Lecture Notes: Linguistics

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An introduction to the methods and some basic ideas of theoretical linguistics.

Contents

Linguistics 20

Introduction to Linguistics

Lecture MW2-4 in Royce 190
Office Hours: W4-5, by appt, or stop by

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Prerequisites: none

Contents: What are human languages, such that they can be acquired and used as they are? This class surveys some of the most important and recent approaches to this question, breaking the problem up along traditional lines. In spoken languages, what are the basic speech sounds? How are these sounds articulated and combined? What are the basic units of meaning? How are the basic units of meaning combined into complex phrases? How are these complexes interpreted?
These questions are surprisingly hard! This introductory survey can only briefly touch on each one. One goal of the class is just to show you why the relatively new science of linguistics is challenging and exciting. The emphasis will be on methods, and on the structure and limitations of the picture being developed by recent theories.

Texts:

Linguistics: An introduction to linguistic theory. V. Fromkin (ed.) Blackwell, 2000

Notes and homework will be posted at `http://wintermute.linguistics.ucla.edu/Lx20/`.

Requirements and grades: There will be 6 homework assignments. They will be assigned on Wednesdays and must be given to your TA the following Monday in lecture. **You must do 5 out of the 6 assignments.** (Since the assignments are also good preparations for the exams, you should do all 6 assignments, and then your best 5 grades will be counted!) The homework will be graded by the TAs and discussed in the discussion sections. Since there is an extra homework built in to this policy: **no late homework will be accepted.** There will be a mid-term exam during the quarter, and an in-class final exam. The exams will be analytic problems very similar to those given in the homework.

5 (out of the 6) homeworks	65%	
1 midterm exam	15%	(15%)
final	20%	

Midterm and final exam dates (both held in class) are posted on the website,

`http://wintermute.linguistics.ucla.edu/Lx20/`,

where lecture notes, and reading assignments will also be posted each week.

Lecture 1 The nature of human languages

We are using a good text, but it has more than we can cover in a 10 week class! In lecture, and in these occasional lecture notes, I will be clear about which parts of the text you are expected to understand completely. And when new material is introduced in the lecture that is not in the text, I will try to produce lecture notes about it, for your reference. That happens in this lecture – the ideas here are closely related to the material of Chapter 1, but do not really appear there.

Human language is the most familiar of subjects, but most people do not devote much time to thinking about it. The basic fact we start with is this: I can make some gestures that you can perceive (the marks on this page, or the sounds at the front of the classroom), and almost instantaneously you come to have an idea about what I meant. Not only that, your idea about what I meant is usually similar to the idea of the student sitting next to you. Our basic question is: *How is that possible??* And: *How can a child learn to do this?*

The attempt to answer to these questions is traditionally broken into separate parts (which you may have seen already in the syllabus), for reasons that will not be perfectly clear until the end of the class:

1. phonetics - in spoken language, what are the basic speech sounds?
2. phonology - how are the speech sounds represented and combined?
3. morphology - what are the basic units of meaning, and of phrases?
4. syntax - how are phrases built from those basic units?
5. semantics - how can you figure out what each phrase means?

A **grammar** is a speaker's knowledge of all of these 5 kinds of properties of language. The grammar we are talking about here is **not** rules about how one <u>should</u> speak (that's sometimes called "prescriptive grammar"). Rather, the grammar we are interested in here is what the speaker knows that makes it possible to speak at all, to speak so as to be understood, and to understand what is said by others.

In each of the 5 pieces mentioned above, there is an emphasis on the basic units (the basic sounds, basic units of phrases, basic units of meaning).[1]

I like to begin thinking about the project of linguistics by reflecting on why the problems should be tackled in this way, starting with "basic units." There is an argument for that strategy, which I'll describe now.

[1]The first idea you might have about the basic units is that they are "words." And so the text adds (on page 8, §1.3.1) a "lexicon" of "words" as a basic "component" of our grammar. I prefer not to describe things quite this way, because I think it can be misleading for reasons that we will get to later. For the moment, notice that there is no chapter of the text on the "lexicon"! There is a reason for that.

1.1 Productivity, and Zipf's law

Productivity: Every human language has an unlimited number of sentences.

This can be seen by observing that we can extend any sentence you choose to a new, longer one. In fact, the number of sentences is unlimited even if we restrict our attention to "sensible" sentences, sentences that any competent speaker of the language could understand (barring memory lapses, untimely deaths, etc.).

This argument is right, but there is a stronger point that we can make. Even if we restrict our attention to sentences of reasonable length, say to sentences with less than 50 words or so, there are a huge number of sentences. The text says on page 8 that the average person knows from 45,000 to 60,000 words. (I don't think this figure is to be trusted! For one thing, the text has not even told us yet what a word is!) But suppose that you know 50,000 words. Then the number of different sequences of those words is very large.[2] Of course, many of those are not sentences, but quite a few of them are! So most sentences are going to be very rare! In fact, this is true. What is more surprising is that even most words are very rare.

To see this, let's take a bunch of newspaper articles – about 10 megabytes of text from the Wall Street Journal – about 1 million words. As we do in a standard dictionary, let's count *am* and *is* as the same word, and *dog* and *dogs* as the same word, and let's take out all the proper names and numbers. Then the number of different words (sometimes called 'word types', as opposed to 'word occurrences' or 'tokens') in these articles turns out to be 31,586. Of these words, 44% occur only once. If you look at sequences of words, then an even higher proportion occur only once. For example, in these newspaper articles 89% of the 3-word sequences occur just once. Since most sentences in our average day have more than 3 words, it is safe to conclude that most of the sentences you hear, you will only ever hear once in your life.

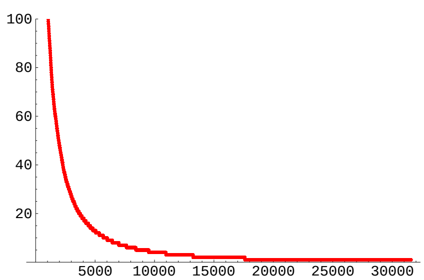

Fig. 1.1: Word frequency vs rank

The fact that most words are rare, but the most frequent words are very frequent, is often called **Zipf's law**.[3] For example, with those newspaper articles again, plotting the frequencies of the most frequent word to the least frequent word gives us the graph shown in Figure 1.1. The top of the curve gets chopped off so that I can fit it on the page! Here, word 1 on the x-axis is the most frequent word, *the*, which occurs 64628 times – off the top of the graph. Word 10 is *say*, which only occurs 11049 times – still off the top of the graph. Word 2500 is *probe*, which occurs only 35 times and so it is on the displayed part of the curve. Words 17,606 to 31,586 are all tied, occurring only once – these are words like *zigzag, zealot, yearn, wriggling, trifle, traumatize,...* You have heard all these words, and more than once, but that's because you've heard many more than a million words. The surprising thing is that as you increase the sample of texts, Zipf's law stays the same: new unique words appear all the time. Zipf's law says that the frequencies in this plot drop off exponentially. This is the reason that most words are rare. Given Zipf's law about word frequencies, it is no surprise that

most sentences you hear, you only hear once.

[2] The number of sequences of length 50 is 50000^{50}. So the number of sequences of length 50 or less is $\sum_{i=1}^{50} 50000^i$, which is about 8.8820×10^{234}. (For comparison, some physicists estimate that there have been 4.6×10^{17} seconds – about 15 billion years – since the big bang.)

[3] More precisely, he proposed that, in natural texts, when words are ranked by frequency, from most frequent to least frequent, the product of rank and frequency is a constant.

1.2 Compositionality

How can people understand so many sentences, when most of them are so rare that they will only be heard once if they are heard at all? Our understanding of exactly how this could work took a great leap early in this century when mathematicians noticed that our ability to do this is analogous to the simpler mathematical task of putting small numbers or sets together to get larger ones:

> It is astonishing what language can do. With a few syllables it can express an incalculable number of thoughts, so that even a thought grasped by a terrestrial being for the very first time can be put into a form of words which will be understood by someone to whom the thought is entirely new. This would be impossible, were we not able to distinguish parts in the thought corresponding to the parts of a sentence, so that the structure of the sentence serves as an image of the structure of the thought. (Frege, 1923)

The basic insight here is that the meanings of the limitless number of sentences of a productive language can be finitely specified, if the meanings of longer sentences are composed in regular ways from the meanings of their parts. We call this:

Semantic Compositionality: New sentences are understood by recognizing the meanings of their basic parts and how they are combined.

This is where the emphasis on basic units comes from: we are assuming that the reason you understand a sentence is **not** usually that you have heard it and figured it out before. Rather, you understand the sentence because you know the meanings of some basic parts, and you understand the significance of combining those parts in various ways.[4]

We analyze a language as having some relatively small number of basic units, together with some relatively few number of ways for putting these units together. This system of parts and modes of combinations is called the **grammar** of the language. With a grammar, finite beings like humans can handle a language that is essentially unlimited, producing any number of new sentences that will be comprehensible to others who have a relevantly similar grammar. We accordingly regard the grammar as a **cognitive structure.** It is the system you use to "decode" the language.

In fact, human languages seem to require compositional analysis at a number of levels: speech sounds are composed from basic articulatory features; morphemes from sounds; words from morphemes; phrases from words. We will see all this later. The semantic compositionality is perhaps the most intriguing, though. It is no surprise that it captured the imaginations of philosophers early in this century (especially Gottlob Frege, Bertrand Russell, Ludwig Wittgenstein). In effect, a sentence is regarded as an abstract kind of picture of reality, with the parts of the sentence meaning, or referring to, parts of the world. We communicate by passing these pictures among ourselves. This perspective was briefly rejected by radically behaviorist approaches to language in the 1950's, but it is back again in a more sophisticated form – more on this when we get to our study of meaning, of "semantics."

[4] Given a rigorous, formal account of how to define simple mathematical languages compositionally, it did not take much longer to discover how a physical object could be designed to behave according to the formal rules of such a language – this is the idea of a computer. So by 1936, the mathematician Alan Turing showed how a finite machine could (barring memory limitations and untimely breakdowns) compute essentially anything (any "computable function"). In the short span of 70 or 80 years, these ideas not only spawned the computer revolution, but also revolutionized our whole conception of mathematics and many sciences. Linguistics is one of the sciences that has been profoundly influenced by these ideas.

1.3 Another fundamental: "creativity"

Meaningful **productivity** is explained by **compositionality**, and compositionality brings with it the emphasis on basic units and how they are combined. These notions should not be confused with another idea that is often mentioned in linguistic texts, and in this quote from the well-known linguist Noam Chomsky:

> [The "creative aspect of language" is] the distinctively human ability to express new thoughts and to understand entirely new expressions of thought, within the framework of an "instituted" language, a language that is a cultural product subject to laws and principles partially unique to it and partially reflections of general properties of the mind. (Chomsky, 1968)

Chomsky carefully explains that when he refers to the distinctive "creativity" of human language use, he is not referring to productivity or compositionality. He says that although linguists can profitably study (productive, compositional) cognitive structures like those found in language, our creative use of language is something that we know no more about than did the Cartesian philosophers of the 1600's:

> When we ask how humans make use of ... cognitive structures, how and why they make choices and behave as they do, although there is much that we can say as human beings with intuition and insight, there is little, I believe, that we can say as scientists. What I have called elsewhere "the creative aspect of language use" remains as much a mystery to us as it was to the Cartesians who discussed it.... (Chomsky, 1975, 138)

Here the point is that we humans are "creative" in the way we decide what to say and do. Chomsky suggests that we produce sentences that are in some sense appropriate to the context, but not determined by context. Our behavior is not under "stimulus control" in this sense.[5]

Regardless of whether we accept Chomsky's scepticism about accounting for why we say what we do when we do, he is right that this is not what most linguists are trying to account for. This is an important point. What most linguists are trying to account for is the productivity and compositionality of human languages. The main question is: What are the grammars of human languages, such that they can be acquired and used as they are?

1.4 One more fundamental: "flexibility"

One thing that the first quote from Chomsky suggests is that language has a certain flexibility. New names become popular, new terms get coined, new idioms become widely known – the conventional aspects of each language are constantly changing. We are inventing the language all the time, extending it in ways that are not predicted simply by the possibility of new compositions from familiar elements (productivity and compositionality). Linguists have been especially interested in what remains constant through these changes, the limitations on the flexibility of human languages. It is easy to see that there are some significant limitations,

[5]Chomsky maintains that we see here definite limits on computational models of mind, since this sort of creative behavior is "not realizable by even the most complex automaton." But this claim is easy to challenge. If the creative aspect of language use is not understood, what could be the basis for the claim that it cannot be realized by any computational system?

but saying exactly what they are, in the most general and accurate way, is a challenge. We can adopt a new idiom naturally enough, at least among a group of friends, but it would not be natural to adopt the convention that only sentences with a prime number of words would get spoken. This is true enough, but not the most revealing claim about the range of possible human languages. You can name your new dog almost anything you want, but could you give it a name like *-ry*, where this must be part of another word, like the plural marker *-s* (as in *dogs*), or the adverbial marker *-ly* (as in *quickly*)? Then instead of *Fido eats tennis balls* would you say *eatsry tennis balls* or *dory eat tennis balls* or *eats tennisry balls* or what? None of these are natural extensions of English. What kinds of extensions really get made and adopted by others? This is partly a question of language learning, and partly a sociological question about how groups come to adopt a new way of speaking.

1.5 Are all human languages spoken?

Obviously not! American Sign Language is a human language with properties very like spoken languages. Since vocal gestures are not the only possible medium for human languages, it is interesting to consider why they are the most common.

1.6 Summary

The basic questions we want to answer are these: how can human languages be (1) learned and (2) used as they are? These are psychological questions, placing linguistics squarely in the "cognitive sciences." (And our interest is in describing the grammar you actually have, not in prescribing what grammar you "should" have.)

The first, basic fact we observe about human languages shows that the answer to these questions is not likely to be simple! Our first, basic fact about the nature of all human languages is that they are **productive** – No human language has a longest sentence. It follows from this that you will never hear most sentences – after all most of them are more than a billion words long!

Zipf's law gives us a stronger claim, more down to earth but along the same lines. Although the most frequent words are very frequent, the frequencies of other words drop off exponentially. Consequently, many words are only heard once, and it is a short step from there to noticing that certainly most sentences that you hear, you hear only once.

To make sense of how we can use a language in which most sentences are so rare, we assume that the language is **compositional,** which just means that language has basic parts and certain ways those parts can be combined. This is what a language user must know, and this is what we call the **grammar** of the language. This is what linguistics should provide an account of.

It turns out that compositional analysis is used in various parts of linguistic theory:

1. phonetics - in spoken language, what are the basic speech sounds?
2. phonology - how are the speech sounds represented and combined?
3. morphology - what are the basic units of meaning, and of phrases?
4. syntax - how are phrases built from those basic units?
5. semantics - how can you figure out what each phrase means?

Most of Chapter 1 in the text is about these 5 things, providing brief sketches of each, but you do not have to understand now what these are, or why matters are divided up this way! You will understand this by the end of the class.

1.7 How to ace this class

Mainly: Do <u>all</u> the homeworks! They are 35% of the grade, and the best preparation for the exams. Doing them will force you to keep up.

1.8 Questions:

Feel free to stop by my office M4-5 or anytime. Short questions can also be emailed to me.

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To: stabler@ucla.edu
Subject: question

In today's lecture on Zipf's law, when you plotted the graph,
what did the x and y axis stand for?
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On the x-axis, 1 represents the most frequent word, *the*, 2 represents the second most frequent word, *be*, word 3 is *a*, word 4 is *of*, word 5 is *to*, word 6 is *in*, word 7 is *and*, word 8 is *for*, word 9 is *have*, word 10 is *say*, and so on. On the y-axis, I plotted how frequent each word was. Instead of writing the words on the x-axis, I just put the numbers 1, 2 ,3,. . . , partly because writing all those words there is hard work, and partly because what I wanted to show was just the shape of the curve. The shape of the curve by itself shows that the most frequent words are very frequent, and the other words are rather rare!

References

[Chomsky1968] Chomsky, Noam (1968) *Language and Mind.* NY: Harcourt Brace Javonovich.

[Chomsky1975] Chomsky, Noam (1975) *Reflections on Language.* NY: Pantheon.

[Frege1923] Frege, Gottlob (1923) Compound Thoughts. Translated and reprinted in Klemke, ed., 1968, <u>Essays on Frege</u>. University of Illinois Press.

[Turing1936] Turing, Alan (1936) On computable numbers with an application to the ensheidungs problem. <u>Proceedings of the London Mathematical Society 42</u>(2): 230-265, 544-546.

[Zipf1949] Zipf, George K. (1949) <u>Human Behavior and the Principle of Least Effort: An Introduction to Human Ecology</u>. Houghton-Mifflin, Boston.

Lecture 2 Phonetics

As discussed in lecture 1, human languages are productive and compositional, like many other much simpler representational systems. For example, there are infinitely many decimal numerals, and they are all built from finitely many parts. Usually we say that the finitely many basic parts are the 10 digits

0 1 2 3 4 5 6 7 8 9

and the way to build larger numerals from these is to arrange these parts in a sequence. Notice that we could assume a larger set of basic parts, like

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19.

Obviously, all the numerals that can be obtained by making sequences from the first set of basic elements can also be obtained by making sequences of the second, larger set of basic elements. Some elements of the second set have parts that are common to other elements, and since this second set does not get us anything new, the first can be preferred. The first set covers all the numerals and it is simpler. The reason for mentioning this obvious point is that similar sorts of reasoning will be used when we try to figure out what the basic elements of language are.

A **first idea** about language **(one that we will reject)** is that (i) the basic elements of language are the words, and (ii) the expressions of the language are formed by making longer and longer sequences of words. By "words" we might mean something like those things that get listed in standard dictionaries, except that we will take the spoken language to be basic and so we will think of the dictionary entries as they are pronounced. My English dictionary (Merriam Webster's Collegiate Dictionary, 10th edition) advertises that it has "more than 160,000 entries." Most speakers of English do not know them all. The text suggests that adults know some 50,000 words, and they can often recognize many more than that. So suppose that we assume that the basic elements of language are these words, something more than 50,000 of them. We typically learn to pronounce them first, only later learning how to spell them and read them, so let's adopt the natural assumption that the spoken language is more fundamental, and concentrate on the sounds of the pronounced words. So our first idea can be that (i) the basic elements of languages are the speech sounds that we call "words" of the language, and that (ii) larger expressions are just sequences of words.

Both parts of this first idea face problems. Part (i) does not look right, because many elements of the set of pronounced words seem to have parts in common. For example, the pronounced forms of the words *newt* and *nude* seem to have some sounds in common, sounds that are also shared by many other words. So there might be a shorter list of basic sounds which can cover all the sounds in all the words of the dictionary. We do not necessarily want the simplest list, though. What we want is the list of elements that people, the users of the language, actually take to be basic. So the question is not just whether there is a list of more basic elements, but whether people actually pay attention to what those parts are. It is easy to see that we do. This will be completely clear by the end of this chapter and the next, but just to start with, we can see that speakers of English actually pay attention to the individual sounds by noticing that the plural of *newt* is formed by adding an [s] sound, while the plural of *nude* is formed by adding a [z] sound. We can see that this is not accidental in two ways. First, we can see that other "regular" plurals fall into a pattern with these cases:

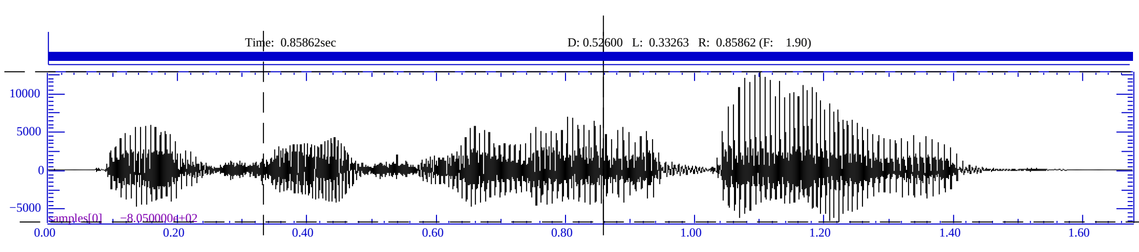
pluralize with [z]	pluralize with [s]
load	loot
mood	moat
code	coat
mode	mote
road	root
food	foot

Second, if we make up new words that speakers have never used before, we can predict that these will also fall into the same pattern. For example, if I say that a bad idea should be called a "crod", and then I ask you what 2 bad ideas would be called, I can predict that you will say "2 crods", pronouncing that plural with a [z] sound. But if I did the same thing with "crot", I would predict that you would pluralize with an [s]. This shows that English speakers are not taking the words as indivisible units, but are noticing the individual sounds in them. We are not consciously aware of this classification of sounds, but it is implicit in the way we use the language. Our implicit pluralization strategy shows that the list of basic elements of English (and other spoken languages) are individual sounds like [s] and [z] and [t] and [d].

Part (ii) of the first basic idea about the language faces a problem too. It is not true that we make expressions of the language just by putting words in a sequence. The sequence "the dog barks" is a good expression of English, something you might say, but the sequence "barks dog the" is not. The latter sequence is not an intelligible expression of the same sort as the former one, and so if we are going to describe how the intelligible expressions are formed from words, the story is going to be more complicated than it is for decimal numerals. Before working on this problem, let's go back to the first one and consider what the basic speech sounds are.

2.1 Speech sounds

If you ask a physicist, sounds are vibrations in the air (i.e. variations in air pressure) produced in various ways by our vocal apparatus, perceived by the vibration of the ear drum that results. Like any other sounds, speech can be plotted in a familiar visual form, with the air pressure on the vertical axis and with time on the horizontal axis. An example is shown in Figure 2.1.



"t h e r e ' s u s u a l l y a v a l ve"

Fig. 2.1: "There's usually a valve" – deviation from average air pressure vs. time

It is very difficult to recognize the speech sounds relevant to humans in this sort of representation, since there are waves of different frequencies and amplitudes caused by the different aspects of articulation. We get a slightly more readable representation of the same data in a spectrograph, as in Figure 2.2. Here we plot frequency on the vertical axis, with time on the horizontal axis, with the magnitude of the departure from average air pressure (amplitude) indicated by shading, increasing from light gray to dark grey to black to white. The white bands of high amplitude are called **formants**. In both graphs, I have put two lines around the sound of the word *usually*.

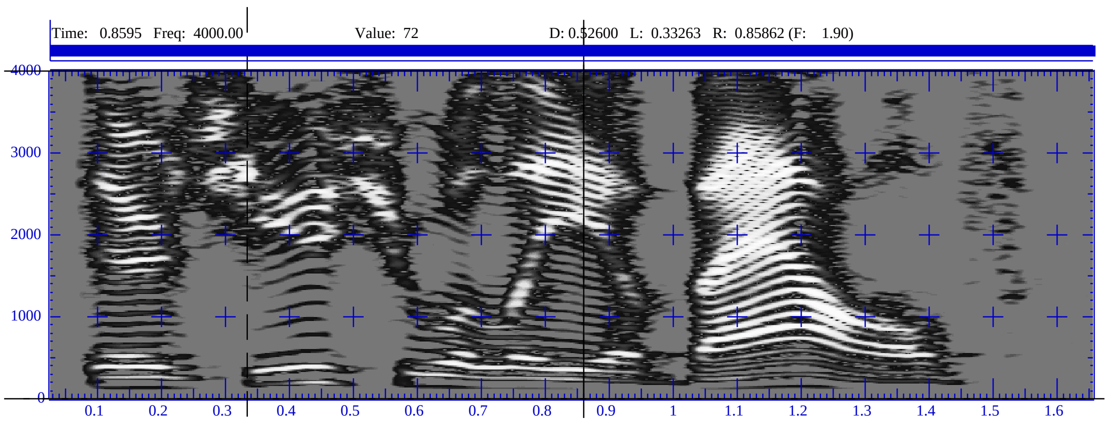


Fig. 2.2: frequency vs. time, amplitude indicated by shading

Even in spectrograms, it is difficult to see the linguistically significant distinctions, but one thing is obvious: word boundaries do not stand out! There is no silence between words, or any other obvious mark. This is no surprise to anyone who has listened to the speech of a language they do not know: you cannot tell where one word ends and the next begins. In fact, this is highly context dependent even when you are fluent in the language, as we see in (nearly) homophonous pairs of English expressions:

(1) a. The good can decay many ways
    b. The good candy came anyways

(2) a. The stuffy nose can lead to problems
    b. The stuff he knows can lead to problems

(3) a. Gladly the cross I'd bear
    b. Gladly the cross-eyed bear

(4) a. I scream
    b. Ice cream

(5) a. Was he the bear?
    b. Wuzzy the bear?

So although we hear individual words, they are difficult to detect in our graphs. We also hear various things as the same sound, even when they are quite different acoustically. For one thing, absolute pitch is represented in our graph, and we can hear it, but it makes no difference to the speech sounds. Also, changing the rate of speech will of course change the acoustic representation and be perceived, even when the speech sounds are the same.

More interesting mismatches between the acoustic representation and our perception are found when you look into them more carefully. A typical [i] sound has formants at 280 cps (cycles per second), 2250 cps and 2890 cps (Ladefoged, 1993).[1] We can see this sound in the spectrogram shown above, sliding by quickly as the final vowel of *usually*, between 0.80 and 0.86 on the horizontal (time) scale. (Check for yourself!) The acoustic properties of vowels vary from one speaker to another, though. Ladefoged & Broadbent (1957), and many other studies, have shown that our perception of vowels is actually adjusted to the voice we are hearing, so that the very sounds we hear as *bet* in the context of one voice may be perceived as *bit* in the context of another voice. The acoustic properties of consonants, on the other hand, vary much more dramatically even for a given speaker, depending on the context in which they are spoken. If you cut the first consonant sound out of [pi] (*pea*) and splice it onto [a] (*ah*), the resulting sound is not [pa] but [ka] (Schatz, 1954; Liberman et al., 1967). In consonant sounds, we are very sensitive to the brief changes in formants. Some sounds that you might think would be simple, are not.

In any case, it is difficult to begin our linguistic theory with the representations of sounds suggested by work in physics. What we want to do is to classify speech sounds in the way that speakers of the language automatically do in their fluent use of the language.[2] As a first approximation, we begin with a classification of sounds based on how the sounds are articulated and how they sound to our remarkably sensitive and complex auditory sense. At some level, this classification should correspond to one based on standard physics, but not in any simple way!

2.2 Articulation and transcription

The basic structure of the human vocal tract is shown in Figure 2.3. We list the basic sounds of 'standard' American English, classifying them roughly according to the manner of their production. X-rays of the mouth in action show that our intuitions about tongue positions are really not very good, and the traditional classification scheme presented here is based largely on perceived sound quality, i.e. on more or less subtle acoustic properties of the sounds.

Many sounds can be made using these parts of the mouth and throat. vowels can be formed by vibrating the vocal chords with the tongue in various positions, and consonants can be produced by stopping or affricating the sound. Writing systems are sometimes classified into phonetic, syllabic, or morphemic, with English classified as phonemic, Japanese katakana as syllabic, and Chinese as morphemic, but anyone who knows these writing systems will realize that the names of these classifications do not match the real complexities of these systems.

It would be wonderful to have an universal alphabet that was truly phonetic, with one

[1] These pitches are all fairly high, as is no surprise considering the small size of the parts of the vocal tract whose resonance gives rise to these formants. For reference: middle C is 221.63 cps; the highest C on a piano keyboard is 4186 cps. So the main formants of [i] are at frequencies higher than the pitch of the first partial of any normal speech. The fact that many different frequencies are present at once also explains how singing, and the intonation we use in questions, etc. is possible: we can vary the fundamental frequency of our acoustic signals (produced by the vibration of the vocal chords) preserving the basic formant structures of the speech sounds (produced by the filtering, resonance effects of the shaping of the vocal tract).

[2] The text says on p 483 "By basic sounds we mean the minimum number of sounds needed to represent each word in a language differently from all other words, in a way that corresponds to what native speakers think are the same sounds in different words." This is not quite right, because two different words can sound exactly the same: "are" is both a form of the verb `be` and also a unit of area; "bank" is both a financial institution and the edge of a river; "nose" is something on your face, but "knows" is a verb. These different words can be pronounced exactly the same, so we really do not want to represent each word "differently from all other words." What we want is to identify the classification of sounds that speakers of the language implicitly use.

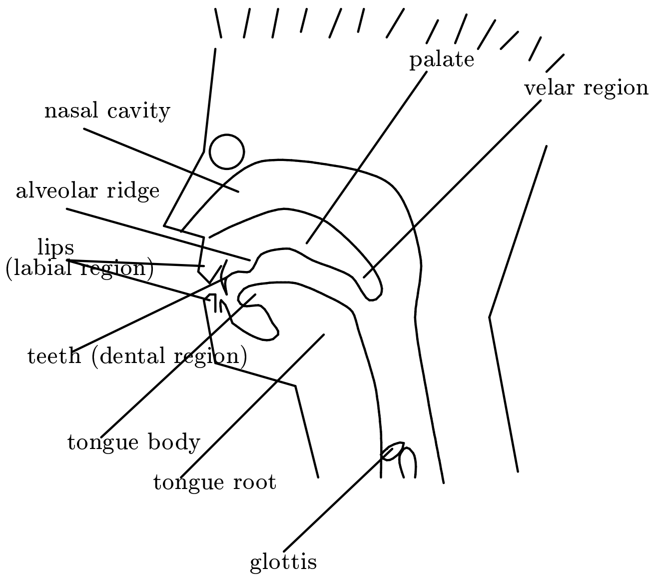
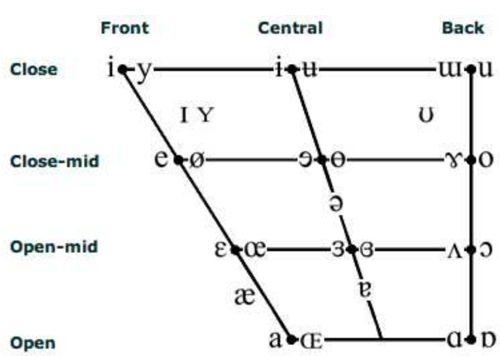


Fig. 2.3: Places of articulation for consonants

symbol for each sound that is used in any human language. This would make it possible to pronounce a sentence in any language just by reading it. This is not quite possible, but the International Phonetic Alphabet comes close. We display it here, and then go through the parts of the alphabet that get used in "standard" American English. (An interactive version is linked to the web page.)

	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	p b			t d		ʈ ɖ	c ɟ	k ɡ	q ɢ		ʔ
Nasal	m	ɱ		n		ɳ	ɲ	ŋ	ɴ		
Trill	ʙ			r					ʀ		
Tap or Flap		ⱱ		ɾ		ɽ					
Fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç ʝ	x ɣ	χ ʁ	ħ ʕ	h ɦ
Lateral fricative				ɬ ɮ							
Approximant		ʋ		ɹ		ɻ	j	ɰ			
Lateral approximant				l		ɭ	ʎ	ʟ			

Where symbols appear in pairs, the one to the right represents a voiced consonant. Shaded areas denote articulations judged impossible.



Where symbols appear in pairs, the one to the right represents a rounded vowel.

We mark some additional distinctions with these little accents, "diacritics":

◌̥	Voiceless	n̥ d̥	◌̤	Breathy voiced	b̤ a̤	◌̪	Dental	t̪ d̪
◌̬	Voiced	s̬ t̬	◌̰	Creaky voiced	b̰ a̰	◌̺	Apical	t̺ d̺
ʰ	Aspirated	tʰ dʰ	◌̼	Linguolabial	t̼ d̼	◌̻	Laminal	t̻ d̻
◌̹	More rounded	ɔ̹	ʷ	Labialized	tʷ dʷ	◌̃	Nasalized	ẽ
◌̜	Less rounded	ɔ̜	ʲ	Palatalized	tʲ dʲ	ⁿ	Nasal release	dⁿ
◌̟	Advanced	u̟	ˠ	Velarized	tˠ dˠ	ˡ	Lateral release	dˡ
◌̠	Retracted	e̠	ˤ	Pharyngealized	tˤ dˤ	̚	No audible release	d̚
◌̈	Centralized	ë	◌̴	Velarized or Pharyngealized	ɫ			
◌̽	Mid-centralized	e̽	◌̝	Raised	e̝		(ɹ̝ =voiced alveolar fricative)	
◌̩	Syllabic	n̩	◌̞	Lowered	e̞		(β̞ = lowered bilabial approximant	
◌̯	Non-syllabic	e̯	◌̘	Advanced Tongue Root	e̘			
˞	Rhoticity	ɚ a˞	◌̙	Retracted Tongue Root	e̙			

Diacritics

And some further informations about pauses, syllables, etc., "suprasegmentals", can also be marked:

ˈ	Primary stress	
ˌ	Secondary stress	ˌfoʊnəˈtɪʃən
ː	Long	eː
ˑ	Half-long	eˑ
◌̆	Extra-short	ĕ
|	Minor (foot) group	
‖	Major (intonation) group	
.	Syllable break	ɹi.ækt
‿	Linking (absence of a break)	

Suprasegmentals

Rather than going through everything in these charts, let's just explore the parts that we need for rough transcriptions of standard English.

