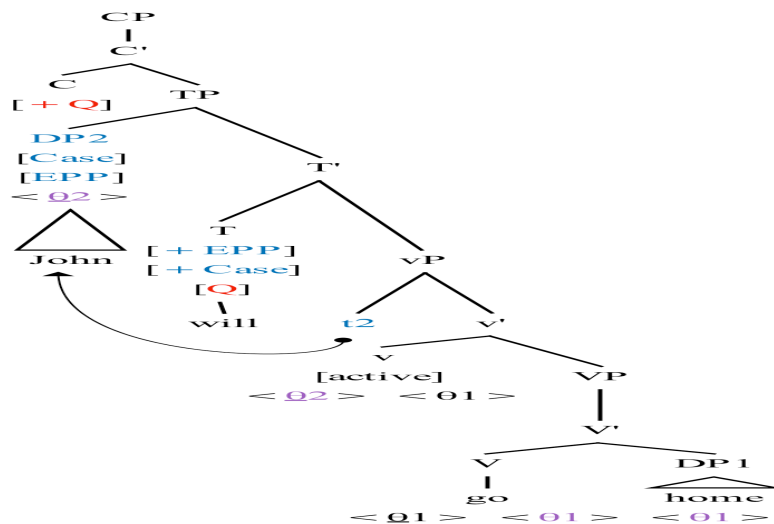
Note the presence of +Q on C. That is feature which encodes the information that the clause is a question. We argued that C is a locus of Assertion/Question by looking at the types of complementizers. We had:

8.
 - a. C= that (assertion) "John said that Mary will go home"
 - b. C= 0 (assertion) "John said Mary will go home"
 - c. C= if (question) "John asked if Mary will go home"
 - d. C= T (question) "John asked will Mary go home"

As we can see (8d) is peculiar. We do not want to assume that Tense can be a complementizer, and yet LI's in T can surface in C but only in yes/no questions. I will suggest that T can be endowed with a feature that can satisfy [+Q] on C that has no PF

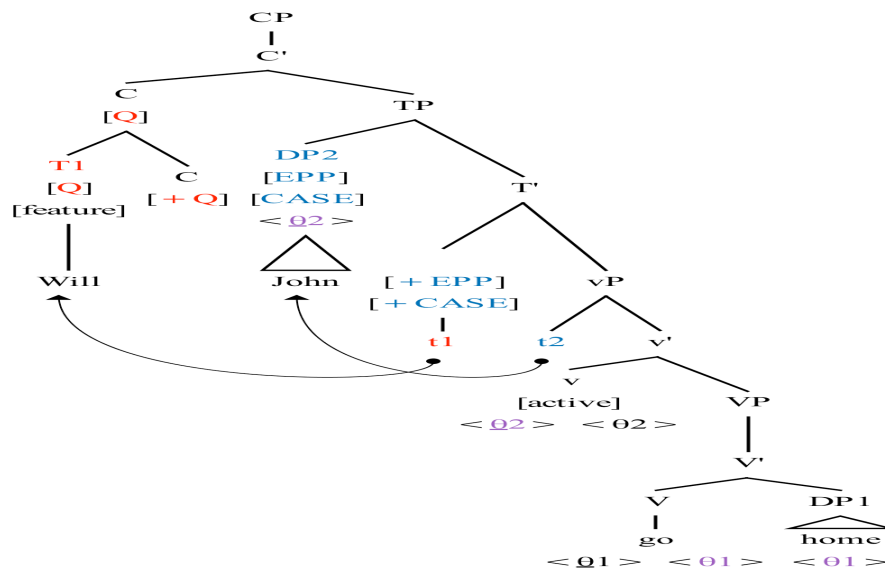
material, we will call it [Q]. The problem is that T is not locally positioned with respect to C. Furthermore, T has its own features that need to be satisfied by a DP (EPP and Case). So before T satisfies the [+Q] requirement on C it has to have its own requirements satisfied. Hence DP movement to Spec-T:

9. DP movement for Case and EPP



Once T has satisfied its own feature requirements it can now accommodate C.

10. T to C movement triggered by [+Q] on C.

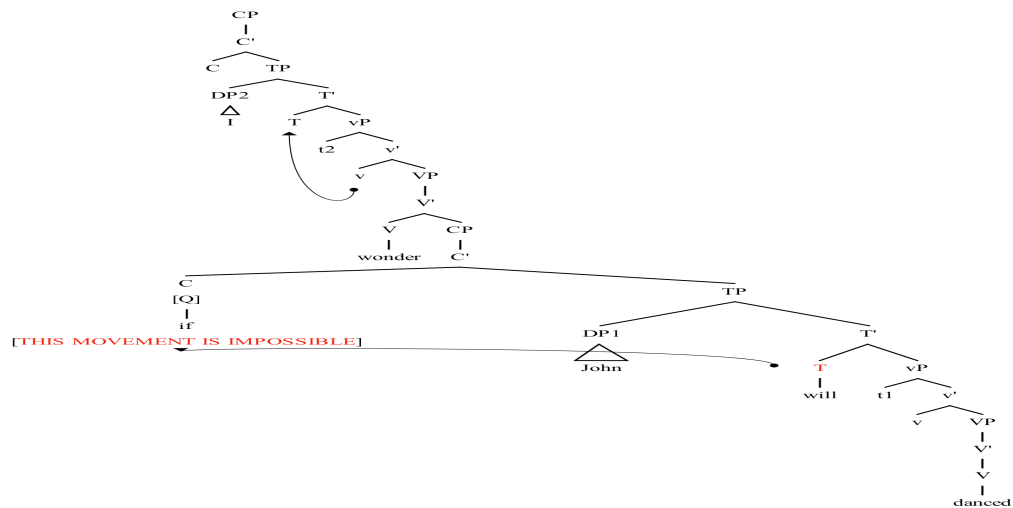


How do we know that T has to move to C in yes no question. Why no just assume that the subject can optionally stay in Spec-v? Well let us look at the interaction of the question complementizer headed by 'if' with T to C movement. If there is no T to C in questions then we predict that yes/no question can have the 'if' complementizer co-occur with subject tense inversion. After all T does not move to C so 'if' is not in the way. The word order is achieved via not moving the DP. This is impossible:

11. a. Will John go home
- b. I wonder will John go home
- c. I wonder if John will go home
- *d. I wonder if will John go home

If C has PF material there is no Subject/tense inversion. This strongly suggests that T moves to C in Yes/No questions.

*12. I wonder if will John dance



The above example involves movement being driven by a semantic trigger, namely [+Q] on C. How about a morphological trigger? We saw that Case, can be one of the triggers for DP movement to Spec-T. Can morphology also drive head movement? The answer is yes. [Tense] feature on T triggers movement of the topmost v to T. Movement of the topmost v to T accounts for the fact that when we have a perfective, progressive, or passive overt auxiliary it is inflected for tense and the main verb is not (note it does not account for why when there is more than one auxiliary both can be inflected for tense).

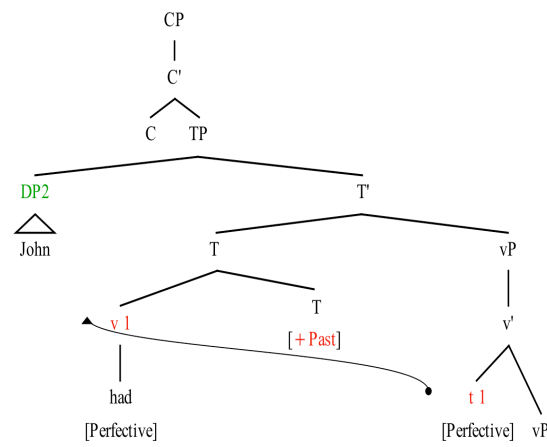
13. a. John had/has danced (perf)
- b. John is/was/ dancing (prog)
- c. Mary is/was photographed (passive)

When tense occupied the following v is not marked for tense:

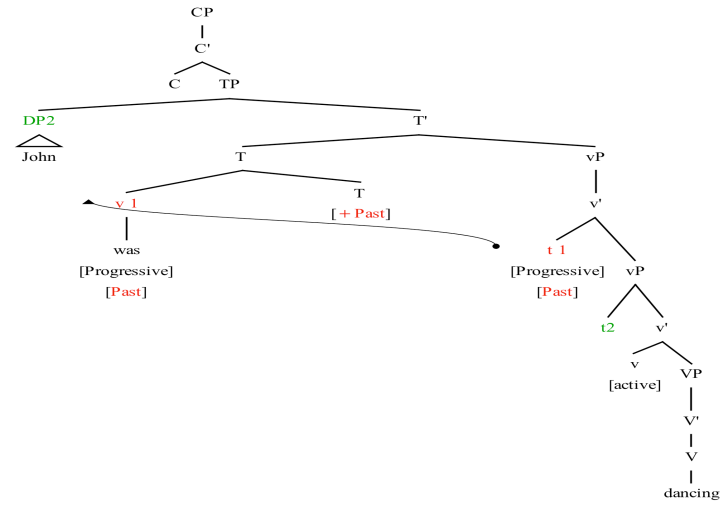
14.
 - a. John will have danced (perf)
 - b. John will be dancing (prog)
 - c. Mary will be photographed (passive)

We can thus assume that there is a [+Tense] feature on T that when there is no PF material requires v movement T.

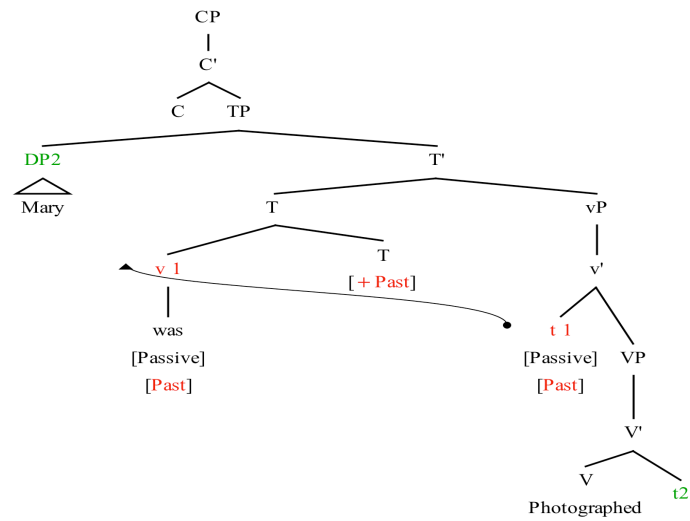
15. v(perf) ->T



16. $v(\text{prog}) \rightarrow T$



17. v(pass) -> T



The fact that *any* topmost *v* can move to *T* suggests that we were right in classifying the perfective, progressive and passive auxiliaries as little *v*. At some level, these three types of auxiliaries have to be labelled as identical.

II. Sequence of movement $v \rightarrow T \rightarrow C$

In the previous sections I suggested that there is $T \rightarrow C$ movement driven by a $[+Q]$ feature on *C*, and $v \rightarrow T$ movement driven by a $[+Tense]$ feature on *T*. The natural question to ask is whether the two operations interact? The prediction is that $v \rightarrow T$ when followed by $T \rightarrow C$ will have *v* ending up pronounced in *C*. This is precisely the case.

- 18. a. Had John danced
b. John had danced (perf)
- 19. a. Was John dancing
b. John was dancing (prog)
- 20. a. Was Mary photographed
b. Mary was photographed (passive)

We see that in the (b) examples we can have different types of *v* pronounced in *C*. This will be argued to involve $v \rightarrow T$ movement triggered by *Tense*, and subsequent $v+T \rightarrow C$ movement triggered by a *Q* feature on *C*.

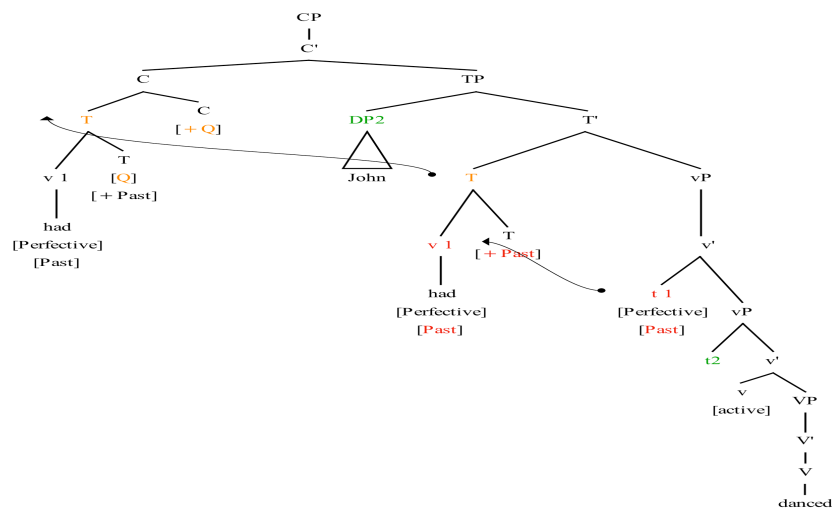
Note that we can test if $v+T$ is in *C* the same way as we checked for pure $T \rightarrow C$ movement, by looking at subordinate clauses with the complementizer 'if'. The logic behind such a test is that if Head movement cannot raise to a position where there is PF material present, then having a complementizer in *C* should block inversion of *T* with the subject. This is precisely the case. We see below that we can have a complementizer 'if' (a examples) , we can have a

v+T above the subject (b examples), but we cannot have both the complementizer and v+T in C (c examples).

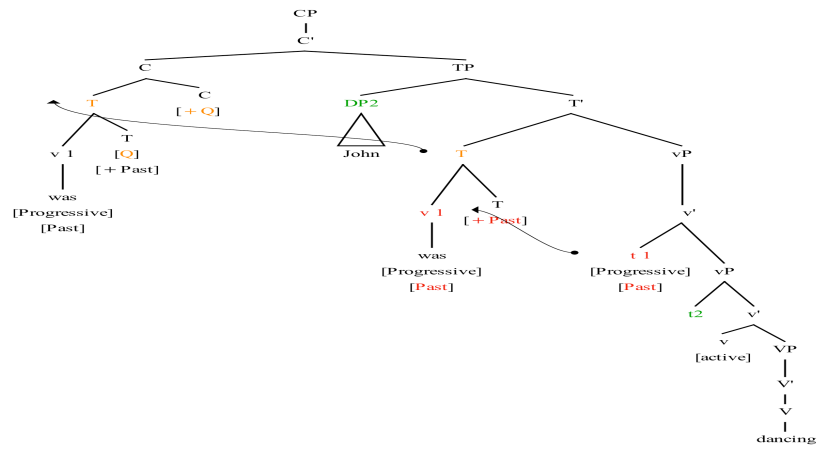
21. a. Josh wondered if Mary had danced
b. Josh wondered had Mary danced
*c. Josh wondered if had Mary danced
22. a. John wondered if Mary was dancing
b. John wondered was Mary dancing
*c. John wondered if was Mary dancing
23. a. Josh wondered if Mary was photographed
b. Josh wondered was Mary photographed
*c. Josh wondered if was Mary photographed

The derivations of the appropriate v->T->C structures are given below.

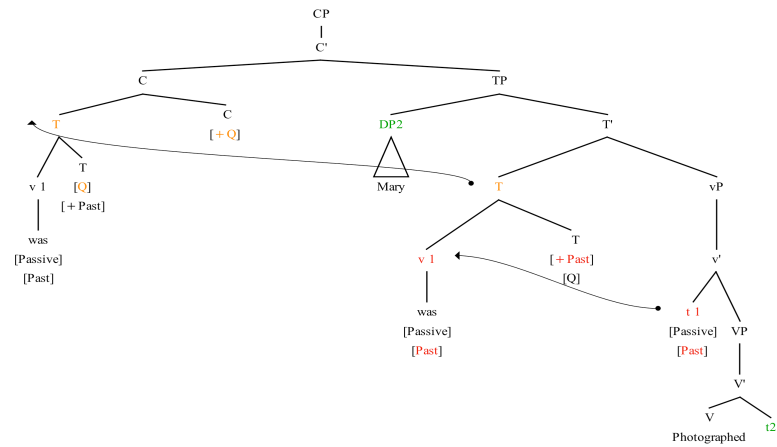
24. $v(\text{perf}) \rightarrow T \rightarrow C$



25. v(prog) ->T -> C



26. v(pass) ->T -> C



III. Relativized Minimality

What happens if we have more than one v? Can we move the lower one above the higher one? The answer is No, we cannot.

27. a. Had John been dancing
 *b. Been John had dancing

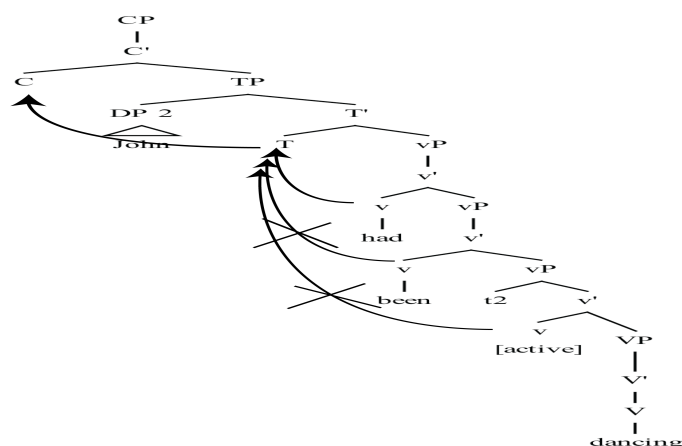
Only the topmost v moves to T and then to C. Head movement is blocked if there is a head filled position on the way.

28. Relativized Minimality (RM) for head movement

Head movement has to proceed through every possible landing site.

RM combined with the fact that you cannot move PF material into a spot where there is PF material derives the fact that we cannot move progressive v above perfective v.

29. Relativized Minimality in Action



What about the main verb? Can it move above *v*, or can it move to *T* at all? It would seem since *V* is a different category than *v* that we should move the main Verb. But it appears that this is not the case. Relativized Minimality considers *V* movement to *v* as a possible landing site. In English for some reason main verbs do rise, but they do in languages like French. But only if there is no auxiliary in *v*. We see that in English we do not have *V*->*T* and thus no *V*+*T* ->*C*. But in French we do, hence we can invert the main verb with the subject in French but not in English.

*29. Danced John?

30. Dansez vous ?

Dance you

'Do you dance'

But if there is an auxiliary, even the main verb in French does not raise to *T*, and thus cannot subsequently be moved when *T* moves to *C*.

31. a. Avez vous dansé

have you danced

*b Dansé vous avez

danced you have

'Have you danced'

The above shows that English main verbs (*V*) do not undergo head movement, but French Main verbs do. How do we know it is the main verb *V* moving and not the whole *VP*. We can see that the inner argument can be left behind.

32. John **lit souvent des livres**
John reads frequently the books
'John frequently reads books'

*33. John reads frequently books

French adverbs can separate 'read' from its complement 'books'. English cannot. This shows that in French the Verb moves to Tense leaving behind the VP containing the object. However, when there is an overt auxiliary in v, main verb movement is no longer possible.

34. a. John **avait souvent lu des livres**
John has frequently read the books
"John has frequently read books"
- *b. John **avait lu souvent des livres**
John has read frequently the books
"John has frequently read books"

Since in French an Auxiliary blocks movement of the main verb we can suspect that Relativized Minimality is a Universal Constraint on Movement.

The above data also suggests that Head Movement is parameterized by language. However the variation is not free, there is only limited room for variation, which is probably a reflex of the morphological richness of the main verb. English main verbs are poorly inflected compared to the French counterparts.

The last question we want to consider is what happens when there is no PF material in any of the v positions occupied by auxiliaries, but we want to ask a Yes/No question in a simple clause like:

35. John danced

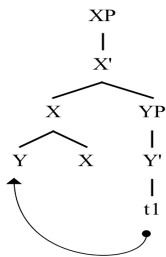
English seems to deploy a dummy 'auxiliary' that is in T as a Last Resort to save the derivation. "Do" spells out Tense information and participates in T->C movement:

36. Did John dance.

§8. DP movement

In the previous section we discussed movement of a Y head to a X head position:

1.



The first thing we noticed is that head movement targets Y^0 categories and moves them to position occupied by other heads, in this case X^0 . The second thing we noticed is that head movement looks like word formation, just in the syntax. Note, Y attaches to X and forms X. What does that look like? Like inflectional morphology, since X and Y stand for word categories just like verb, Tense, Complementizer. Head movement does not change the category of the moved item or the position it is moved to. What it does do is create a complex lexical item that appears to be a fusion of features of two lexical items: the one moved and the one moved to. This fusion is not unconstrained. In English, head movement cannot take place if the landing site has overt phonological information - we can only move a head into a position occupied by a null lexical item. In other languages, head movement is argued to be able to move to positions occupied by prefixes and affixes. English could be argued to have movement to a head occupied by an affix, that would be the case of past tense T, which might be argued to have an -ed affix, thus:

2. John had danced

Involves 'have' raising from v(perf) to T and attaching to the past affix. The problem is we cannot extend this analysis to main verbs in English since they do not move to T (see discussion on French in previous chapter).

Setting aside the complication with main verbs in English, which by no means is trivial, just hard to solve, we can generalize that head movement moves heads to null head positions.

3. Head movement (X-movement) targets a null head position.

- NEVER a Specifier position.
- NEVER an overt head (one that has an LI with PF features, possible exception bound morphemes like affixes and prefixes)

The obvious second question we have is what drives head movement. We have argued that movement is feature driven and it is the features of the target that drives movement. In the case of head movement those features were Tense, and Question features.

4. Head movement is driven by features on the target: Tense needs verbal elements, a C with +Q needs T.

Why these features and not others?

As far as why a C with +Q needs tense, that is not clear. But T->C in yes/no questions has been attested in many languages. Whatever is driving the operation it is pretty robust.

An easier question to answer is why does little v move to tense, when possible. And why in many languages, for example French, even main verbs move to Tense. What drives verbs to move up the tree all the way up to Tense? The answer lies in how syntax represents information about the verb's semantics and morphology. I have already argued that verbs assign theta roles; I have also already argued that the subject theta roles are assigned by a

separate head headed by a lexical item that is null, when the verb is active, and filled by 'be' when passive.

- 5. a. John likes Mary
- b. Mary is liked by John

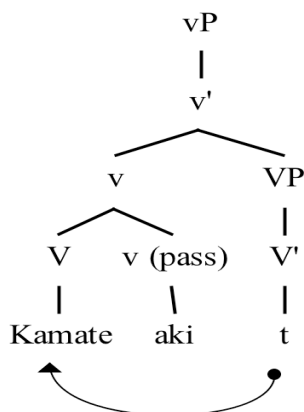
What does that mean? It means that syntax represents the passive/active semantic dimension of the verb 'like' with the help of a functional head *v*. This is in English, in other languages passive does not need to be expressed by a separate auxiliary marker. Consider an example from Kiribatese (Micronesia). [The subscripts indicate verb agreement, ignore them; also ignore the Kiribatese word order. Example from Keenan, Edward L., and Matthew S. Dryer. "6 Passive in the world's languages." (1981)].

- 6. a. E_i kamate- a_j te naeta $_j$ te moa $_i$
it kill-it the snake the chicken
'The chicken killed the snake'
- b. E_i kamate-**aki** te naeta $_j$ (iroun te moa $_i$)
it kill-pass the snake(by the chicken)
'The snake was killed (by the chicken)'

What does that mean? It means that in some languages passive is expressed by morphology on the main verb, nothing else. How do we reconcile our analysis of English where passive/active is expressed by little *v*, whereas in Kiribatese passive seems to be just an ending? One possibility is to say that these languages differ in their syntactic representation, where Kiribatese just lacks a passive/active *v* head. Such a proposal, however, raises the question of how children 'know' when languages have *v*-heads for passive/active, and when do they not know? Let me assume that language acquisition does not involve a child being born with a blank slate, instead a child has some form of UG. Universal Grammar, even in its most rudimentary version implies that a child starts off with some sort of hypothesis as to the phrase structure of the target language. So it is a valid question, do we start with English

which has *v* (passive), or with Kiribatese, which appears not to have a passive/active *v* head? The answer can be determined by looking at what mechanisms we need to assume in order to get to English from Kiribatese and vice versa, from Kiribatese to English. Going from Kiribatese UG to English syntax would be hard for a child since it would mean that children would be able to add abstract *v*-heads. This raises the problem that we would not know when to stop adding all sorts of abstract heads to our inventory of *v*. Conversely, if we assume that UG furnishes us with a *v*(passive/active), as in English, then to get to Kiribatese all we need to have is the main verb move to *v*(passive/active) and ‘pick up’ the affix that head little *v*.

7.