Stop, fricative and affricate consonants:

			manner	voice	place
1.	[p]	s**p**it	plosive stop	−voice	labial
1a.	[p^h]	**p**it	plosive stop	−voice	labial
2.	[b]	**b**it	plosive stop	+voice	labial
6.	[t]	s**t**uck	plosive stop	−voice	alveolar
6a.	[t^h]	**t**ick	plosive stop	−voice	alveolar
20.	[k]	s**k**ip	plosive stop	−voice	velar
20a.	[k^h]	**k**eep	plosive stop	−voice	velar
7.	[d]	**d**ip	plosive stop	+voice	alveolar
21.	[g]	**g**et	plosive stop	+voice	velar
	[ʔ]	bu**t** 'n (button)	glottal stop	−voice	glottal
3.	[m]	**m**oat	nasal stop	+voice	labial
8.	[n]	**n**ote	nasal stop	+voice	alveolar
22.	[ŋ]	si**ng**	nasal stop	+voice	velar
4.	[f]	**f**it	fricative	−voice	labiodental
5.	[v]	**v**at	fricative	+voice	labiodental
10.	[θ]	**th**ick	fricative	−voice	interdental
11.	[ð]	**th**ough	fricative	+voice	interdental
12.	[s]	**s**ip	fricative	−voice	alveolar
13.	[z]	**z**ap	fricative	+voice	alveolar
14.	[ʃ]	**sh**ip	fricative	−voice	alveopalatal
15.	[ʒ]	a**z**ure	fricative	+voice	alveopalatal
24.	[h]	**h**at	fricative	−voice	glottal

The **stops** (plosive and nasal) momentarily block the airflow through the mouth. They are sometimes calles -continuant
The vowels, fricatives, glides, and liquids are **continuants**, +continuant, because they do not block airflow through the mouth.

The **nasals** [n m ŋ] are produced by lowering the velum to force the air through the nose.

The **fricatives** [s ʃ f z v θ ð h ʒ] do not quite block airflow, but constrict air passage enough to generate an audible turbulence.

The **affricates** [ʧ ʤ] are represented as sound combinations: very brief stops followed by fricatives.

Liquid and glide consonants:

			manner	voice	place
16.	[l]	leaf	lateral approximant	+voice	alveolar
16a.	[l̩] or [əl]	bottle	syllabic lateral approximant	+voice	alveolar
9.	[ɹ]	reef	(central) approximant	+voice	retroflex
37.	[ɹ̩] or [əɹ] or [ɚ]	bird	syllabic (central) approximant	+voice	retroflex
	[ɾ]	butter	flap	+voice	alveolar
19.	[j]	yet	(central) approximant	+voice	palatal
23.	[w]	weird	(central) approximant	+voice	labiovelar

The **approximants** are less restrictive, more vowel-like than the fricatives.

The **liquids** [ɹ l] have less constriction than the fricatives.[3]
Liquids can appear in a **syllabic** form, sometimes written [ər əl], or alternatively with a diacritic mark: [ɹ̩ l̩].

The **glides** [j w] involve a rapid transition.

All of the consonants made by raising the blade of the tongue toward the teeth or alveolar ridge are called **coronals**. They are the dental, alveolar and alveopalatal stops, fricatives, affricates, liquids and alveolar nasals: [t d ð θ s z n l r ɾ ʃ ʒ tʃ dʒ]. (Not labials, palatals, velars or glottals.)

Sounds that do not restrict air flow enough to inhibit vibration of the vocal chords are called **sonorants**: they are the vowels, glides, liquids and nasals. They are "singable." Non-sonorants (plosive stops, fricatives, affricates) are called **obstruents**.

(6) Every spoken language contrasts vowels with consonants, and sonorant consonants with obstruents.[4]

Why would such a thing be so?

[3]As indicated, we use [ɹ] for the American "r" sound, following the standard IPA notation, though the text uses [r]. In IPA, [r] represents a trill "r". When I am talking and writing about American English, I sometimes put the r rightside up too.

[4]In ASL, there is a very similar contrast between the positions assumed in a gesture and the movements that occur between positions. It is natural to regard the movements as analogous to vowels and the positions as analogous to consonants. In spoken languages, there are some syllabic consonants, like [r̩ l̩] in English, but they never occur adjacent to vowels. In ASL, there are syllabic positions, but never adjacent to movements. This kind of description of ASL is developed by Perlmutter (1992), for example.

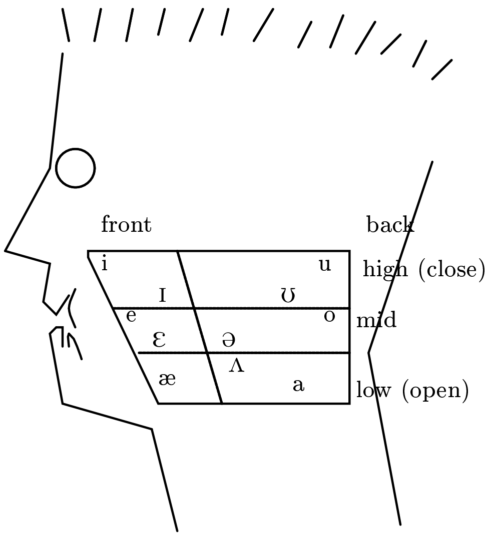


Fig. 2.4: Tongue position for vowel classification

Simple vowels:

			tongue body height	tongue body backness	lip rounding	tongue root tense (+ATR) or lax (−ATR)
25.	[i]	b**ea**t	high	front	unrounded	+ATR
26.	[ɪ]	f**i**t	high	front	unrounded	−ATR
34.	[u]	b**oo**t	high	back	rounded	+ATR
33.	[ʊ]	b**oo**k	high	back	rounded	−ATR
28.	[ɛ]	l**e**t	mid	front	unrounded	−ATR
32.	[o]	r**oa**d	mid	back	rounded	+ATR
31.	[ɔ]	c**augh**t	mid	back	unrounded	+ATR
36.	[ʌ]	sh**u**t	low	back	unrounded	−ATR
27.	[e]	**a**te	mid	front	unrounded	+ATR
29.	[æ]	b**a**t	low	front	unrounded	−ATR
30.	[a]	p**o**t	low	back	unrounded	+ATR
35.	[ə]	ros**e**s	mid	back	unrounded	−ATR

Diphthongs: vowels which change in quality in a single syllable

38.	[aɪ]	l**ie**s	+ATR
39.	[aʊ]	cr**ow**d	+ATR
40.	[oɪ]	b**oy**	+ATR

The list of relevant speech sounds varies from one dialect of English to another. For me the vowel [ɔ] in *caught* is different from the vowel [a] in *cot*, but this distinction is not present for many English speakers.

Tenseness:

The **long** or **tense**, +ATR vowels are [i u a o e] and all of the diphthongs [oɪ aɪ aʊ].[5]

(In elementary school, I was taught that the vowels were [e i aɪ o u], pronounced in their long forms here. To this list of long vowels, we have added [a aʊ].)

The tense/lax distinction is harder to sense by tongue position, though you can feel the tenseness in the tongue root in the tense/lax pairs like *beat/bit, mate/met, shoot/should, coat/caught*.

Probably the best way to remember this feature of vowels is to use the following generalization about English:

(7) Monosyllabic words can end in tense vowels, but not in lax vowels.[6]

OK: bah, see, sue, say, so, sigh, now
[ba], [si], [su], [se], [so], [saɪ], [naʊ]

NOT: [sɪ], [sɛ], [sæ], [sʊ]

(8) Syllables with lax vowels other than [ʊ] can end in [ŋ]; syllables with [ʊ] or tense vowels do not end in [ŋ]:

OK: sing, length, sang, sung, song
[sɪŋ], [lɛŋθ], [sæŋ], [sʌŋ], [soŋ]

NOT: [sʊŋ], [saŋ], [siŋ], [suŋ], [seŋ], [soŋ], [saʊŋ]

2.3 Explaining the sounds of human languages

Why classify speech sounds into **phones** in just the way indicated here? One idea is this:

> If two speech sounds distinguish two words in any language, they should be represented as different phones;
> Distinctions that are never relevant to distinguishing two words should not be represented (e.g. absolute volume, absolute pitch).

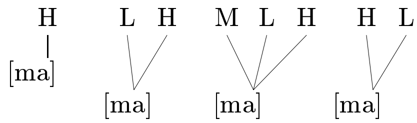
Notice, for example, that the sounds [t] and [t^h] do not distinguish any two words in English. But [t] and [t^h] do distinguish words in Hindi, and so we mark the distinction in our classification system. The ideal is that the classification system should be a notation for the sounds of any spoken human language.

But we have not really stuck to this ideal of marking every distinction of every language in the phones listed above. For example, [ma] is often used as a word for "mother" in English. But in Mandarin Chinese, there are the variants [ma] with a high tone vowel meaning "mother," [ma] with rising pitch, meaning "hemp," [ma] with falling pitch, meaning "scold," and [ma]

[5] The vowel [o] of standard American English is sometimes classified as lax. In fact, the tenseness of this vowel varies from one American English dialect to another, as Halle (1977) and others have observed. Eastern New England dialects have a laxer [o] than most other parts of the country. For any particular speaker of American English, though, the tenseness of [o] is fairly uniform across lexical items. In contrast, in standard Southern British English (RP) some words seem to have a rather lax [o] while other words have tenser form. Ladefoged (1993) suggests that tenseness is a phonological property and not phonetic at all – contrary to what its name and association with the ATR feature would suggest.

[6] One of the most common words of English, *the*, pronounced [ðə], is one of the few counterexamples to this claim. This word *the* has quite a few special properties.

with a lowering and then rising tone meaning "horse."[7] The following notation is sometimes used to mark these distinctions:



So really, by the same logic that motivates including both [t] and [t^h] in our inventory of sounds, we should include all four of these tonal variations of [a]. Could there be other variations?

Another example is the [k] sound of English. For most English speakers, the [k] in *keel* is high and more forward, more central ("scarcely a velar articulation at all"). On the other hand, the [k] in cool is high and back. The sounds are slightly different, too. Ladefoged & Maddieson (1986, 17ff) report that in some Australian and other languages, such slight variants of [k] are used to distinguish words. So really they all should have different entries in our list of phones. Other examples will come up later.[8]

It is in the context of such observations as these that we should assess the claim one sometimes hears, that there could be a "completed" IPA chart of all the possible sounds. The claim is:

(9) the class of phones, the class of possible speech sounds for all human languages, is finite.

¿! Is this believable? The diversity of languages needs to be weighed against universals such as (6). And remember: finite sets can be enormous![9]

A couple of other interesting points come up when we consider [t] and [t^h] in English. First, the use of one or another of these allophones in English is not random. The first consonant in *top* is always [t^h]. In almost every context, one or the other of these sounds is the one used by English speakers, not both. In this case, we say that the sounds have **complementary distribution**: where one of the sounds is used, the other is never used. Pairs like this, different sounds that never distinguish different words in a language, but which are predictable in context are called **allophones**. The tonal properties of vowels in English do not seem to be predictable in quite this way. This provides a reason to regard [t] and [t^h] as allophones of /t/, while the tonal variations of [a] in Mandarin are not allophones in English.

2.4 Looking ahead: articulatory processes

Another interesting issue comes up when we consider English dialects in which the *t* sound is almost always pronounced as [ɾ] when it occurs in the middle of a word. So for example, for these speakers the medial consonant in the word *latter* has the same sound as the medial consonant in the word *ladder*. It is common to transcribe both words with [læɾəɹ] or [læɾɹ̩]. But this misses something important: the words do not sound exactly the same because the

[7] You can hear these variants if you have web access and audio, at:
http://hctv.humnet.ucla.edu/departments/linguistics/VowelsandConsonants/Vowels%20and%20Consonants/chapter2/chinese/recording2.1.html

[8] In English, a slight lengthening of a simple vowel does not in itself distinguish two words. (Here we do not mean the changing of a simple vowel into a diphthong, which would be a phonemic change.) But lengthening simple vowels does make a difference in Serbo-Croatian. Also notice the discussion of *latter* and *ladder* below – there it may look like vowel length is the relevant distinction, but that, we claim, is an illusion.

[9] This kind of proposal will get discussed later in the text – in §13.1.2 – but we need to introduce some preliminary ideas before that discussion will make sense.

[æ] in *ladder* is regularly longer than the [æ] in *latter*. This shortening of a vowel is often indicated by putting a mark over the vowel:

ladder [læɾɪ̣]
latter [lă̆ɾɪ̣]

This is OK, except that this representation might lead us to miss an important generalization, roughly:

(10) Vowels are slightly longer before voiced consonants in English.

We have seen that [d] is voiced, but [t] is not, so the spelling of the words would lead correctly to the lengthening of the vowel in *ladder* but not *latter*. But in the phonetic transcription, we seem to have lost a distinction which is really there. We classified [ɾ] as voiced, but it seems that the [ɾ] in [læːɾɪ̣] is really a voiced [d], while the [ɾ] in [læɾɪ̣] really a voiceless [t]. We will resolve this problem with our theory of phonology, according to which the [ɾ] in these words arises from an underlying representation of either [t] or [d] by a process called **flapping**.

Flapping is one example of an articulatory process in English. Several are common: **dissimilation** (carefully distinguishing two adjacent sounds), **deletion** (dropping a sound, such as the first vowel in *parade*), **epenthesis** (inserting a sound, such as a [p] in the pronunciation of *something* as [sʌmpθɪŋ]), **metathesis** (reordering sounds, as in the pronunciation of *spaghetti* as [pəskɛɾi]), and progressive and regressive **nasalization** (spreading the nasal sound forward or backward, respectively, marked with a tilde), as in [mæ̃n]. These will be treated more carefully within the framework of our phonological theory.

2.5 Summary

Know the phones of standard American English, as listed here and in the book (but on the exams, sound charts like the ones here will be provided). Understand vowel and diphthong classifications front/back, high/mid/low, round/unrounded and at least roughly where each vowel sound is made. Know the consonant classifications stop/fricative/affricate/liquid/nasal/glide, voiced/unvoiced, and at least roughly where each consonant sound is made. Know what the voiced flap is. Know which sounds are +coronal and which are +sonorant. Know the diacritics for stop aspiration (as in [p^hɪt]), vowel shortening (as in [lă̆ɾɪ̣]), and nasalization (as in [mæ̃n]).

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Lecture 3 Phonology introduced

It would be natural to assume that the phones we listed in the last chapter are the basic elements of language, with words and sentences being formed just by putting the phones into sequences. This turns out not to be right! The sounds [t] and [t^h] are different, but in a certain sense this difference does not matter in English. In English, these two phones are both variants of the same "underlying" sound, the sound /t/. These basic, underlying sounds we will call **phonemes**. The phonemes are really the basic elements of the language, but their properties can be altered when they are pronounced. This is the kind of picture that will be developed in this chapter. We will also consider again the point that not every sequence of phonemes can form a word. In our standard decimal numeral system, 1111 is a perfectly good number, but not only is [kkkk] not an English word, it is not even a possible word. Why not? When we look into the matter, we find that the arrangements of sounds are very restricted and predictable. When we try to state what these restrictions are, we are led almost right away to a rather complicated picture of what is going on in the language. And this is just the beginning. You will be surprised.

3.1 Aspirated voiceless stops

We have already observed that the sounds [t] and [t^h] cannot occur just anywhere. Similarly for [k] and [k^h], and also for [p] and [p^h]. One idea is that we simply remember that *pit* is pronounced [p^hɪt] while *spit* is pronounced [spɪt]. This idea does not work, because it does not account for the fact that if we make up new words, like *piv* and *spiv*, we automatically pronounce them as [p^hɪv] and [spɪv], respectively, even though no one has told us how they are to be pronounced. Also, if it were just a matter of remembered pronunciations, we would have no explanation for why (almost) all words beginning with the *p* sound have the aspirated form.

An alternative idea is that there is just one basic sound, which we will call /p/, which gets aspirated automatically in certain contexts and not in others. Similarly for /t/ and /k/. This would explain why we treat new words in the regular way, and why the words already in the language are pronounced as they are. So what is the context in which stop consonants get aspirated? It is not just beginnings of words, since the /p/ in *upon* [ʌˈp^han] and the /t/ in *retake* are also aspirated. One simple idea is:

(1) English voiceless stops are aspirated syllable-initially.

We observed in class that the English voiceless stops form a natural class: they are the −continuant, −voice sounds. Consequently, the rule (1) can be expressed as follows:[1]

[1] The +aspirated feature is sometimes given the name: +spread glottis, because it involves keeping the glottis open to allow a buildup of pressure behind the stop.

(stop aspiration – first try)

$$\begin{bmatrix} -\text{continuant} \\ -\text{voice} \end{bmatrix} \rightarrow \begin{bmatrix} +\text{aspirated} \end{bmatrix} / [_{syllable} \;\_\_\_$$

For the dialect discussed in class, this idea has a couple of problems. In the first place, it makes the wrong prediction about the stops in words like

happy	[ˈhæpi]
upper	[ˈʌpɹ̩]
walking	[ˈwakɪŋ]

It was suggested in class that we could adjust our rule by adding the requirement that the stop be at the beginning of a stressed syllable. Notice that the consonants in these examples occur in the unstressed syllables. So we can make this adjustment to our rule:

(stop aspiration – second try)

$$\begin{bmatrix} -\text{continuant} \\ -\text{voice} \end{bmatrix} \rightarrow \begin{bmatrix} +\text{aspirated} \end{bmatrix} / [_{\substack{stressed \\ syllable}} \;\_\_\_$$

This is much better, but it still makes the wrong prediction about words like these

prey	[ˈpɹ̥e]
tray	[ˈtɹ̥e]
clay	[ˈkl̥e]
clever	[ˈkl̥ɛvɹ̩]
Trevor	[ˈtɹ̥ɛvɹ̩]

(In these words the liquids are sometimes voiceless, as indicated by the small circle diacritics.) In all of these cases, any aspiration associated with the stop seems to just become part of the following liquid, causing the liquid to sound less voiced. So we can restrict our description of the aspiration context a little bit more, as follows:

(stop aspiration)

$$\begin{bmatrix} -\text{continuant} \\ -\text{voice} \end{bmatrix} \rightarrow \begin{bmatrix} +\text{aspirated} \end{bmatrix} / [_{\substack{stressed \\ syllable}} \;\_\_\_ \begin{bmatrix} -\text{liquid} \end{bmatrix}$$

In class it was suggested that maybe there is some aspiration on the second p in "pepper" [pɛpɹ̩]. If that's true, then this rule is too restrictive, missing some cases. We could just drop the requirement that the syllable needs to be stressed, but that lets in many more cases. (Think about whether we want all of them!) We may return to this again later.

So the basic idea here is that various words may have the **phonemes** /p/, /t/ or /k/ in them. Words are associated with sequences of phonemes. These phonemes are then pronounced in one way or another according to their context. The collection of phonemes of 'standard'

American English may then be slightly smaller than the classification of phones, since two different sounds, two different phones may just be alternative pronunciations of the same underlying phoneme. In fact, phonemes can often be pronounced in many different ways. Many different phones can represent /t/:

(2)
a. [t] as in stop
b. [t^h] as in top
c. [ɾ] as in latter
d. [ʔ] as in "button" contracted to "but'n", or "a'las" for "atlas"
e. [t˺] often the t is unrelased in fluent speech, as in "she wen' home" – it can dissappear completely!

Counting different phonetic sounds as instances of the same phoneme might make you think that the phonemic classification of sound segments is just "coarser" than the phonetic classification. But later we will see that the classification of phonemes must also be "finer" than the classification of phones, in a sense, since in some cases we count one phonetic sound as a realization of different phonemes. In effect, this is what happens in flapping and various other processes.

3.2 Vowel shortening

The first phonological rule considered in the text is not stop aspiration, but vowel shortening (p522). We mentioned lengthening only very briefly when looking at the slides of different dialects at the beginning of the class, but we proceed in a way that is essentially similar to the cases of aspiration and flapping: we look for clear cases of vowel shortening to discover where it happens and where it doesn't. We will indicate shortening by placing a cup-like mark right over the vowel in the phonetic representation.[2]

bad	[bæd]	bat	[bæ̆t]
Abe	[eb]	ape	[ĕp]
phase	[fez]	face	[fĕs]
leave	[liv]	leaf	[lĭf]
tag	[t^{h}æg]	tack	[t^{h}æ̆k]

...

It could be that each of these words is just stored in the lexicon with the possibilities for vowel lengthening indicated. But this is not right, as we can see by observing the same lengthening in similar non-words:

gad	[gæd]	gat	[gæ̆ t]
mabe	[meb]	mape	[mĕp]
naze	[nez]	nace	[nĕs]
meave	[miv]	meaf	[mĭf]
kag	[k^{h}æg]	kack	[k^{h}æ̆k]

...

So there is some regularity here that is not simply learned on an arbitrary word-by-word basis. So what are the contexts in which vowels are lengthened in this way? Well, as observed in the

[2] Here, we use the mark to indicate shortening [ĕ] instead of the mark to indicate lengthening [eː]. Both marks are introduced in the IPA chart on page 496.

last chapter [d b z v g] are all +voice, while [t p s f k] are not. This suggests that vowels are longer when they appear before voiced consonants. The following kind of format is often used for expressing such a generalization:

(V-length – first try)

$$\begin{bmatrix}+\text{vowel}\end{bmatrix} \rightarrow \begin{bmatrix}+\text{long}\end{bmatrix} / \underline{\quad\quad} \begin{bmatrix}+\text{voice}\\ +\text{consonant}\end{bmatrix}$$

This rule makes predictions about many cases we have not considered, so it would be good to check them!

3.3 Flapping

Now we can now consider flapping, as we did in class. Recall that the flap [ɾ] was introduced in the phonetics chapter with the word "butter" as a voiced alveolar consonant. We find this sound in many words (listed here by standard spelling, not phonetically):

ladder	latter	utter	udder
madder	matter	mutter	hottest
soda	cider	pedal	pedant
modify	hitter	outing	edict
jaded	edible	etiquette	outing

It will be good practice to begin with some simple ideas and fix them up again. A first idea is that /t/ and /d/ are flapped only when they are "medial" consonants, flanked by vowels or syllabic liquids.

Let's express this first idea in our rule notation. What class includes the vowels and syllabic liquids – well they are sonorants, but that's not what we want, since it includes nasals. But the vowels and syllabic consonants can be syllables, so let's call them +syllabic. The next question is: What features distinguish /t/ and /d/? In fact, these are alveolar plosive stops: i.e. they are picked out by the features −nasal, −continuant, +alveolar. Putting all of this together, we can express our idea about flapping this way:

(flapping – first try)

$$\begin{bmatrix}-\text{continuant}\\ +\text{alveolar}\\ -\text{nasal}\end{bmatrix} \rightarrow \text{ɾ} / \begin{bmatrix}+\text{syllabic}\end{bmatrix} \underline{\quad\quad} \begin{bmatrix}+\text{syllabic}\end{bmatrix}$$

This rule is a good first approximation, but it is not quite right. Looking at the flapped /t/, since the difference between [t] and [ɾ] is easier to hear than the difference between [d] and [ɾ], it is easy to find counterexamples to the rule we have formulated. Here are a couple – these are cases where we have a real [t] between vowels, one that does not get flapped (again, listing examples by spelling):

proton	neutron	altitude
aptitude	retail	attest
mattress	retool	protest
protect	multitude	infinitude
attorney	attempt	attack
attentive	attention	detest
undertone	undertake	return
retroactive	retire	retouch
retort	retain	retaliate
attract	fatigue	eternal
material	maternal	pretested

We can find a similar list of /d/'s that do not get flapped:

radar	ado	reproduce
redo	deduce	residue
redraft	reduction	redouble
redeem	podiatrist	bedeck

It helps to consider minimal contrasting pairs again, cases as similar as possible, but where only one member of the pair shows flapping:

rider	[ɹaɪɾɹ̩]
radar	[ɹedaɹ], NOT: [ɹeɾaɹ]
atom	[æɾəm]
atomic	[ət^{h}a mɪk], NOT: [əɾamɪk]
proton	[pɹot^{h}an], NOT: [pɹoɾan]
rattle	[ɹæɾəl]
retail	[ɹit^{h}el]

What is going on here? Well, there seems to be a difference in stress in each pair, which we could regard as the difference between a stressless syllable and a syllable that receives secondary stress. As specified on the IPA chart (p.496 of the text), using the vertical mark above for primary stress and the vertical mark below for secondary stress, then the data is this:

rider	[ˈɹaɪɾɹ̩]	radar	[ˈɹeˌdaɹ]
atom	[ˈæɾəm]	atomic	[əˈt^{h}a mɪk]
proton	[ˈpɹoˌt^{h}an]		
rattle	[ˈɹæɾəl]	retail	[ˈɹiˌt^{h}el]

It seems that flapping does not apply if the second vowel has secondary stress (as in *proton* or *retail*), but only when the following vowel is totally unstressed (as in *rattle*). So we can improve our flap rule as follows, where we now take care to mean "totally unstressed" by -stress:

(flapping)

$$\begin{bmatrix} -\text{continuant} \\ +\text{alveolar} \\ -\text{nasal} \end{bmatrix} \rightarrow \text{ɾ} / \begin{bmatrix} +\text{syllabic} \end{bmatrix} \underline{\qquad} \begin{bmatrix} +\text{syllabic} \\ \text{-stress} \end{bmatrix}$$

This handles all of the examples listed above. The examples considered in class were a little different, but led to a very similar rule.

3.4 Nasalization

We didn't get to discuss this in class, but the text also mentions that in English, vowels sometimes acquire a nasal sound which we indicate with a tilde over the vowel:

tɛd	tɛ̃n	nɛt
hæt	hæ̃nd	næt

Suppose the generalization is simply this: a vowel that occurs before a nasal consonant becomes nasalized. Make sure you could represent this generalization with the rule notation we have been using above. Is this generalization correct? Why would nasalization work this way? What kinds of evidence could be provided to convince someone who claimed they could not hear the difference? How could you convince someone who thought nasals could also spread to a following vowel?

3.5 The new picture, and remaining questions

The new story seems intuitive, but it is surprising in a number of ways.

1. We assume that words are listed in in the lexicon not as sequences of phones, but as sequences of **phonemes**. – These are the basic units of the language.
2. The phonemes are defined just as **segments** of sound with particular properties, particular features, features which may be altered in certain contexts. So a segment with the features of a /t/ may be altered to surface as a [ɾ] or as a [ʔ].
3. **Rules** apply to underlying segments, altering features of specific segments on the basis of the linguistic context (which sounds are to the left and write, whether there is a word or syllable boundary, whether there is stress, ...)

Like every good story, this one leaves us with more puzzles.

Q1. What are the phonemes of English, and how can we defend the idea that something is a phoneme?

We have introduced a certain strategy, and we will get more practice with it in the next lectures.

Q2. The text says on p. 522:[3]

> The very fact that the appearance of [e] and [ĕ] is predictable is important: it means that the difference between the two cannot be used to distinguish words from each other.

Why not? Is this a matter of logic?[4] Or is it an empirical matter?

[3] This quote refers to the difference between [e] and [ĕ], but in class we used the different notation [eː] and [e], as mentioned in footnote 2 on page 21.

[4] For example, it is a matter of logic that if all men are mortal, then it must be the case that: if Socrates is a man, then he's mortal. – The opposite assumption is nonsense!

Lecture 4 Phonemes and rules of variation

At the beginning of the class, we mentioned that although language is flexible and changing constantly, the way we speak influences our perceptions in sometimes surprising ways. Looking at sound combinations in the last class, we see some examples of this. First, we see there are small variations in the phoneme inventories of even "standard" English speakers, and we also see that distinctions that do not matter in your own dialect are sometimes hard to hear. For me, there is a clear difference between "caught" /kɔt/ and "cot"/kat/, and between "paw" /pɔ/ and "pa" /pa/. But for many Californians, this distinction is hard to hear. As you practice in phonetics and phonology, you will get better at noticing a range of distinctions, but each new language and dialect can present challenges!

The methods introduced last time are important, so let's make them explicit here. They can be applied when you have the relevant data, even when you are not a speaker of the language.

(1) The **phoneme** basic unit of sound, and **phonological** rules specify how those sounds change in context.

The changed sounds, the variants which occur in one or another context, are sometimes called **allophones**.

So among the **phones** of American English which we discussed in the first lecture, some may be phonemes, but others may be variants, "allophones."

The previous lecture notes list 40 or so **phones** for 'standard' American English, but the text proposes a different inventory, with 39 **phonemes**:

24 consonants	voice		bilabial	labio-dental	dental	alveolar	palato-alveolar	palatal	velar	glottal
stops	-		/p/			/t/	/ʧ/		/k/	
	+		/b/			/d/	/ʤ/		/g/	
fricatives	-			/f/	/θ/	/s/	/ʃ/			/h/
	+			/v/	/ð/	/z/	/ʒ/			
nasals	+		/m/			/n/			/ŋ/	
approximant	+	lateral				/l/				
	+	central	/w/			/r/		/j/		

11 vowels	front unrounded	central unrounded	back unrounded	back rounded
upper high	/i/			/u/
lower high	/ɪ/			/ʊ/
upper mid	/e/	/ə/		/o/
lower mid	/ɛ/		/ʌ/	
low	/æ/		/a/	

3 diphthongs
/aɪ/
/aʊ/
/oɪ/
1 syllabic consonant
/r̩/ or /ɚ/

Among the consonants, notice that there is just one phoneme for each of /t/, /k/, /r/, /l/, and /w/ even though they have variants, and it is assumed that the flap [ɾ] is a derived form. All of the other consonants in our list of phones correspond to phonemes.

The vowel chart lists 11 simple vowels, 3 diphthongs, and 1 syllabic consonant. Comparing this to the list of phones, we see that the /l̩/ of the previous chapter is not listed as a phoneme, nor is /ɔ/. I think the /ɔ/ is left out not because it is derived, but because it is becoming rather rare; and the text says on p490 that /l̩/ is left out because it will be treated as /əl/.

So this is a catalog of 39 phonemes altogether, but we have seen that this varies slightly among English speakers. Some other languages have as few as 11 phonemes (Polynesian, Pirahã) and some have 100 or more phonemes (e.g. the Khoisan language !Xóõ; some other languages like the Caucasian language Ubykh have a good number of consonants).

It is commonly (but not universally) assumed that in every dialect of every language, each word is associated with a sequence of phonemes. This picture of **phonemes** as the basic units, the picture expressed in (1), raises the basic question:

(2) **How do we identify the phonemes and the variants?**

We did this informally when we identified some variants of /t/, /r/ and the vowels last time, but it is useful to be explicit about the procedures. Let's state them first, and then go through some more examples.

On the standard view developed here, the phonemes of a language are the segments of sound that occur in lexical entries, and this idea is captured with the following procedure:

4.1 Minimal pairs

Identifying different phonemes with minimal pairs

1. Find pairs of different words that differ in a single sound: the differing sounds in these pairs are different phonemes, or variants of different phonemes.

Complications for this method:

- Sometimes a minimal pair cannot be found, just because of accidental gaps in the lexicon. The text (pp533,534-535) gives the English example of /ʒ/ and /ð/

So, for example, the minimal pair

[bæd] [fæd]

shows that [b] and [f] are (variants of) different underlying phonemes. And the pair

[t^hɪp] [lɪp]

shows that [t^h] and [l] are (variants of) different underlying phonemes.

With sounds like /ð/ and /ʒ/, it can be hard to find perfect minimal pairs, but we can come close:

seizure	/ˈsiʒr̩/	neither	/ˈniðr̩/
adhesion	/ədˈhiʒən/	heathen	/ˈhiðən/

So the previous procedure identifies variants of distinct phonemes, but the possibility of variants, the possibility that each phoneme can be altered according to its phonological context, makes determining the actual catalog of phonemes of a language rather abstract, and so we need a second procedure:

4.2 Phonological rules

Identifying phonemes and phonological rules

1. Identify the environments in which each sound occurs
   (it can happen that the distribution is complex, but we can begin by assuming that adjacent sounds and boundaries are most likely to be relevant)
2. Identify collections of sounds that never appear in the same environment:
   sounds in **complementary distribution**.

   (we are especially interested when the complementary sounds are related, sharing many features)
3. If the characterization of these collections of sounds and their environments involve lists of sounds, see whether the elements of each list fall into natural classes, so that they can be identified by their features.
4. For each such collection, consider the hypothesis

   H: the element of the collection that occurs in the widest range of environments is the phoneme, and the other forms are derived from the phoneme by phonological rules.

Complications for this method:

- Sometimes phonological rules are optional, so the related forms will not be in a perfect complementary distribution.
- Sometimes two sounds have complementary distributions not because one is derived from another, but because they occur in different places for other reasons, or because of an accidental gap in the lexicon.
  The text (pp548-549) gives the English example of /h/ and /ŋ/. (See also p551 on /ŋ/)

So for example, one of the first sound changes mentioned in the text is English n dentalization:

no	[no]	tenth	[tɛn̪θ]
annoy	[əˈnoɪ]	month	[mʌn̪θ]
onion	[ˈʌnjən]	panther	[ˈpæn̪θr̩]

This list suggests that the /n/ is dentalized just when it precedes /θ/, but this list is too short. We should check a range of data, with particular attention to sounds that are similar to /θ/: other alveolars, other fricatives. A wider consideration supports the idea that this change is specific to

1. <u>Identify the environments for the sounds</u> [n n̪]

n	n̪
___o	tɛ___θ
ə___oɪ	mʌ___θ
ʌ___jən	pæ___θr̩

2. In this data, the environments for [n] and [n̪] are completely different. The [n] and [n̪] are in complementary distribution, even just considering only the immediately following sounds.
3. The sounds inolved here are very specific, and so we do not need arbitrary-looking lists to describe what's happening. Reflecting on how these sounds are made, it seems like an natural rule since the dental and alveolar gestures are similar.
4. We propose the hypothesis that /n/ is a phoneme, and that [n̪] is an allophone derived by the following rule:

   (n dentalization)

   $$\text{n} \rightarrow \left[\ \text{+dental}\ \right] / \_\_\_\theta$$

   As discussed in class, it could be that this change takes place in more contexts than our rule says (maybe not just before θbut before any interdental fricative?), but so far, with the data shown above, in these notes, we see the change only in this context.