This means that head movement allows us to have a uniform syntax for Kiribatese and English as far as passive/active. Note that we need head movement independently of passive/active in order to account for T->C in yes/no questions. Are there languages where we see yes/no questions via inversion and, at the same time, information encoded by little *v* expressed on the main verb? Yes. My favorite language, Polish, has what can be seen as an approximation of the perfective expressed as a prefix and has inversion yes/no (it also has yes/no via a complementizer in simple questions).

8. a. Jan czytał książkę

- Jan read book
 'Jan read a book'
- b. Jan **prze**czytał książkę
 Jan had+read book
 'Jan had read a book'

In example (8b) you can see that the perfective is expressed by a prefix on the verb. We could claim that Polish just does not have v(perf) and has no need for head movement. But that would pose a problem for the facts below which show that head movement takes place in yes/no questions:

9. a. **Będzie** Jan czytał książkę
 Will Jan read book
 'Will Jan read a book'
- b. **Czy** Jan będzie czytał książkę
 If Jan will read book
 'Will Jan read a book'
- *c. **Będzie czy** Jan czytał książkę
 Will if Jan read book
 '*Will if Jan read a book'

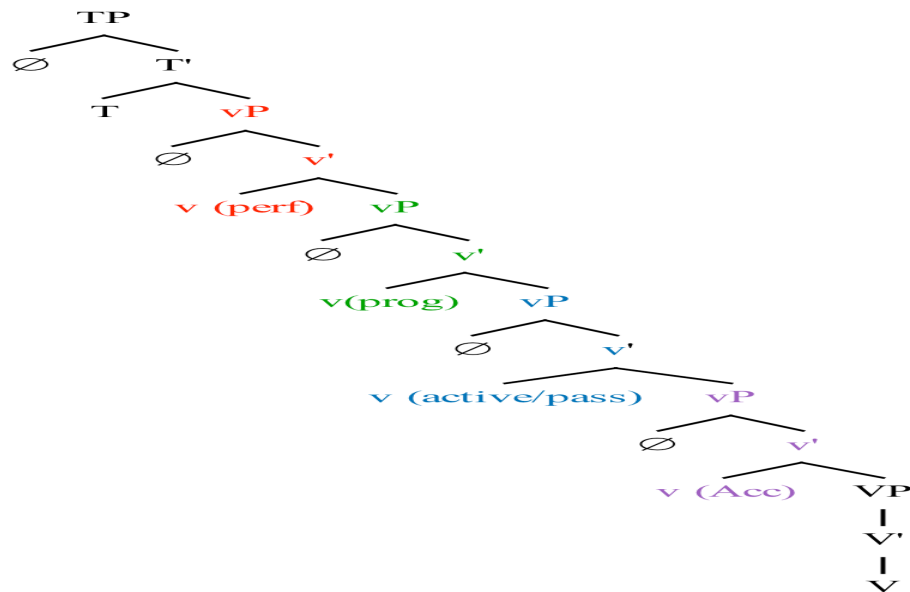
We can see that the future Tense markers invert with the subject in (9a) just as it would in English. Furthermore, we see in (9b,c) that this movement is to C because when C is filled with the complementizer 'czy' inversion is impossible.

Polish has head movement, which means that a child does not need to assume any additional mechanisms for perfective formation that are not present in English. There is v(perf) and the main verb moves to it, adjoining to the prefix. The difference between

Polish and English is that perfective in English is not a prefix, but a independent lexical item and movement to it is impossible.

The above discussion paints a picture where the whole array of v heads above the main verb is an expression of that main verb's morphology and semantics. We can argue that if we find in any language some aspect of the main verb's morphology and semantics expressed as a separate words, like perfective in English, then we need to assume that UG furnishes us with the option that there is a dedicated v head encoding that information. In languages where v shows up as a suffix, we have V movement v, in languages where v surfaces as a word, we cannot have head movement and the main verb's information looks 'dispersed' among different words. [This array of v-head expressing different dimensions of the main verb is going to be called its extended projection.](#) Here is how it will look:

10. Verb extended domain



Most of it was already discussed. The new item is v(acc). We will go over it shortly. It is used

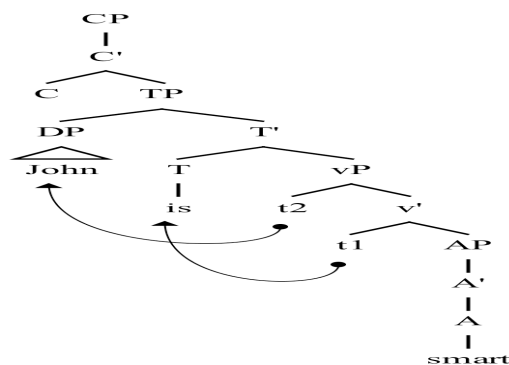
to assign accusative case to the object. I need to stress that not every *v* in this projection shows up in every structure. We already have assumed that *v*(prog) and *v*(perf) show up only if there is a progressive or perfective marker. I have argued that *v*(active/passive) is always there, since every sentence is active or passive. It is a simplification that we will try to maintain, but the picture is more complex since there are clauses that are never passive.

11. a. John arrived
*b. John was arrived
12. a. John is smart
*b. smart was by John

The complication results from the fact that *v*(active/passive) is used here to encode a binary opposition of two structures: passive vs. active and, at the same time, to encode the ability to assign a semantic theta role of an Agent in structures which are called causatives (every causative has an agent - the causer).

I will maintain that *v*(active/passive) is always present when there is a main verb. And in cases like (12a) the *v* always active and takes an AP:

13.



Note that *v*→*T* because *T* is PF empty.

To summarize:

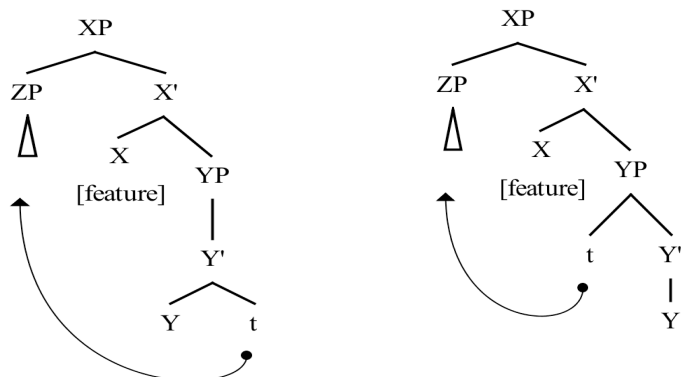
14.
 - a. Head movement triggered by +Q on C forces T->C
 - b. Head movement between VP and TP is triggered by the need to wrap the dispersed information of the main verb on T and different v heads.
 - c. Head movement is blocked if a landing site is already filled by a word
 - d. Head movement obeys Relativized Minimality
 - e. English main verbs do not move to T, instead we insert 'do'
 - f. English main verbs move to v provided they are PF empty

So what about DP Movement?

DP movement does not go to head position.

In our discussion of head movement we assumed that the internal argument DP originates in the Specifier position of v(active) but is moved to Specifier of tense (Spec-T). This section is devoted analyzing XP movement operations like DP movement and differentiating them from head movement discussed in the previous section. Our first observation that we can make is that XP movement targets positions in the tree that are different from positions targeted by head movement.

15. Phrasal movement (XP-movement) targets a specifier position and NEVER a head position, although it is triggered by the features on the head of the phrase that hosts the specifier position.



The grammar appears to have two systems running in parallel, head movement that fuses features on the Lexical level between heads, and XP movement that is also triggered by the features on a head, but feature composition takes place between phrases and not heads. It is not clear or obvious why we have two systems. We can see that head movement within the verb phrase and up to T can be motivated by the need to assemble dispersed features of the main verb. However, it is hard to establish why there is a different mechanism behind Yes/No questions, which are derived via head movement of T to C, and a different mechanism behind satisfying to EPP or Case, namely one that involves movement of whole DP to Spec-T. One possibility is that EPP and Case cannot be satisfied by D, or N since there are feature impoverished compared to a DP. This is the most encouraging line of research, but it requires a much more articulated theory of syntactic features. Until we have one, we will assume a simplified mechanism where:

16. Head movement is triggered by

- a. +Q features on C that require T raising to C in the case of Yes/No questions
- b. +Tense features on T that require a v to raise to T
- c. features on each v that attract the lower v or V to move in order to re-assemble the Verbs semantic/morphological features.

- It is important to note again that head movement cannot proceed if the target head has PF material, unless it is an affix.

- Head movement is constrained by Relativized Minimality. It cannot skip a valid landing site: X^0 - position.

17. XP movement is triggered by

- a. +Case features on v (acc) requiring a DP (acc)
- b. +Case features on T (Nom) requiring a DP (Nom)
- c. EPP on T
- d. Wh-features on C (we will discuss this in the next chapter)

- It is important to note that XP movement targets the Specifier position since this is the only available position in X-bar.

- Furthermore, XP movement cannot take place if the Specifier position is occupied by another XP.

- XP movement is also subject to Relativized Minimality, in this case it requires that an XP move through every possible Specifier position (that is why floating quantifiers like 'all' can be left behind in any Spec- v since the DP modified by 'all' moves through every Spec- v on its way to Spec-TP).

Causatives

The first instance of DP movement we will discuss is Object raising out of the complement position of V. Then we will return to Subject movement to Spec-T.

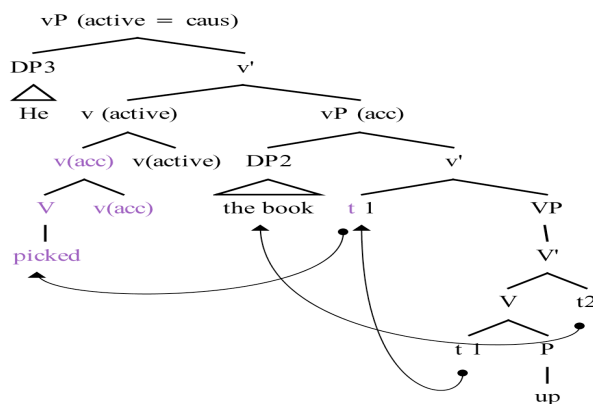
In English, we see that certain particle verbs allow the object/internal argument to separate the preposition from the verb, as in the example below:

18. a. He picked up the book
b. He picked the book up

How come the object can be in between the verb and its particle? We propose that there is a $v(\text{acc})$ head assigning case to objects and, in English, the main verb moves to that head.

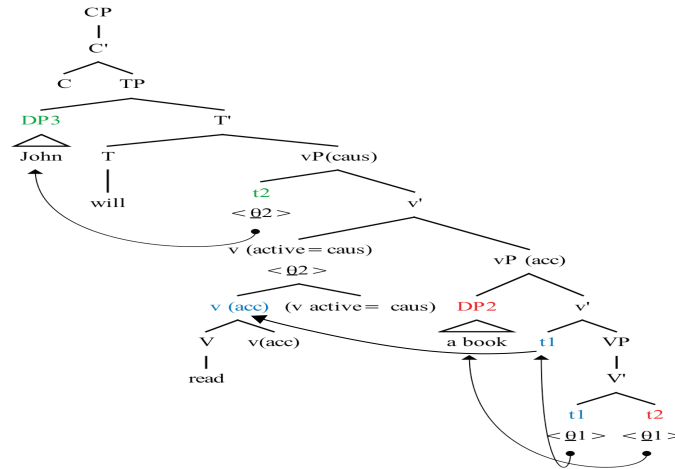
Here is the derivation:

19. Particle verbs (note this is just part of the derivation, subject movement is not shown)



Crucially, preposition verbs are a combination of $V+P=V$ and when we move the main verb to $v(\text{acc})$ and then $(v$ (active), we can either move the V or the $V+P$. However, we would never get the right word order unless the $DP2$ object also moves. Hence evidence for a $v(\text{acc})$ head. We also make the system more symmetrical. In the previous chapter, I have argued that the subject DP gets its theta role in one position: $Spec-v$ (active), but case in another position $Spec-T$. The object was the odd one out, getting its theta role and case in the same position. Now we see that it is not the case, the object gets a theta role as a complement of V and case in $Spec-v$ (acc).

Below is a sample derivation of "John will read a book"



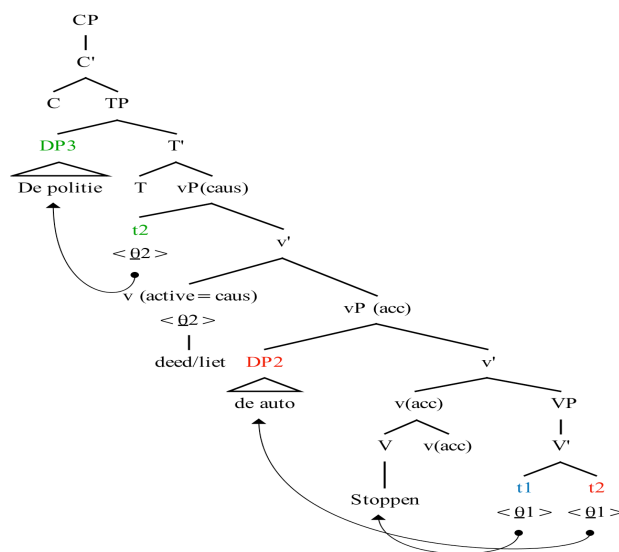
Note that I am suggesting that v (active) is also considered a causative verb. In most cases that means the same thing, and active clause has a causer=agent. We can actually see in languages like Dutch an overt causative v blocking head movement of the verb to v (caus=active). This changes the word order compared to English, since the DP object is raising to Spec- v (acc) but the main Verb is not raising to v (caus). Thus Dutch provides additional support for causative verbs and v (acc).

21. De politie deed/liet de auto stoppen.

the police did/let the car stop

'The police stopped the car.'

Deed/liet are in v(causative)



From the discussion above we can conclude that the notion of subject and object involves derived positions triggered by Case, EPP and Agreement (which we will not discuss much for now). The notion of Internal and External argument is defined semantically as a theta role position and is established not by movement but at Deep Structure.

22. Subject/Object vs. Internal/External Argument

- Both subject and object are structural positions derived via movement
 - subject in Spec-T (Case and EPP)
 - Object in Spec v(acc) (case)
- Internal and External arguments are thematic positions established at Deep Structure
 - External argument Spec-v (caus=active)

- Internal argument Sister of V

Now we are ready to explore mismatches between Internal and External arguments and Subjects and Objects. One of the most obvious ones is Passive.

Passive

It is not always the case that a Subject=Agent(External Argument). Consider the following examples:

- | | | | |
|-----|----|---------------------------------|-----------|
| 23. | a. | He (nom) photographed her (acc) | - Active |
| | b. | She (nom) was photographed | - Passive |
| 24. | a. | I (nom) photographed them (acc) | -Active |
| | b. | We (nom) were photographed | - Passive |

We see that the Patient in Passive acts like a Subject. It gets:

-Nominative case

-Agreement with top v

-Above T:

as in : We will be photographed

How do we derive the Passive from the Active, and why should we? Let me answer the second question first. There is a connection between the a and b sentences in 23 and 24. If the (a) sentence is True, then the (b) one has to be true. The (a) and (b) sentences have the same theta roles and verbs, meaning they have the same Deep Structure. We would like to map both expression from one underlying structure in order to capture these facts that we assume also play a role in language development.

Now how to derive the (b) examples from the (a) ones? The first thing we notice is that:

25.

Little v(active/passive) can have either: +active feature, or +passive feature:

A. When (+Active)

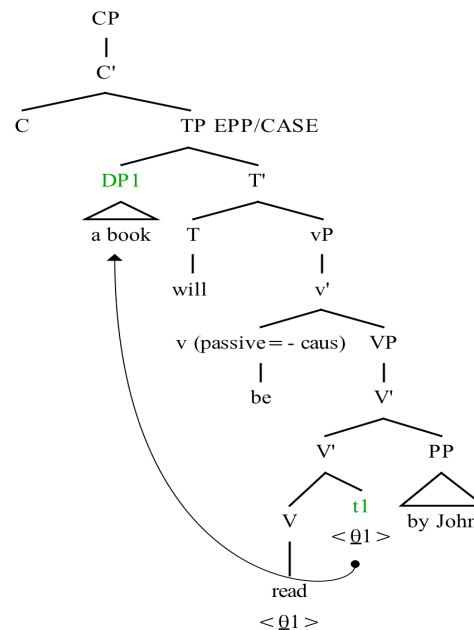
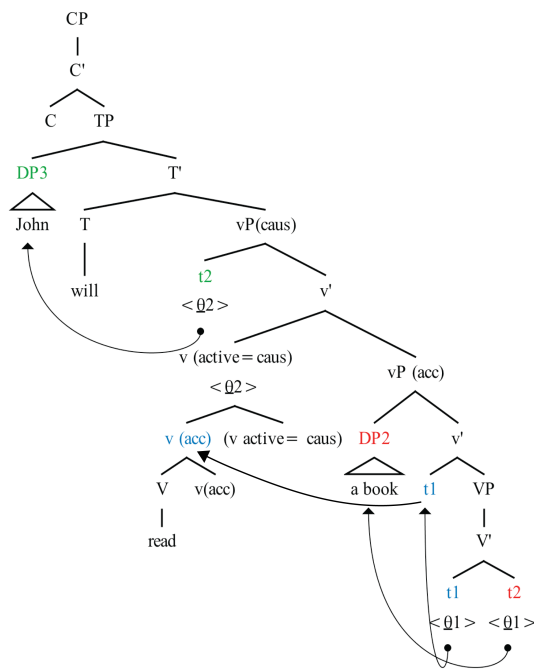
- There is Agent theta role
- There is v(caus=active)
- Agent in Spec-T = Subject
 - gets Nom case
 - verb agrees with Agent
- There is Theme/Patient theta role
- There is v(acc) assigning case, Spec-v(acc) = Object

B. When (+Passive)

- There is No Agent theta role
- There is no v(caus=active) but v (passive)
- There is No v(acc)
- Theme/Patient is in Spec-T = Subject
 - Gets Nom case
 - Verb agrees with it

26. Compare: John will read a book vs.

A book will be read by John



Unaccusatives and Unergatives

The above derivations raise the question whether there are non-passive constructions that also lack a v(caus) and v(acc)? In other words, can we have a passive without an active equivalent? A good theory predicts that if something is allowed, then it should occur. There is nothing in our theory that says only when deriving passive from active we can drop v(acc) and v(caus). Such cases will be called unaccusatives. Consider the following sentences in Italian. We will argue that Molti studenti in Italian below has moved from inner argument position of 'arrive', but agrees with the verb and gets Nom case:

27. Molti studenti sono arrivato

Many students are arrived

'Many students have arrived'

Such verbs will be called unaccusatives, and contrasted with unergatives, like ‘telephone’ where there is no inner argument:

28. Molti studenti hanno telefonato
 Many students have telephoned

The first obvious difference is that the aux is different: “are” in unaccusatives, and ‘have’ in unergatives. There is another difference. So called Ne extraction (Ne is like a floating quantifier: of them)

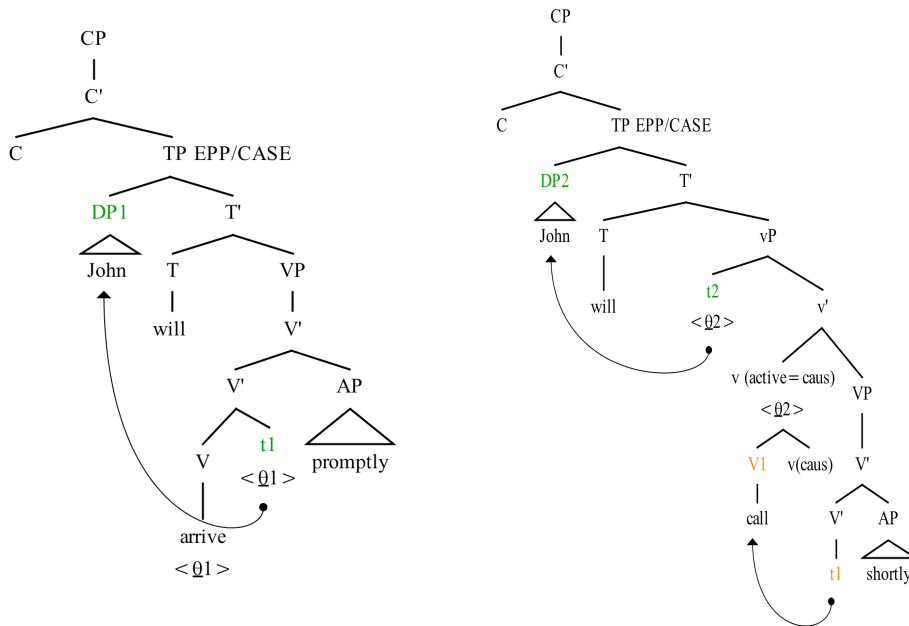
29. a. Ne sono arrivati molti
 Of them are arrived many
 ‘Many of them have arrived’
 *b. Ne hanno telefonato molti
 of them have telephoned many
 ‘Many of them have telephoned’

‘Ne’ can raise out of the DP ‘Ne molti’ leaving ‘molti’ in object position in (a) but not in (b). This is correlated with ‘arrive’ having one **inner** argument, and ‘telephone’ having one **outer** argument. Support for the claim that Ne can be extracted from inner argument but not outer argument position comes from intransitives allowing Ne extraction and transitives (ones that have an outer argument) blocking it

30. a. I bamibini NE mangiano molti
 The children of them eat many
 ‘The children eat a lot of them’
 *b. Molti Ne mangiano gli spaghetti
 Many of them eat the spaghetti
 ‘Many of them eat spaghetti’

In English, we will argue the distinction is the same as in Italian. Hence we derive unaccusatives and unergatives differently:

31.



Unaccusative

Unergative

It is important to note that we have a relationship between the properties of $v(\text{caus})$ and $v(\text{acc})$, a relationship which is defined by C-selection: $v(\text{acc})$ as the complement of $v(\text{caus})$. In light of the above relationship, the observation that we can observe passive vs. active and unaccusative vs. unergative alternations has led researchers to the following generalization:

32. Burzio's Generalization:

When $v(\text{caus})$ is +passive - \rightarrow no $v(\text{acc})$

Thus if a verb does not assign a Agent/Theme theta role it does not assign an Accusative Case as in:

- Unaccustives

- He(nom) arrived

- Passives

- She(nom) was photographed

- Both have no Agent/Theme theta role and inner argument gets Nom case by moving to Spec-T for EPP

Raising.

Let us now return to Subject movement. Consider the following examples:

33. a. John will seem to dance
 b. It will seem that John is dancing

The verb 'seem' does not assign an Agent theta role as (b) shows because of 'it'. This means that in (a) we have one theta role and one DP. But we also have two TP's, meaning two subject positions! One TP headed by 'will,' the other by 'to'. Remember that we have EPP, this is the Extended Projection Principle:

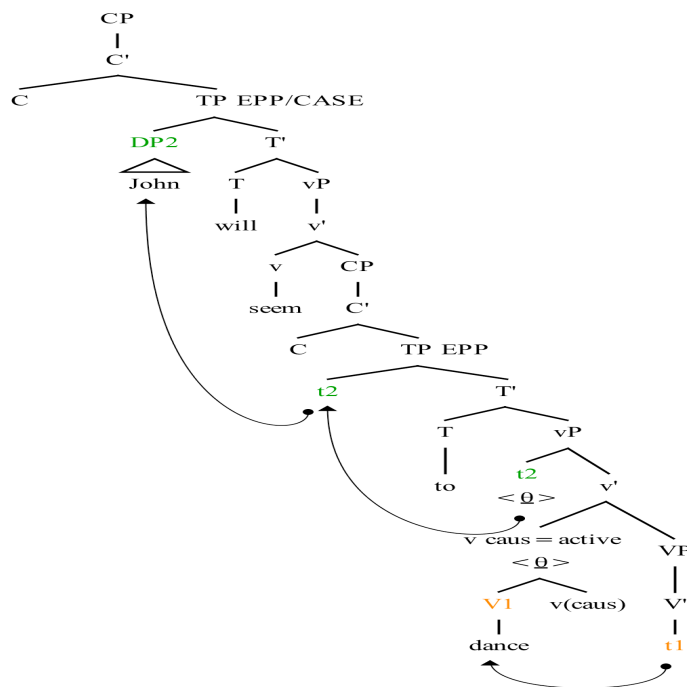
34. Every TP must have a filled Specifier.