The other examples we considered last time – stop aspiration, flapping – were more complicated, but the method was the same.

Chapter 12 is mainly devoted to presenting examples of this procedure. 17 or so different phonological rules are discussed, some at great length:

(p555)	English t aspiration (class formulation slightly different)
(p522)	English vowel shortening
(pp530,555,567)	English flapping
(p527)	English l devoicing
(p527)	English l dentalization
(p527)	English l velarization
(p545)	English vowel nasalization
(p550)	English alveolar place enforcement
(p552)	English (optional) ae diphthongization
(p555)	English preglottalization
(p564)	English post-nasal t-deletion
(p566)	English /aI/ raising
(p539)	Maasai /k/ spirantization
(p539)	Maasai post-nasal voicing
(p531)	Spanish /d/ spirantization
(p559)	Choctaw rhythmic lengthening
(p561)	Korean stop nasalization

The important point is not to memorize this list of rules. The important thing is to know how to use the procedures to find such rules, and what they signify.

One important thing to notice is that these rules are not necessary, so they must be learned. Other languages do things differently.

4.3 Ordering the rules

There is one more wrinkle to consider: what happens when more than one rule can apply? What we say about this matters! We can see that this matters by considering a dialect that has the following pronunciations:

	phoneme sequence	phone sequence
ladder	/lædr̩/	[læɾr̩]
latter	/lætr̩/	[læ̆ɾr̩]

We will get the wrong result for the word *latter* if we apply first flapping and then shortening:

/lætr̩/
⇓ flapping
[læɾr̩]
vowel shortening does not apply (because ɾ is voiced)

We could avoid this result if we insisted that vowel shortening applies before flapping.

The data we are trying to model here might not be trusted though, because, in most common dialects of American English, there is little if any difference between the pronunciations of *latter* and *ladder*. But there is a dialect of English which provides a more audible distinction that can be used to explore these issues. In this dialect (mentioned in the text on pp566-570), we have a diphthong [ʌɪ] that is heard in words like the following (more data in the text):

write	[rʌɪt]	ride	[raɪd]
tripe	[tr̥ʌɪp]	tribe	[tr̥aɪb]
rice	[rʌɪs]	rise	[raɪz]
sight	[sʌɪt]	side	[saɪd]

This difference can be seen in the spectrogram (this one from Moreton & Thomas):

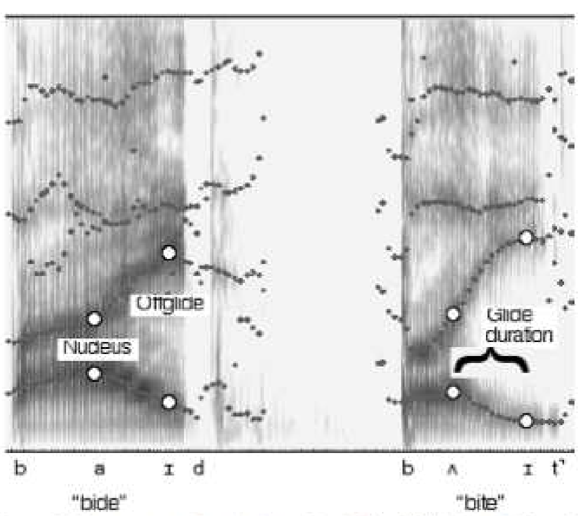


Figure 5. Measurement points (nuclear F1 and F2, offglide F1 and F2, and glide duration) for examples of *bide* and *bite*. Frequency range shown is 0 to 5000 Hz. The window is 1.00 s wide.

Now, let's use procedure 2 to see what's going on with the sounds [ʌɪ] and [aɪ]:

1. Identify the environments for the sounds [ʌɪ aɪ]:

aɪ	ʌɪ
r___t	r___d
tr̥___p	tr̥___b
r___s	r___z
s___t	s___d

2. In this data, the environments for [aɪ] and [ʌɪ] are completely different – these sounds are in complementary distribution
3. Looking at the consonants immediately following the vowel, the sounds [t p s] are -voice, and the sounds [d b z] are +voice.
4. We can propose the hypothesis that /aɪ/ is a phoneme, and that [ʌɪ] is an allophone derived by the following rule:

   (aɪ-raising)

$$\text{aɪ} \rightarrow \text{ʌɪ} / \_\_\_ \begin{bmatrix} +\text{consonant} \\ -\text{voice} \end{bmatrix}$$

With this idea, we can look at what happens with flapping in this dialect, and what we find is this very audible difference between some forms in which both flapping and aɪ-raising can apply (in my dialect, this is much clearer than the *latter/ladder* case mentioned above and in class):

	phonemes	actual phones
writer	/raɪtr̩/	[rʌɪɾr̩]
rider	/raɪdr̩/	[raɪɾr̩]

We get the wrong result for the word *writer* if flapping applies first:

/raɪtr̩/
⇓ flapping
[raɪɾr̩]
aɪ-raising cannot apply because ɾ is voiced

We can avoid this result by insisting that aɪ-raising applies before flapping. So the point of this section is: when more than one rule can apply, we need to decide which has priority. One way to do this specifies an order in which the rules apply.

Notice how this kind of proposal complicates our picture of phonological processes. In fact, the presentation here and in the text plays a kind of trick. When listing the environments for the sounds [aɪ] and [ʌɪ], we did not include the writer/rider pair,

[rʌɪɾr̩]   [raɪɾr̩]

If we had included it, we would have noticed that [aɪ] and [ʌɪ] are not in complementary distribution. So what we really did is to set this last case aside as exceptional at first, and then explain it by proposing the raising rule.

In dialects with the vowel difference between "ladder" and "latter", yielding respectively

ladder	/lædr̩/	[læɾr̩]
latter	/lætr̩/	[lǎ̆ɾr̩]

it could appear that there is a phonemic contrast between [æ] and [æ̆], but now we see there is the alternative option of saying that shortening occurs before flapping. (If flapping occurred first, then since the flap is voiced, we would hear the long vowel in both cases.)

Ordering the rules also increases the complexity of our account considerably, and so some recent work in the field explores reformulations of the theory that avoids this. You will hear much more of this if you take more phonology.

4.4 Phonology and morphology

In the text, section 12.10 also observes that adding a prefix or suffix can change the relevant environment for phonemes in ways that affects pronunciation. For example, adding "-able" /əbər/ to "note" /not/ triggers flapping. This section of Chapter 12 talks about morphology, the study of word formation. We will discuss morphology soon, but this section is understandable using just the familiar understanding of words and suffixes.

Using ˈ to mark primary stress,

note	ˈnot
notable	ˈnoɾəbəl
notation	noˈteʃən

We get flapping not only across stem-suffix boundaries but across word boundaries:

not a mistake ˈnoɾəmɪˈstek

Do we get shortening of [e] across suffix or word boundaries? Do we get dentalization of n across suffix or word boundaries?

4.5 Phonologies vary

There is nothing necessary about the English phonological rules we have considered (n-dentalization, vowel shortening, flapping,. . .). Other languages can have different treatments even of the same sounds. In Bengali, the n/n̪ sounds are not in complementary distribution; on the contrary, for Bengalis, this distinction is phonemic and easy to hear. In English the ð/t sounds are not in complementary distribution and are phonemic, but the d/ɾsounds do have complementary distributions and are not phonemic. In Spanish we find the opposite situation (as discussed in the text on pp.530-531).

[pita] means 'century plant', while [piɾa] means 'funeral pyre'.

The occurrence of d/ð, on the other hand, is governed by a rule like this:

(Spanish spriantization)

d → ð/[+vowel]____

(The conversion of stops to fricatives is often called "spirantization.")

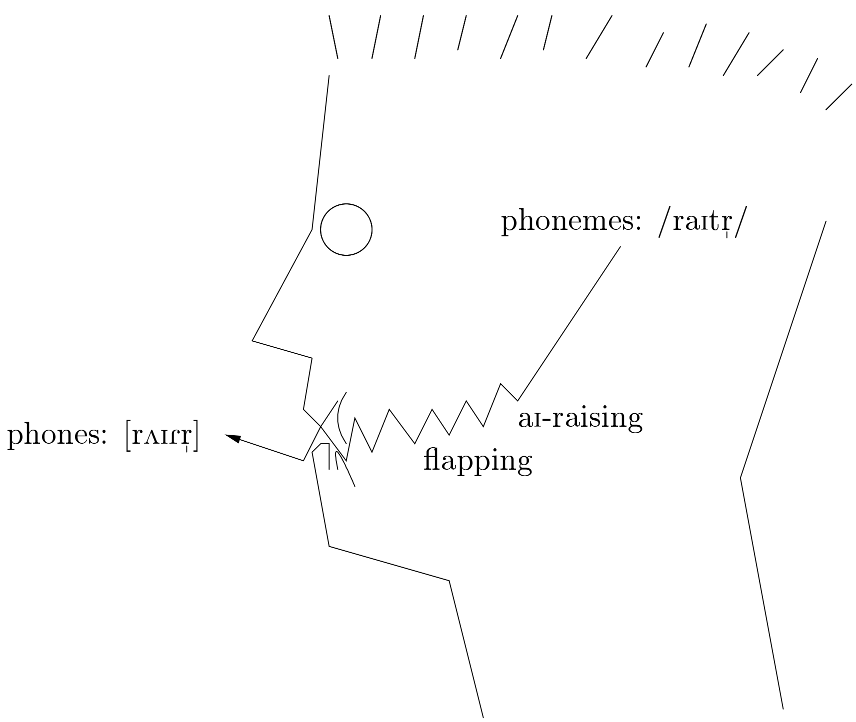
4.6 Summary

You do not need to memorize these rules, but you should be able to understand them, and more importantly, follow the steps to their formulation:

1. the minimal pair procedure for identifying (variants of) different phonemes
2. the procedure for identifying phonemes and phonological rules

The procedures are quite simple in outline. If someone else is available to provide the relevant data for a language you don't know, these methods can be applied. But in real applications, there are often complexities, some of which were mentioned in this lecture.

Even the first few steps taken in this class provides a surprising picture of how language works. When you think of a word or phrase to say, you have a phoneme sequence like /raɪtr̩/ in mind. Then, rules apply, *with some having priority over others*, to make some adjustments in how the phonemes sound when they are pronounced, so that the result might be, for this example, [rʌɪɾr̩]:



References

[Elliott Moreton and Erik R. Thomas 2007] Origins of Canadian Raising in voiceless-coda effects: a case study in phonologization. Laboratory Phonology 9: 37-64.

Lecture 5 Phonotactics, syllables, stress

So far we have seen that there may be fewer speech sounds than it seems at first, because a single sound can have various predicable variants. The regularity we call 'voiceless stop aspiration' explains why English has words like [pʰɪŋ] but not [pɪŋ]. This rule, and the other rules we have considered to describe variations, seems to be related to the manner in which these sounds are produced. The first phonology chapter in the text begins with a warning of three complexities in phonology (p.519): (i) there is quite a lot of variation that seems to happen "mostly for phonetic reasons;" but (ii) there are other complex distributional facts; and (iii) sound distributions are also influenced by word-formation (morphology) and phrase-formation (syntax). The phonology considered so far seems to fall under (i), and now we can see that there has to be much more to phonology than that, more 'phonotactics'. 'Phonotactics' are the principles restricting the permissible sound sequences in a language.

Returning to the example of decimal representations of numbers, we have seen that certain sequences like [pɪŋ] do not occur because stop aspiration will apply, but we have not considered why there is no English word [kkk]. Does voiceless stop aspiration apply? That is, is the first k in this sequence in a stressed syllable and not followed by a liquid? To answer this question we need to know more about syllables and stress – nothing in this sequence looks like a syllable!

The relevance of syllables to explaining the distribution of sounds generally is easy to see. Consider the following facts for example. English allows the word

[pɪŋk]	but not	*[pɪnk]
[drɪŋk]	but not	*[drɪnk]

And there is some regular pattern here that gets projected onto new words we might make up too, since

[pɛŋk]	is possible, but not	*[pɛnk],
*[pʌmk]	is extremely odd,	
*[pimk]	is extremely odd,…	

The relevance of syllables to these facts is obvious because we have other words with the wierd sequences [nk], [mk]:

[ɛnkod] [ɛnkʌmpəs] [pʌmkɪn]

It looks like the syllable boundaries, sometimes marked with a period, are relevant here:

[ɛn.kod] [ɛn.kʌm.pəs] [pʌm.kɪn]

Chapter 13 in the text addresses these things, and we turn to them now.[1]

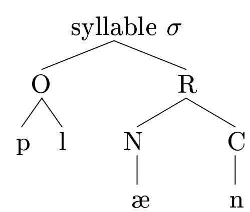
5.1 Features

Before looking at syllables, the text first observes that the phonological rules of the previous chapters have not really taken the phonemes to be basic: rather, the phonemes have various features in common, and the phonological rules pay attention to those features. For example, the feature [+voice] is something that English speakers pay attention to! So the smallest unit of analysis is really not the phoneme, but the phonological feature.

The text provides further examples to support the idea that referring to features provides a way to describe how the phonology of a language works, and how phonologies of different language are similar.

5.2 Syllables

The idea that one of the natural units of speech is a **syllable** is familiar from traditional grammars and dictionary entries, and we have already referred to syllables in trying to formulate our phonological rules precisely. It is traditionally assumed that a **syllable** is formed from zero or more consonants, followed by a vowel, and ending with another, usually shorter, sequence of zero or more consonants.[2] These three parts of a syllable are called the **onset** (O), the **nucleus** (N) and the **coda** (C), respectively, with the nucleus as the only obligatory part, and with the **tree** structure:



Here the syllable "σ" is called the **root node** of the tree – so the root is upside-down, the way family trees often are. In this upside-down tree, the root has two parts, the onset and the rime. In analogy with family trees, we call these two parts **daughter nodes** of the root. The right daughter is the rime, which is in turn the **mother** of two more daughters: the nucleus and the coda. In analogy with a real tree, the **nodes** that are furthest from the root, those along the bottom of the tree, are sometimes called **leaves**.

Why assume that the elements of the syllable group in this way, as [onset [nucleus coda]] rather than as [[onset nucleus] coda]? Well, one kind of argument comes from the fact that it is quite easy to divide syllables at the onset-rime boundary. Not only is this done in rhyming poetry, but also in language games like Pig latin. We see the same thing in "Yinglish" expressions like *fancy-shmancy, road-shmoad*. More importantly, there are fundamental restrictions

[1] All of chapter 13 is good reading, and provides useful background, but the crucial parts are: pp587-593 on syllables, and 597-602 on stress. – These are two loose ends from the previous lectures that we need to take care of.

[2] Some prominent approaches to phonology have tried to do without syllables altogether. Among those who accept syllables, it is a matter of controversy whether ASL has anything corresponding to a syllable structures – perhaps it could if vowels were equated with movements, and consonants with held positions...

on sound sequences which hold syllable-internally, as suggested by the *[pʌmk], [pʌm.kɪn] contrasts mentioned above, and discussed in more detail in the next section.

There are other restrictions on the structure of the English syllable. Consider the possible onsets:

(1) Any single consonant phoneme is a possible onset, except ŋ, and maybe ʒ.[3]
(Remember that ʔ is not counted as a phoneme here.)

(2) Only certain 2-consonant onsets are possible.

Since there are 24 consonants in our list of English phonemes, that means there are 24^2=576 different pairs of consonants. But the ones that occur in common English words are just those given by the +'s in this table (cf. the discussion in the text on p.591):

	w	j	ɹ	l	m	n	p	t	k
p		+	+	+					
t	+	+	+						
k	+	+	+	+					
b		+	+	+					
d	+		+						
g	+	+	+	+					
f		+	+	+					
θ	+		+						
ʃ			+						
s	+			+	+	+	+	+	+

This chart misses words with unusual sounds (borrowings from other languages, etc.). For example, *sphere* begins with the unusual onset [sf]. Clearly, [s] has special properties!

Notice that less than half of the consonants ever begin a complex onsets. Never ʧ, ʤ, v, ð, ʒ, m, n, ŋ, l, r, w, j.

(3) The number of different 3-consonant sequences is 24^3=13,824. But in onsets, there are even fewer 3-consonant possibilities than there were 2-consonant possibilities!! I count just these 9:

	w	j	ɹ	l	m	n
sp		+	+	+		
st		+	+			
sk	+	+	+	+		

See if you can think of any I missed. Again we see dramatically the special properties of [s].

(4) (Certain other onsets appear in words borrowed from other languages.)

Why are the possible onsets and codas so restricted? We will return to this question.

A simple strategy for specifying the structure of most (but not all!) English syllables is this: **First**, each syllabic phone (each vowel and syllabic consonant) is a nucleus. **Second**, we have the preferences (p592 in the text):

[3] Maybe we should count English as allowing an initial ʒ for names like Dr. Zhivago. – It is hard to draw a sharp line between borrowings from other languages and sound sequences that naturally occur in English.

(a) prefer syllables without onsets or codas (“open syllables”),

but if there are consonants around, the preference is to put them into the onsets:

(b) prefer syllables with onsets,
as long as this does not yield an onset that the language disallows.

When consonants occur between two vowels, then, we typically prefer to associate the consonants with the onset of the second syllable. In other words, each onset should include the longest possible sequence of consonants preceding a nucleus. **Finally**, any remaining consonants must be codas of the preceding nuclei. For obvious reasons, this idea is sometimes called the “onsets before codas” rule; what it amounts to is: “maximize onsets.” (Linguists have argued that this tendency may be due to the perceptual cues needed to recognize consonants, and the fact that final consonants are often unreleased (Ohala, 1990; Steriade, 1999).)

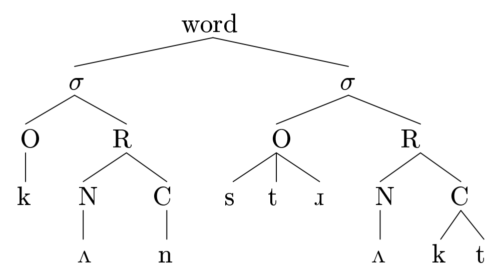
So, for example, the word *construct*

/kʌnstɹʌkt/

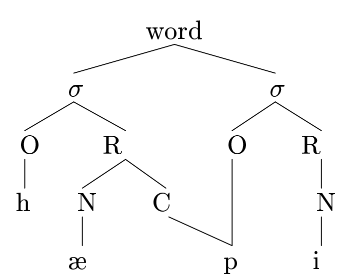
gets parsed into two syllables (shown by the dot in the last step) this way:

kʌnstɹʌkt	sequence to syllabify
k [$_N$ ʌ] nstɹ[$_N$ ʌ] kt	identify nuclei
[$_O$k] [$_N$ ʌ] n[$_O$stɹ][$_N$ ʌ] kt	maximize onsets
[$_O$k] [$_N$ ʌ][$_C$n].[$_O$stɹ][$_N$ ʌ][$_C$kt]	other consonants in codas

This last line shows with brackets the same thing that can be drawn with the tree:



This rule works properly for many words (try *matron, atlas, enigma*), but it does not seem to provide quite the right account of words like *apple* or *gummy* or *happy.* The first syllable of *apple* is stressed, and it sounds like it should include the consonant. Cases like these are called **ambisyllabic**: a consonant is ambisyllabic if it is part of a (permissible) onset but immediately follows a stressed lax (-ATR) vowel. For the word *happy*, the text presents a structure on page 588 in which the [p] sound is both the coda of the first syllable and the onset of the second one – there’s just one [p] sound but it’s ambisyllabic:[4]



[4]The tree for the ambisyllabic /hæpi/ in the text on p588 does not show the onsets, nuclei and codas, because these are not introduced until the next page – p589.

Notice that **this is not a tree**! It's not a tree because two of its branches "grow back together" – the /p/ has two mothers! That's not the way trees work! Unfortunately, that seems to be what happens with ambisyllabic consonants.

5.3 Syllables 1: feature agreement

We introduced syllables using the *[pʌmk], [pʌm.kɪn] contrast. That is, across syllable boundaries we find certain consonant combinations that seem to be impossible syllable-internally. Let's consider these more carefully.

The text suggests on p588: "in English, a nasal followed by a non-coronal stop (p,b,k,g) ... is obligatorily homorganic with the stop when the two are in the same syllable."

Remembering that the non-coronal stops = labial stops + velar stops. And the nasals = labial m + velar ŋ + alveolar n. So considering all 12 possible non-coronals+nasal combinations, the generalization above tells us that 8 are impossible syllable-internally:

mp	mb	*mk	*mg
*ŋp	*ŋb	ŋk	ŋg
*np	*nb	*nk	*ng

This explains the *[pʌmk], [pʌm.kɪn] contrast. The latter allows /m/ before /k/ because a syllable boundary intervenes. Similarly for "drainpipe", "gunpoint", "unpronounceable", "incredible", "ingrown", and many others.

The text also suggests (p588) "A parallel observation .. when [sequences of obstruents (plosive stops, fricatives)] occur in the same syllable, the entire cluster must have the same voicing value."

For example, we have [kʌbz] and [kʌps] but neither *[kʌpz] nor *[kʌbs]. But across a syllable boundary we find [b] next to [s] in "absurd" [əb.sr̩d], and "Hudson" [hʌd.sən], for example. We also have words like these:

[glɪmpst]	"glimpsed"
[tɛmpts]	"tempts"
[ɛnstɪŋkts]	"instincts"

Here the nasals are voiced, and occur in consonant clusters that include voiceless segments. So consonant clusters containing obstruents need not always have the same voicing value, only actually adjacent obstruents. But there are also words like this,

[θaʊzəndθs] "thousandths"

However, maybe this transcription, with [dθ], is not accurate; when native American speakers pronounce this, does it really have a [d] or [ɾ] in it? Maybe not.

A more restricted version of this idea is sometimes considered:[5]

The Voice Agreement Principle: Obstruent sequences at the end of an English word cannot differ with respect to voicing.

[5] This principle and the next one are from the text, pp.612ff, but this is from the the next chapter – <u>not assigned!</u> Here it is enough to notice just that various versions of these simple ideas are being explored in our attempt to get the facts exactly right.

Another possibly related question is: why do we have

skits [skɪts] trailed [treld] but never *[szɪts] *[tdeld]?

The Not-Too-Similar Principle: Obstruent sequences cannot differ only in voicing.

These and other regularities should be explored more carefully, but we will have to leave that for another time (like a good class in phonology!)

5.4 Syllables 2: the Sonority Principle

Of the infinitely many possible consonant combinations, only a tiny fraction occur. And the regularities mentioned in the previous section explain only a small part of this.

One other idea, one that we will formulate just roughly here, excludes a much larger range of combinations than the generalizations given above. This idea is based on the idea that there are degrees of sonority. Listing sounds in order of increasing sonority we get an order like the following:

The Sonority Hierarchy:

−sonorant						+sonorant
stops	affricates	fricatives	nasals	liquids	glides	vowels

Very roughly, sonority corresponds to the amplitude (i.e. volume) of the speech sound. The onsets and codas in English seem to respect this ordering according to the following principle:[6]

Sonority principle (SP): onsets usually rise in sonority towards the nucleus, and codas fall in sonority away from the nucleus.

This accounts for the impossibility of words with onsets like *rtag*, while allowing *trag*. And it accounts for the impossibility of words with codas like *gatr* while allowing words like *gart*. Similar sonority hierarchies play this kind of role in other human languages too, though there is significant variation in exactly what onsets and codas each language includes.

The SP reveals the syllable as a kind of cycle in the rising and falling sonority of human speech, as Leonard Bloomfield proposed quite a long time ago:

> In any succession of sounds, some strike the ear more forcibly than others: differences of *sonority* play a great part in the transition effects of vowels and vowel-like sounds... In any succession of phonemes there will thus be an up-and-down of sonority... Evidently some of the phonemes are more sonorous than the phonemes (or the silence) which immediately precede or follow... Any such phoneme is a *crest of sonority* or a *syllabic*; the other phonemes are *non-syllabic*... An utterance is said to have as many *syllables* (or *natural syllables*) as it has syllabics. The ups and downs of *syllabification* play an important part in the phonetic structure of all languages. (Bloomfield, 1933 p120)

[6]The text provides slightly more restricted observations, saying for example (p591): "...English, like many other languages, does not allow sonorant-obstruent sequences at the beginning of a word..."

5.5 Stress (briefly!)

We won't give much attention to stress in this class, but it is clear to everyone that in English and many other languages, some syllables are more prominent, more stressed than others. We have been indicating this with stress marks: a high mark to indicate primary stress on the following syllable, and a low mark to indicate secondary stress on the following syllable:[7]

əˌsɪm.əˈle.ʃən

The text proposes another representation, using a "pile" of **grid marks** to indicate the stress of each syllable:

			x	
	x		x	
x	x	x	x	x
ə	sɪm	ə	le	ʃən

Here we pile up grid marks according to the following rules:

o. each syllable has a grid mark x,

a. syllables with more stress have more grid marks, and

b. we use no more grid marks than necessary.

These rules can handle even more complex cases, like the phrase *maintain assimilation* in which the second word has more stress on its most stressed syllable than the first word does.

These are ways of representing the stress in a word or phrase, but what decides where the stress should go in the first place? It turns out that the rules of English stress assignment are not simple, and they vary with dialects, so we will just observe a couple of things:

1. The text says (p598): "In English, stressed syllables – whether they carry main or subsidiary stress – are chiefly identified by the vowel qualities they allow: vowels such as [æ], [a], [ɛ], [ɔ], [ʊ], or [u], [i] or [ʌ] are permitted only under stress."

   By "stress", this passage cannot mean just "main stress" though, as we see from many examples we have already seen in the text, like these:

(p598) [i] in *nuclear* [ˈnʊkliɚ]	(p572) [i] in *lucky* [ˈlʌki]
(p572) [ɛ] in *extract* [ɛkˈstrækt]	(p572) [a] in *Exxon* [ˈɛksan]
(p572) [ɛ i] in *mentality* [mɛnˈtælɪɾi]	(p535) [æ] in *adhesion* [ædˈhiʒən]
(p535) [a] in *automatic* [aɾəˈmæɾɪk]	

   In any case, it is clear that vowel quality and stress <u>are</u> related, as we see also in the following generalization (one that was mentioned earlier)...

2. A syllable is said to be **light** if its rime consists of just one short (-ATR) vowel, with no coda; otherwise, it is **heavy**.[8] In these terms, we can observe that in English:

   Stressed syllables must be heavy (though not all heavy syllables are stressed.)

   Since monosyllabic nouns and verbs are typically stressed, we see that this last idea was already mentioned when we pointed out earlier that monosyllabic nouns and verbs in English cannot end in lax vowels: we do not have nouns like [sɪ], [sɛ], [sæ], [sʊ].

[7] The [m] in this example immediately follows the stressed lax vowel [ɪ] so it is really "ambisyllabic" in the sense mentioned on page 36 of these notes, and shown by the tree for *happy* on page 588 of the text.

[8] As discussed on page 16 of the notes for Lecture 2, the short (-ATR), lax vowels of our local American English are [ɪ ɛ æ ʊ].

3. English stress assignment varies with the "syntactic category" of a word.

   a. **Examples.** the verb *digest*, as in *Did you digest that chapter?*,
   has stress on the second syllable [daɪˈʤɛst];
   the noun *digest*, as in *Let's get the "Reader's digest" version!*,
   has stress on the first syllable [ˈdaɪʤɛst].
   A similar thing happens in pairs like *ábstract/abstráct, éscort/escórt, súrvey/survéy, tórment/tormént, cónvict/convíct.*

   b. **Tendencies:** (Burzio) In American English most unsuffixed words respect the following rules, where a 'superheavy' syllable is one that has either has a long vowel (the long [+ATR] vowels are [e i a o u]) and a coda, or else a vowel and a two consonant coda:

   - In nouns, a heavy penultimate syllable is stressed if there is one, and otherwise the antepenult is stressed if there is one.
     – for example, agenda /aˈdʒɛndə/, but America /əˈmerɪkə/
   - In verbs, if the final syllable is superheavy it gets stressed, and otherwise the penultimate syllable gets stress.
     – for example, prevent /priˈvɛnt/, but imagine /ɪˈmædʒɪn/

In recent surveys of the stress systems of various languages, among languages that assign a single primary stress per word, penultimate and final stresses are fairly common, but initial stress is found more often (Hyman 1977; see also Gordon 2004):

	number of languages	percentage
initial	114	37.3
penultimate	77	25.2
final	97	31.7
antepenultimate	6	2
peninitial	12	3.9

5.6 Reflecting on the big picture: Speech perception

Reflecting on the whole picture of phones, phonemes, syllables, and stress – the first 5 lectures – it may seem simple enough (?), but it makes the language understanding task seem quite amazing. What we hear is nothing like a sequence of sounds that correspond 1 for 1 with the phonemes of words. Rather, each sound in each word affects and is affected by neighboring sounds in complicated ways, and the words are all run together. Thinking of the basic sequence of phonemes as a row of Easter eggs, pouring forth in our speech at a rate of about 3 per second, the famous linguist Charles Hockett described the speech understanding problem this way:

> Imagine a row of Easter eggs carried along a moving belt; the eggs are of various sizes and various colors, but not boiled. At a certain point, the belt carries the row of eggs between the two rollers of a wringer, which quite effectively smash them and rub them more or less into each other. The flow of eggs before the wringer represents the series of impulses from the phoneme source; the mess that emerges from the wringer represents the output of the speech transmitter. At a subsequent point, we have an inspector whose task it is to examine the passing mess and decide, on the basis of the broken and unbroken yolks, the variously spread out albumen and the variously colored bits of shell, the nature of the flow of eggs which previously arrived at the wringer. (Hockett, 1955, 210)

This might exaggerate our difficulties slightly. One thing that the phonological constraints and “smearing” or “spreading” (i.e. **assimilation**) effects like nasalization provide is a kind of redundancy. This is suggested in the text on p522. With this redundancy, we can do perfectly well even if we miss a bit here and there. The linguist Steve Pinker puts it this way:

> Thanks to the redundancy of language, yxx cxn xndxrstxnd whxt x xm wrxtxng xvxn xf x rxplxcx xll thx vxwxls wxth xn “x” (t gts lttl hrdr f y dn’t vn kn whr th vwls r). In the comprehension of speech, the redundancy conferred by phonological rules can compensate for some of the ambiguity in the sound wave. For example, a listener can know that “thisrip” must be *this rip* and not *the srip* because the English consonant cluster *sr* is illegal.

5.7 A question

```
To: E Stabler <stabler@ucla.edu>
Subject: Ling 20 Question

I have a question about the book.  On page 583 it lists [+consonantal]
as a feature value for /a/.  I am assuming this is a typographical
error, but I wanted to ask you about it nonetheless.
```

Right, a typo!

5.8 Summary

Phonemes are sound segments defined by features. Words are given by the sequence of phonemes in them, but these features may be altered by phonological rules (such as **stop aspiration**, **vowel shortening**, **flapping**), which apply in a certain order to the sequence of sound segments.

Sequences of phonemes are organized into **syllables**. Each syllable has a **nucleus**, which combines with an optional **coda** to form the **rime**, and an optional preceding **onset**. We drew the parts of a syllable with a **tree** that has its **root** at the top. Every **node** in a tree is either a **mother** or a **leaf**. Know how to syllabify English words and how to draw the syllables with trees. And we will use trees a lot to show the parts of many other things later.

(The funny situation of **ambisyllabicity**, where a single sound is part of two different syllables, is sometimes drawn with a structure that is **not a tree** because the shared consonant has two mothers! We will not worry about this complication in this class.)

The parts of the syllable must conform to size limits and sonority patterns. We saw that the things that can occur in the parts of English syllables are restricted. We considered restrictions on nasal+non-coronal clusters, and on obstruent clusters as examples. At a higher level of abstraction, more approximately, we also notice the sonority principle **SP**. We want to aim for a story that provides a more accurate account of these generalizations.

We didn’t say much about stress in this class. We can observe quickly that stress patterns can depend on whether a word is a **verb** or a **noun**. – And we will have much more to say about these “syntactic categories” later. The tendencies for English stress on page 40 should be understandable (but you don’t need to memorize them).

Though it's only briefly mentioned in the text, it's useful to understand the replies to Hockett, mentioned in the last section of these notes, explaining why things are not as bad as they might seem from the point of view of figuring out what phonemes you are hearing.

Finally, we have at least the outlines of an explanation for why no word of English could have the phonetic representation [kkkk]. At least, we see that since this has no vowels, it has no syllable nuclei, and hence no syllables. Furthermore, it violates the Not-too-similar principle.

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Lecture 6 Morphology

We have seen how sequences of sounds – phonemes – can form syllables.[1] But most syllables do not mean anything – they are often just parts of words, so how does recognizing the sound patterns help us make sense of how speech sounds (or signing gestures) mean something?? We need something more!

Contrast the language of decimal numbers: each digit has a meaning on its own, and we calculate the meaning of any sequence of digits accordingly. Human language apparently does not work like that. We needed to look at the sounds and their features to make sense of certain regularities that appear in speech, but those sounds and features are typically not meaningful by themselves.

The meaningful units seem to be 'words' – or something like that. So how do words relate to the patterns of speech sounds. One simple idea is that words are built up from syllables. (We'll see: that's close, but not quite right.) This kind of thing happens elsewhere in the physical and biological world: cells are built from molecules, and human beings are built from cells,. . . . So maybe there are similarly different "levels of organization" in human creations like language. (Why would that be?)

6.1 Words, morphemes, roots, and affixes

The text says (p26) that the following sentence has 13 words (12 different words, since 1=11):

ðə	fɹɛndz	ˈpɹamɪst	tu	ɪnˈkwaɪɹ	ˈkeɹfəli	əˈbaʊt	ə	ˈskulmæstɹ̩	for	ðə	feɹ	biˈankə
The	friends	promised	to	inquire	carefully	about	a	schoolmaster	for	the	fair	Bianca
1	2	3	4	5	6	7	8	9	10	11	12	13

Some of these words are **complex** in a different sense from having multiple phonemes, and multiple syllables.