As I mentioned, EPP is not well understood. But there is good empirical evidence for it. Cases like:

36. a. It will rain
 *b. will rain

show that even when there is no theta role to assign - it is not an agent or patient - there is still a need to have something in Spec-T. So the question is simple: what is in Spec-T headed by 'to' in (33a)? The answer, the DP trace of 'John':

37. Subject Raising



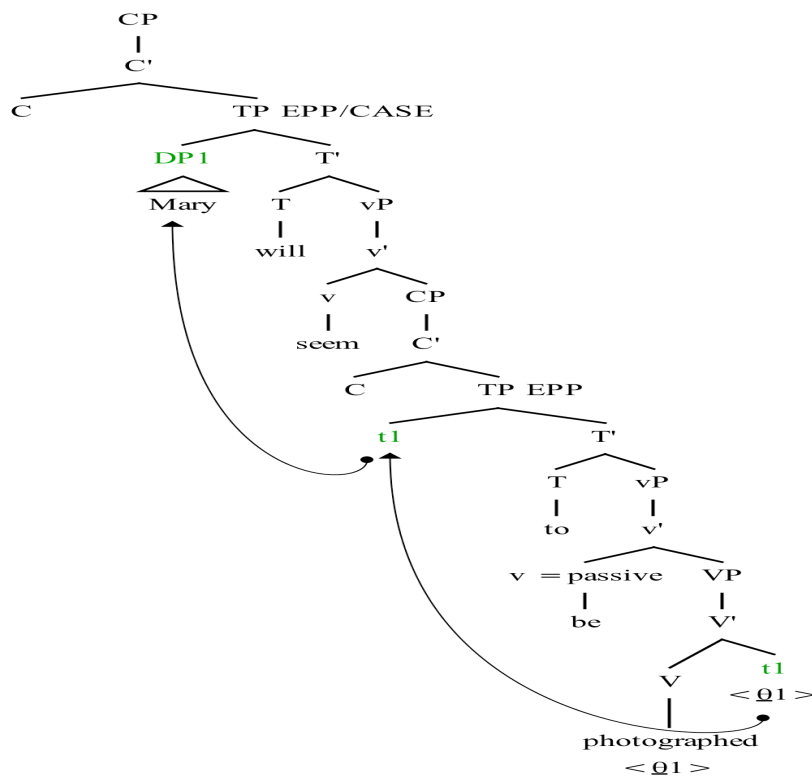
Raising is possible out of a clause that does not assign Nominative case to a clause with a verb that does not assign: (i) an Agent theta role, and (ii) that does not have an inner DP argument.

38. Typical Raising verbs:

Seem, Appear, Is likely , Seems likely, Appears likely

Raising verbs have the status of little v (probably a defective causative, passive like v) since they do not assign any theta roles. Note we can have raising from a a passive infinitival too:

39. Raising out of a Passive infinitival



In the above example, the internal argument of the passive becomes the subject, but because T is infinitival it cannot assign case so the DP raises to the Spec-T of the main clause. Raising shows us that the EPP can be satisfied by the same DP more than once, unlike Case. It also shows that a trace can function as a DP for EPP. Hence the copy theory of traces, where we assume that movement leaves behind almost exact copies of the elements that have been moved.

There are some telltale signs that raising has taken place stemming from the fact that Raising verbs allow to move an argument into the Spec-T above them:

- They have a subject but no External argument
- Theta roles are from the verb the argument moved from

For example, when we look at Idioms we see that for purposes of idiomatic interpretation the DP argument behaves as if it had not moved, suggesting that idioms are tied to theta roles (movement positions highlighted with t)

40. a. The **tabs** would appear **t** to be kept **t** by the FBI
 b. The **sh*t** seems **t** to have **t** hit the fan

The above idioms show that the DP subject (first case from passive) of the embedded infinitival can raise to the Spec-T of the raising verb.

Another useful diagnostic is that Extraposition is also possible with raising verbs.

41. a. It appears likely [that John will leave]
 b. [That John will leave] appears likely

The above diagnostics are useful in establishing what is and what is not a raising structure. When applied to different verbs they give interesting results:

42. a. It is likely that John will dance
 b. John is likely to dance

Compare with

- a. John is keen to dance
*b. It is keen that John will dance

It appears that many verbs take CP's with infinitival T, but not all are raising structures. But there is still no over subject!

43. a. The sh*t is likely to hit the fan (Raising)
*b. The sh*t is eager to hit the fan (Control)
44. a. That John will dance is likely (Raising)
*b. That John will dance is eager (Control)

Non-raising verbs do not pass the test for raising. This shows that non-raising verbs assign their own Agent theta role. But then we need two DP's, what is the other one?

45. PRO and Control

- The Null DP is called PRO. PRO can absorb a theta role, it can satisfy EPP but it cannot get case.
- PRO needs to be controlled, that is co-indexed with some antecedent in the discourse or in the sentence. In that respect PRO is an ANAPHOR.

We can have subject or object control of PRO, as in the examples below:

46. a. John_i likes [_{CP} to PRO_j swim]
b. John_i told Roger_k [_{CP} PRO_k to swim]

PRO is a phonetically null pronominal that does not get case but absorbs theta role and satisfies EPP, however, PRO shows up in binding:

47. John_i is eager [_{CP} PRO_i to photograph himself_i/him_{*i/i}]

Remember;

- Condition A says 'himself' needs a DP antecedent in the same minimal CP that c-commands it

- Condition B says pronoun cannot be co-indexed with DP in the same minimal CP that c-commands it

Why is (47) fine with reflexive?

-PRO c-commands it, and in same minimal domain.

Why is a pronoun in (47) not possible with index same as John?

-PRO C-commands it, and is in the same minimal domain.

In that sense 'him' in (47) cannot directly refer to John just like:

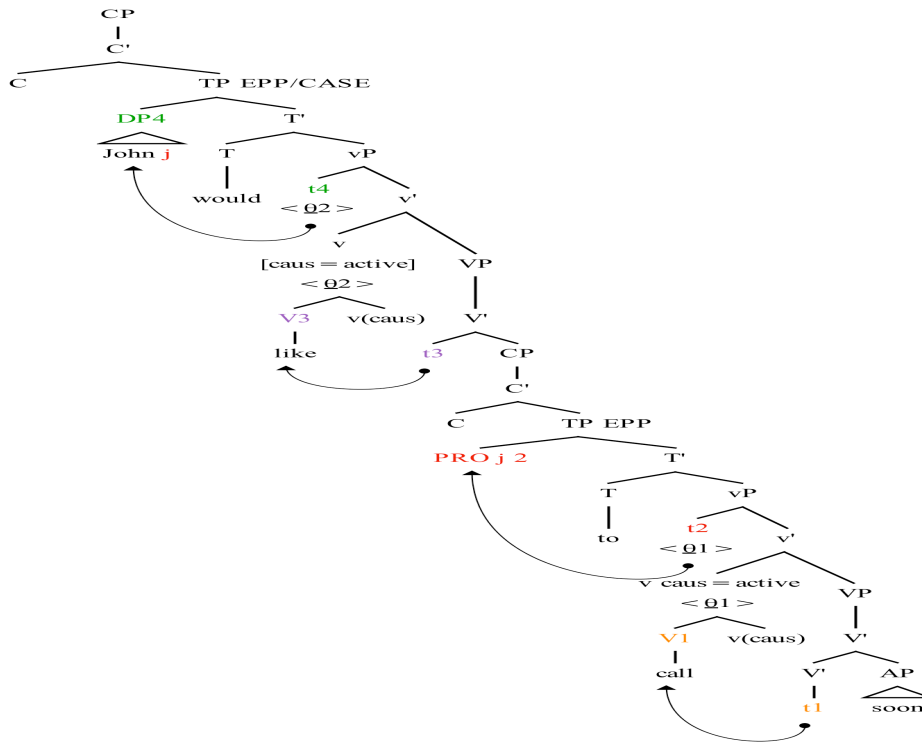
48. John_i said that he_i likes him_{*i/j}

-Pronoun cannot have same index as c-commanding and same domain DP antecedent

PRO is hybrid of pronoun (can be in different CP domain) and reflexive (needs to have overt antecedent)

Derivation of a control structure:

49.



ECM

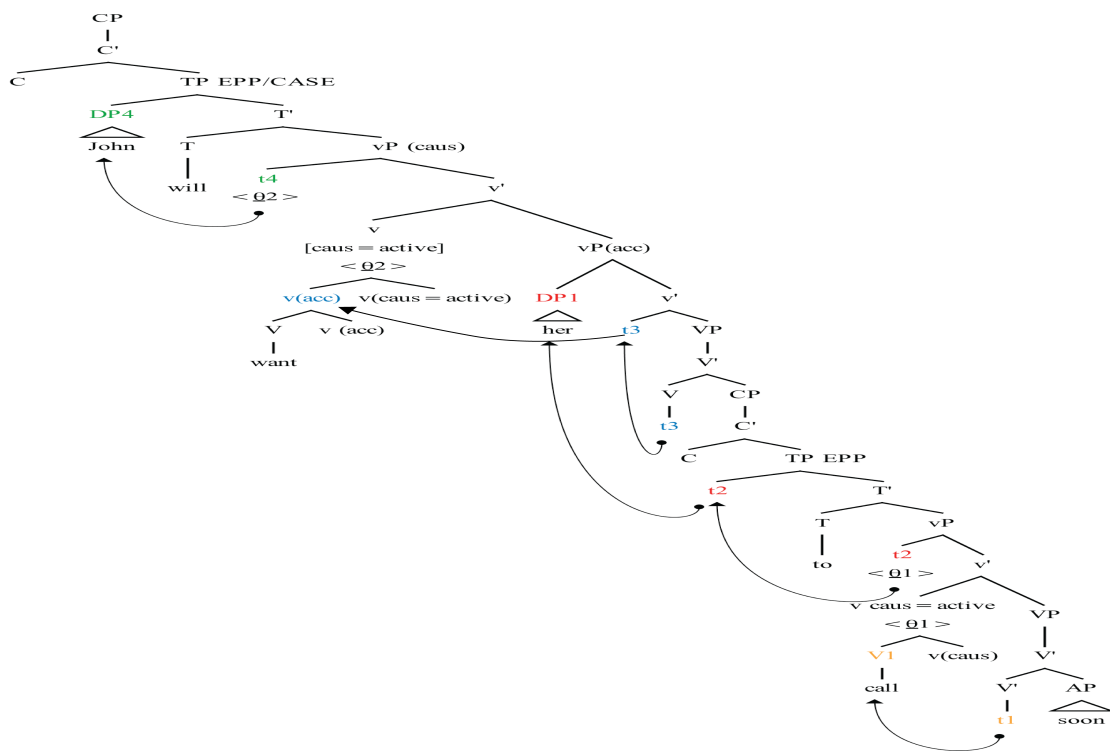
In Raising structures we saw that a DP subject can move from an infinitival Spec-T to a finite Spec-T provided there is no $v(\text{caus})$ assigning an Agent theta roles in the upper clause. In essence, Raising is taking advantage of the fact that verbs like ‘seem’ don’t assign an Agent but have a full TP that assigns case, and they take as their complements CP’s that have a verb that assigns an Agent theta role but no Case since they have a T which is infinitival. The question is: can we have a situation where the raising verb assigns an Agent theta role, but does not assign a Patient theta role; however, it can assign object case? The answer is yes we can! Such structures are called Exceptional Case Marking Structures (ECM).

50. Raising to object

John wants **her**(acc) to go home

'Her' gets accusative case from 'want'. But the interpretation suggests that 'her' has Agent theta role from 'go'. Why? Example (50) does not mean that 'John wants her' and then 'someone will go home'. Remember, principle of compositionality! 'Her' is not the Patient of 'want'. The solution is to propose Movement from External argument position of the infinitival to Object position of the finite clause. This is additional evidence for our assumption that Internal Arguments get their case from a separate v (acc). ECM structures once again show that, once we clearly define the algorithm, we should expect everything that is allowed by the computational system to happen. Consider the derivation:

51. ECM



§ 9 Wh-movement

In this section we will discuss the properties of so called wh-question. we have already discussed Yes/No questions and argued that their meaning is derivative on the meaning of their answer.

1. Will John dance

- 2.
- a. Yes = John will dance
 - b. No = John will **not** dance
 - c. No = John **will not** dance
 - d. No = **Not John**, will dance

We see that 1 triggers a set of possible answers that are expressions asserting the truth or falseness of the proposition 'John will dance'. There is only one way it can be true, in (2a) there has to be an individual 'John' there has to be an action of 'dancing' that takes 'John' as its argument, and the event is in the future. Examples (2b-d) list the possible ways the proposition 'John will dance' can be negated. The set of possible answers in (2) is essentially the meaning of the question in (1).

The semantic relationship between 1 and 2 has led us to argue that 1 is derived from the same structure as 2. This allows us to assume that both expressions share the same Deep-Structure where thematic roles are encoded and potentially where most truth condition equivalencies have to hold. In the syntax Yes/No questions have been argued to involve movement of T->C provided there is a [+Q] feature on C. Thus the difference between 1 and 2 is that in 2 we do not have a [+Q] feature on C. Evidence that C is involved in the movement came from the inability of T->C when there is a question complementizer (the fact that complementizers came in two flavors: question vs. non-question is also evidence that C is essential for question formation).

3.
 - a. I wonder will John dance
 - b. I wonder if John will dance
 - *c. I wonder if will John dance

However, language is not limited to yes/no questions. Consider the following expressions:

4.
 - a. What will John read
 - b. John will read a book
 - c. John will read X

X= infinite set of DP's = { a big book, a book that..., Susan's facial expression, ...)

Example (4a) is also a question, but not a yes/no one. Example (4b) is one possible answer. But the set of answers is infinitely large. However, it is not undefined. Only DP's that combine with 'John will read +DP' can be substituted for X. **Thus the answer to (4a) is an infinite set of propositions 'John will read X_{DP}'**. The issue is whether we want to have these two structures related by claiming that they share a common Deep-Structure. The relationship between yes/no questions and their answers has led us to believe that the structures have to be related, and we can see that a similar relationship holds between wh-questions and their answers. The question-answer pair has the same theta roles assigned, and the meaning of the wh-question is its possible set of answers. It seems that if we want successfully to argue that Yes/No questions share the same Deep-Structure as their answers, we have to do the same for Wh-questions.

Before we discuss the syntax of wh-expressions we need to clarify what wh- words are. Their categorial status

6.

a. Who -> DP

- Who did you see: I saw *John*_{DP}

b. Which -> AP, DP, CP

Which book did you read: I read the *red*_{AP} book, I read *John's*_{DP} book, I read the book *that you gave me*_{CP}

c. Where -> PP, AP

Where did you dance: I danced *in the library*_{PP}

Where do you go: I went *downtown*_{AP}

c. Why -> CP

Why did you dance: I danced *because Mary asked me to dance*_{CP}

d. How -> AdvP, PP

How did you dance: I danced *very awkwardly*_{AdvP}, I danced *with a smile on my face*_{PP}

e. When -> DP, PP, QP

When will you dance: I will danced *this evening*_{DP}, *on Friday*_{PP}, *every morning*_{QP}

f. What -> DP, CP, AP

What did you see: I saw *a book*_{DP}, I saw *that Mary is dancing*_{CP}

What farmer did you see: I saw an *American*_{AP} farmer

e. Whose -> DP

Whose book did you read: I read *John's*_{DP} book

The above incomplete but representative list shows us that it is hard to establish a unique category for some of the wh-words. We will assume a simplified view, the category of the wh-word corresponds to one chosen answer. The denotation of a wh-word is a more complex affair. In essence, a denotation of any given lexical item can be understood as a member of set consisting of individuals, or functions that map individuals to prepositions. Wh-words appear to have more complex denotations. They are not individual members of a set of individuals or functions, but rather sets of members that belong to sets that denote individuals or functions. In essence they are variables that take as their value appropriate expressions that can be part of the proposition that is the answer to the question. For example, 'who' is a variable that takes as its values any DP that can be used in the answer. In that respect wh-expressions are not different from anaphoric expressions like pronouns, reflexives, or even PRO. They need to get their meaning from other linguistic expressions that are present in the discourse.

The syntax of questions is associated with the properties of C. We have argued that C can have a [+/-Q features] which triggers inversion of T->C when it is positive. Questions with wh-words also have T->C.¹ However, they also involve movement of the Wh to Spec-C. We can deduce that there is Spec-C movement because of the linear order of the wh relative to

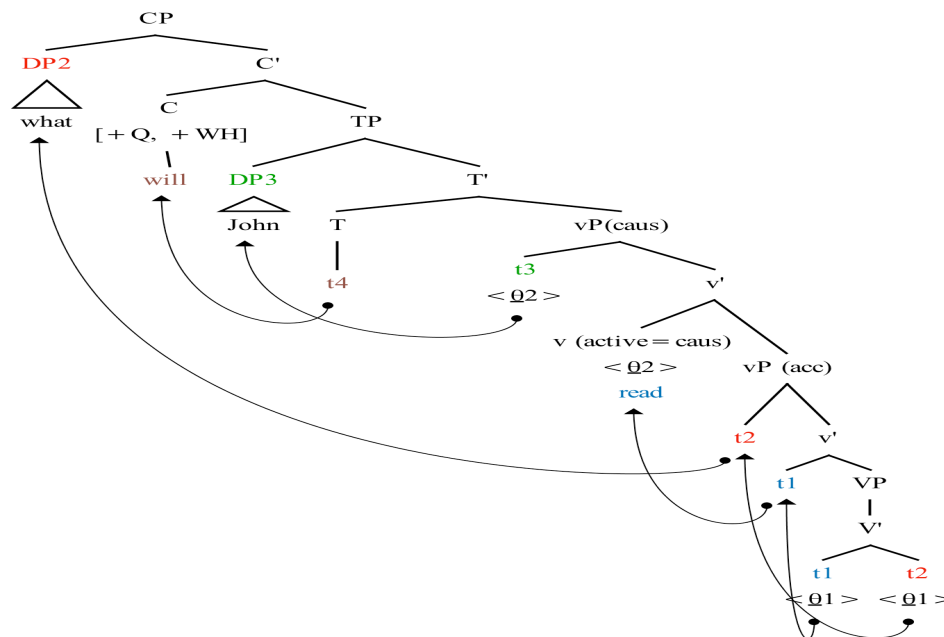
1. 'Do' support involving inserting a dummy 'do' in T in order to move it to C also applies with the exception of subject wh-questions. Consider the contrast:

- a. Did John dance
- b. Who danced
- c. Who did danced

Remember do-support is triggered when there is no auxiliary or modal, but PF material is needed in T, like in cases of T->C.

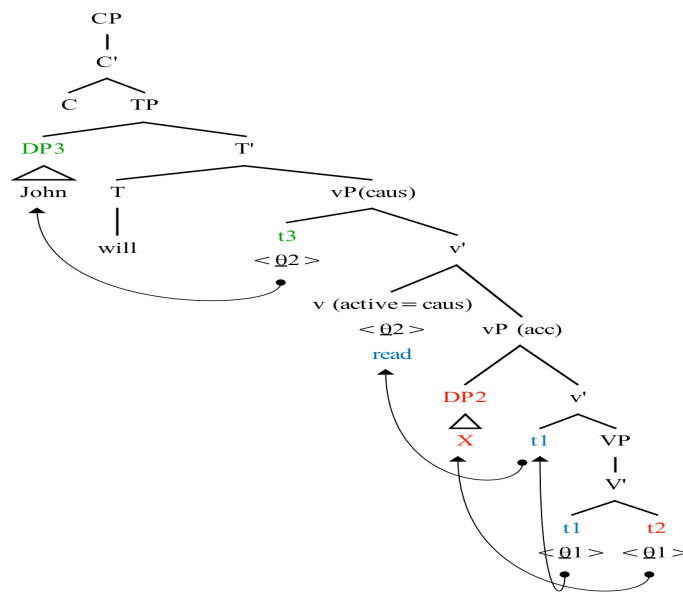
the tense marker in C which is above the subject in Spec-T. Combined with the fact that we cannot have a question complementizer with wh-questions there seems to be compelling evidence that English wh-words have movement to Spec-C.

7. a. What will John read
- *John* is in Spec-T (EPP, Case)
 - *Will* is T->C since it precedes *John*. Supported by the fact that in subordinate clauses *will* cannot co-occur with question complementizers:
- *I wonder if will John dance*
- *What* needs to be above C, only possible position, Spec-C



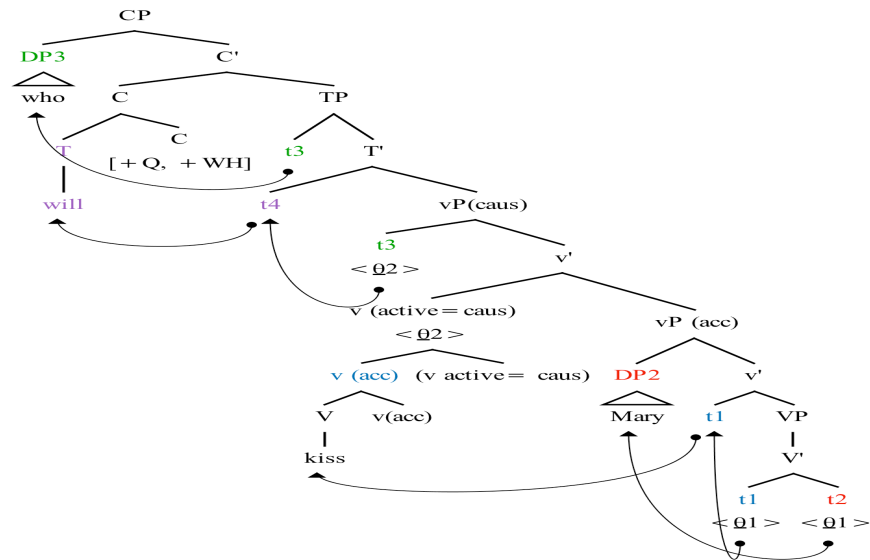
- b. Deep structure representation of (7a) plus movements

c. Deep structure representation of the possible answers to 7(a)



Word order helps us determine that there is wh-movement to Spec-C. We can encode that by assuming that in addition to a $[+/- Q]$ feature where have a $[+/- WH]$ feature which when present triggers wh-movement to Spec-C. the combination of the both gives us the combination of wh-movement with T->C movement. However, relying on word order to identify wh-movement can be tricky. Recall that movement is triggered by features on the target head, not by the need to have a different word order. Word order differences are simply a by-product of the operation. Movement will not always yield a difference in word order. Consider subject wh-questions:

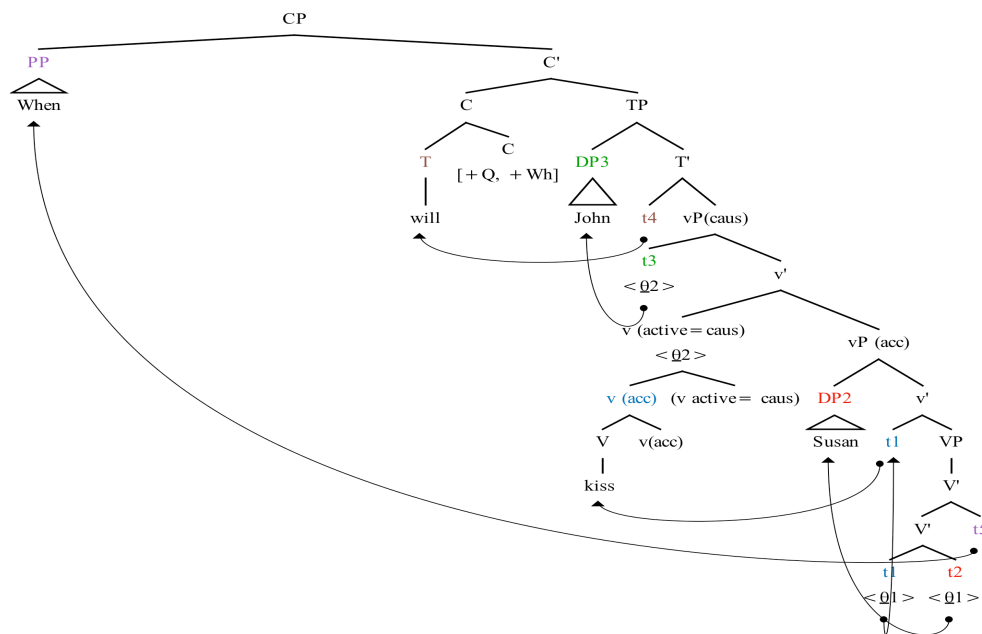
8. Who will kiss Mary?



We will argue that there is wh-movement of the subject Wh to Spec-CP and T->C raising, however, the combination of movements gives us the same relative linear word order.

Note that not only arguments can undergo wh-movement, adjuncts can do so as well. However, adjuncts, unlike arguments do not participate in case-checking or EPP prior to undergoing wh-movement.

9. When will John kiss Susan (Answer John will kiss Susan X = PP: next year, on Friday ...)



The above shows that in the case of arguments DP movement from a theta position driven by Case, EPP and a Agreement precedes wh-movement.