(1) a **compound** is a word that has other words as parts,
like *school-master* or *looking glass*

(2) a **word** can be composed of a **root** (or "base") together with 0 or more **affixes**
like *friend-s, promis-ed, care-ful-ly*
(an affix is a **prefix** or **suffix** – and some other possibilities are mentioned later)

Why is *-ed* a suffix of *promised*, but *pr-* is not a prefix? The answer proposed in the text is:

(3) A **morpheme** is the smallest meaningful unit in a language, and

[1]And we noticed that the permissible patterns of speech sounds depend mainly on <u>features</u> of sounds – like whether they are voiced – so maybe really we should say that we produce noises with certain features to form syllables.

(4) Roots and affixes are morphemes.

So *-ed* is an affix because it means PAST, but *pr* is not a morpheme of any kind because it is not meaningful. So the morphemes of the first sentence are these:

ðə	fɹɛnd	-z	ˈpɹamɪs	-t	tu	ɪnˈkwaɪɹ	keɹ	-fəl	-li	əˈbaʊt	ə	skul	mæstɹ̩	for	ðə	feɹ	biˈankə
The	friend	-s	promis	-ed	to	inquire	care	-ful	-ly	about	a	school	-master	for	the	fair	Bianca
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

But we cannot understand definitions (1) or (2) without saying what a word is.

So, what is a word? The text says (p25) "Words are meaningful linguistic units that can be combined to form phrases and sentences." But this definition would include all morphemes, and we are told (p26) that words are not the smallest units of meaning. So what is a word? It seems the text is not quite clear, and in fact, there is some controversy about this in the field. We see that when roots and affixes are combined, as in *care-ful-ly* or *re-ceive*, the result is often something that can occur freely, even when the parts cannot. So perhaps the text means something like this:

(5) A **word** is a morpheme, a complex of roots and affixes, or a compound, that can occur freely.

To understand this definition, we will modify the definition of compound by providing rules for their formation, and we need to explain what it means "to occur freely." This latter idea is rather hard to pin down, so let's rely on our intuitions for the moment. Very roughly, an expression occurs "freely" if it can appear in a wide variety of contexts.

According to this picture, the "atoms" of morphology are morphemes, the smallest meaningful units. Since the study of meaning is called semantics, this is a picture according to which morphemes are **semantic atoms.**[2]

[2]This view is controversial. We will mention some puzzles it raises later, on page 52.

6.2 Syntactic atoms

When *morphemes* and related notions are getting introduced in the text, we are also told about morphemes having particular “parts of speech:” nouns, verbs, adjectives, etc. These notions refer to the role the morpheme plays in assembling a phrase, and the study of phrases is **syntax**, so these are syntactic categories.

Let’s abbreviate the “parts of speech,” these syntactic categories in this way:

noun = N	verb = V	adjective = A	adverb = Adv	determiner = D	preposition = P
[fɹɛnd]	[se]	[hæpi]	[ˈkwɪkli]	[ðə]	[wɪð]
friend	*say*	*happy*	*quickly*	*the*	*with*

As indicated in the text (by the “frames” on pp31-32), each part of speech plays a certain kind of role in building up a phrase, and can only occur in certain positions. We will get to syntax soon, and have much more to say about parts of speech then. But just using what you may know from using the dictionary, we can label many of the morphemes in our first sentence:

D	N	?	V	?	P	V	N	?	?	P	D	N	N	P	D	A	N
ðə	fɹɛnd	-z	ˈpɹamɪs	-t	tu	ɪnˈkwaɪɹ	ker	-fəl	-li	əˈbaʊt	ə	skul	mæstɹ̩	foɹ	ðə	feɹ	biˈankə
The	friend	-s	promis	-ed	to	inquire	care	-ful	-ly	about	a	school	-master	for	the	fair	Bianca

It is not immediately obvious what parts of speech, if any, the bound morphemes have – we will return to this later. But we might notice right away that we typically assign these familiar parts of speech to the complex words in this sentence too. (We will return to see whether it is right to do so in just a moment – (it is!))

N	V	A	Adv	N
fɹɛnd -z	ˈpɹamɪs -t	keɹ-fəl	keɹ-fəl -li	skul mæstɹ̩
friend-s	promis-ed	care-ful	care-ful-ly	school-master

This suggests that it is not just morphemes that are nouns, verbs, adjectives, and so on. So what are these “parts of speech”? They are the smallest units of syntax. They are the **syntactic atoms**. These parts of speech may be familiar, but bringing them into the first pages of the discussion of morphology not only introduces a whole bunch of terminology, but also raises some general questions:

Q1 Are morphemes syntactic atoms?
(= Are the smallest units of meaning also the smallest units of phrases?)

Q2 How do morphemes relate to the sounds we have studied (phones, phonemes, syllables)?

These are good questions, but let’s postpone them! We should first see some morphology before asking how it relates to everything else. The questions for morphology are these:

Q3 How do words get put together to make compounds?

Q4 How do roots and affixes get put together to form words?

It turns out there are some clear and interesting things that can be said about these problems. We return to Q1 and Q2 after we see what morphology says about Q3 and Q4.

6.3 English morphology

We consider English first, and then look at some different phenomena in other languages.

6.3.1 Compounds

Compounds are words formed from other complete words. For example:

> bartend, apple pie, jet black, part supplier,
> boron epoxy rocket motor chamber instruction manual writer club address list

6.3.2 Roots + affixes

Some suffixes can combine quite freely

phon	spelling	effect	examples
-ɹ̩	-er	changes V to N	kill-er
-əbəl	-able	changes V to A	manage-able
-nɛs	-ness	changes A to N	happi-ness

Other affixes are much more fussy. We have, for example,
$[_N$ $[_N$ Reagan] -ism] $[_N$ $[_A$ modern] -ism] $[_N$ $[_N$ library] -ian] $[_N$ $[_A$ $[_N$ Darwin] -ian] -ism]

but not

*$[_A$ $[_N$ $[_N$ Darwin] -ism] -ian] *$[_A$ $[_N$ $[_N$ Reagan] -ism] -ian]

And we have the possessive or plural $[_N$ Reagan -s], but not
*$[_N$ $[_N$ Darwin -s] -ism] *$[_A$ $[_N$ Darwin -s] -ian] *$[_A$ $[_N$ Darwin -s] -ian] -ism

These restrictions are not just memorized word-by-word either. If we invent a new verb *glark*, and say that Schwartzenegger is *glarkable*, then we immediately know that this means that Schwartzenegger can be glarked, and we know that we have said something about *glarkability*. We can describe some of these regularities as follows:

Some suffixes can combine only with roots

Some examples, many from Fabb (1988):

phon	spelling	effect	examples
-ən -iən	-an -ian	changes N to N	librari-an, Darwin-ian
		changes N to A	reptil-ian
-ədʒ	-age	changes V to N	steer-age
		changes N to N	orphan-age
-əl	-al	changes V to N	betray-al
-ənt	-ant	changes V to N	defend-ant
		changes V to A	defi-ant
-əns	-ance	changes V to N	annoy-ance
-et	-ate	changes N to V	origin-ate
-d	-ed	changes N to A	money-ed
-fəl	-ful	changes N to A	peace-ful
		changes V to A	forget-ful
-hʊd	-hood	changes N to N	neighbor-hood
-ɪfaɪ	-ify	changes N to V	class-ify
		changes A to V	intens-ify
-ɪʃ	-ish	changes N to A	boy-ish
-ɪzəm	-ism	changes N to N	Reagan-ism
-ɪst	-ist	changes N to N	art-ist
-ɪv	-ive	changes V to A	restrict-ive
-aɪz	-ize	changes N to V	symbol-ize
-li	-ly	changes A to A	dead-ly
-li	-ly	changes N to A	ghost-ly
-mɛnt	-ment	changes V to N	establish-ment
-ori	-ory	changes V to A	advis-ory
-ʌs	-ous	changes N to A	spac-eous
-i	-y	changes A to N	honest-y
-i	-y	changes V to N	assembl-y
-i	-y	changes N to N	robber-y
-i	-y	changes N to A	snow-y, ic-y, wit-ty, slim-y

(You do not need to memorize the tables of affixes! It is enough to know how to read them, and you can see roughly how many suffixes we can list with rough indications of the restrictions on where they occur. Some languages have many more affixes than English.)

Some suffixes can combine with a root, or a root+affix

phon	spelling	effect	examples
-eɹi	-ary	changes N-ion to N	revolut-ion-ary
-eɹi	-ary	changes N-ion to A	revolut-ion-ary, legend-ary
-ɹ̩	-er	changes N-ion to N	vacat-ion-er, prison-er
-ɪk	-ic	changes N-ist to A	modern-ist-ic, metall-ic
-(eʃ)ʌn	-(at)ion	changes N-ize (etc) to N	symbol-iz-ation, impress-ion, realiz-ation
-(ət)oɹi	-(at)ory	changes V-ify to A	class-ifi-catory, advis-ory

Some suffixes combine with a specific range of suffixed items

phon	spelling	effect	examples
-əl	-al	changes N to A	natur-al
		sometimes allows -ion, -ment, -or	
-jən	-ion	changes V to N	rebell-ion
		sometimes allows -ize, -ify, -ate	
-ɪti	-ity	changes A to N	profan-ity
		sometimes allows -ive, -ic, -al, -an, -ous, -able	
-ɪzəm	-ism	changes A to N	modern-ism
		sometimes allows -ive, -ic, -al, -an	
-ɪst	-ist	changes A to N	formal-ist
		sometimes allows -ive, -ic, -al, -an	
-aɪz	-ize	changes A to V	special-ize
		sometimes allows -ive, -ic, -al, -an	

6.3.3 English morphological rules

Looking over the discussion so far, we can see some basic patterns. Let's review some of them. If we consider compounds first, we notice a striking pattern:

[$_V$ [$_N$ bar] [$_V$ tend]]

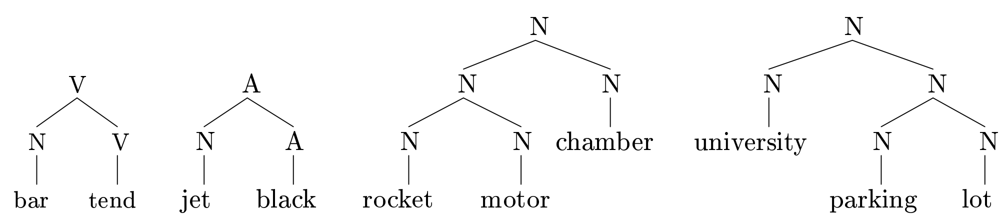
[$_N$ [$_N$ apple] [$_N$ pie]]

[$_A$ [$_N$ jet] [$_A$ black]]

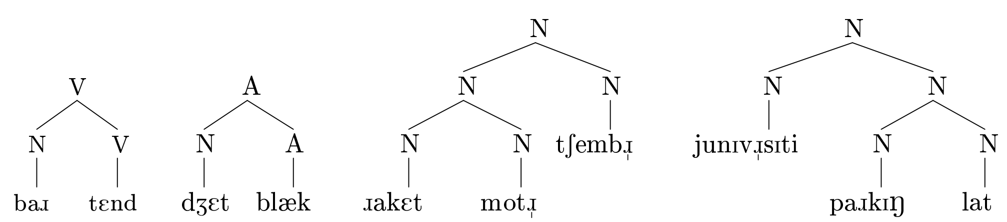
[$_{Npl}$ [$_{Nsg}$ part] [$_{Npl}$ suppliers]

[$_{Nsg}$ [$_{Npl}$ parts] [$_{Nsg}$ supplier]

[$_N$ [$_N$ [$_N$ rocket] [$_N$ motor]] [$_N$ chamber]]



When we care about the pronunciation of the morphemes, we could put that into the trees instead of the spellings:



Notice that the different structures of the last two examples, what modifies what, is figured out by considering what makes the most sense (more discussion of this in the text). Another basic thing we see is that the roots combine in pairs. The pairs we see here can be described with rules like the following (this rule format is not presented in the text):

$$V \rightarrow N\ V$$

N $\rightarrow$ N N

A $\rightarrow$ N A

There is another regularity here. All of these rules have the form

X $\rightarrow$ Y X

This regularity in English compounds is described as follows:

(6) In English, the rightmost element of a compound is the **head**.

(7) A compound word has the category and features of its head.

This is called the **English right head rule** or the **head-final principle** (p68 in the text).[3]

There is an analogous way to write affixation rules. The important thing to notice is that the right head rule in compounds predicts some of the patterns we see in affixation:

(8) an English suffix often changes category, but prefixes rarely do

(9) the conditions on affixation typically refer to the just the last suffix

The conditions for attaching a suffix never refer to the root, which may seem surprising to a non-linguist, since, intuitively, it is usually the root that provides most of the meaning of the word.

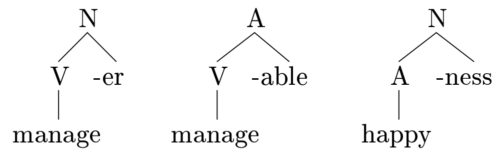
How can we exploit this insight that affixes and compounds both seem to have their properties determined by their righthand members? Well, we can just suppose that affixation structures are right-headed too. Then, considering the most productive affixes first, we can use rules like the following to describe their requirements and their effects:

N $\rightarrow$ -er / [V____]	(manager)
A $\rightarrow$ -able / [V____]	(manageable)
N $\rightarrow$ -ness / [A____]	(happiness)

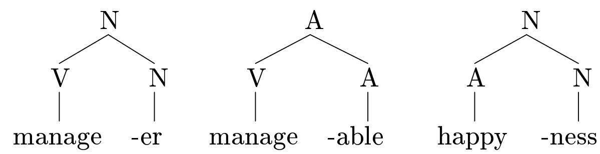
Notice how these rules achieve the desired category-changing effect, with the English right head principle. As we can see by drawing trees for some examples:

[3] In syntax, we will see that phrases have heads too. The head of a phrase is generally different from the head of a word, though. As we will see, there is no right head rule for syntactic heads in English.

For affixation structures, the TEXT presents trees like the following:



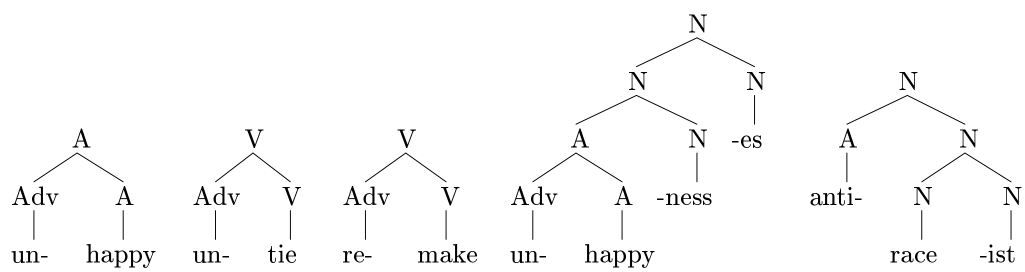
But if we use the rules given above, then INSTEAD, we can provide categories for the affixes, conforming to the English right head rule:



Prefixes in English tend not to be category changing, but rather just modifiers, and so if we had to assign categories to them, we could observe that

1. A modifies N, as in *happy guy*
2. Adv modifies V, as in *he completely finished*
3. Adv modifies A, as in *completely happy*

So we could assign trees like these to prefix structures:



THESE trees bring some of the facts about affixes under the same generalization that we had for compounds: the right sister determines category.

Applying the right head rule to each of the affixes in our first example sentence, we obtain a category for all of the suffixes:

D	N	N	V	V	P	V	N	A	Adv	P	D	N	N	P	D	A	N
ðə	fɹɛnd	-z	ˈpɹamɪs	-t	tu	ɪnˈkwaɪɹ	keɹ	-fəl	-li	əˈbaʊt	ə	skul	mæstɹ̩	foɹ	ðə	feɹ	biˈankə
The	friend	-s	promis	-ed	to	inquire	care	-ful	-ly	about	a	school	-master	for	the	fair	Bianca

6.4 How morphology relates to other things

OK. Now let's reflect on the general questions Q1 & Q2 from page 45 about how morphological elements compare to the elements of phonology, syntax and semantics.

6.4.1 Morphology and phonology

We asked in the first lines of these lecture notes (on page 43), and again in Q2 (on page 45), whether morphemes are built out of syllables. We now have lots of evidence against that idea!

(10) **Morphemes can be smaller than syllables**: the plural, possessive, or contracted verb *-s*; and the affixes *-y*, *-ic*, *-ed* often are less than a full syllable

The text even considers the idea that a morpheme can be completely unpronounced (pp75-78, and this idea will come up again on pp.279,322-3).

(11) **Morphemes can be multi-syllabic**: many nouns, verbs and proper names are morphologically simple, but have more than one syllable: *apple, ridicule, Merodachbaladan*

(12) **Some morphemes are not sound sequences at all:** the text presents several cases of morphemes that attach to a word to reduplicate all or part of the sounds in that word. For example, in Pima:

gogs	gogogs	ˈuvi	ˈuˈuvi	jiosh	jijosh	toobi	totobi
'dog'	'dogs'	woman	women	god	gods	rabbit	rabbits

We find another interesting connection between morphemes and phonology when we look more carefully at how the morphemes are pronounced. For example, notice that our first example contained the past tense morpheme that is usually spelled "-ed", pronounced [t]:

ðə	fɹɛnd	-z	ˈpɹamɪs	-t	tu	ɪnˈkwaɪɹ	keɹ	-fəl	-li...
The	friend	-s	promis	-ed	to	inquire	care	-ful	-ly...
1	2	3	4	5	6	7	8	9	10...

Looking at a wider range of examples, we see that there are other past tense forms:

spelling	phon	spelling	phon	spelling	phon
promis-ed	pɹamɪs-t	penn-ed	pɛn-d	load-ed	lod-əd
dropp-ed	dɹap-t	hugg-ed	hʌg-d	nett-ed	nɛɾ-əd
kick-ed	kɪk-t	snar-ed	sner-d	fat-ed	feɾ-əd

I have arranged these examples so that we can easily consider the environments and see that they are complementary just considering the preceding consonants:

-t environments	-d environments	-əd environments
s___	n___	d___
p___	g___	ɾ___
k___	ɹ___	ɾ___

The complementary distribution suggests that these are not 3 different morphemes, but 3 variants of the same morpheme. And these environments suggest that we get [-t] after voiceless consonants, [-əd] after [d] and [ɾ], and [d] otherwise. (We can check some other cases to see if this is right, but when we do that, we should recognize the irregular forms, like "meet"/"met" [mit/mɛt]. Setting irregulars aside, our generalization seems to work. So we could hypothesize that the morpheme is [d], and that we get variants – "**allomorphs**" – according to this rule, whic does not apply to every [d] but only the past tense suffix [-d]:

(regular past tense allomorphy – first try)

-d → -t/[-voice]____
-d → -əd/(d,ɾ)____

This is not quite right though. The final consonant in "fate" and "net" is [t], and, according to our earlier flapping rule, this [t] will not turn into a flap unless it is followed by an unstressed vowel. This is similar to the "rule ordering" issues considered earlier. To handle this we could say:

(regular past tense allomorphy – second try)

-d → -t/(-voice other than [t])____
-d → -əd/(d,t)____

This gets approximately the right effect but it does not look very elegant, and so many more sophisticated accounts have been proposed. (You will certainly see some of them if you take more linguistics.)

6.4.2 Syntactic atoms and semantic atoms

We asked earlier, in Q1 (on page 45), whether semantic atoms (the smallest units of meaning) are always also syntactic atoms (the smallest units of phrases: verbs, nouns, adjectives, etc). While these often go together, it is possible to find cases where syntactic atoms are not semantic atoms, and vice versa. Interestingly, some of these are cases where the syntactic atoms are nevertheless elements that our morphological rules can (and presumably should) apply to.

The traditional view about morphemes faces some problems. First: in many sentences the semantic atoms, the simplest meaningful units, are not morphological atoms. This is shown by the existence of multi-morphemic **idioms**. An idiom is a complex expression whose meaning is not determined by the meanings of its parts in the usual way. Phrasal idioms are often discussed, but there are also idiomatic compounds and words – these expressions have special meanings that cannot be calculated from the meanings of their parts:

(13) **idiomatic phrases:** He threw in the towel, He kicked the bucket, His goose is cooked.

(14) **idiomatic compounds:** cut-throat, pick-pocket, scare-crow, push-over, try-out, pain-s-taking, pig-head-ed, carpet-bagg-er, water-melon, sun-flower

(15) **idiomatic root+affix:** librar-ian, material-ist, wit(t)-y.

It is natural to say that, in these idiomatic uses, the parts of these phrases are not meaningful (though they can be meaningful in other contexts).

Second: some morphological atoms are not meaningful, as in the following examples:

(16) **cran-**berry, **rasp-**berry, **huckle-**berry, un-**couth**, in-**ept**, dis-**gust**-ed, dis-**gruntl**-ed

6.5 Summary

The traditional view presented in Chapter 2 says that **morphemes** are **semantic atoms,** and morphology is about how words are built from morpheme roots, morpheme affixes, and other words.

You should know what these morphological elements are: **roots, affixes, suffixes, prefixes, infixes, compounds, reduplicative morphemes**. You do not need to memorize the English suffixes! but **know the right head rule**, and you should understand our rule notation for compounds and affix structures. You should be able to write the **morphological rules which would describe some new data**, and **draw the trees for the word structures** – trees like the ones in these notes, where the affixes have categories.

For the general picture of what's happening, you should know that the basic units of morphology are quite different from any units we considered in phonology. We pronounce words with sounds, but the units of sound don't match up with the units of the words in any simple way! And you should know that many words are idioms, in a sense; just like many phrases are. (And this presents puzzles for the traditional view that morphemes are semantic atoms.)

In this lecture, we have the advent of rules like: X → Y X. That means that inside an X, another X can recur – in this sense, these rules are **recursive**. Notice that we did not have recursive rules in the earlier parts of the class. There are no general rules for building phonemes that contain phonemes in them, or for building syllables that have syllables in them. Rather, there is a fixed list of phonemes. And the number of syllables is finite too – bounded by the size of the onset, nucleus, and coda. But with the recursive rules for affixes and compounds, the number of words is **infinite.** And this is just the beginning. From now on, we will have recursion everywhere!

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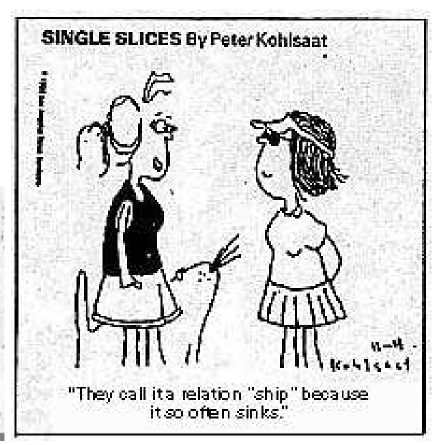


"They call it a relation "ship" because it so often sinks."

Lecture 7 review: the picture so far…

7.0 phonetics and phonology

Phoneme: The text says these are "the basic distinctive speech sounds of the language." They are the atoms of phonology. On one view, they are the underlying elements associated with basic lexical items. A test that does quite well for determining which variants are phonemic: 2 sounds are different phonemes if changing one for the other can change one word into another. We use 'minimal pairs' for this.

Allophony: Phonemes get pronounced in various ways. Some variation is determined in regular ways by phonetic context. Know the recipe for detecting this kind of conditioned allophony, and how to define the variation with a rule. (Examples discussed: stop aspiration, vowel lengthening, flapping,…)

(stop aspiration)

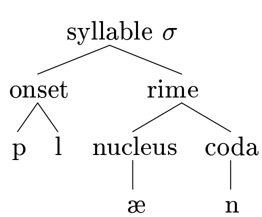
$$\begin{bmatrix} -\text{continuant} \\ -\text{voice} \end{bmatrix} \rightarrow \begin{bmatrix} +\text{aspirated} \end{bmatrix} / [_{\substack{\textit{stressed} \\ \textit{syllable}}} \underline{\quad\quad} \begin{bmatrix} -\text{liquid} \end{bmatrix}$$

(flapping)

$$\begin{bmatrix} -\text{continuant} \\ +\text{alveolar} \\ -\text{nasal} \end{bmatrix} \rightarrow \text{ɾ} / \begin{bmatrix} +\text{syllabic} \end{bmatrix} \underline{\quad\quad} \begin{bmatrix} +\text{syllabic} \\ \text{-stress} \end{bmatrix}$$

We saw that when more than one rule applies, it sometimes matters which one applies first!

Phoneme distribution, 'phonotactics': There are a number of restrictions on where speech sounds can occur. Some of these are sensitive to whether the sequences occur inside a single syllable. Know our simple procedure for syllabification in English, and how to diagram the resulting syllable structures with trees. (Example phonotactic restrictions discussed: obstruent clusters tend to be homorganic, esp inside any syllable,…)



7.1 morphology

Morpheme definition: typically defined as 'semantic atoms', and this characterization usually fits (but there are some puzzling cases discussed below)

The 'bound morphemes' or 'affixes' must attach to another element, while the 'free morphemes' are more independent.

Allomorphy: Like phonemes, morphemes can vary in ways that depend on their phonetic context. Know the recipe for detecting allomorphy and defining the variation with a rule.

(regular past tense allomorphy – second try)

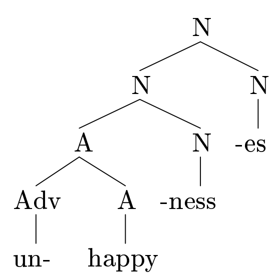
-d → -t/(-voice other than [t])____
-d → -əd/(d,t)____

(How to handle the description of irregular past tenses?)

Morpheme distribution: affixes are "fussy" – they can only attach to certain things. Those things are typically similar in their their syntactic properties (same 'category': noun, verb,...), and when elements attach, the rightmost element typically determines the category of the result (this is the 'right hand head rule').

For the moment, we are identifying basic syntactic categories as collections of elements that can appear in a given position in a sentence.

As in phonology, in rule assembly too, we saw that when more than one rule applies, it sometimes matters which one applies first! We can use a tree diagram to show how a word is assembled. (When we are paying attention to the speech sounds, we can put the sounds into the tree; but often the spelling is used just because it's easier for us to read.)



There are various abbreviated notations for morpheme structures too. For example, *-ness* attaches to adjectives to form nouns. Given the right hand head rule (RHHR), we could say that *-ness* is a noun – then the RHHR tells us that it forms nouns. And to express that it appears in contexts where it can attach to an adjective, we could write:

N → -ness / [A____]

We saw that noun compounding occurs quite freely in English:

N → N N

This last rule is an example of a place where morphology begins to be *recursive.*

7.2 Some problems that mix topics

We mentioned last time that, obviously, a morpheme can have many sounds and syllables in it. But also, morphemes can be smaller than syllables, and can extend across syllable boundaries:

promis-ed, leaf-y, fight-er, Darwin-ian, modern-ist-ic, advis-ory

7.2.1 Domains of phonological rules

Where do phonological rules apply? Many of our examples might suggest that they apply inside morphemes. We looked at examples like these:

1. [t^{h}ek^h] take vs. steak [stek^h]
2. [mid] mead vs. meet [mĭt]
3. [bʌɾɹ̩] butter vs. vs. butt [bʌt^h]
4. [mæ̃n] man vs. mat [mæ̆ t^h]
5. [et̪θ] eighth vs. ate [et^h] (p544 alveolar dentalization)

But at least some of these rules can extend across morpheme and syllable boundaries.

1. flapping: fight-er, writ-er, light-er
2. nasalization: agree-ment, happi-ness

And the rules can even extend across word boundaries! This is highlighted by the examples of alveolar dentalization on page 544, for example.

1. flapping: writer/'write her (a letter)', shouter/'shout her (name)', kidder/'kid herself (about it)'
2. nasalization: 'they gave me nothing'

7.2.2 English stress

We didn't say very much about stress, but it is an important topic. It seems to depend on syllable structure, and stress differences also hold among larger units of linguistic structure, extending across syllable and word boundaries, even phrases. Stress levels were illustrated in class and in the lecture notes with acceents [ə.ˌsɪm.ə.ˈle.ʃən]. This example has 5 syllables, with primary stress on the 4th, and secondary stress on the 2nd. Here I have used the IPA stress marks (the little vertical lines), but sometimes linguists and dictionaries put stress accents over the vowels, like this: *assìmilátion*. There is recent evidence that much more subtle differences in stress – more than just primary and secondary – are pronounced and perceived. The text discusses the possibility of marking stress by piling up x's over the syllables to indicate their relative prominence.

			x	
	x		x	
x	x	x	x	x
ə	sɪm	ə	le	ʃən

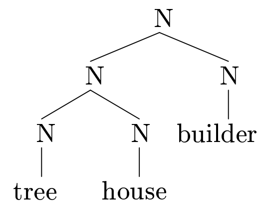
The advantage of this notation is that, with enough x's, we can mark as many contrasts as you want.

7.2.3 Semantic values of compounds, and idioms

Notice that in noun compounds, the semantic relation between the two nouns is often natural in some sense, but it is quite various!

dog house	house a dog lives in
tree house	house in a tree
fire house	house where fire trucks are kept

We also noticed that the motivation for one structure or another in noun compounds cannot be determined by what the nouns want to attach to (obviously, since these sequences just have nouns in them), but can sometimes be determined semantically:



...since it is more natural to talk about builders of tree houses than to talk about house builders who live in trees or something like that.

7.2.4 Reduplication

Lakhota is an indigenous language spoken in the northern American plains by several thousand people (text p61). It uses reduplication to mark the singular plural distinction in certain verbs:

singular	plural	meaning
gí	gígí	‘to be rusty brown’
ská	skaská	‘to be white’
shá	shashá	‘to be red’
zí	zizí	‘to be yellow’

Bambara is an African language spoken by about 3 million people in Mali and nearby countries. It has an especially simple kind of “reduplication” structure, which we see in complex words like this:

wulu	‘dog’	wulo o wulo	‘whichever dog’
malo	‘rice’	malo o malo	‘whichever rice’
*malo o wulu	NEVER!		
malonyinina	‘someone who looks for rice’	malonyinina o malonyinina	‘whoever looks for r

Clearly the forms on the right are complex: they seem to be formed from a morpheme that means WHICHEVER together with another noun. But notice that the way the WHICHEVER morpheme is pronounced is different in each case: it is a reduplicative morpheme. It has the effect of causing the whole noun that it attaches to to be pronounced twice. This morpheme is clearly not specified by any particular sequence of phonemes at all.

Compare English ‘contrastive focus reduplication”: (examples from Ghomeshi et al 2004)

I'll make the tuna salad and you make the SALAD-salad
My car isn't MINE-mine; it's my parents'
I'm up, I'm just not UP-up.
Are you LEAVING-leaving?

Intensive reduplication:

Prices keep going up up up!
It's mine mine mine!
Let's go out there and win win win!

7.3 Summary

You are responsible for the assigned readings, but the main focus is (no surprise!) on material that is summarized in the lecture notes, and used in the homeworks. The exam will be problems like the ones you had in the homeworks. Good luck! If there are questions about English phonemes, I will include a table like the one on the next page, so you don't have to memorize (though with a little practice it gets fairly easy to tell the place and manner of articulation without even thinking about the table – just by pronouncing the sound!). Notice that the flap [ɾ], the glottal stop ʔ], and the aspirated consonants [p^h t^h k^h] are not in the table, because they are not phonemes in English – but you should know what they are and their features, since we have talked so much about them.

			manner	voice	place
1.	/p/	s**p**it	plosive stop	−	labial
2.	/t/	s**t**uck	plosive stop	−	alveolar
3.	/ʧ/	**ch**ip	plosive stop affricate	−	alveopalatal
4.	/k/	s**k**ip	plosive stop	−	velar
5.	/b/	**b**it	plosive stop	+	labial
6.	/d/	**d**ip	plosive stop	+	alveolar
7.	/ʤ/	**j**et	plosive stop affricate	+	alveopalatal
8.	/g/	**g**et	plosive stop	+	velar
9.	/f/	**f**it	fricative	−	labiodental
10.	/θ/	**th**ick	fricative	−	interdental
11.	/s/	**s**ip	fricative	−	alveolar
12.	/ʃ/	**sh**ip	fricative	−	alveopalatal
13.	/h/	**h**at	fricative	−	glottal
14.	/v/	**v**at	fricative	+	labiodental
15.	/ð/	**th**ough	fricative	+	interdental
16.	/z/	**z**ap	fricative	+	alveolar
17.	/ʒ/	a**z**ure	fricative	+	alveopalatal
18.	/m/	**m**oat	nasal stop	+	labial
19.	/n/	**n**ote	nasal stop	+	alveolar
20.	/ŋ/	si**ng**	nasal stop	+	velar
21.	/w/	weird	central approximant	+	labiovelar
22.	/j/	yet	central approximant	+	palatal
23.	/l/	leaf	lateral approximant	+	alveolar
24.	/ɹ/	reef	central approximant	+	retroflex
25.	/ɹ̩/ or /ɚ/ or /əɹ/	bird	central approximant	+	retroflex

			tongue body height	tongue body backness	lip rounding	tongue root tense (+ATR) or lax (−ATR)
1.	/i/	b**ea**t	high	front	unrounded	+
2.	/ɪ/	f**i**t	high	front	unrounded	−
3.	/u/	b**oo**t	high	back	rounded	+
4.	/ʊ/	b**oo**k	high	back	rounded	−
5.	/ɛ/	l**e**t	mid	front	unrounded	−
6.	/o/	r**oa**d	mid	back	rounded	+
7.	/ʌ/	sh**u**t	low	back	unrounded	−
8.	/e/	**a**te	mid	front	unrounded	+
9.	/æ/	b**a**t	low	front	unrounded	−
10.	/a/	p**o**t	low	back	unrounded	+
11.	/ə/	ros**e**s	mid	back	unrounded	−
12.	/aɪ/	l**ie**s	dipthong			
13.	/aʊ/	cr**ow**d	dipthong			
14.	/oɪ/	b**oy**	dipthong			

liquids = /l,ɹ,ɹ̩/
glides = /j,w/
coronals = dental, alveolar and alveopalatal stops, fricatives, affricates, liquids, and alveolar nasal
sonorants = vowels,glides,liquids,nasals
obstruents = non-sonorants

Lecture 9 Syntax: Constituents and categories

9.1 Productivity begins in morphology

9.1.1 First: morphemes, words and parts of speech are different!

Chapter 3 briefly makes a couple of claims about morphemes which are not quite right when the term "morpheme" is used as we are using it – as a semantic atom.