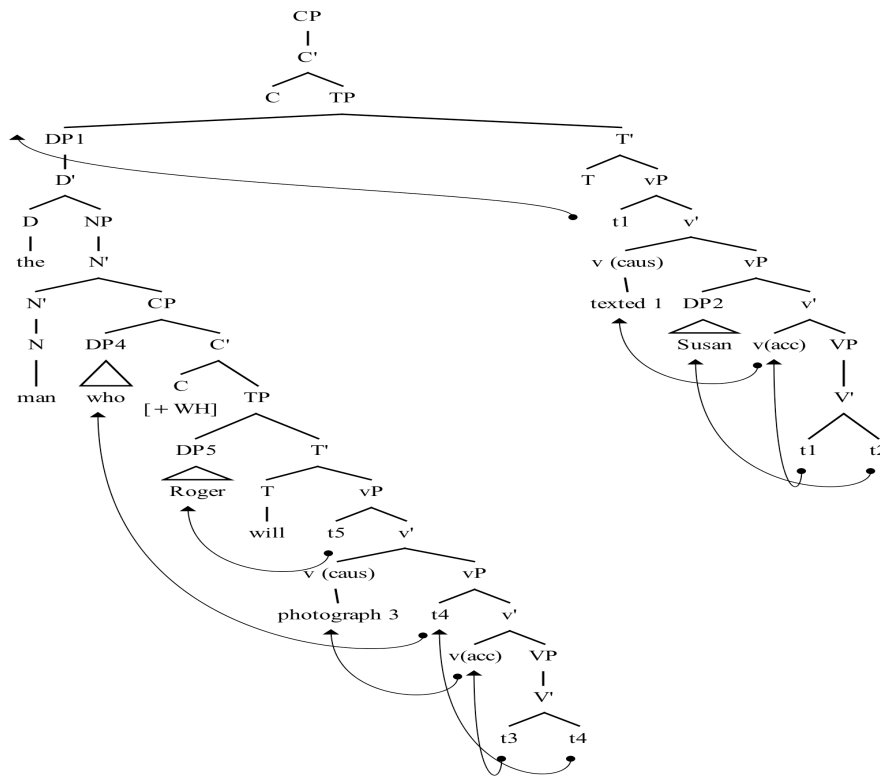
From a language Acquisition point of view, the assumption that both subject and object wh-phrases move to Spec-C makes more sense than the assumption that there is no T->C and wh-movement in the case of subject wh-constructions. Why? Imagine a child hearing wh-questions and attempting to figure out how they are derived. She will hear an object wh-construction and see from the word order that there is movement of T->C and Wh to Spec-C. Then she will hear subject wh-constructions and be faced with a choice, generalize that the movements are the same in both constructions or assume that since there is no change in word order, subject wh constructions are derived in a special way. Crucially, the generalization that in every wh-construction there is wh movement makes the correct predictions for both subject and object wh-constructions. There is no need to abandon it, or

make exceptions. Adopting a general wh-movement rule for every case of wh-questions simplifies the acquisition process.

Relative clauses.

Notice we have not fused the Q feature with the Wh feature. This is in order to account for the independent existence of Yes/No questions from wh-questions. But such a division makes an interesting prediction, namely that wh-movement should occur independently of Yes/No questions. The result should be a construction where the wh-word behaves like an anaphor, requiring an antecedent but there should be no questions semantics. This prediction is supported by the existence of relative clauses. Relative clauses are CP modifiers of Nouns. They are modifiers that have a similar effect on the noun as adjectives. Their internal syntax involves wh-movement. The wh-phrase behaves like an anaphor in that it always has the same denotation that as the modified noun. There is no question semantics.

10. The man **who Roger photographed** texted Susan. Who= man (notice I simplified the head movement diagrams)



Notice that the relationships inside the CP modifying the noun are that of a regular clause that has wh-movement. The only difference is that there is no +Q feature, hence no T->C and not questions semantics. The wh-word has to find a referent, and that referent has to be the NP the CP modifies. Relative clauses can have the wh-word stand in for an argument or an adjunct. We call the relative clause an object relative clause, if the wh-word is an inner argument, and a subject relative clause when the wh-word is an outer argument. Note the subject/object/adjunct status of the wh-word is independent of the subject/object/adjunct status of the nominal it modifies. They can match but they do not have to. The modified noun (called a head noun) is not directly related with the structure in CP. The relationship is mediated by the wh-word called a **relative pronoun**.

10.
 - a. The **man** *who* Roger will photograph _ texted Susan
Object relative clause modifying a subject
 - b. Alice texted the **man** *who* Roger will photograph _
Object relative clause modifying an object
 - c. The **man** *who* _ will photograph Roger texted Susan
Subject relative clause modifying a subject
 - d. Alice texted the **man** *who* _ will photograph Roger
Subject relative clause modifying an object
 - e. Alice texted the man in the **room** *where* Susan will photograph Roger _
Adjunct relative clause modifying an adjunct
 - f. Alice painted the **room** *where* Susan will photograph Roger _
Adjunct relative clause modifying an object
 - g. The **room** *where* Susan will photograph Roger _ is full of furniture
Adjunct relative clause modifying a subject

The DP containing a relative clause behaves like normal DP, it will participate in case and EPP configurations like any other DP.

Attract and Islands

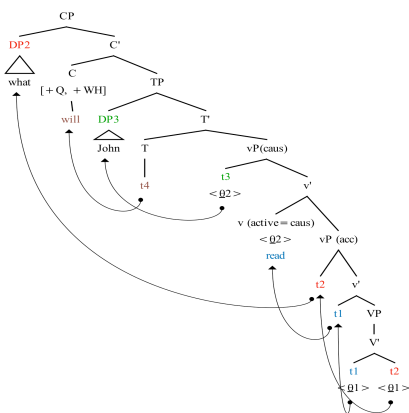
Examples containing wh-movement indicate that Relativized Minimality responsible for blocking head movement over another head position, or DP movement over another DP does not apply here. Consider the following examples:

11.
 - *a. **Been** John **has** swimming
 - b. **Has** John **been** swimming
12.
 - *a. **John** seems that **it** appears to swim
 - b. **It** seems that **John** appears to swim

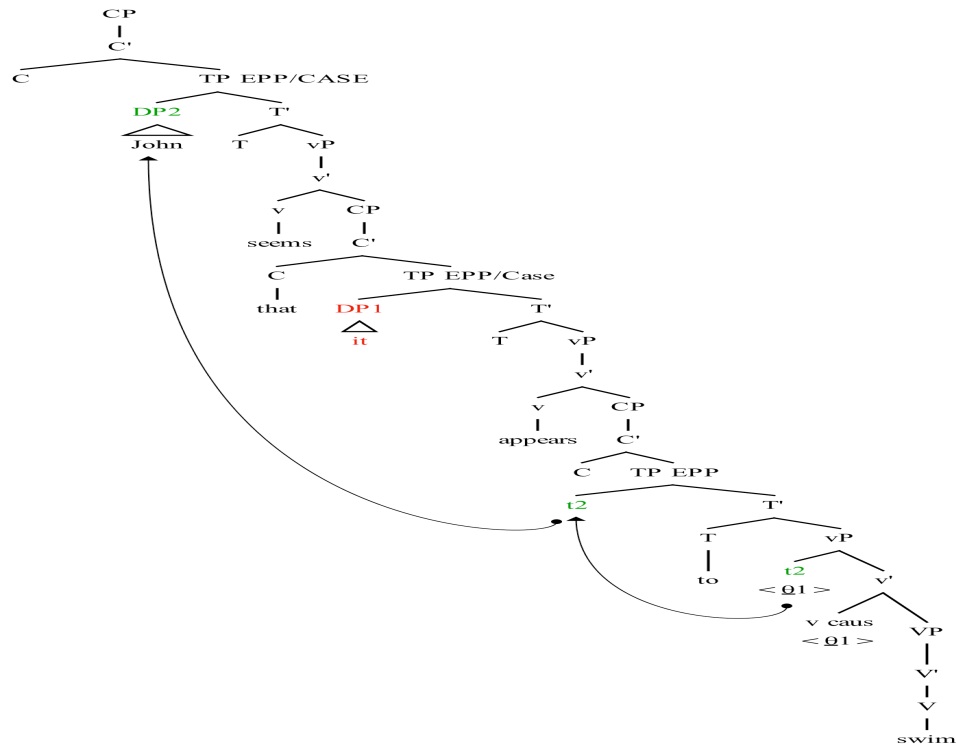
13. a. Who will John kiss
b. Who will kiss John

Example (11) shows that the progressive cannot move over a perfective, hence Relativized Minimality applies to head movement. Example (12) shows that the DP *John* cannot raise above the Spec-TP position occupied by *It* indicating that DP movement for case/EPP is also subject to Relativized Minimality. Head positions do not block Spec-positions and vice versa hence DP movement is not blocked by the existence of an auxiliary in v, neither is auxiliary movement blocked by a DP in Spec-T. However, as (13) shows, wh-movement of an object is not blocked by a DP subject higher up in Spec-T

14.



However, DP movement over another DP should be bad as the diagram for 12a= 15 shows



We need to somehow account why wh-movement of a DP is not blocked by another DP, whereas DP movement of a non-wh is blocked by a higher DP. The answer lies in the trigger of movement. We will adopt an approach where certain heads have features that are uninterpretable by syntax. The way to make these features interpretable is to pair the head with a constituent that has the interpretable version of said features. We can use the notation that we need to ‘check’ uninterpretable features abbreviated as [F] by moving a constituent that contains the interpretable version of [F] abbreviated as [F’].

For example, head movement will have the following list:

16. Head movement triggering features (English)

a. Satisfied by V categorial features

–v(+acc)

–v(+caus)

b. Satisfied by v categorial features (any v will do provided it does not have V in it)

–T(+tense)

Satisfied by T with all features made interpretable (basically T with PF material in it)

–C (+Q)

However, heads can have inherently interpretable features, in which case they will not trigger movement.

17. These features are inherently interpretable if part of a PF word (there is no head movement).

–v(+acc) Never in English (always satisfied by V->v)

–v(+caus) Never in English (always satisfied by V->v (caus), or V+ v(+acc)->v (caus))

–v(prog) is/been, etc.

–v(perf) have/had, etc

–T(+tense) will, could should, can, might

–C (+Q) whether, if

The same holds for Phrasal movement there will be a set of features that trigger it.

18. YP movement is triggered by uninterpretable features on a head X

–v(+case)

needs DP that has not been assigned case

–T(+case)

needs DP that has not been assigned case

–T (EPP)

needs DP

–C (+Wh)

needs a Wh expression

Note:

Case/EPP driven movement precedes wh-move.

We can reduce relativized minimality in head movement by claiming that what is moved to a head X is the closest head Y. Closeness is defined in terms of c-command. Where Y is the closest head to X if there is no head Z that c-commands Y and is c-commanded by X.

19. Attract

A given head X with an uninterpretable feature [F] is called a **probe**. A probe can seek a **goal** - a constituent Y, c-commanded by X. Y needs to contain an interpretable feature [F'] which has the property that [F'] can check [F]. Checking [F] makes [F] interpretable to syntax. In order for checking to occur Y containing [F'] is moved, depending on the nature of [F], either to : a head adjoin to X position, or to Spec-X position.

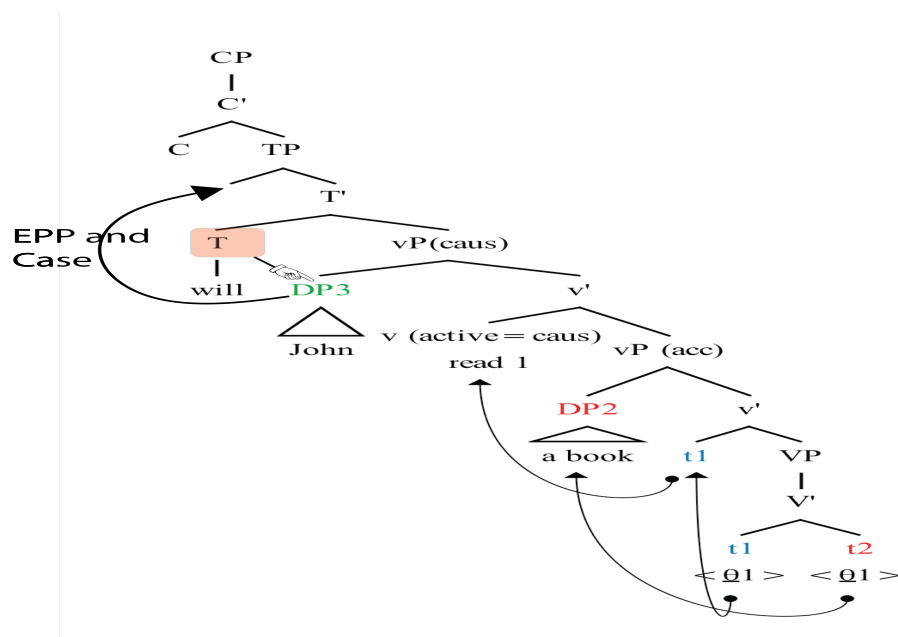
A probe will not seek past the closest appropriate goal. Closeness is defined in terms of c-command. Where Y is the closest head to X if there is no head Z that c-commands Y and is c-commanded by X.