- on page 89, the text says "In this chapter, we will see how words are combined with each other to form grammatical sentences in a. . . rule-governed way." Given our definition of *word* from Chapter 2 (and p.44 of lecture notes 4a), though, we might conclude that in the sentence "He's bad!" [ˌhizˈbæd], the contracted form is a word. But now we will treat it as 2 parts of speech, the pronoun *he* and a form of the verb *be*.
- on page 98, the text says "Although the number of grammatical English sentences is infinite, the number of English morphemes (and words) is not. . . " We saw that with recursive rules in morphology, **the number of English words is infinite**. In particular, according to the view presented in Chapter 2 and in class, the number of English nouns infinite. It is perhaps possible though to regard those rules as outside of morphology, restricting morphology to root+affix structures. But even with root+affix structures, the text acknowledges that these can be quite productive in English and many other languages. So although English has finitely many morphemes, from which the words are built, it has infinitely many words.
- on page 99, the text says ". . . within the mental lexicon of any single speaker, there is a pronunciation associated with each morpheme." But we saw in Chapter 2 and in class that some morphemes are not associated with pronounced material. There can be null affixes, but the more interesting case are the reduplicative morphemes: rather than being associated with any particular pronounced material, these morphemes copy all or parts of the morphemes they are attached to.

9.1.2 productive affixation

We noticed last week that following are among the most "productive" affixes – meaning that these elements combine with the wides range of elements:

phon	spelling	effect	examples
-ɹ̩	-er	changes V to N	kill-er
-əbəl	-able	changes V to A	manage-able
-nɛs	-ness	changes A to N	happi-ness

But when we look at what *-er* attaches to, we find some restrictive patterns. It attaches to **many single syllable adjectives** (ES judgements):

bigg-er	kind-er	ripe-r	*intelligent-er	*adequate-r	*haphazard-er
tall-er	nice-r	strong-er	*active-r	*placid-er	*us-able-r
redd-er	blu-er	green-er	*violet-er	*crimson-er	
pink-er	whit-er	black-er	*ivory-er	*turquoise-r	*azure-r
browner	blonder	gray-er	*indigo-er		

Affix *-er* also attaches to **some 2-syllable adjectives, mainly with light final syllable**:

happy-er	tidy-er	friend-ly-er	mellower	heavier
purpl-er	orange-r	little-r		

Puzzling cases:

quiet-er	*just-er	*apt-er	?dead-er
un-happy-er	un-tidy-er	un-health-y-er	un-luck-y-er
unruly-er			

Maybe a combination of features determines *-er* acceptability (Light, et al):

number of syllables	cold-er	happi-er	?water-y-er	*temporary-er
weight of final syllable		happi-er	*hapless-er	
final stress		un-happi-er	*slippery-er	
latinate		fast-er	*just-er	
degree vs binary	stronger	?dead-er		

The affixation rules are recursive, but with these largely unspecified restrictions on productivity, there are limits to how many suffixes we get:

	symbol-ize	to put into symbols
	idol-ize	to make into an idol
?	kill-er-ize	to make into a killer
?	kill-er-ize-r	someone who makes people into killers
?	kill-er-ize-r-ize-r	someone who makes people make people into killers

9.1.3 productive compounding

Now let's compare noun compounding in English. Earlier, we considered examples like these:

blackbird   apple pie   student protest   biology laboratory safety precautions

We saw that these these nouns can be grouped into pairs in a way that makes semantic sense.[1] We could write a rule that says that a noun can be made from two nouns:

$$N \rightarrow N\ N.$$

It seems that the number of syllables in each noun and such phonological properties of the nouns do not matter. These are productive enough that the recursion is apparent: there is no fixed limit on the length of noun compounds in English.

[1] Exercise XX in the text points out that the default stress for these compounds is influenced by the grouping, the bracketing.

This is interesting for many reasons. First, this is the kind of rule that makes human languages infinite. Second, these compounds have such a simple structure, and they are present in some form or other in most languages, that it has been proposed that they are the fossils of the earliest structures of human language (Jackendoff 2009, Bickerton 1990), possibly a relic of the earliest 'protolanguages'. Third, productive noun compounds with more than 2 words are highly ambiguous – you have to know what is meant to understand them.[2] As we will see, most English sentences have some similar structural ambiguities. Let's brieflu consider compounds a little more closely, to correct some possible misconceptions from our earlier discussions and to set the stage for other parts of syntax.

We observed that many familiar noun compounds are idiomatic, but we did not really say what the non-idiomatic noun compounds mean. One linguist has claimed that there are 9 basic relations:

NN	a.	onion tears	**cause**	(Levi 1978)
	b.	vegetable soup	**have**	
	c.	music box	**make**	
	d.	steam iron	**use**	
	e.	pine tree	**be**	
	f.	night flight	**in**	
	g.	pet spray	**for**	
	h.	peanut butter	**from**	
	i.	abortion problem	**about**	

And when we consider nouns related to verbs, it seems various grammatical roles are possible

$N[_N V]$	a.	parent refusal	**subj**	(Levi 1978)
	b.	cardiac massage	**obj**	
	c.	heart massage	**obj**	
	d.	sound synthesizer	**obj**	
	e.	child behavior	**subj**	
	f.	car lover	**obj**	
	g.	soccer competition	**(at|in? modifier)**	
	h.	government promotion	**subj|obj**	
	i.	satellite observation	**subj|obj**	

If you don't know the meanings of the compound (or the words in it), you will not be able to tell how it should be interpreted.[3] These English examples look similar to

[2] The number of different binary branching trees for n leaves is $\frac{(2(n-1))!}{(n)!(n-1)!}$ (Catalan, 1838). For $n = 2, 4, 8, 16, \ldots$ leaves, the number of possible trees is $1, 5, 429, 9694845, \ldots$. So for a noun compound with 8 words, like *boron epoxy rocket motor chamber sales market potential*, there are $catalan(8) = 429$ different binary trees.

[3] Jackendoff mentions a New York Times story (3 June 2007) about *child camel jockey slavery* which many people do not know how to interpret, at first. It is a story about children serving as camel jockeys, and so it is bracketed [[child [camel jockey]] slavery]. There is a wikipedia page about child camel jockeys.

Quechua	rumi ñan	warmi wagra	
	stone road	female cow	
German	Geshirr-spüler	dish-washer	
	Eisen-bahn	iron track	
Spanish	auto-escuela	car school	(Booij)
	cine-club	cinema club	
	tele-novela	television novel	
	video-arte	video art	

It is sometimes claimed that Mandarin Chinese is left and right headed

Chinese	$[[\text{du}]_N[\text{fàn}]_N]$	drug-criminal	(Ceccagno&Basciano 2009; Packard 2000)
	$[[\text{hán}]_N[\text{shou}]_V]_V$	letter-sell	'order by mail'
	$[[\text{jín}]_V[\text{du}]_N]_V$	prohibit-poison	'ban the sale and abuse of drugs'

The following VN examples seem to have a different kind of structure, and these have mainly idiomatic meanings:

French	essui-glace	wipe-window	windshield wiper
	couche-tard	lie-late	one who stays up late
Italian	lava-piatti	washes dishes	dishwasher
	porta-sapone liquido	soap container liquid	liquid soap container
Spanish	abre-latas	opens cans	can opener
	saca-corchos	removing corks	corkscrew
English	$[\text{jump-rope}]_V$	$[\text{jump-rope}]_N$	
	$[\text{pick-pocket}]_V$	$[\text{pick-pocket}]_N$	
	$[\text{break-fast}]_V$	$[\text{break-fast}]_N$	
	$[\text{cut-throat}]_N$	$[\text{dread-nought}]_N$	
	$[\text{scatter-brain}]_N$	$[\text{twinkle-toes}]_N$	

9.2 Parts of speech, syntactic atoms

Syntax is the theory of phrases. A sentence is a certain kind of phrase, and when we look at these phrases, we see that many of them have parts. The idea that an expression can be a complex of parts is already familiar syllable structures in phonology and word structures in morphology. A tree structure is a diagram of what the parts are and how they are assembled. (Compare a diagram of a car, which might show that the engine and the body are different parts, each of which is in turn assembled from more basic parts.) Linguists often call the parts of a sentence its "constituents," but you can just as well call them parts or pieces or units.

The justification for the particular units of structure that we use in syntax comes from their use in our account of how structures are built. We used the same logic in phonology. The motivation for a phonological feature like *voice* and *sonorant*, for example, came from its utility in describing speech sounds – we found that vowels were lengthened before +voice, −sonorant sounds. Similarly in morphology. Some suffixes can only attach to roots, so we conclude that roots are important units of word structure. Now we introduce some basic units of phrase structure. The discussion of syntax begins in Chapter 3 of the text.[4]

[4]Although the whole chapter is good reading, we will focus initially on the introductory pages 89-101 and then, next week, on the methods for figuring out what the structure is on pages 138-185.

In syntax, building phrases, the action begins at the parts of speech – roughly the word level — though at some points we will dig in to look at affixes. As we will see, many of the categories of expressions at this level and above will have infinitely many elements in them.

We have already introduced word-level categories: N (noun), V (verb), A (adjective), P (preposition), Adv (adverb), D (determiner). A category is just a class of expressions that share some important properties. We have already seen some of the distinctive morphological properties of these categories of expressions. For example, they differ with regard to which affixes they allow. Many adjectives can be suffixed with -ly to form an adverb; but no determiners can. We have also seen that these different sorts of expressions differ with regard to the possibilities for compounding. English allows noun compounding quite freely, but does not freely allow determiner compounding. So when we label an expression N, we are saying, among other things, that this is an expression of the kind that can be used to build compounds in a certain way.

These same categories of expressions, (N, V, A, P, Adv, D) have distinct roles in syntax. We will begin with the hypothesis that these are the "syntactic atoms", the basic units that will be referred to in our account of how phrases are built in human languages. We get a first, basic appreciation of the importance of these categories by noticing that these categories predict certain "distributional" properties, properties having to do with where a word can occur in a sentence.

In our discussion of morphology, parts of speech were introduced by where they occur, by their distribution in the language. For example, where one **verb** can occur, other similar verbs can usually occur:

(1) They can run/hide/fly/go/break

Where one **determiner** can occur, others can too:

(2) The/a/some/one/every/each book was read by every student. The/some/two/all/most books were read by every student.

Contexts where **adverbs** occur:

(3) He serves us politely/badly/happily

(4) He quickly/slowly served the dinner

And adjectives:

(5) the exciting/big/hot/huge/depressing/gleeful/rugged/red book

Some word classes are less familiar than the ones we have already mentioned (N, V, A, P, Adv, D), and so we will introduce some additional categories. For example, at the beginning of the following sentence, the words that can occur are called **modals**:

(6) Can/could/shall/should/must/would I be frank?

There are some contexts where the only word that can occur is some form of the verb **to be**:

(7) Is/was he going out

This suggests that although *be* may be a kind of verb, it's really in a category by itself!

Notice that the words *that/this* can appear in the position of determiners (at least to a good first approximation):

(8) this/that/the/every book is on sale

(9) I bought this/that/the/every book

So here, the words *that/this* are presumably determiners. We might call them "demonstrative" determiners. There is another use for *that* which is quite different though:

(10) I know that it is on on sale

Here, what follows *that* is a sentence, not a noun. In this use, it is a **complementizer (C)**. There are other complementizers:

(11) I wonder whether it is on on sale

(12) I wonder if it is on on sale

We will say more about complementizers later.

The distributional properties we have been looking at correspond with certain basic semantic properties. These may be more familiar, but they are actually less useful.

(13)
a. verbs V typically denote actions (*run, eat, buy, break*)
b. nouns N typically denote entities (*dog, cat, number, word*)
c. adjectives A typically denote states (*hot, sick, old*)
d. adverbs Adv typically denote manners (*slowly, cynically, painfully*)
e. prepositions P typically denote locations or relationships (*near, far, with, about*)
f. determiners D serve to specify or quantify a noun (*the, this, which, five*)
g. complementizers C introduce "clauses" or "sentences"

These rough semantic criteria are very unreliable! *Running* specifies an activity, but is a perfectly good noun. *Love* specifies a relationship, but is also perfectly good noun. *fast* may seem to specify a manner, but it is an adjective. What we are interested in is the role these words play in building phrases, so we get much more reliable evidence from "distributional" arguments of various kinds than from intuitions about what these expressions mean or denote.

9.3 Categories and "finest" categories

It is easy to see that *dog* and *dogs* cannot occur in all the same positions: they are not exactly the same category. If we carve up the categories in the finest way possible, singlular nouns and plural nouns (as we are now calling them) will have to be in different categories. In the same "finest category" with *dog* we certainly have *cat, horse, rabbit,...*, but not plural nouns. Similarly, for the (traditionally masculine) name *Bill*; it is certainly in the same finest category as *John, Fred, Sam,...*. But there are other words that seem to be in a special category by themselves, like *is*, or *has* – make sure you can present evidence that, for example, *is* and *was* are not in exactly the same category, nor are *is* and *has*, nor *is* and *reads*, or anything else. We will give a lot of attention later to these words that are in special finest categories by themselves.

9.4 Substitutions and Phrases

Consider the distribution of the pronoun "she." We can see that this does not have the distribution of any of the categories already mentioned (N(sg,pl),V(aux,main),A,P,Adv,D(sg,pl)). We find it in contexts like this:

(14) she reads

(15) she is a doctor

(16) the report says she discovered the answer

We notice that in these cases, the pronoun appears to be the **subject** of a sentence. What other things can be substituted into those contexts? That is, what other things can be a subject in these contexts?

a. **other (sg, 3rd person) pronouns:** he, it

b. **demonstrative determiners:** this, that

c. **certain phrases (containing determiners):** a scientist, the manager, every manager of the department, a friend of mine, the former White House chief-of-staff

Checking other pronouns, we find that they often occur where certain determiners and phrases with determiners can occur. To a first approximation, we can divide the contexts up this way

nominative case pronouns, in subject position: I/you/he/she/it/we/they studied the report

accusative case pronouns, in object position: the project studied me/you/him/her/it/us/them

genitive (possessive case) pronouns, in determiner position: Al read my/your/his/her/its/our/their book

Notice that nouns can have adjective modifiers and determiners associated with them; verbs can have adverb and prepositional modifiers associated with them, adjectives can have degree phrases and adverb modifiers associated with them, adverbs can have degree phrases and adverb modifiers associated with them:

(17) [the happy students] are reading linguistics

(18) the balloon [quickly rose up]

(19) He is [so completely happy]

(20) He is [so totally completely] finished

But pronouns, demonstrative determiners, and the phrases with determiners cannot have any other modifiers or determiners added to them:

(21) * [the happy he] reads linguistics

(22) * [one expensive this/that] is being sold

(23) * [the happy a scientist] reads linguistics

In a sense, pronouns are complete: no more modifiers (**tall he left*) or determiners (**the he left*) are allowed.. For these reasons, we give pronouns the category: determiner phrase (DP). We give them the phrasal category because they are complete in the same way that the phrase *the happy student* is complete.

So we have identified our first phrases: these are the things that have the same distribution as prounouns do. And we can use a **pronoun substitution test** to identify these things. (The reasons for calling these things 'phrases' will become clear later.) So we have two kinds of tests for identifying the parts, the "constituents" of a phrase so far:

First constituency tests:

(24) **Substitution tests for N(sg,pl),V(aux,main,forms),A,P,Adv,D(sg,pl)**: 'frame-based' reasoning – finding items that occur in similar contexts

(25) **Pronoun substitution test for determiner phrases (DPs)**: The unit we will call a determiner phrase (DP) can often be replaced by a pronoun

a. *The store with the top hats* has closed

b. *It* has closed

This perspective has introduced a couple of basic ideas. First, obviously, words go together to form larger units of structure. That is, in our account of how phrases are assembled, it is natural to refer to units that have more than one word in them. We did this earlier when we talked about "sentences", "subjects," "objects" and so on, but now we will try to be more systematic about it. The justification for assuming that some sequence of words forms a unit comes from the fact that we refer to this unit in the syntax. We use "constituency tests" to provide some preliminary evidence. They are preliminary checks on the units that our syntax is likely to refer to. These are our starting point, and so they are very important!

9.5 Manipulations

We not look at some more significant structural manipulations. Instead of just trying to put one piece of an expression in for another, we try "twisting" the sentence into various related forms, seeing what pieces tend to hang together in these twists, like in a puzzle where part ot the problem is to figure out what the pieces really are.

One thing we can do to a sentence to get a very closely related form is to move a piece of it to the front. For example, consider **the student from Venice** in the following sentences, where it can appear in different positions, but not left out:

(26) a. I like the student

b. the student , I like

c. * I like

If we try moving arbitrary other parts of the sentence to the front, we get really strange results:

(27) a. * student, I like the

b. * like the student, I

The element that moves easily, *the student*, is a determiner phrase. Other kinds of things seem to be able to move in the same way, but they are all phrases:

Two more constituency tests:

(28) **Preposing (topicalization) test for phrases**: Only phrases can be preposed.[5]

a. i. I saw the picture of the statue
   ii. the picture of the statue, I saw
   iii. * of the statue, I saw the picture
   iv. * picture of the statue, I saw the

b. i. I ate with a spoon
   ii. with a spoon, I ate
   iii. * a spoon, I ate with

c. i. he may be completely reckless
   ii. completely reckless, he may be
   iii. * reckless, he may be completely
   iv. * completely, he may be reckless

d. i. the witches stirred the cauldron very slowly
   ii. very slowly, the witches stirred the cauldron
   iii. * slowly, the witches stirred the cauldron very
   iv. * very, the witches stirred the cauldron slowly

(29) **Postposing test for phrases**: Only phrases can be postposed (much less flexible).

a. The student [that I told you about yesterday] arrived.
b. the student arrived that I told you about yesterday

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[5] The text, on page 152, says that nouns, adjectives, and adverbs can be topicalized. But the examples below show that it is noun phrases, adjective phrases, and adverb phrases can be topicalized. In fact, this is what the text on page 153 is driving at. You cannot prepose a noun out if the phrase that it is the head of. The text also says that verbs can be preposed. Verbs and verb phrases are a special case, with special properties, so I leave it out until we come back to look at verb phrases in detail later.

Lecture 10 Syntax: the anatomy of a phrase

10.1 More consituency tests

So far we have seen the most important

(1) **Substitution tests for N(sg,pl),V(aux,main,forms),A,P,Adv,D(sg,pl)**, noting that some of these categories are not "finest categories," but something a little broader than those.

(2) **Pronoun substitution test for determiner phrases (DPs)**

We can also identify elements by "manipulations:"

(3) **Topicalization (preposing) test for phrases**: Only phrases can be preposed.

(4) **Postposing test for phrases**: Only phrases can be postposed.

a. The student [that I told you about yesterday] arrived.

b. the student arrived that I told you about yesterday

Another thing that can be noticed about phrases, is that they often constitute acceptable answers to questions, even when the answers are not complete sentences:

Constituency test 5

(5) **Sentence fragment test for phrases**: Only phrases can be answers to questions

a. Who came? Maria

b. Who came? the president of the student union

c. Who came? * the

d. Who came? * the president of

e. What did she do? ran the student council for 2 years.

f. When did she do it? last year

g. How did she do it? with lots of hard work

h. How did she do it? quickly

i. How did she do it? * with

Constituency test 6

(6) **Coordination test for constituents of the same type**: For the most part, constituents are coordinated (using *and, or, but,...*) with other constituents of the same category.

a. [$_{NP}$ The old man] and [$_{NP}$ Maria] went over the books.
b. They [$_{V}$ wrote] and [$_{V}$ rewrote] the address.
c. * They [$_{V}$ wrote] and [$_{NP}$ Maria] the address.
d. They looked [$_{P}$ up] and [$_{P}$ down]
e. They [$_{VP}$ wrote it] and [$_{VP}$ sent it out]

10.2 Determiner phrases: first thoughts

Our constituency tests show us, no surprise, that in the following sentences, the sequences in the brackets form units:

(7) [cats] sleep
(8) I saw [cats]
(9) [Orange cats] sleep
(10) [Orange orange cats] sleep
(11) [Orange orange orange cats] sleep
(12) ...
(13) I saw [orange cats]
(14) [Terrifying orange cats] sleep
(15) I saw [terrifying orange cats]
(16) [big terrifying orange cats] sleep
(17) I saw [big terrifying orange cats]
(18) ...

In these examples we see that the plural noun *cats* can be modified by any number of adjectives (A). What kind of unit is [orange cats]? Is it a noun? To say it is a noun would suggest that [orange cat] is a singular noun that can enter into noun compounds the way *cat* does, but this is not right:

(19) tiger cat
(20) tiger cat salesperson
(21) * tiger orange cat
(22) * tiger orange cat salesperson

This sugests that [orange cat] is not a noun. It looks like a noun together with a modifier, so let's call it a noun phrase (NP). What are the properties of expressions like this one? One is: they do not enter into compounding the way nouns do. Another property we see in (7)-(18) is that expressions like *orange cat* can be modified by more adjectives. So NP is also a category that can be modified by adjectives. One way of putting this (a way that will get further confirmation from other sorts of considerations later) is to say that when we add a modifying adjective to a NP, we get another NP, another category that can be modified in the same way. The units [orange cats], [big orange cats], and so on are not nouns, but they are noun phrases, NPs.

Another property of plural expressions like [orange cats] that we see in the examples above is that they can be the subjects of sentences, and when they appear as subject of a sentence, they can be replaced by pronouns:

(23) [orange cats] sleep

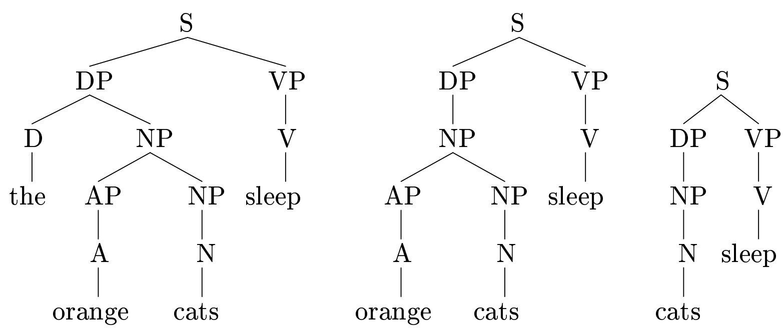
(24) [they] sleeps.

This means that, in these contexts, these phrases are determiner phrases, DPs. Are NPs and DPs the same thing? No! Notice that DPs like [the orange cats] or [they] cannot be modified the way [cats] or [orange cats] can be:

(25) * big the orange cats sleep

(26) * big they sleep

So what we want to say here is that a NP can form a DP either by itself or with modifiers. We can draw out these possibilities with trees:



Notice that, in all of these trees,

(27) *the* is a D

(28) *orange* is an A

(29) *cats* is a N

But only in the third tree is *cats* a DP.

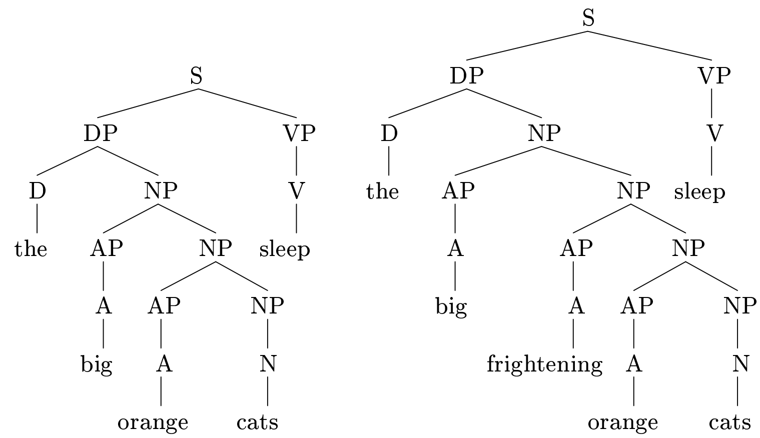
So we call the kind of things that we see as subjects in these sentences determiner phrases (DPs). Then we see that [cats] is a N; it is also a NP, and it is also a DP. The expression [orange cats] is a NP but not a N. And the expressions [the orange cats], with the determiner *the* in it, is a DP but not a NP and not a N.

Putting all of this together, we can think of the N *cats* as having the potential of collecting certain associated units to make a phrase: it can combine with 0 or more modifiers to make a NP. Then the NP can combine with 0 or 1 determiner to make a DP. We will see that other sorts of phrases have collect similar kinds of units.

As the text observes on page 165, to allow for any number of modifiers, we need a recursive rule. The text proposes a rule that combines an adjective with a NP to make a NP, but since the adjectives can themselves be modified, we will propose this rule:

$$\text{NP} \rightarrow \text{AP NP}$$

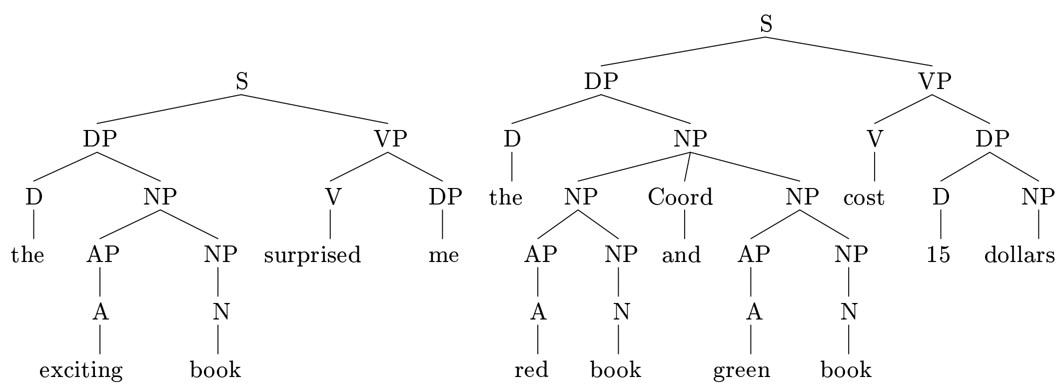
This says that a NP can be formed from an adjective phrase and a NP. With this idea, we get structures like this:



Coordination tests confirm the idea that the adjectives and noun form a constituent to the exclusion of the determiner:

(30) [the [red book] and [green book]] cost 15 dollars.

And we show this in our trees:



10.3 Arguments and modifiers

Sentences are formed when words – **heads** – combine in appropriate ways with other units. In effect, each head can have other constituents as “satellites”. We will distinguish two basic kinds of satellites: arguments and modifiers. We will consider arguments more carefully next time.

10.4 Summary

We introduced important tests for constituency – (we will get much more practice, but you need to know them!) We showed how phrase structure could be indicated in trees or with brackets. The relations in the trees can be represented with rules.

Summary: syntactic constituency tests

(1) **Substitution tests for N(sg,pl),V(aux,main,forms),A,P,Adv,D(sg,pl):** we started with these

(2) **Pronoun substitution test for determiner phrases (DPs)**:

a. The store with the cool stuff has closed

b. It has closed

(3) **Topicalization (preposing) test for phrases**: Only phrases can be preposed.[1]

a. i. I saw the picture of the statue

ii. the picture of the statue, I saw

iii. * of the statue, I saw the picture

iv. * picture of the statue, I saw the

b. i. I ate with a spoon

ii. with a spoon, I ate

iii. * a spoon, I ate with

c. i. he may be completely reckless

ii. completely reckless, he may be

iii. * reckless, he may be completely

d. i. the witches stirred the cauldron very slowly

ii. very slowly, the witches stirred the cauldron

iii. * slowly, the witches stirred the cauldron very

iv. * very, the witches stirred the cauldron slowly

e. i. Robin said she would sing a song... and

ii. sing a song, she did

iii. * sing, she did a song

(4) **Postposing test for phrases**: Only phrases can be postposed.

a. The student that I told you about yesterday arrived

b. the student arrived that I told you about yesterday

(5) **Coordination test for constituents of the same type**: For the most part, constituents are coordinated (using *and, or, but,...*) with other constituents of the same category.

a. [$_{\text{NP}}$ The old man] and [$_{\text{NP}}$ Maria] went over the books.

b. They [$_{\text{V}}$ wrote] and [$_{\text{V}}$ rewrote] the address.

c. * They [$_{\text{V}}$ wrote] and [$_{\text{NP}}$ Maria] the address.

d. They looked [$_{\text{P}}$ up] and [$_{\text{P}}$ down]

e. They [$_{\text{VP}}$ wrote it] and [$_{\text{VP}}$ sent it out]

[1] The text, on page 152, says that nouns, adjectives, and adverbs can be topicalized. But the examples below show that it is noun phrases, adjective phrases, and adverb phrases can be topicalized. This is what the text on page 153 is driving at. For example, we see that you typically cannot prepose a noun out of the phrase that it is the head of!

Lecture 11 Structures from heads+rules

[NB: as mentioned in class, we are still covering material from last week's reading. The second syntax chapter in the book (Chapter 4) covers several things that we will not go into in detail, so the new required reading for this week is quite short. The most important things will be in the lecture notes.]

Looking over the syntactic structures we drew last time and reviewing especially that last two pages of the previous lecture notes, we can see some basic things going on:

- D, N, V, A, Adv, P, C are **heads** (=syntactic atoms, 'basic parts of speech') which combine with 0 or more phrases (e.g. direct or indirect objects) to form DP, NP, VP, AP, AdvP, PP, CP.

The heads are given to us by morphology, and there are infinitely many of them. Notice that <u>whenever</u> we have a noun N, we will have an NP. And in the class, we will assume that the same goes for V, A, P, and Adv. (This is a slight departure from the text, where it is assumed that, for example, you can have an A without an AP.)

- **Modifiers** are optional, and they can combine (recursively) with NP, VP, AP, AdvP, PP
- When we think about where modifiers appear, we notice that a modifier of a head X usually cannot appear between X and its complements:

		the		student		finished		the		homework	
slowly	_		*		_		*		*		_
big	*		_		*		*		_		*

- So in *cats sleep*. In that sentence, we say that the noun *cats* is a DP, because it plays the same role in the syntax as a phrase like *the cats* with a determiner does.

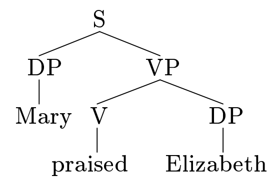
As discussed in class, we can understand these options now, simply with the idea that APs attach to the left of NPs, and AdvP attaches on either side of VP (unless they are preposed – in that special case they must attach to something else).

11.0.1 Arguments of VP introduced

The **direct object** of a verb is called its **argument** or **complement**, such as *Elizabeth* in

(1) Mary [$_{\text{VP}}$ praised Elizabeth]

Mary is the **subject**, external to the VP. The subject is usually also regarded as an argument. Semantically, the subject and the direct object refer to things that are essentially involved in the action named by the verb. This is typical of arguments, and distinguishes them from modifiers. It is not natural to think of *Elizabeth* as modifying *praised* in (1).



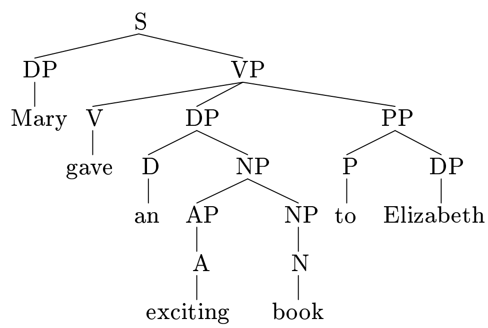
Notice that the DP *Elizabeth* is a **sister** of the head V. In this configuration, the pattern VP → V DP is not recursive.

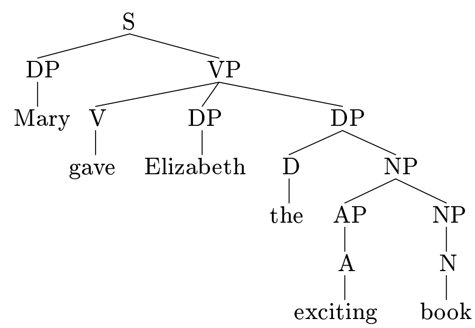
An **indirect object** is a argument of the verb as well, such as *Elizabeth* in

(2) I [$_{\text{VP}}$ gave an exciting book to Elizabeth]

(3) I [$_{\text{VP}}$ gave Elizabeth an exciting book]

Here we have two DPs inside the VP, two arguments: a direct object (*an exciting book*) and an indirect object (*Elizabeth*).



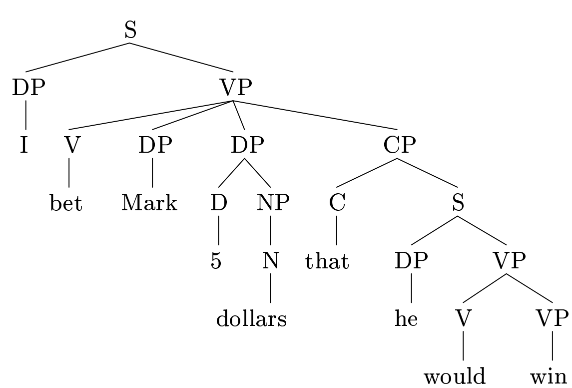


Notice that the DP *Elizabeth* is a **sister** of the head V. In this configuration, the pattern VP → V DP DP is not recursive, which fits with the fact that we cannot just stick more DPs into the VP:

(4) * I [$_{\text{VP}}$ gave Elizabeth the book the door Friday Mary Hamlet]

So just a limited number of DP arguments are possible in VPs. In fact, the limit of required complements seems to be 3, in all human languages.

Some English verbs require 2 complements, like *put*, but I do not know of any that require 3. But some verbs appear to allow 3, as in *I bet [Mark] [5 dollars] [that they would win].*



It is an interesting fact that it is hard to think of verbs other than *put* which require 2 complements. I know only a few: *hand*, maybe also *set, lodge*.

Sometimes complements are mandatory, sometimes optional. But modifiers are always optional.

(5) I praised Mary.

(6) ? I praised.

(7) I put the car in the garage.

(8) * I put in the garage.

This confirms the intuitive idea that arguments play a fundamentally different role in syntax from modifiers. When you look up a verb in a good dictionary, it will usually tell you something about what objects it can take, since verbs are fussy about this, but the dictionary will not tell you what modifiers the verbs allow, since most verbs allow most modifiers!

11.0.2 Modifiers in VP

As we have seen, Like the modifiers in NP, we can have any number of modifers in a VP:

(9) I [$_{\text{VP}}$ gave Elizabeth the book]

(10) I [$_{\text{VP}}$ happily gave Elizabeth the book]

(11) I [$_{\text{VP}}$ happily gave Elizabeth the book on Friday]

(12) I [$_{\text{VP}}$ happily gave Elizabeth the book on Friday in class]

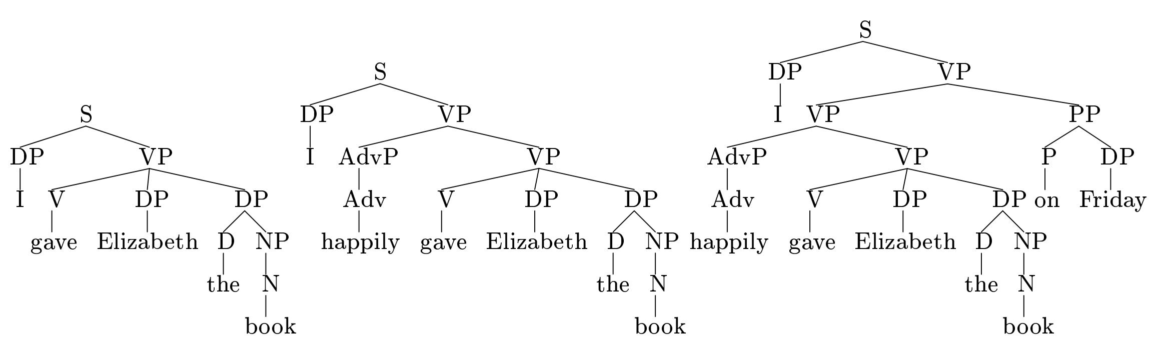
(13) I [$_{\text{VP}}$ happily gave Elizabeth the book on Friday in class with the rest of my notes]

(14) ...

In order to add any number of modifiers like this, we need recursive rules, like the one we proposed for noun phrases.

$$\text{VP} \rightarrow \text{AdvP VP}$$
$$\text{VP} \rightarrow \text{VP AdvP}$$
$$\text{VP} \rightarrow \text{VP PP}$$
$$\text{VP} \rightarrow \text{PP VP}$$

Drawing these ideas out in trees, we get structures like these:



Now lets go back to consider what counts as an argument versus a modifier in a VP. Direct and indirect objects are not modifiers, but arguments, as in:

(15) I sent money

(16) I sent Mary money

(17) I sent money to Mary

Notice that the indirect object can appear in a PP. We cannot have multiple indirect objects:

(18) * I sent [Bill] money [to Mary] [to Sam]

However, the number of PPs that can be included in a VP seems essentially unlimited:

(19) I worked on Sunday in the city on that project without a break.

Are all of these PPs arguments? Or are some of them modifier modifiers? In fact, it seems that there is a principled difference between arguments and modifier PPs, revealed by tests like the following.

Tests for modifiers and arguments in VP

(20) **Optionality**: Arguments are sometimes required, sometimes optional. Modifiers are always optional.

a. I praised Mary

b. ? I praised

c. I sang [on Saturday]

d. I sang

(21) **Iteration**: The number of arguments is strictly limited. There can be any number of modifiers. That is, modifiers can be "iterated" or "repeated."

a. I sang with gusto on Saturday with Mary about love at the auditorium.

(22) **modifiers can modify "do so" VPs**:

a. I sang a song with Mary while you did so [with Bill]. (modifier)

b. * I saw Bill while you did so [Mary]. (argument)

(23) **unlike arguments, modifiers are OK in "do what" pseudoclefts**:

a. What Mary did [with Bill] was sing a song. (modifier PP)

b. * What Mary did [Bill] was give a book. (argument NP)

(24) **modifiers can modify coordinated XPs**:

a. Robin [$_{VP}$ wrote a book] and [$_{VP}$ sang three songs] [with Sandy.]

(25) **modifiers can be left behind in VP-preposing**:

a. Robin said she would sing a song, and [sing a song] she did, [with Sandy].

b. * Robin said she would give Mary a book, and [give Mary] she did, [a book].

Usually, these tests provide convergent evidence about the status of any given PP. When these tests yield different results, it is less clear what to say about the structure.

In sum, when a verb V and its direct object DP form a verb phrase VP, we say that the DP is a **complement**. A complements is a **sister** of the head. Complements, together with the subject, are also called **arguments**. The notion "complement" usually means the structural relation, sister of the head, while the word "argument" usually means the semantic relation: usually a specification of what the verb applies to, one of the essential components of the event.

11.1 S(emantic)-selection and argument roles, ‘θ-roles’

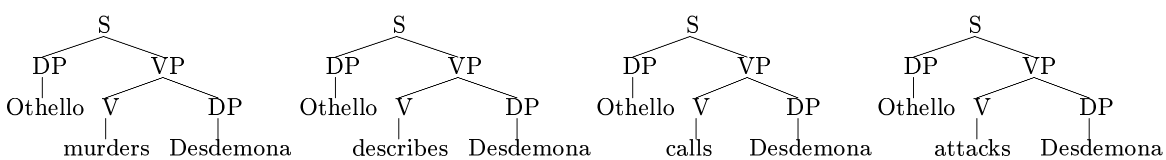
For understanding the difference between arguments and modifiers, reasoning about what the sentences mean can be helpful. For examples, subjects often name the *agent* of the action, and the object often names the *patient* or *theme* of the action. It is hard to pin down these notions precisely, but the text (pp.129, 227) points out that sentences like the following are very odd (the text uses ! to mark these odd sentences):

(26) ! the rock murdered the tree

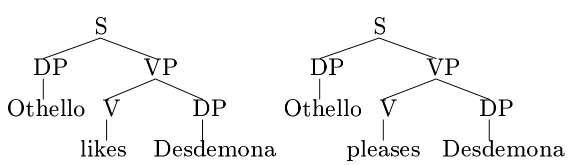
(27) ! the forest described Macbeth

This oddity comes from facts about what the verbs mean, facts about the semantic role that the subject and object are expected to play. The verbs *murder* and *describe* normally have subjects that are ‘agents’, animate agents. Since this is a matter of what the DPs mean, what they refer to, they are called **s(emantic)**-selection requirements.

Consider a bunch of simple English sentences like these:



In all of these sentences, the subject is, in some sense, the **agent** of the action denoted by the verb, while the object is more passive – the text says that the objects in these sentences are **patients** of the actions denoted by the verbs. In contrast, if we compare



In the first of these latter sentences, the subject is the **experiencer** and the object is the **theme** – the thing that the psychological attitude denoted by the verb is about. But in the second sentence, the subject is the **theme** and the object is the experiencer. We expect that our sentences will not only be assembled appropriately, but that the elements will have appropriate sorts of meanings.

11.2 Syntactic rules

The way each constituent – each “node” in a tree – can be composed of parts – its “children” of the node – can be represented with a rule. For example, we see in each of the trees just displayed that each S “node” has two children – a DP and a VP. We represent this fact with a “phrase structure rule”: S $\to$ DP VP. Remember that the arrow in this rule can be read “can be formed from.” Collecting all the rules from all the trees we have displayed, we find these:

	basic rules for selected elements		rules for modifiers
(137)	S → DP VP		
(124a)	$DP \rightarrow \left\{ \begin{array}{c} (D)\ NP \\ Name \\ Pronoun \end{array} \right\}$		
(123)	$NP \rightarrow N\ (\left\{ \begin{array}{c} PP \\ CP \end{array} \right\})$		
(130)	$VP \rightarrow V\ (DP)\ (\left\{ \begin{array}{c} PP \\ CP \\ VP \\ AP \end{array} \right\})$		
(120)	PP → P (DP)		
(122)	AP → A (PP)		
(138)	CP → C S		
	AdvP → Adv		
		(123')	~~NP → (A) N (PP)~~
		(73c.iii)	NP → AP NP
			NP → NP PP
			VP → AdvP VP
			VP → VP AdvP
			VP → VP PP
			AP → AdvP AP
	$\alpha \rightarrow \alpha$ Coord α		(for α=S,D,V,N,A,P,C,Adv,VP,NP,AP,PP,AdvP,CP)

Remember that parentheses go around optional elements. And set brackets go around elements when you have to choose exactly one. **These rules are not complete!** but they are a good starting point, and they are, I think, intuitive.[1]

11.3 Arguments in PP, NP and AP

Just as the traditional 'object' of a verb is an argument, so the object of a preposition is its argument. It is not always required, and there are other possible arguments besides DP:

(28) He looked [$_{PP}$ up]

(29) He looked [$_{PP}$ up [$_{DP}$ the chimney]]

(30) He walked [$_{PP}$ up [$_{PP}$ to the chimney]]

[1]These rules are are slightly simpler and more general that the "complete list of phrase structure rules" on page 175 of the text. Our rules differ from the text primarily in these respects:

a. the "complete list" on p175 of the text includes rule (122) for APs, but it does not provide any rule that let's an AP occur in a sentence, so we add a few modifier rules.

b. As discussed in class, the text does provide rule (123') on page 165, but once we have (73c.iii) also from page 165, we can eliminate (123').

c. To allow sentences like *cats sleep*, we need to allow the determiner in rule (124a) to be either unpronounced ("empty") or optional. The rules in the text do not indicate the fact that there can be no (pronounced) determiner before the noun.

d. We add a rule for coordinate structures. This rule is special, because it works on so many categories.

(31) He is [$_{\text{PP}}$ beside [$_{\text{DP}}$ me]]

(32) He walks [$_{\text{PP}}$ with [$_{S}$ you leading the way]]

These phrasal arguments are attached as sister to P.

The rules given above also include the possibility of arguments for NP and AP. Intuitively, *Sarajevo* is a argument of V in the sentence:

(33) They destroyed Sarajevo in 1993

In a similar way, the phrase [$_{\text{PP}}$ *of Sarajevo*] seems to be an of N in the sentence:

(34) The destruction of Sarajevo in 1993 was terrible

We will accordingly attach [$_{\text{PP}}$ *of Sarajevo*] as a sister to N, and we attach [$_{\text{PP}}$ *in 1993*] as an modifier. This fits with the fact that neither of the following are any good:

(35) * They destroyed in 1993 Sarajevo

(36) ?? The destruction in 1993 of Sarajevo was terrible

We use this idea for nouns that are clearly related to verbs that take complements, like *claim, study, idea, proposal, thought, fear, desire, argument,. . . .* For example, consider

(37) The argument [of the noun] [in this sentence] is familiar

(38) ?? The argument [in this sentence] [of the noun] is familiar

In this case too, we say [*of the noun*] is a argument, a sister of the N *argument*, but [*in this sentence*] is a modifier, a sister of NP.

We can also get arguments in APs, arguments which are rather similar to DP arguments. For example,

(39) That was [$_{\text{AP}}$ clever]

(40) That was [$_{\text{AP}}$ clever [$_{\text{PP}}$ of Mary]]

(41) It is [$_{\text{AP}}$ important]

(42) It is [$_{\text{AP}}$ important [$_{\text{PP}}$ to Bill]]

11.4 Summary

Based on the tests for constituency introduced last time, we find constituent relations that can be represented in trees (or with labeled brackets). This class was mainly spent drawing trees (almost none of which appear here in these notes).

We went over again the important distinction between complements and adjuncts (arguments and modifiers). This distinction is slightly tricky. The complements of a V are sometimes obligatory, and always limited in number; the complements of an N are never obligatory, but are still always limited in number. Some tests for V modifiers were presented, and they are summarized again below – understand them.

Finally, in this lecture we saw how we can write down the rules for building the phrases that we have drawn in these trees. You should be familiar with all the rules in the table on page 82.

What is emerging now is a picture of the syntax in which the basic elements are lexical items, which have categories, sometimes requiring complements in addition.
Then the phrases get assembled according to a few rather simple rules, at least so far. Special attention needs to be given to one issue:

Constituents of VP. This is probably the trickiest part of our approach to syntax (and many basic questions about verb phrase structure are still not settled).

The things traditionally called the subject and the (direct or indirect) objects of the verb are **arguments**. The object and indirect object are **complements**, sisters of the V An argument can be a DP, PP, CP, or other category:[2]

The king doesn't give his money to charity very often

The king knows that rich people should pay income taxes, and he doesn't like them!

He prefers for the wealthy to prosper

He wonders whether his plans for the kingdom will succeed

The **modifiers** of verbs, on the other hand, can be adverbs or prepositional phrases, and they are sisters of VP. That is, there is recursion on VP in this pattern.

The queen listens politely

She completely supports her husband

She spoke on Sunday at the rally in the rain

How can we tell arguments and modifiers apart?? We repeat our tests here:

(43) **Optionality**: arguments are sometimes required, sometimes optional. Modifiers are always optional.

(44) **Iteration**: The number of arguments is strictly limited. There can be any number of modifiers. That is, modifiers can be "iterated" or "repeated."

a. I sang about love with gusto on Saturday at the auditorium with my band

(45) **modifiers can modify "do so" VPs**:

a. I sang a song with Mary while you did so with Bill. (modifier)

b. * I saw Bill while you did so Mary. (argument)

(46) **unlike arguments, modifiers are OK in "do what" pseudoclefts**:

a. What Mary did with Bill was sing a song. (modifier PP)

b. * What Mary did Bill was give a book. (argument DP)

(47) **modifiers can modify coordinated VPs**:

a. Robin [$_{\mathrm{VP}}$[$_{\mathrm{VP}}$wrote a book] and [$_{\mathrm{VP}}$ sang three songs]] with Sandy.

(48) **modifiers can be left behind in VP-preposing**:

a. Robin said she would sing a song, and [sing a song] she did, [with Sandy].

b. * Robin said she would give Mary a book, and [give Mary] she did, [a book].

[2] The text suggests that the adjective phrase in *She is beautiful* is not the argument of the verb *be*, but a predicate. There is something right about this proposal. Notice for example that *beautiful* does not have a θ-role (that is, *beautiful* is not an agent, patient, theme, experiencer,...). We may come back to these issues later, but for now we will think of *beautiful* as a complement, sister of V, even if it is not an argument.

Lecture 12 Phrase structure and movement

12.1 Review and some loose ends.

We have observed that phrases are built according to some very general principles:

- Each **head** of category X combines with its **complements** (possibly none) to form XP.
  So complements are always **sisters** of the head.
- **Modifiers** are optional phrases, and they can combine (recursively) with the phrase they modify

In English specifically, we find phrases combining in certain orders, which we represent with a set of rules like the ones given on page 82 of these lecture notes.

We noticed that the rules on page 82 are too permissive – for example, while some verbs select DP objects, others do not – so we have to factor in the specific requirements of each lexical item. We say that each lexical item can "select" certain other phrases that it needs to combine with. But as we mentioned briefly before, really we should distinguish 2 kinds of selection: 'categorial' and 'semantic'.

12.1.1 C(ategorial)-selection

Words get put into the syntactic structures according to their category. For example, a verb can go where the rules allow a V to occur. However, an intransitive verb like *laugh* can only go into a tree that does not have a direct object. A transitive verb like *surprise*, on the other hand, can go into a tree with a direct object, but not one with both a direct and indirect object.

We can assume that each word is associated with a specification of the arguments that it can occur with. The arguments of a verb are its subject and its complements. Let's adopt the policy of <u>underlining</u> the subject argument, so that we will not distinguish it from the complements.

word	category	arguments
laugh	V	<u>DP</u>
surprise	V	<u>DP</u> DP
send	V	<u>DP</u> DP
send	V	<u>DP</u> DP DP

These are important distinctions among elements of the category V – the category divides into **subcategories** according to the categories of the arguments each verb requires.

Some verbs allow sentences, or CP clauses of the form [$_{CP}$ that S] as arguments. For example,

(1) John knows [$_{CP}$ that [$_{S}$ Mary laughs]]

(2) John told [$_{DP}$ Bill] [$_{CP}$ that [$_{S}$ Mary laughs]]

Infinitival clauses (using the 'infinitive' form of the verb, with *to*) can also occur as arguments:

(3) John knows [$_{S}$ her to be a dedicated linguist]

(4) I prefer [$_{S}$ her to explain it]

These infinitival clauses have accusative case subjects, and the verb in them is never present or past, but infinitival.

We can represent the way that different verbs assign different roles to their arguments by augmenting the lexical entries. For example, we could use a notation like this – similar to the proposal on page 231 except that we will indicate the subject by <u>underlining</u>, so that it can be distinguished from the complements. (Here I also indicate the "roles" of the subject and object, but this is just for your intuitions and we will not emphasize these roles in this class.)

word	category	arguments	
laughs	V[TNS]	agent — <u>DP</u>	
murders	V[TNS]	agent — <u>DP</u>	patient — DP
likes	V[TNS]	experiencer — <u>DP</u>	theme — DP
pleases	V[TNS]	theme — <u>DP</u>	experiencer — DP

So in sum, we have

c-selection: a lexical item can impose category restrictions on its complements.

s-selection: a lexical item can impose semantic restrictions on its arguments.

The lexical entries include these restrictions, so for example, we have already seen that we can think of the word *describes* as coming with the following information, which indicates that its subject argument (indicated by underlining) plays the semantic role of being the agent, while the complement argument (not underlined) plays the role of the theme:

word	category	arguments	
describes	V[+TNS]	agent — <u>DP</u>	patient — DP

Other verbs can have different selection requirements:

word	category	arguments	
laughs	V[+TNS]	agent — DP	
dives	V[+TNS]	agent — DP	
murders	V[+TNS]	agent — DP	patient — DP
likes	V[+TNS]	experiencer — DP	theme — DP
pleases	V[+TNS]	theme — DP	experiencer — DP

12.1.2 c-selection of clauses

A sentence has a subject DP and a predicate. We will call sentence-like phrases 'clauses' and apply this term to a large range of constructions that have a subject and predicate – I indicate some of them here in brackets:

(5) $_S$Kate defies Petruccio

simple clause

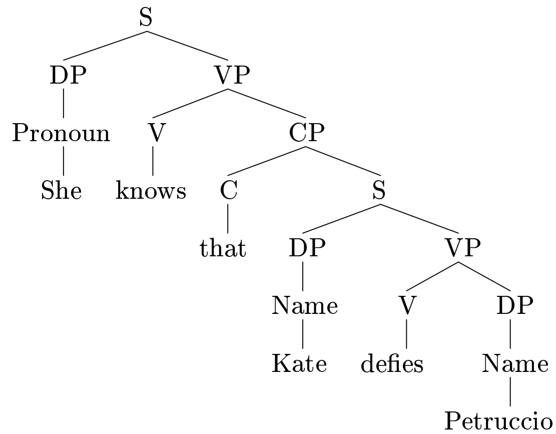
(6) She knows that [$_S$Kate defies Petruccio] — clausal complement of V
She wonders whether [$_S$Kate defies Petruccio]
She prefers for [$_S$Kate to defy Petruccio] — (infinitival clause, pp131,281)
She prefers [$_S$Kate's defying Petruccio] — ('possessive -ing clause)

(7) The claim that [$_S$Kate defies Petruccio] is true. — clausal complement of N

Let's consider *that*-clauses first:

(8) She knows that [$_S$Kate defies Petruccio]

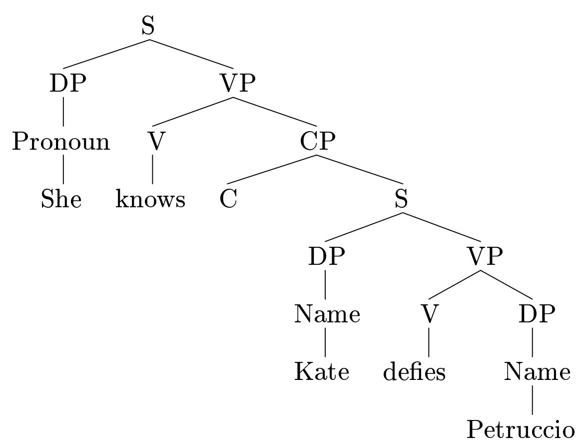
What is the complement of the verb *knows* here? This particular kind of *that* is called a **complementizer** and so a standard idea is that here we have the verb selecting a **complementizer phrase (CP)**:



(Here I have put in the categories 'Pronoun' and 'Name', but they are special instances of DP, so sometimes I will leave these out – They are special instances of DP because they seem not contain determiners in them.) The important point about this tree is the phrase CP formed from the C *that*: this kind of complementizer phrase is selected by *knows*. We already have the phrase structure rule that allows this:

$$\boxed{\text{CP} \rightarrow \text{C S}}$$

Notice that this is perfectly good even without the complementizer *that*. These two sentences mean exactly the same thing, so it is natural to assume that the structures with and without the complementizer are exactly the same:[1]



Although we have rules for building CPs, and rules that allow Vs to select them,

$$\text{CP} \rightarrow \text{C S}$$
$$\text{VP} \rightarrow \text{V CP}$$

it is clear that not all verbs c-select CPs. For example the verb *dive* allows the modifier *from the cliff*, but not a DP or CP complement:

[1] With this idea, that a complementizer position can have no pronounced material in it, it becomes possible to assume that

(1) **simple clauses are CPs** with silent C.

In fact, this idea has some appealing features that we will notice when we consider questions. As we will see, this idea provides some positions, positions in the CP, that get filled in questions. This idea is proposed in the text on page 278. We'll return to this.

(9) a. He dives from the cliff

b. * He dives the ocean

c. * He dives that Kate defies Petruccio

But verbs like *know* can select a CP complement, and the C can be *that*, it can be silent, or it can be *whether*:

(10) a. He knows whether Kate defies Petruccio

b. He knows that Kate defies Petruccio

c. He knows Kate defies Petruccio

Not all verbs that take CP complements allow this same range of CPs:

(11) a. He questions whether Kate defies Petruccio

b. * He questions that Kate defies Petruccio

c. * He questions Kate defies Petruccio

(12) a. * He thinks whether Kate defies Petruccio

b. He thinks that Kate defies Petruccio

c. He thinks Kate defies Petruccio

(For reasons that will be discussed soon, we will not count *why* or *what* or *which* as complementizers.) This variation is specific to the verbs, and so we assume it is represented it in the lexicon, where the difference between CP[that] and CP[wh] must be represented, and we can use just CP to mean either one:

word	category	arguments	
		experiencer	theme
knows	V[+TNS]	—	—
		DP	CP
		experiencer	theme
questions	V[+TNS]	—	—
		DP	CP[wh]
		experiencer	theme
thinks	V[+TNS]	—	—
		DP	CP[that]

12.1.3 Auxiliary verbs

One particularly interesting case of selection happens with auxiliary verbs. When we consider sentences with auxiliary verbs, a simple pattern is easy to see:

(13) He might have been diving

(14) He has been diving

(15) He is diving

(16) He dives

(17) He has been diving

(18) He has dived

(19) He might be diving

(20) He might have dived

(21) He might dive

If we put the modal verbs in any other orders, the results are no good:

(22) * He have might been diving

(23) * He might been diving

(24) * He is have dived

(25) * He has will dive

The regularities can be stated informally as follows:

(26) English auxiliary verbs occur in the order MODAL HAVE BE. So there can be as many as 3, or as few as 0.

(27) A MODAL (when used as an auxiliary) is followed by a tenseless verb, [-TNS]

(28) HAVE (when used as an auxiliary) is followed by a past participle, [PASTPART]

(29) Be (when used as an auxiliary) is followed by a present participle, [PRESPART]

(30) The first verb after the subject is always the one showing agreement with the subject and a tense marking (if any), [+TNS]

We have already seen a mechanism for telling us what can follow a verb: its complement list! So these auxiliary verbs can be treated as having special complements: VPs. We can list the requirements as follows:[2]

word	category	complements
will,would,shall,should,may,might,must,can,could	V[+TNS]	VP[-TNS]
has,have,had	V[+TNS]	VP[PASTPART]
is,are,was,were	V[+TNS]	VP[PRESPART]

Notice that the lexical entries on page 86 give tensed forms of some verbs, but our verbs also have infinitives, and present and past participles.

This was not mentioned in class, but while it is natural to think of the verb in a simple sentence like *he dived* – the **agent** of the diving – it is not so natural to think of the auxiliary in *he is diving* as having a subject. For this reason, it is usually assumed that auxiliary verbs do not have subjects (at least, not in the way that main verbs do). With that assumption, we can list the complements selected by each verb as follows (showing underlined subjects only for main verbs, not auxiliary forms):

[2]Many of these auxiliary verbs have other uses too, which will require other entries in the lexicon. F

(1) He willed me his fortune. His mother contested the will. (WILL as main verb, or noun)

(2) They can this beer in Canada. The can ends up in California. (CAN as main verb, or noun)

(3) The might of a grizzly bear is nothing to sneeze at. (MIGHT as noun)

(4) I have hiking boots. (HAVE as main verb)

(5) I am tall. (BE as main verb)

word	category	arguments	
have	V[-TNS]		
having	V[PRESPART]	VP[PASTPART]	
had	V[PASTPART]		
be	V[-TNS]		
being	V[PRESPART]	VP[PRESPART]	
been	V[PASTPART]		
laugh	V[-TNS]		
laughing	V[PRESPART]	—	
laughed	V[PASTPART]	DP (underlined)	
murder	V[-TNS]		
murdering	V[PRESPART]	—	—
murdered	V[PASTPART]	DP (underlined)	DP
like	V[-TNS]		
liking	V[PRESPART]	—	—
liked	V[PASTPART]	DP (underlined)	DP

With lexical entries like these, we can account for all of the patterns of auxiliary verbs that we saw in (13-25), but the earlier examples (7) and (9) remain mysterious!

12.1.4 Case

We have seen various examples of DPs:

(31) Mary, Elizabeth, Bill (proper names)

(32) I, you, he, she, it, we, they (nominative case pronouns)

(33) me, you, him, her, it, us, them (accusative or objective case pronouns)

(34) my, your, his, her, its, our, their (genitive case or possessive pronouns)

(35) an exciting book, the door, the car, the garage (descriptions)

We have already noticed that these DPs have different distributions:

(36) *him laughs

(37) *Mary surprises he

Now it is easy to be more precise about how the form of the pronominal DP depends on its position in the structure:

Case assignment to DPs

a. the subject of a tensed clause is nominative case

b. the complements of a verb are accusative (objective) case

c. the complement of a preposition is accusative (objective) case

12.1.5 Subject-verb agreement

It is also a familiar fact that the highest verb in a sentence is tensed, and present tense forms agree with their subjects. For example,

(38) She is[+TNS] smart!

(39) * She are[+TNS] smart!

(40) She is[+TNS] describing[prespart] the solution

(41) * She are[+TNS] describing[prespart] the solution

(42) She prefers[+TNS] for us to solve[-TNS] it

(43) * She prefer[+TNS] for us to solve[-TNS] it

Looking at just the highest verb for the moment, we see that it agrees with the subject. This is a completely familiar idea:

Subject-verb agreement: A present tense verb must agree with its subject. That is, the head of T[+tns] agrees with its specifier.

12.2 Interim Summary

A speaker knows some basic things about each word that are relevant to assembling phrase structure, including

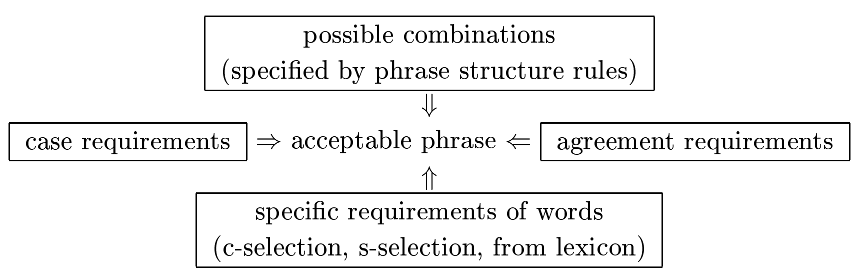
phrase structure combinations allowed by the rules

Case assignment to DPs

Subject-verb agreement

lexical requirements

The phrase structure is assembled to respect all these different things:



12.3 Movement!

12.3.1 Wh-questions

We now introduce another kind of dependency: movement. Movement gets discussed in Chapter 4 of the text. (The whole chapter is good reading, but we will focus on pages 224-245.)

We have briefly surveyed a range of clause-types found in English (a similar range is found in other human languages):

(1) [$_S$Kate defies Petruccio] — simple clause

(2) She knows that [$_S$Kate defies Petruccio] — V complement clause

(3) The claim that [$_S$Kate defies Petruccio] is true. — N complement clause

(4) She prefers for [$_S$Kate to defy Petruccio] — V infinitival complement clause (pp131,281)

(5) She sees [$_S$Kate defy Petruccio] — small clause (p133)

But now let's consider questions. In the text and in class, we saw that in both

(6) I know [he is describing **which problem**]? (bold for emphasis!)

(7) I know [which problem John is describing]?

it is natural to regard *which problem* as the object, the theme of *describe.* This idea fits with the argument structure given above, in which this verb takes both a subject and an object. This idea also explains why it is no good to put an object in that position:

(8) * Which problem is John describing the book?

The only problem is that the expression *which problem* in (7) is not in the usual object position – it is in a more "remote," preposed position.

Similar observations can be made about *which students* in (9)

(9) Which students are you thinking want to take the exam?

In sentences like these, it is natural to assume that *which students* is the subject of *want.* This explains why we have subject-verb agreement:

(10) * Which student are you thinking want to take the exam?

(11) Which student are you thinking wants to take the exam?

(12) * Which students are you thinking wants to take the exam?

Again, the only puzzle is how does the subject get into the "remote" "preposed" position, at the front of the sentence.

To explain these facts, the text proposes another kind of dependency:

wh-movement (first version): A phrase containing a wh-word can be preposed.

Let's postpone just for a moment showing any hypotheses about what the tree structure of these wh-questions are. The text shows a structure on p244, but does not explain it. We will postpone the question for just a minute while we set the stage for understanding what's going on.

There is another puzzle about sentences (7) and (9) which we have not tackled yet! Namely, what is going on with that auxiliary verb *is* and *are*. It is easy to see that the auxiliary verb in wh-questions like these has to agree with the DP that <u>follows</u> it!

(13) Which book are you buying?

(14) * Which book is you buying?

(15) Which book is she buying?

This looks like subject-verb agreement, but the subject and verb seem to be reversed from their usual order! To understand this, let's first be a little bit more explicit about the categories of auxiliary verbs.

There is a range of wh-constructions which contain sentences:

(16)	[Who [$_S$defies Petruccio]]?	wh-question (questioning the subject)
(17)	She knows [who [$_S$defies Petruccio]].	V wh-complement clause
(18)	The woman [who [$_S$defies Petruccio]] is Kate.	N wh-modifier ("relative clause")
(19)	[Who does [$_S$Kate defy]]?	wh-question (questioning the object)
(20)	She knows [who [$_S$Kate defies]]	V complement clause
(21)	The guy [who [$_S$Kate defies]] is bad news.	N wh-modifier ("relative clause")

We saw that both CPs with declarative sentences and CPs with questions can be embedded. (And so the "relative clauses" are CP questions, attached as modifiers in NP – see new modifier rule on page 96.) There are a number of puzzling things going on here that we should look at more carefully, but it will take several steps. . .

12.3.2 Yes/no-questions

First, let's go to material Chapter 5 "The distribution of verbal forms" (esp.pp257-300, and some things in this chapter – aux verbs, morphology – which have already been discussed).

When we look over our earlier examples of (13-25), we see that each one allows the first auxiliary verb to be preposed:

(22) a. He is diving
b. Is he diving?

(23) a. He has dived
b. Has he dived?

(24) a. He has been diving
b. Has he been diving?

(25) a. He might have been diving
b. Might he have been diving?