The above states that A head X attracts movement by searching down the root of the tree for a potential 'goal' of movement. The first identified goal will block lower down ones. Crucially, features targeted in head movement are different from those targeted in XP movement. Furthermore, features targeted in DP movement are different from those targeted in wh-movement. Hence blocking occurs only between elements containing similar enough features. Crucially, an Attract account of movement makes the same predictions as Relativized Minimality, plus it can also incorporate the intuition that a DP that does not contain a wh word will not have the appropriate set of [F'] features to be a

goal for a Complementizer that is seeking interpretable features [F'] with the value [+Wh] to 'check' its own un-interpretable features [F] = [+Wh].

Consider the following version of Attract in DP movement.

20. hand points to DP that is the goal of the T head probe for Case/ EPP features. DP3 blocks probing for DP2



In the above DP3 will never allow T to probe further down the tree to 'see' DP2. Note DP3 is c-commanded by T and DP2 is c-commanded by DP3. The situation is different with Wh-movement.

Attract as computational efficiency - evidence from islands and cyclicity.

Violations of Attract are sometimes called Minimal Link Condition Violations. The idea is simple, movement proceeds in shortest possible steps/hops. For example moving a wh word across a wh-word is not possible in English:

22. * a. Who(m) will who kiss
 b. Who will kiss whom

Examples like (22a) are called wh-island violations. The term island is supposed to make you imagine being stranded on an island on not being able to get out. The topmost Wh is like an ocean barrier, the poor inner wh-word cannot move across it. Such a system forces that movement to be as short as possible, it is always the closest wh- that will raise. This kind of computational efficiency shows that syntax has idiosyncratic constraints independent of semantics and phonology. One would want these constraints to be universal, but unfortunately wh-islands can be violated in many languages. Consider Polish:

23. a. Kogo kto pocałował
 whom(acc) who(nom) kissed
 b. Kto kogo pocałował
 who(nom) whom(acc) kissed
 ‘Who kissed whom’

It is far from obvious how to deal with such variation. It could be the ability to have different word orders, that allows us to position the wh-phrases in different ways. Polish is a free word order language, but obeys constituent structure suggesting there are a lot more movement operations than in English. Thus both word orders in non-wh constructions are also possible:

24. a. Janka Maria pocałowała
 John(acc) Mary (nom) kissed
 b. Maria pocałowała Janka
 Mary (nom) kissed John (acc)
 ‘Mary kissed John’

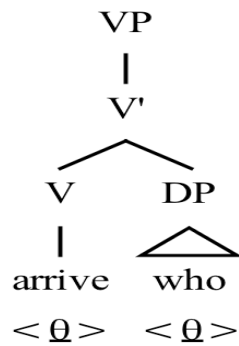
It could be that (23a) is preceded by movement responsible for (24a), which is impossible in English. However, that leaves us with the question why is (24a) possible. The answer must lie in that Polish has more DP movement triggers than Case, EPP and Agreement, as in English. There are a few candidates for such triggers. One possibility is information structure. Slavic is known to prefer to group old and new discourse information. Hence word order can be a reflection of discourse, unlike in English. These matters are far from settled, however, it is obvious that if we want to assume that wh-islands are a reflex of computational efficiency, we need to find the overriding factor that allows languages like Polish to override them.

Derivational syntax

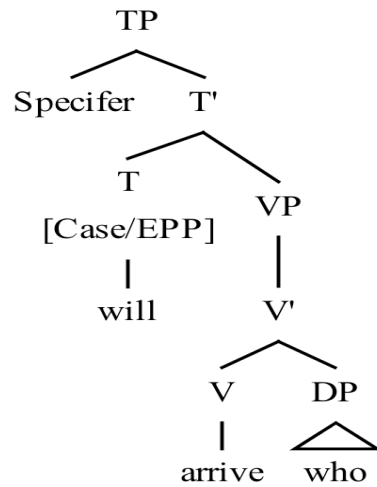
Fortunately, there are other islands that appear to be more robust cross-linguistically. These point to a more radical vision of syntax, where we assume a very dynamic derivational model, where movement is part of the tree building algorithm. Up until now we assumed a model of syntax where the tree representation is established first and then movement takes place. But a more radical version can be adopted where movement takes place in parallel to phrase structure building. Elements are introduced into the derivation and moved to their respective positions before the rest of the tree is built.

25. Steps of the derivation

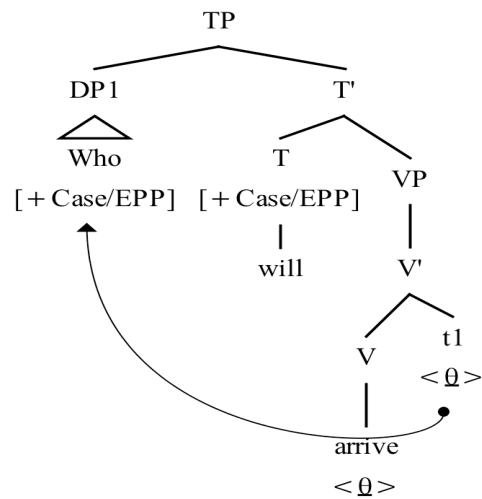
Step 1 Merging inner argument with main verb, assigning theta roles (assume DP has been already assembled in a similar dynamic fashion), and Step 2: projection of VP



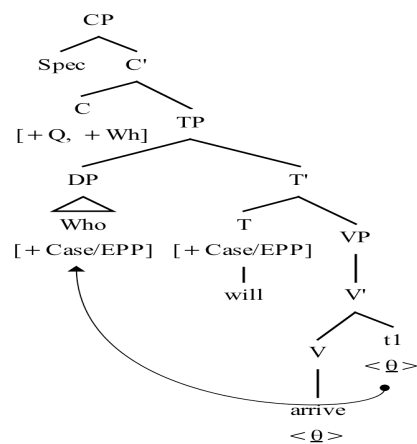
Step 3 VP is merged with T forming T', Step 4 T' projects TP with Specifier empty



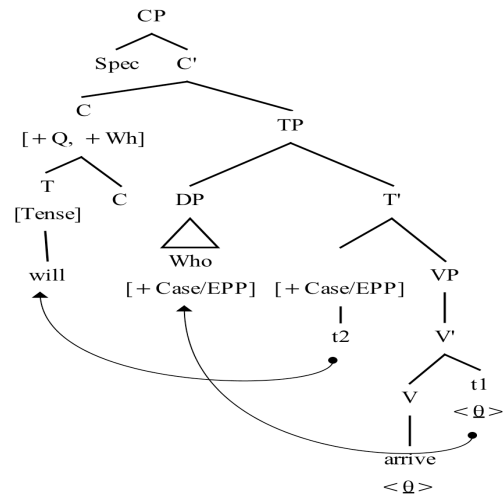
Step 5 DP is probed by T for Case/ EPP and moves to Spec-TP (note C is not present in the tree yet)



Step 6 C is Merged with TP projecting C'; Step 7 CP is formed with empty Spec

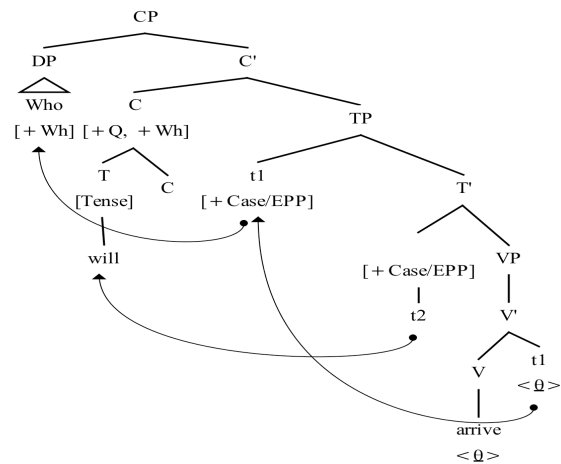


Step 8 C probes T because of Q feature and triggers head movement (remember Tense can



check +Q)

Step 9 DP is probed by C for wh features and moves to Spec-C

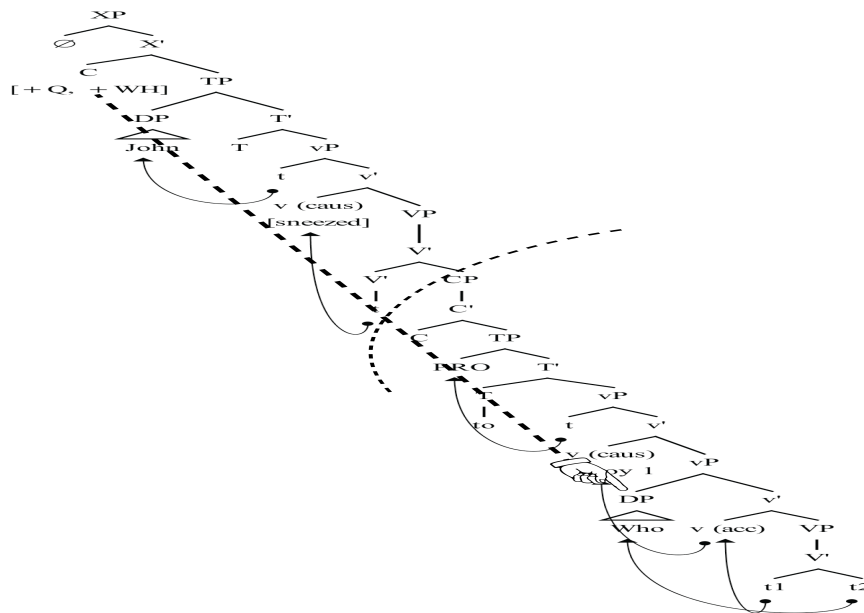


A purely derivational account has its advantages. For one, Movement is a tree building operation and not something special. Two computational efficiency of movement is less mysterious: now tree building has to be computationally efficient. It also has the nice prediction that elements introduced pre-assembled are islands. Thus cross linguistically it is hard to find examples where you can move out of a an adjunct. These are called adjunct islands. Consider the following example:

26. a. John sneezed *to annoy Mark*
 b. *To annoy who* did John sneeze
 *c. *Who* did John sneeze *to annoy*

Example (26a) shows an example of unergative with a CP adjunct. Moving the whole adjunct for wh-movement is fine, as shown in (26b). However, as (26c) shows, moving part of the wh inside the adjunct is not possible. If we assume Adjuncts are inserted into the tree pre-packaged then we can derive the inability of C to probe inside the CP.

27. Inability to probe inside an adjunct:



Adjunct Islands are very robust, even languages like Polish. Such universality suggests that a more strict derivational approach to tree derivations might be on the right track. There is evidence that syntax likes to build tree in smallest steps. For example, wh-movement seems to proceed via every spec-CP. For one, a question complementizer will block it:

28. a. I will wonder if **John** went home
 *b. **Who** will I wonder if _ went home
 c. **Who** will I wonder _ went home

We can account for the ungrammaticality of (28b) by assuming that the subject wh has to move through the lower Spec-CP position in order to move to the higher one. The presence of the if complementizer blocks somehow this movement. Probably because there is a clash with the checked +Q features on the embedded C because of the presence of 'if' and the Wh

features of the moved Wh. Crucially, the composition of the embedded C influences wh-movement from the lower clause to the Spec-C of the higher clause. This can be captured if we force wh-movement to take place via every Spec-C. This predicts that complementizers should be sensitive to wh-movement. In Irish they are to the point that they change form:

28. Cé a dúradh léithi a cheannódh é?
who aL was-said with-her aL would-buy it
'Who was she told would buy it?'

The form of the complementizer 'a' which forces a process called Lenition is only found if there has been Wh-movement above it.

Movement of the wh-word via every Specifier of C is called cyclicity.

END