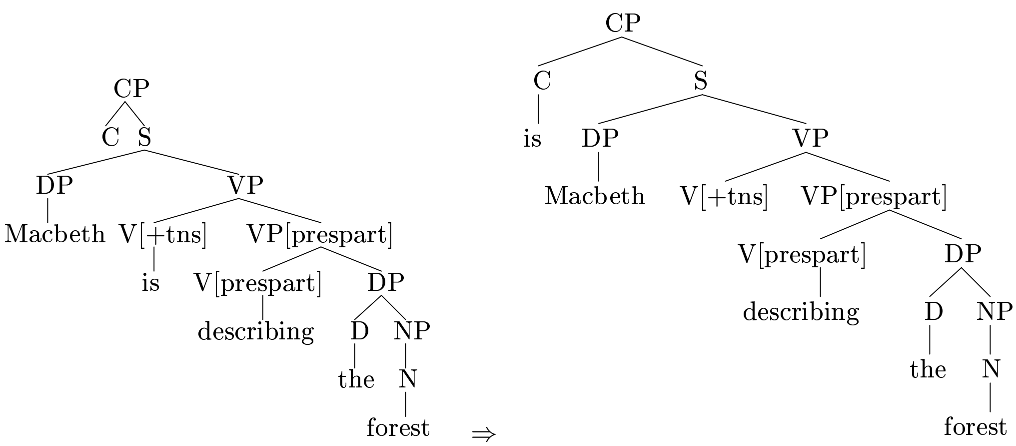
(26) a. He might be diving
b. Might he be diving?

(27) a. He might have dived

b. Might he have dived?

After looking at wh-movement, it is natural to propose some kind of "preposing" in this case too, except that in this case, the preposing moves just a verb, not a whole verb phrase. What position does the verb move to? Well, we have seen that sentences can be preceded by complementizers (C), so one idea is that in these sentences, the auxiliary verb moves to the C position:

Subject-auxiliary inversion (first version): The highest auxiliary in a tensed sentence can be preposed to C to make a question.



(Draw an arrow from V[+tns] to to make clear what happened here!)

Notice that we can make these into "echo" questions with stress and intonation:

(28) Macbeth is describing WHAT FOREST?

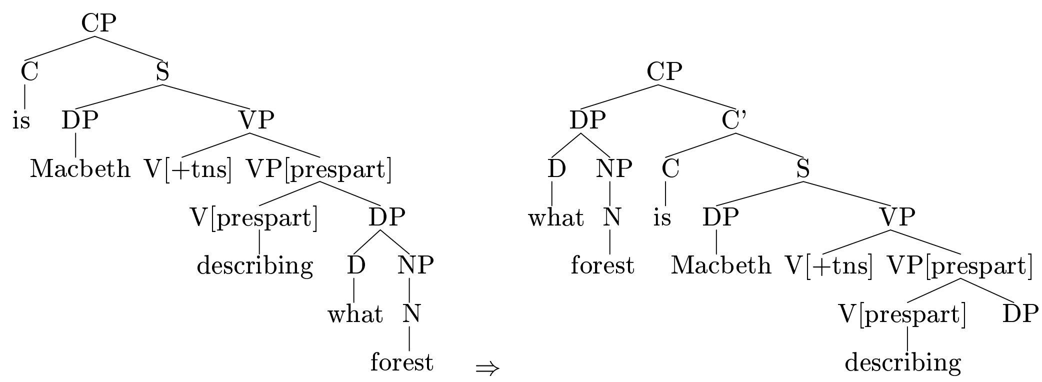
(29) Is Macbeth describing WHAT FOREST?

Or, with normal question intonation,

(30) What forest is Macbeth describing?

Now we can make sense of the tree (90) on page 244 of the text:

wh-movement (second version): A phrase containing a wh-word can be preposed to attach to CP. (When we do this, we assume that C+S form an intermediate phrase C'.)



12.4 Summary

In class, we mentioned the goal of treating S as TP (this brings a few more small changes next week, but for now we can simply put TP where S is):

	basic rules for selected elements		rules for modifiers
(137)	~~S → DP VP~~		
(tentative!)	TP → DP VP		
(124a)	DP → {(D) NP, Name, Pronoun}		
(123)	NP → N (PP)		
(130)	VP → V (DP) ({PP, CP, VP})		
(120)	PP → P (DP)		
(122)	AP → A (PP)		
(138)	~~CP → C S~~		
(new!)	CP → C'		
(new!)	C' → C TP		
	AdvP → Adv		
		(73c.iii)	NP → AP NP
			NP → NP PP
		(new!)	NP → NP CP
			VP → AdvP VP
			VP → VP PP
			AP → AdvP AP
	$\alpha \rightarrow \alpha$ Coord α		(for α=D,V,N,A,P,C,Adv,VP,NP,AP,PP,AdvP,TP,CP)

movement and insertion rules:

wh-movement: A phrase containing a wh-word can be preposed to attach to CP.

Affix hopping: A tense suffix can move to the main verb, in an adjacent VP. (no hopping across *not*)

These lists are incomplete but this is a good start.

Lecture 13 Questions, etc.

Last class we introduced one of the standard analyses of English tense and auxiliaries. Today we can begin a review by catching a few loose ends from the last lecture, and then briefly discuss passive sentences.

13.1 The variety of clauses

We have observed that simple clauses have tense, but other clauses don't. We could add the requirement [+tns] to our sentences, but then we will need a separate account for "infinitival clauses". Is there a better way to say what's going on with +tns?

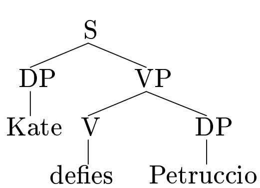
In Chapter 3 "Syntax I", on pages 160, 181-182, there was a suggestion about this which may seem rather surprising: the suggestion is that simple sentences are Tense Phrases, TPs:

(1) **sentences are TPs**

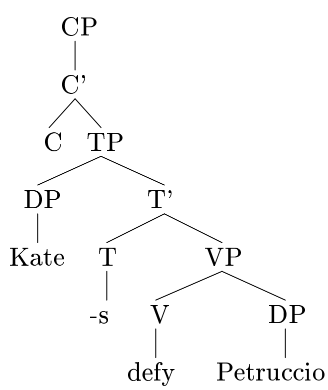
But this is puzzling. We have seen that many English phrase structure rules have the form XP *to* X (YP), so in the case of TPs, where is the tense T? Well, in the case of the infinitival *to*, it precedes the VP, and in tensed clause, we have seen that the tense of the clause gets realized on the first verb (which is sometimes an auxiliary V that selects a participle or progressive form. So, if we have to put T somewhere, a natural choice is to put it between the subject DP and the VP. This is achieved by replacing the rule "S $\rightarrow$ DP VP" with these rules:

$$\text{TP} \rightarrow \text{DP T'} \qquad \text{T'} \rightarrow \text{T VP}$$

So the idea is that we should elaborate our tree structures like this:



becomes

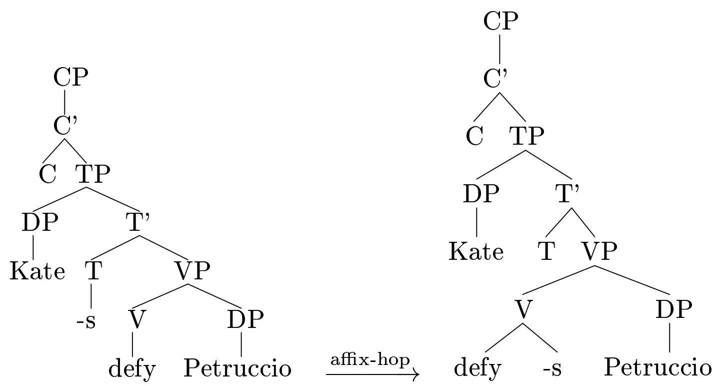


Several points to notice here. First, the CP is often put at the top of the tree even when there is nothing in C, because these are positions that things can move to. But the more serious and obvious issue with this proposal is that it puts the tense affix on the wrong side of the verb. We have *-s defy* but we want *defy -s*! (As noted in class, I am using -s instead of a more abstract label for the affix PRESENT, just to remind you how present tense is usually pronounced, when you can hear it. And when you can't hear it, we assume that it is doing the same thing as it is when you can hear it.)

The simplest idea for getting from *-s defy* to *defy -s* is just to assume that an affix can move, that it can "hop" onto an adjacent verb, so let's propose this new movement rule, restricting it to this particular case:

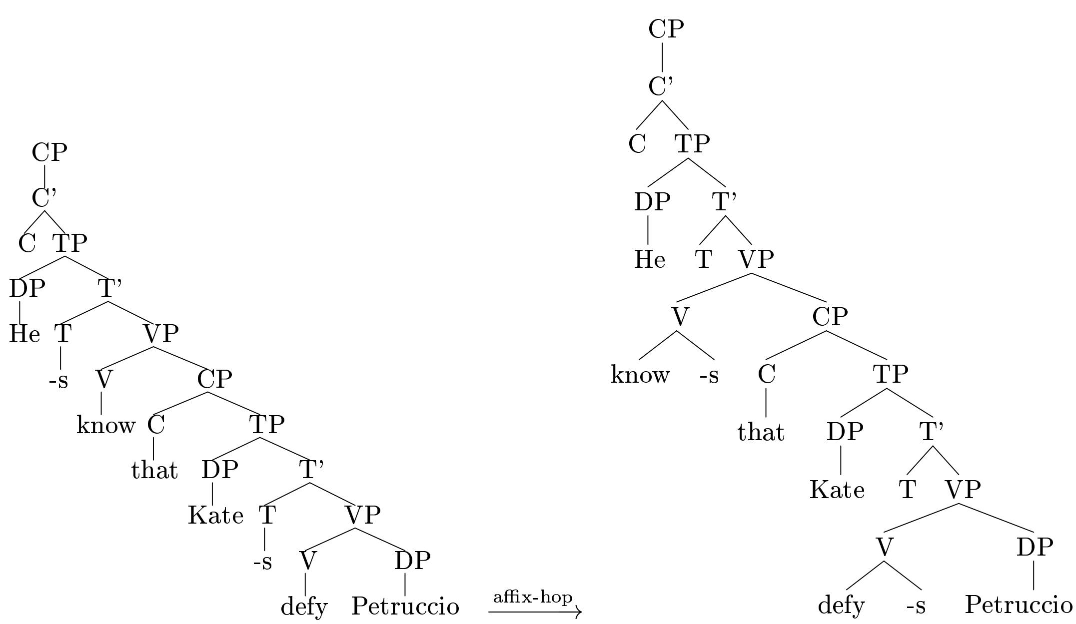
Affix hopping: A tense suffix can move down to the (non-auxiliary) verb of an adjacent VP.

So affix hopping applies in our example:

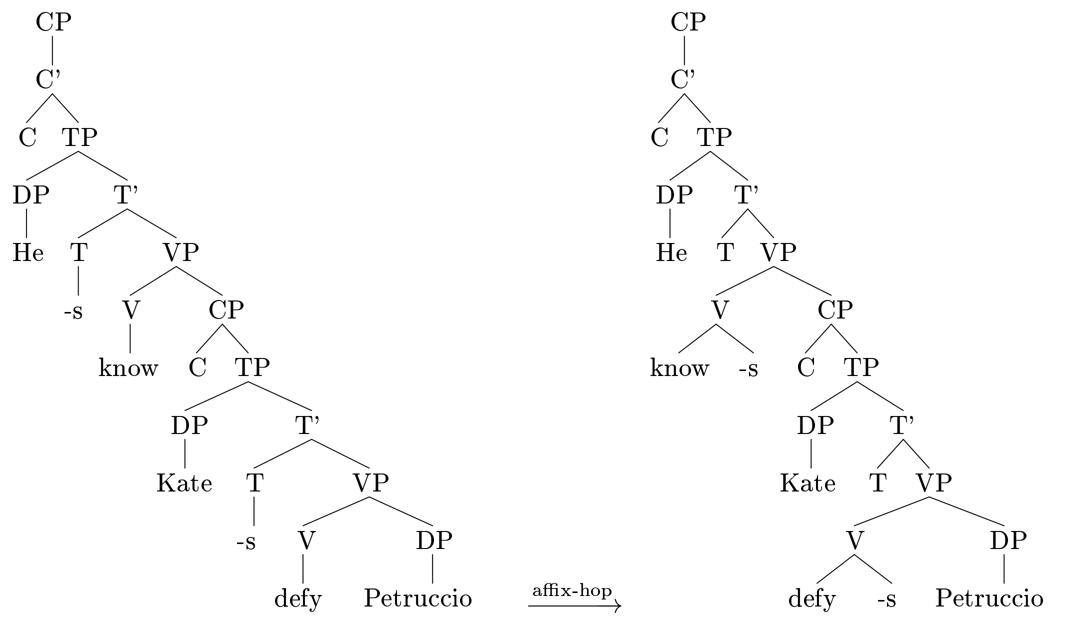


It is useful to draw an arrow in the tree on the right, from the T node where -s began to the place where it moved, as was done in class. Draw it! Draw it here, and in all the trees produced by movements in these notes. If you don't know where to draw the arrow, ask!

And this structure is exactly the same when it appears as the complement of a verb, as in example (2):



And of course the structure is exactly the same even when the complementizer position C does not have *that* in it:

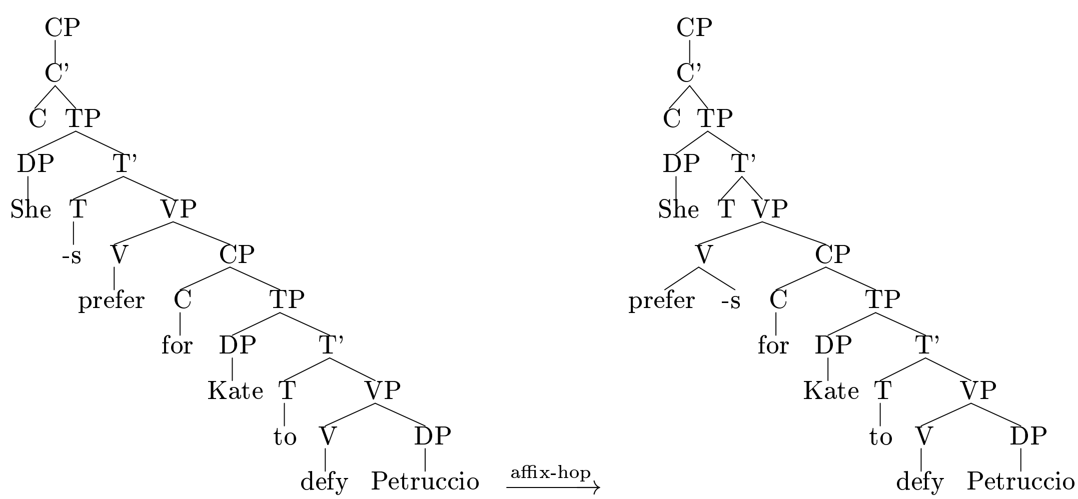


(It is a good exercise to draw arrows in these trees from the T where -s starts, to the position where it ends up after affix hopping!)

Now let's turn to a basic question that we neglected earlier:

Question 1: What is the structure of infinitival clauses like the one in (4)?

With the new structures we are drawing for sentences, we can assume that the structure of (4) is almost exactly the same:



NOTICE! that affix hopping cannot apply in the embedded sentence because there is no affix! Instead, we have the word *to*. Now let's look at the verb forms that occur in these clauses.

13.2 Auxiliaries, Negation and the verb DO

Before looking at verb forms more carefully, it is interesting to make one quick observation about a respect in which *do* is unlike the auxiliary verbs (modals, BE, HAVE). We have seen that auxiliary verbs can invert with the subject to form a yes/no question:

(2) Othello is the one

(3) Is Othello the one?

(4) Othello would be it.

(5) Would Othello be it?

Other verbs cannot form questions in this way:

(6) Othello killed it

(7) * Killed Othello it?

So what about DO? It does not act like the other auxiliaries:

(8) Othello did it

(9) *Did Othello it?

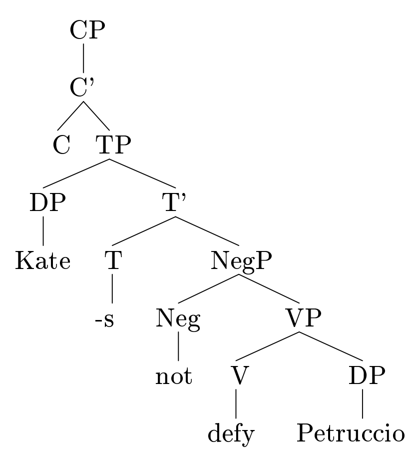
It is also easy to see that when an object is questioned, as in (19), there must be an auxiliary verb (Modal, HAVE, BE) or else DO, and subject-auxiliary inversion must take place. Chapter 5 observes that a similar thing happens when negation is added to simple clauses:

(10) * [Kate not defies Petruccio]

(11) * [Kate defies not Petruccio]

(12) [Kate does not defy Petruccio]

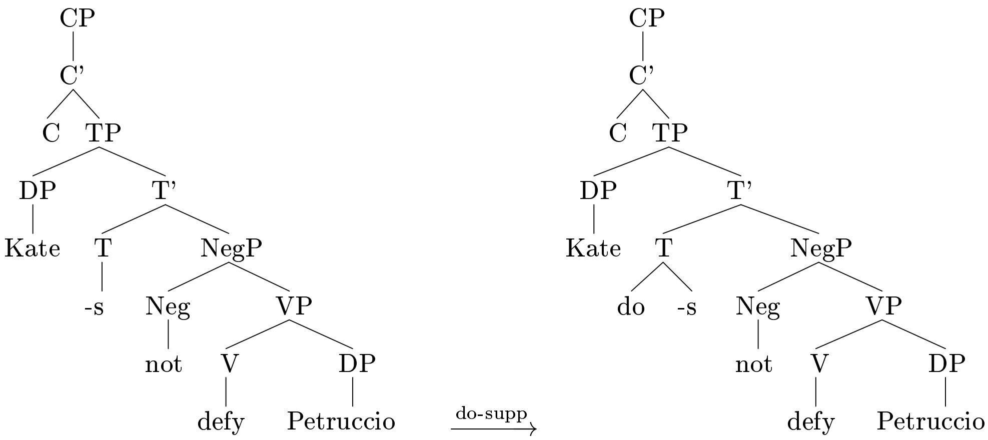
Why is this? When we look at the structure here, it suggests the simple idea that the *not* gets in the way of affix hopping:



What can save this structure? Putting the "dummy verb" *do* into the T position so that the affix can attach to it. We propose this rule (p286):

Do-support: Insert DO to save a stranded suffix in T.

So we get:



This theory, with affix hopping and do-support, gives us an analysis of *Kate does not defy Petruccio*, but it leaves a puzzle about the auxiliary verbs. How are negated sentences with auxiliaries possible?

(13) She will not defy Petruccio

(14) She has not defied Petruccio

(15) She is not defying Petruccio

(16) * She not has defied Petruccio

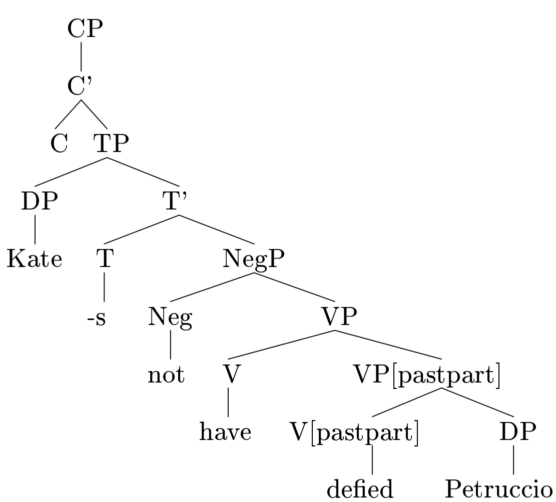
(17) She will not have been defying Petruccio

(18) ?? She will have not been defying Petruccio

(19) ?? She will have been not defying Petruccio

(20) ?? She will have been defying not Petruccio

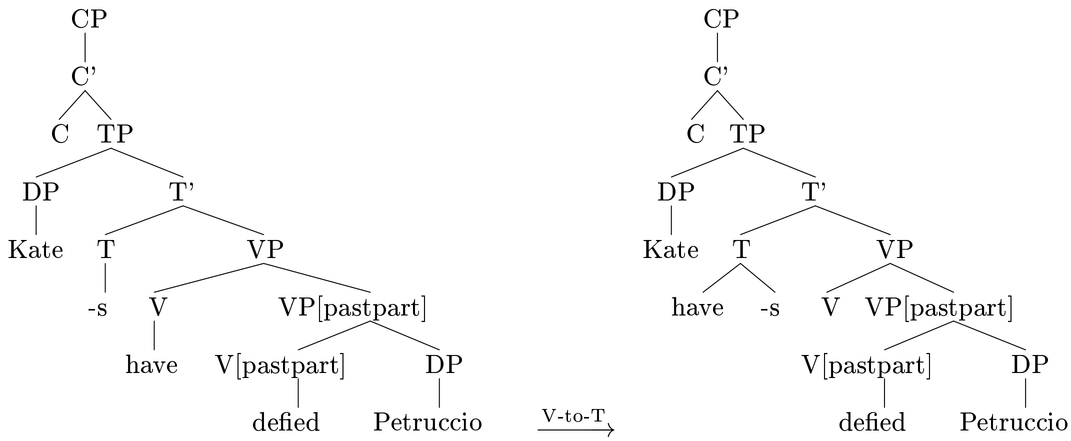
These examples suggest that the way an auxiliary verb gets associated with tense suffixes is different from the way that main verbs do. How could these auxiliaries get associated with T properly, even when there is a *not*? Consider the structure:

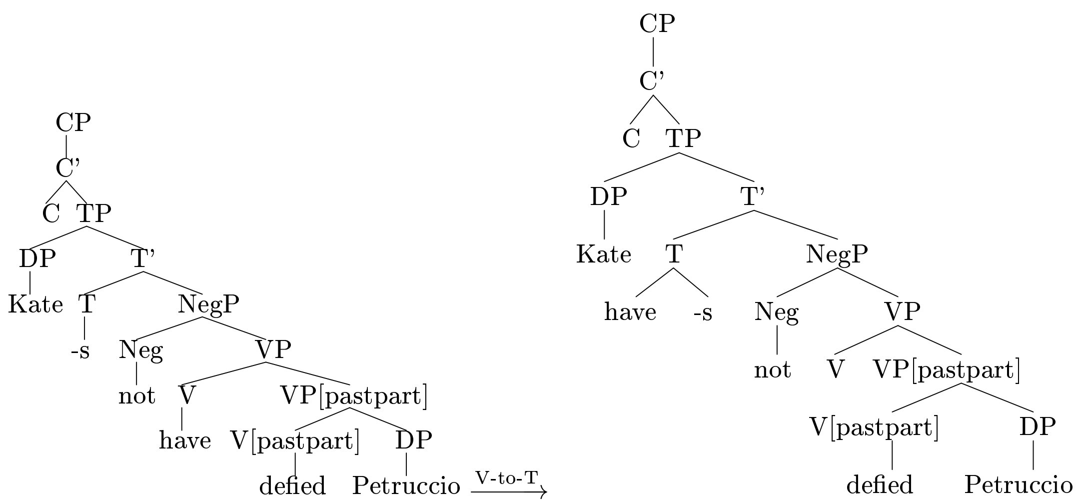


It is possible to propose a different mechanism to associate HAVE with the suffix in structures like this:

V-to-T head movement: an auxiliary verb can raise attach to T

If we assume that this rule is not blocked by negation, then we get the required contrasts that we want, with these derivations:





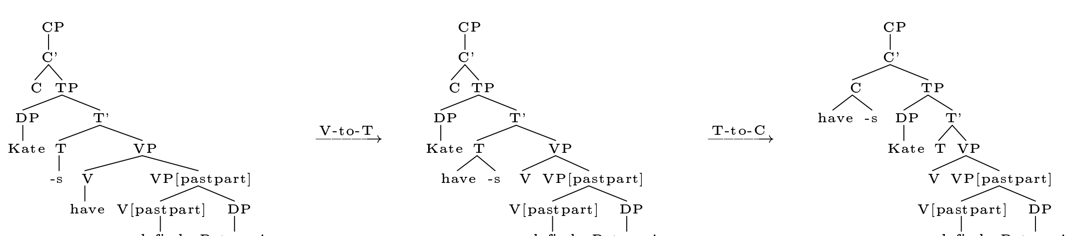
(It's a good exercise to draw an arrow again to indicate the movement from V to T.)

13.2.1 Subject-Auxiliary inversion again

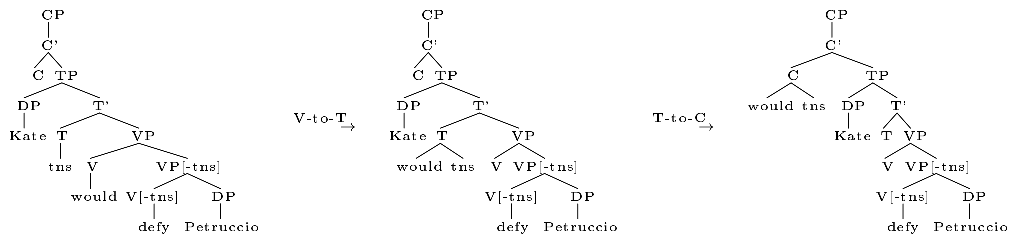
Now that we have modified our structures (using CP and TP instead of S), and we have put the tense suffixes under T, it is worth considering Subject-Auxiliary inversion again. It can now be expressed like this:

T-to-C head movement T can raise to an empty C.

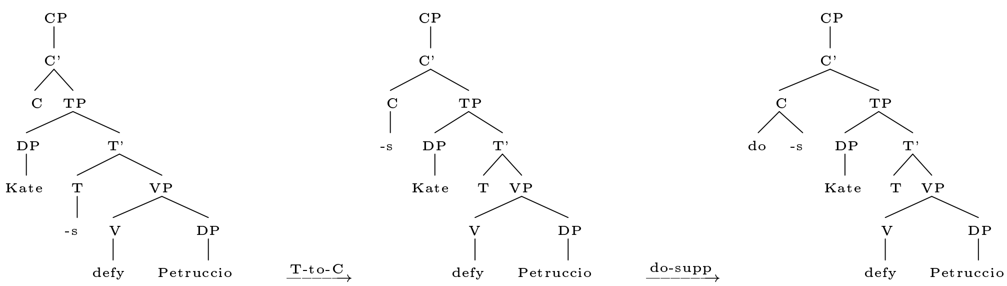
So the steps in deriving *Has Kate defied Petruccio* are these:



Some auxiliaries contain both a verb or modal and the past tense morpheme, and so in these cases we can either say that a tense suffix attaches but then the V+tns is pronounced with one word. For example:



And when there is no auxiliary verb, then there is no V-to-I raising, but do-support applies, so we derive the sentence *Does Kate defy Petruccio* in the following steps:

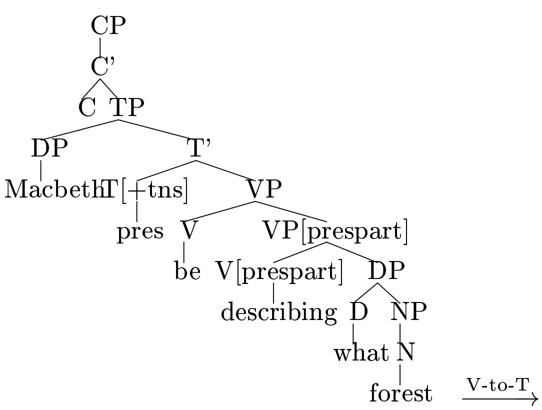


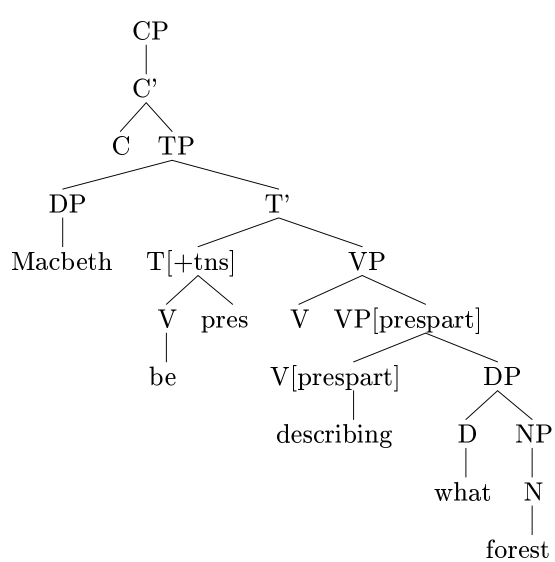
(For practice, make sure again that you can draw the arrows in the derived trees indicating all the movements that have been done.)

13.3 Wh-questions reviewed

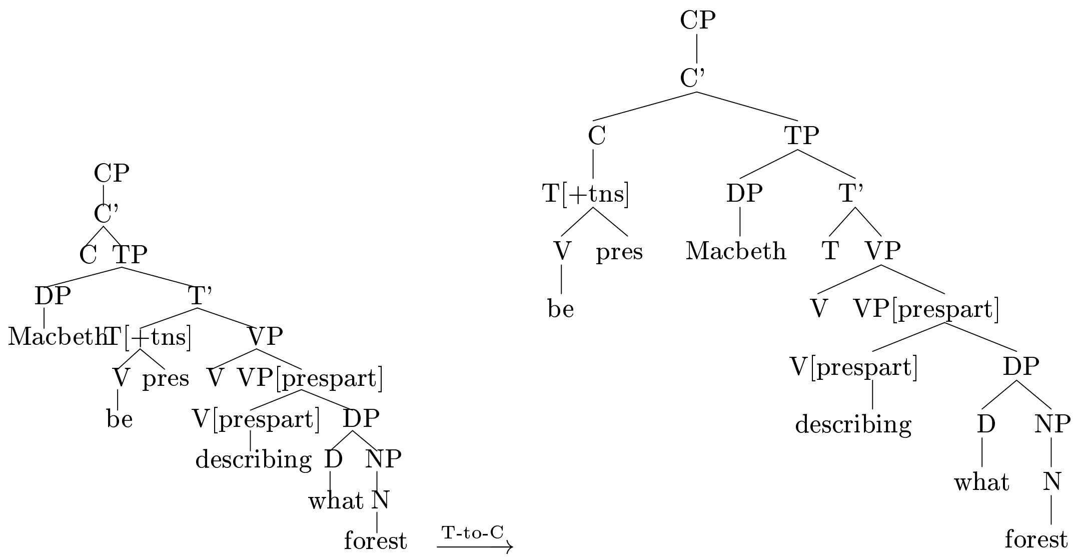
Last week we mentioned the idea that wh-phrases can be preposed. Now, if we treat these phrases as the "subjects" of the CP, just like regular subjects are related to TP, we get the following simple 3-step analysis of a question like *What forest is Macbeth describing?*.

STEP 1: move the auxiliary verb up to Tense using "V-to-T",

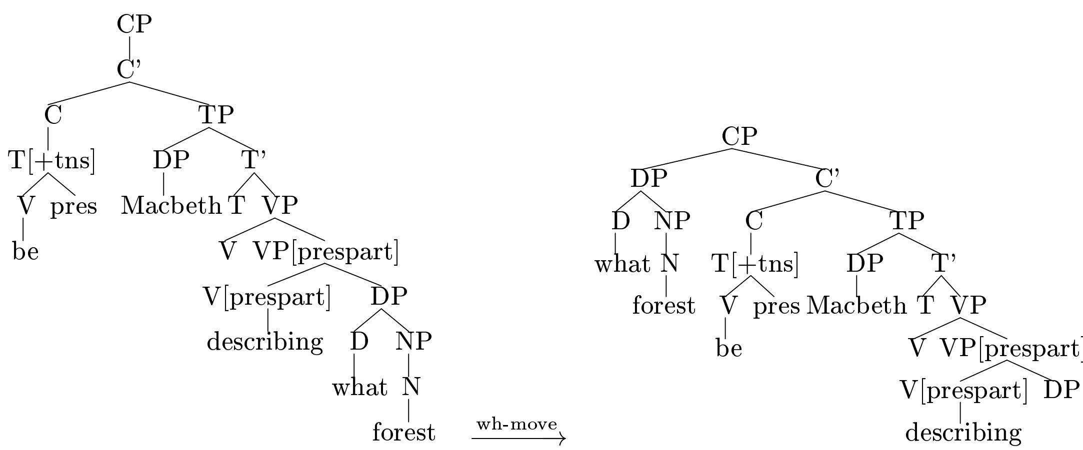




STEP 2: move aux verb + tense to C using "T-to-C":

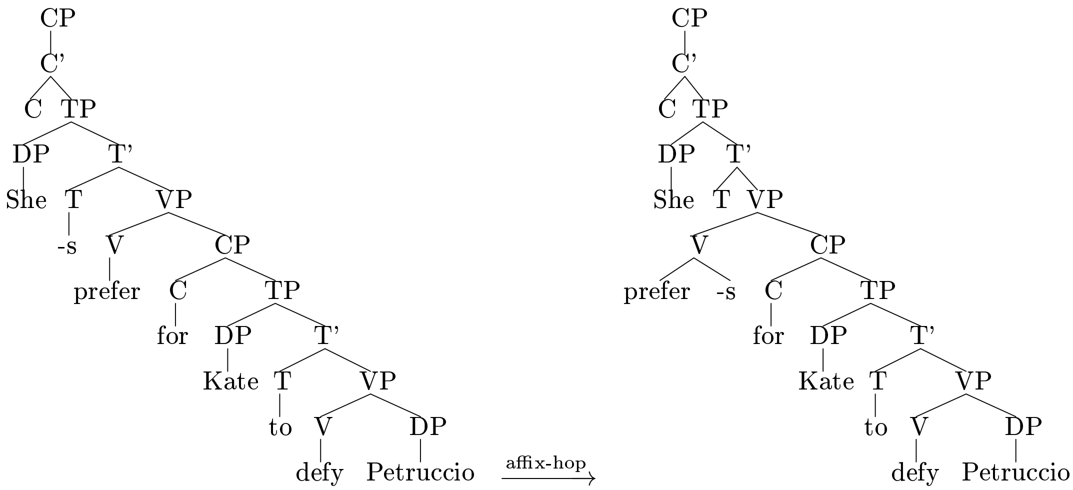


STEP 3: move the wh-phrase to attach to CP, using the "wh-question formation" rule:



13.4 Infinitive clauses reviewed

With the new rules for tense and clauses, infinitival clauses have the same kind of tree as tensed clauses. We showed this tree already to illustrate this:



NOTICE! that affix hopping cannot apply in the embedded sentence because there is no affix! Instead, we have the word *to*.

13.5 Passive sentences

I notice that Chapter 5 discusses one use of auxiliary verbs that I have not mentioned in class: the passive (pp.259-270).

(21) They executed Socrates

(22) They will execute Socrates

(23) They have executed Socrates

(24) They are executing Socrates

(25) They have been executing Socrates

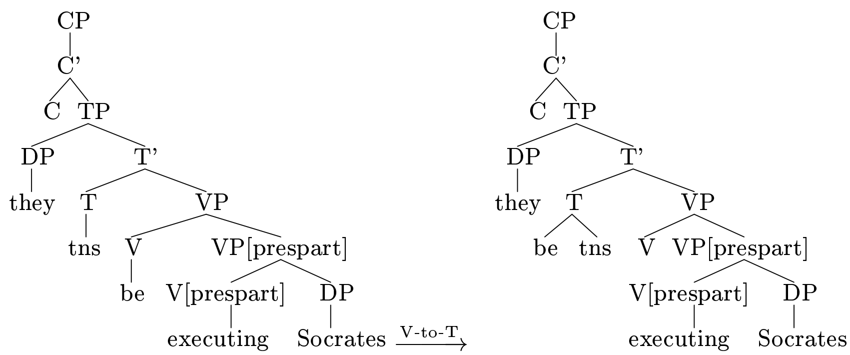
(26) They will execute Socrates

(27) Socrates was executed (by them) ⇐ **the passive form**

Recall that for the (non-passive) sentences (21)-(26) we had lexical entries like this:

word	category	selects	
they	DP	(nothing)	
Socrates	DP	(nothing)	
will	V	VP[-TNS]	
have	V	VP[PASTPART]	
be	V	VP[PRESPART]	
been	V[PASTPART]		
execute	V	agent	patient
executing	V[PRESPART]	—	—
executed	V[PASTPART]	<u>DP</u>	DP

Notice that the (non-passive) forms of *execute* listed here all select the same arguments. We derived a sentence like (24) in the following way:



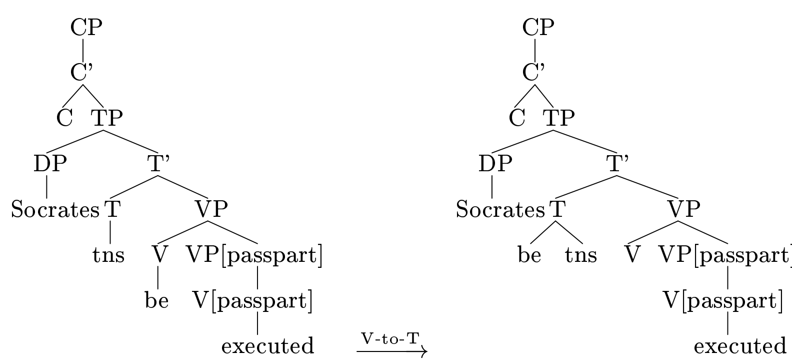
(For practice, mark the movement with an arrow.) Now consider the **passive form** of the verb:

(27) Socrates was executed.

A funny thing about this first is that there is only one argument, and it is the patient, not the agent. So when we add "passive participles" to the lexicon, their argument structures are different (and this change is only possible when the tenseless form of the verb takes a complement):

word	category	selects
be *been*	V V[PASTPART]	VP[PRESPART] or V[PASSPART]
executed	V[PASSPART]	patient — DP

Given these lexical entries, the derivation of passives is otherwise the same:



(Mark the movement with an arrow. If you study more syntax, you will encounter more revealing analyses of passive constructions, but this simple approach will be enough for now.)

Syntax review

1. **constituency tests:** substitution for word level categories, substitution by a pronoun, substitution by *do* or *do so*, phrasal preposing, coordination, sentence fragments (phrasal answers to questions)

tests for VP modifiers: optionality, iteration, modification of *do so*, modification of "*do what* pseudoclefts", modification of coordinations, VP preposing (leaving modifier behind)

2. **c-selection:** a lexical item can impose category restrictions on its complements.
3. **s-selection:** a lexical item can impose semantic restrictions on its arguments.
4. **Case assignment to DPs**
   a. the subject of a tensed clause is nominative case
   b. the complements of V and P are accusative case
5. **Subject-verb agreement:** A present tense verb must agree with its subject
6. **lexical entries:** (with subject arguments underlined)

laugh	V[-TNS]	agent
laughing	V[PRESPART]	—
laughed	V[PASTPART]	<u>DP</u>

execute	V[-TNS]	agent	patient
executing	V[PRESPART]	—	—
executed	V[PASTPART]	<u>DP</u>	DP

		patient
executed	V[PASSPART]	—
		<u>DP</u>

like	V[-TNS]	experiencer	theme
liking	V[PRESPART]	—	—
liked	V[PASTPART]	<u>DP</u>	DP

have	V[-TNS]	
having	V[PRESPART]	VP[PASTPART]
had	V[PASTPART]	

be	V[-TNS]	VP[PRESPART]
being	V[PRESPART]	or
been	V[PASTPART]	V[PASSPART]

7. **phrase structure rules: sentences are TPs inside CPs formed by these rules**

	basic rules for selected elements		rules for modifiers
(137)	~~S → DP VP~~		
	TP → DP T'		
	T' → T NegP		
	T' → T VP		
	NegP → Neg VP		
(124a)	$DP \rightarrow \left\{\begin{array}{c}\text{(D) NP}\\ \text{Name}\\ \text{Pronoun}\end{array}\right\}$		
(123)	NP → N (PP)		
(130)	$VP \rightarrow V\ (DP)\ (\left\{\begin{array}{c}\text{PP}\\ \text{CP}\\ \text{VP}\end{array}\right\})$		
(120)	PP → P (DP)		
(122)	AP → A (PP)		
(138)	~~CP → C S~~		
	CP → C'		
	C' → C TP		
	AdvP → Adv		
		(123')	~~NP → (A) N (PP)~~
		(73c.iii)	NP → AP NP
			NP → NP PP
			NP → NP CP
			VP → AdvP VP
			VP → VP PP
			AP → AdvP AP
	$\alpha \rightarrow \alpha$ Coord α		(for α=D,V,N,A,P,C,Adv,VP,NP,AP,PP,AdvP,TP,CP)

8. **<u>After</u> phrase structure and lexical reqs are met, then movement and insertion rules:**

Wh-movement: A phrase containing a wh-word can be preposed to attach to CP.

Affix hopping: T affix can move to main V head of its complement VP (not over Neg).

V-to-T head movement: auxiliary verbs can raise to T (possibly over Neg).

T-to-C head movement (subj-aux inversion): T can raise to an empty C.

Do-support: Insert DO to save a stranded suffix in T.

Lecture 14 What it all means

What is it to understand a sentence?[1] So far we have this picture: we recognize sound sequences, syllables, morphemes, words, parts of speech, and phrases. But how to these mean anything?

Uttering a sentence is sometimes compared to making a move in a game. A move in a game cannot be understood in isolation; it has a certain role with respect to the rest of the game; and it is partly governed by conventions or rules but some room for creativity is often allowed. Uttering a sentence has these same properties. Clearly the things we say play an important role in our interactions; the language is partly governed by conventions but leaves room for creativity; and understanding a sentence involves recognizing a large collection of relations between the sentence and other things. Many utterances seem to be related to our perceptions: if I hold up a yellow pencil for you to see (assuming that you have normal vision) and I say "That's a yellow pencil" you will know that I have said something true partly because you can hear the sounds, syllables, morphemes, words, parts of speech, and phrases. But also you can perceive the pencil and its color, you know that the word "yellow" names that color, etc. Giving an account of these connections between the linguistic things and me and my pencil goes well beyond the bounds of linguistic theory! We don't expect linguistic theory to say anything all about me, or about pencils, or about colors.

So if an expression's having a certain meaning amounts to its having a certain role in a whole network of activities, the prospects for semantics may seem slim.

But we are saved by the fact that many of the most important relations that a sentence enters into are purely linguistic. For example, while it is beyond the scope of linguistic theory to say whether a sentence like "I have a yellow pencil" is true, it is not beyond the scope of the theory to account for the fact that <u>if</u> "I have a yellow pencil" is true, then so is "I have a pencil." This relation is independent of whether either sentence is actually true. And obviously, someone who does not know this basic relation between these 2 sentences cannot be said to understand them. This kind of relation is especially important because it gives us a purely linguistic approach to the important semantic property of being true or not. Let's define the relation "entailment" as follows:

(1) Sentence S1 **entails** sentence S2 just in case in any possible situation where S1 is true, S2 is also true.

(And in making these judgements, we hold the context fixed, so that a name refers the same thing in S1 as it does in S2, etc. . . The "speaker" of S1 is assumed to be the same in S2. And if S1 uses "pencil" to refer to the usual writing implement, then I do not understand it in S2 to refer to a particular kind of brush that artists use for fine detail in paintings.)

It is important that this entailment relation just involves the possible situations in which the

[1] Here we cover material from Chapter 7 of the text.

sentences are true, and does not involve any more complicated considerations about whether the two sentences are relevant to each other in any other ways. So, for example, all of the following claims about entailment relations are all correct:[2]

(2) The sentence *Stabler has a yellow pencil* entails the sentence *Stabler has a pencil.*

(3) The sentence *Stabler has a pencil* does not entail the sentence *Stabler has a yellow pencil.*

(4) The sentence *Stabler has a pencil* entails the sentence *Either 5 is a prime number or 5 is not a prime number*

(5) The sentence *Stabler has a pencil* entails the sentence *Stabler has a pencil and 5 is an odd number.*

A competent speaker of English may not know whether the sentence *Stabler has a yellow pencil* is actually true, but a competent speaker does have a grasp of simple entailment relations. So really when we say something true, we are telling the audience that many many things are true: both the sentence actually uttered and also other things that are entailed by it.

It is also no surprise to notice that when someone tells us what a phrase means, or we look something up in a dictionary, we learn things about entailment relations (at least, to a first approximation). For example, if you ask what the noun *platypus* means, and I say it is a peculiar egg-laying mammal native to Australia, a simple idea is that I have told you:[3]

(6) The sentence *Sophia saw a platypus* entails *Sophia saw a peculiar egg-laying mammal native to Australia.*

In developing our semantic theory, we will give a lot of attention to the semantic property of being true or not, and particular attention will be given to the semantic relation of "entailment," which has the special technical sense that we just defined. The reason for this is not just that being true is sometimes important, but more that it gives us a way of approaching semantics without saying anything at all about pencils or the many other things our expressions can refer to.

14.1 Compositional semantics

Gottlob Frege's idea (discussed in Lecture 1) was that the meaning of a phrase is determined by the meaning of its parts and by the way those parts are put together. We assume that the relevant parts, the parts we will interpret, are the phrases and words of syntax and morphology. A complete semantic theory should provide a list of all the morphemes and their meanings, and show how the meaning of phrases is composed from the meanings of the parts. In particular, we want to be able to determine the entailment relations of a sentence using this kind of analytical strategy. Let's begin with a simple sentence:

[2] These examples show that one sentence can entail another even when the sentences are about different things. It is possible to study a different relation which holds only between sentences that are **relevant** to each other, but it turns out that this relation is much more difficult to understand. The study of entailment has been fruitful in linguistics, and it is the main subject of standard logic. The study of so-called "relevance logics" is much more difficult and even the fundamentals remain rather obscure. In this class, we will stick to entailment in this special sense. It is a simpler idea than relevance.

[3] The "rules" that specify entailments like this are sometimes called "meaning postulates" (Fodor et al, 1975), following a philosophical tradition developed by (Carnap 1956) and many others. There is a long-standing philosophical controversy about whether a distinction can be drawn between those postulates which hold in virtue of meaning and those which hold just because of facts about the world (Quine 1951), but we will ignore this issue for the moment.

(7) Sophia laughs

Here it is natural to assume that (in a "normal" context of utterance), the proper name *Sophia* refers to something, and the sentence (interpreted literally) asserts that this thing has the property named by *laughs*. Let's use double brackets to represent what expressions refer to, so for example, [[Socrates]] refers to a person, and we will regard [[laughs]] as referring to the set of things with the property of being something that laughs. Then we can say:

(8) The sentence [*Sophia laughs*] is true just in case the person [[Sophia]] is in the set [[laughs]].

Expressing the matter in this slightly awkward form allows us to notice some general claims about sentences of this form.

(9) When DP is a proper name, the sentence [DP T'] is true just in case [[DP]] is in [[T']].

We can also notice that the set of things in the set [[sings beautifully]] is a subset of (is completely included in) the set [[sings]]. Whenever we have this kind of subset relation, we have a corresponding entailment relation. Since [[sings beautifully]] is a subset of [[sings]], the sentence *Maria sings beautifully* entails *Maria sings.* This simple relation holds in general:

(10) When DP is a proper name, and whenever we have two verb phrases T'1 and T'2 where [[T'1]] is a always subset of [[T'2]], then the sentence [DP T'1] entails [DP T'2].

Since the set [[laughs]] is completely included in the set [[either laughs or doesn't laugh]], the sentence *Sam laughs* entails *Sam either laughs or doesn't laugh.* This kind of fact is very basic to our understanding of a language, and we will have more to say about it later.

14.2 Determiners and nouns

We might guess that in all sentences, the subject DP names some thing, and the T' names a property which that thing has. But this guess would be wrong! It does not work when we move to even just slightly more complicated sentences. Consider the sentences

(11) No cat laughs

(12) Every student laughs

(13) Most people laugh

(14) Less than 5 teachers laugh

In these sentences, the subjects do not name single objects. Each different determiner makes an important contribution to the sentence. For the different determiners D in sentence of the form [[D NP] T'], we have rules like the following:

(15) [*No* NP T'] is true just in case nothing in ⟦NP⟧ is also in ⟦T'⟧.

(16) [*Every* NP T'] is true just in case ⟦NP⟧ is a subset of ⟦T'⟧.

(17) [*The* NP T'] is true just in case there is a particular thing (determined according to context) in ⟦NP⟧ that is also in ⟦T'⟧.

(18) [*Most* NP T'] is true just in case the set of things in both ⟦NP⟧ and ⟦T'⟧ is larger than the set of things that are in ⟦NP⟧ but not in ⟦T'⟧.

(19) [*Less than 5* NP T'] is true just in case the set of things in both ⟦NP⟧ and ⟦T'⟧ has less than 5 things in it.

These rules tell us what each of these determiners mean: each one represents a kind of relation between ⟦NP⟧ and ⟦T'⟧.

14.3 Adjectives

We have not really provided the basis for determining the semantic properties of infinitely many sentences yet: we have only considered simple Ds, NPs and T's. In our syntax, one of the first things we added which made the language infinite was adjectives. These make the language infinite, because they are introduced by recursive rules, signifying that they can be repeated any number of times. So let's consider how semantic properties of sentences with adjectives could be figured out, no matter how many adjectives there are.

Let's start with simple sentences again. Consider the sentences

(20) Every student laughs

(21) Every Transylvanian student laughs

The first sentence is true when the set ⟦student⟧ is a subset of the set ⟦laughs⟧. The second sentence is true when the set of things that are in both ⟦student⟧ and ⟦Transylvanian⟧ is a subset of ⟦T'⟧. Adjectives like this are called "intersective":

(22) An adjective A (and the AP it forms) is **intersective** if [*every* [AP NP] T'] means that the set of things that are in both ⟦AP⟧ and ⟦NP⟧ is a subset of ⟦T'⟧.

The reason for the name "intersective" is obvious: the set of things that are in both ⟦AP⟧ and ⟦NP⟧ is the **intersection** of ⟦AP⟧ and ⟦NP⟧. The intersection of ⟦AP⟧ and ⟦NP⟧ is sometimes written ⟦AP⟧ ∩ ⟦NP⟧.

Intersective adjectives can be iterated in a noun phrase, and we know what the result will mean. A *Transylvanian student* is something that is in both the sets ⟦Transylvanian⟧ and ⟦student⟧. A *female Transylvanian student* is something that is in the sets ⟦female⟧, ⟦Transylvanian⟧ and ⟦student⟧. A *Republican female Transylvanian student* is something that is in the sets ⟦Republican⟧, ⟦female⟧, ⟦Transylvanian⟧ and ⟦student⟧. And so on.

Not all adjectives are intersective. Consider the adjective *big*. It does not really make sense to look for a set of things with the property of being *big*. Consider the sun for example. We usually think of it as big, and it is certainly a big member of the solar system – the biggest in fact. But it is a tiny star, not big at all by stellar standards. So is it big or not? The question does not even make sense. It does not make sense to have a set of big things, because we need to know, big relative to what? Relative to the planets, relative to the stars, or relative to an electron? Adjectives like *big* are sometimes called **scalar** because they refer to size: *big, little, short, wide, narrow, ...* . These adjectives are non-intersective.

The **negative adjectives** like *fake, bogus, phony, false* are also non-intersective. A fake diamond may be made out of glass. But it is not fake glass. It is real glass but fake diamond. Similarly non-intersective are the **conjectural adjectives** like *ostensible, alleged, apparent, possible, likely.* An alleged thief may be undeniably a person, and not a thief at all. So the adjective *alleged* is not intersective because whether a thing is alleged or not is relative to the property being alleged. It does not make sense to have a set of objects with the property of being alleged.

14.4 The simple semantics more concisely

The simple ideas about meaning that we have just sketched can be expressed easily with the tools of set theory, using the following symbols:

$x \in A$	x is an element of set A
$A \cap B$	the intersection of A and B, that is, the set of things that are in both A and B
$A \subseteq B$	A is a subset (or equal to) B
$A - B$	the result of removing all elements of B from A
$\|A\|$	the number of things in set A
$\emptyset$	the empty set

With these symbols we can express (9), (14-18) and (22) more simply, like this:

(9')	[[Name T']]=true	just in case	[[Name]]∈[[T']]
(14')	[[*No* NP T']]=true	just in case	[[NP]]∩[[T']]=∅
(15')	[[*Every* NP T']]=true	just in case	[[NP]]⊆[[T']]
(16')	[[*The* NP T']]=true	just in case	something (determined by context) is in [[NP]]∩[[T']]
(17')	[[*Most* NP T']]=true	just in case	|[[NP]]∩[[T']]| > |[[NP]]-[[T']]|
(18')	[[*Less than 5* NP T']]=true	just in case	|[[NP]]∩[[T']]| <5
(22')	[[AP NP]]=[[AP]]∩[[NP]]	just in case	AP is intersective

In this table, we can see that the truth of each sentence is determined compositionally, by the meanings of the sentence parts.

Sentences like [*two out of three* NP T'] say something like: 2/3 of the things that are in [[NP]] are also in [[T']]. That is, we can divide [[NP]] into the things that are also in [[T']],

$$[\![NP]\!] \cap [\![T']\!],$$

and the things that are in [[NP]] but not in in [[T']],

$$[\![NP]\!] - [\![T']\!],$$

and then the claim is that the first set has twice as many elements as the second:

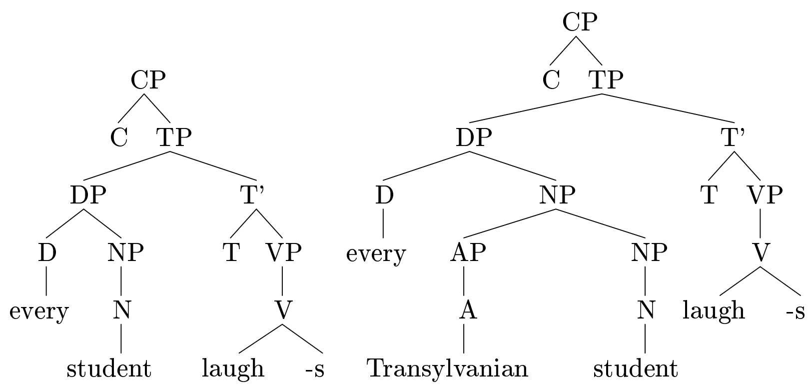
(new) [[*2 out of 3* NP T']]=true just in case $|[\![NP]\!] - [\![T]\!]'| = |[\![NP]\!] \cap [\![T]\!]'| * 2$

(The text gets this one wrong on page 381!)

The basic facts listed above also allow us to understand some entailment relations. For example, the fact that *every student laughs* entails *every Transylvanian student laughs* can be seen from this simple fact of set theory:

<u>if</u> [[student]]⊆[[laughs]] <u>then</u> ([[Transylvanian]]∩[[student]])⊆[[laughs]].

Here we are not paying much attention to the rather elaborate syntax that we provided for sentences like this:



But of course this structure does matter for the meaning – as we will see shortly!

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Lecture 15 DPs and polarities

We have seen that sentences of the form [[D N] T'] can be regarded as saying that the sets ⟦N⟧ and ⟦T'⟧ have the relationship denoted by ⟦D⟧. We also saw that determiners can denote a wide range of relations. Here, we observe first that determiners do not denote just any relation: they are all "conservative." Some are also "decreasing" and this sometimes gets marked with "negative polarity items."

15.1 What relations can determiners represent?

All the determiners we have looked at share an important property: they are all "conservative" in the following sense.[1]

(1) A determiner D is **conservative** if the following conditions hold:
whenever [D N] is a singular DP in a sentence [D N T'], the sentence [D N T'] entails and is entailed by [D N *is a N that* T'].
whenever [D N] is a plural DP in a sentence [D N T'], the sentence [D N T'] entails and is entailed by [D N *are Ns that* T'].

So for example, the singular determiner *every* is conservative because the sentence *every student laughs* entails and is entailed by *every student is a student that laughs* (and similarly for every other sentence with *every*). And the plural *most* is conservative because the sentence *most platypuses sing* entails and is entailed by *most platypuses are platypuses that sing*.

It is easy to make up a determiner that is not conservative in this sense. Let's make up the plural determiner *nall*, so that we can say *nall platypuses are ordinary things*. Let's say that this sentence means that everything that is not a platypus is an ordinary thing. That is a sensible claim. In general, we can define *nall* as follows:

(2) [*Nall* N T'] is true just in case everything that isn't in ⟦N⟧ is in ⟦T'⟧.

So it is true to say: nall the people who are in this room are missing this great lecture! That just means that everything that is not a person in this room is missing this great lecture. The sentence *Nall squares are striped* just means that everything that is not a square is striped.

The important point is that the determiner *nall* is <u>not</u> conservative. We see this by observing that *nall squares are striped* does not entail *nall squares are squares that are striped.* The latter sentence, *nall squares are squares that are striped*, means that everything that is not a square is a square that is striped – that's absurd! So the special entailment relation that

[1] The definition is slightly complicated by the fact that some determiners like *every* can only occur in singular noun phrases like [*every student*], while other determiners like *most* usually require plural noun phrases, like [*most students*]. Notice that the definition just uses the verb *is* for singular noun phrases and the verb *are* for the plural noun phrases.

identifies conservative determiners does not hold in the case of this made up determiner *nall*. That is, *nall* is not conservative.

The surprising thing is that no human language has determiners that are non-conservative like *nall* is (Keenan & Stavi 1986):

(3) In all human languages, every determiner is conservative.

Notice that being conservative or not, in this sense, is a semantic property. You cannot tell whether *nall* is conservative or not from its phonological or syntactic properties – whether it is conservative or not depends on what it means.

15.2 Decreasing determiners and NPIs

Certain adverbials like *at all, much, one bit* and *ever* seem to require a context that is negative in some sense. They are called **negative polarity items** (NPIs). (These were discussed on pp245-252, and on pp198-224, in the text.)

(4) The fairies do not like witchcraft at all/much/one bit

(5) Nobody likes witchcraft at all/much/one bit

(6) The fairies will never like witchcraft at all/much

(7) No fairies like witchcraft at all/one bit/much

(8) * The fairies like witchcraft at all/much/one bit

(9) * The fairies will like witchcraft at all/much/one bit

These sentences suggest that the NPIs can only occur when there is something negative in the sentence – a negated VP, a negative determiner, or a negative AdvP. But we see that the situation is slightly more complicated when we look at a wider range of sentences:

(10) Nobody told the elves [that [the fairies would care at all]]

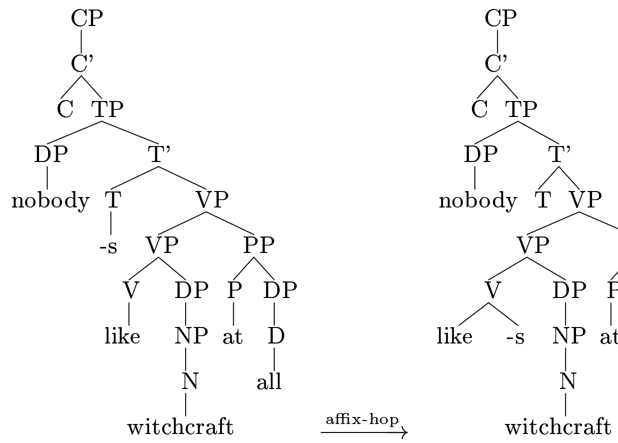
(11) The news [that [the fairies do not like witchcraft]] surprises the elves.

(12) The news [that [the fairies do not like witchcraft at all]] surprises the elves.

(13) * The news [that [the fairies do not like witchcraft]] surprises the elves at all.

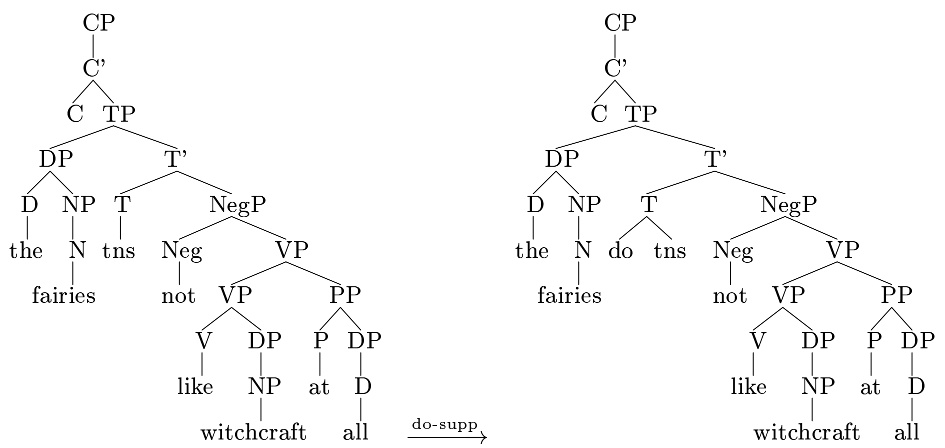
These last sentences all contain negative elements, but the last one is no good! Apparently, the negative elements have to appear in certain positions in order for NPIs to be allowed.

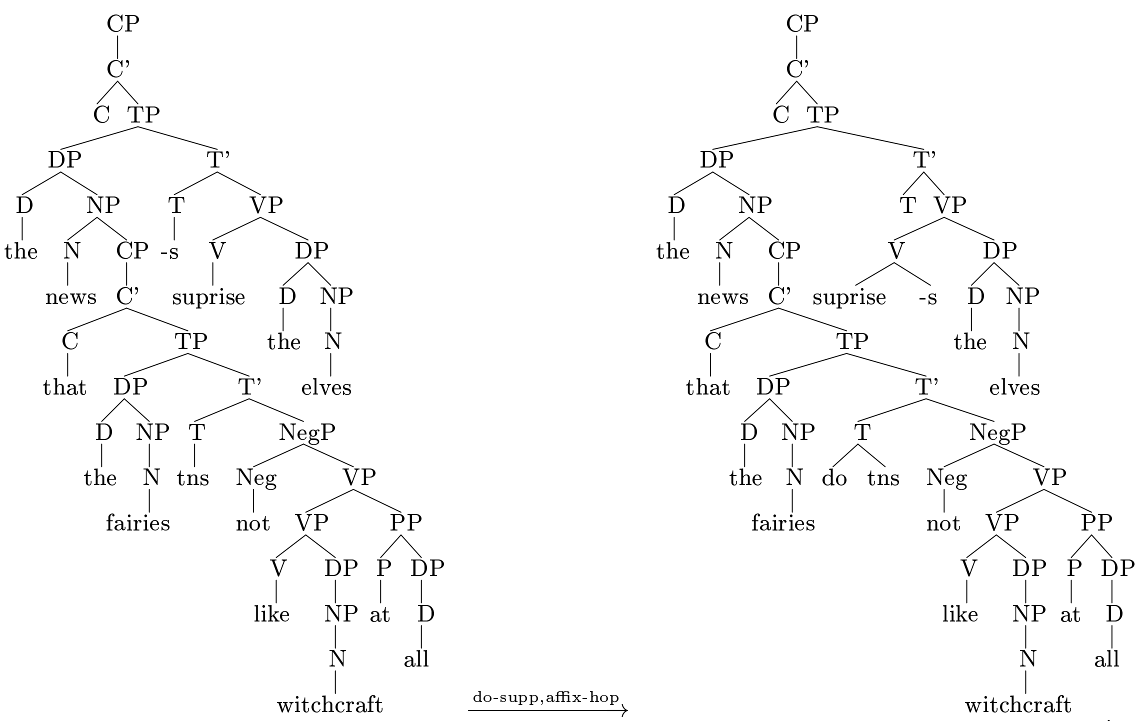
We now know how to draw the syntactic structures for all of these sentences, so let's do that and see if we can figure out what's happening.



The NPI *at all* is allowed in this example, and in the following:

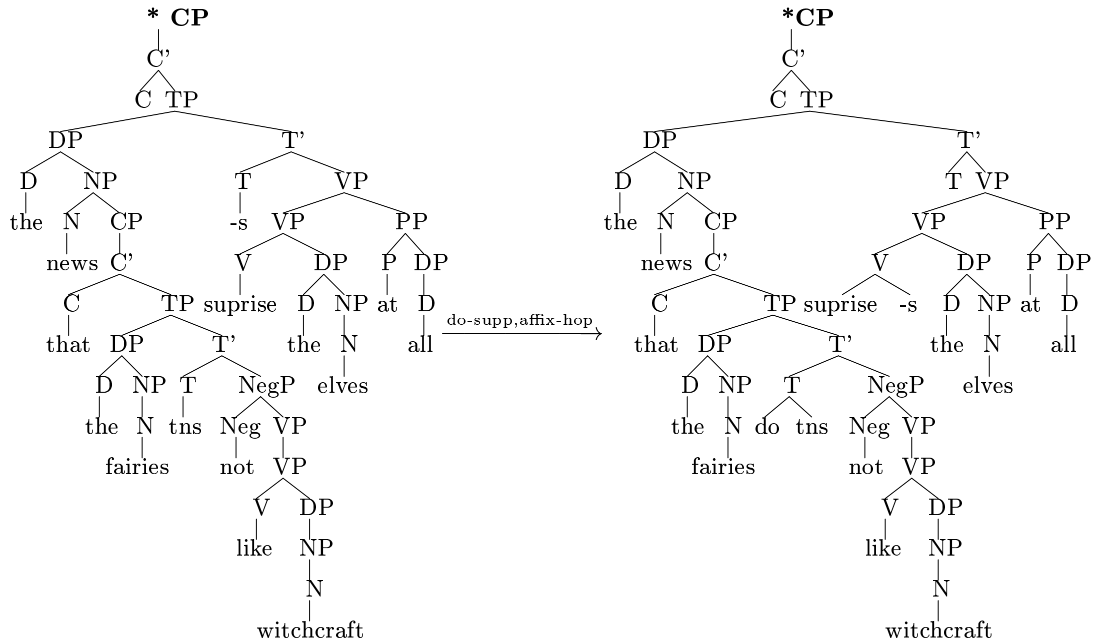
(In the tree on the right, mark the movement with an arrow!)





(In the trees on the right, mark movements (if any) with arrows!)

The problem is in examples like this:



(In the tree on the right, mark the movement with an arrow!)

So what is wrong with this last example? One idea is that the negative element (*not* in this example) and the NPI have to be in the same smallest CP, but the earlier example (10) shows that's not right. The text considers various ideas, but finally comes to this conclusion:

(14) the parent category of the negated phrase must include the NPI.

The relationship required between the negated phrase and the NPI turns out to be an important one, so the proposal (14) gets formulated by first naming the relationship:[2]

(15) A node X **c-commands** Y if either Y is the sister of X, or Y is a descendant of a sister of X.

(16) **NPI licensing (first version):** An NPI must be c-commanded by a negative element.

The negative element X can be a Neg head or a negative DP like "nobody." (We will have more to say later about what else counts as a "negative DP".) The negative polarity items Y that we have considered so far can be PPs like *at all* or other adverbials *much, one bit.*

This story seems pretty good, but there are cases where *ever* can occur in a sentence that does not have any explicitly negative item:

(17) a. Less than 3 students ever laugh.
b. * Some student ever laughed.

(18) a. At most 30 students ever laugh.
b. * 30 students ever laugh.

(19) a. No student likes <u>anyone</u>
b. * A student likes <u>anyone</u>

[2] The text (p. 223) uses this slightly simpler definition: "A node X **c-commands** Y if the parent of X includes Y." This definition agrees with ours on all the cases we will consider here.

(20) a. No student saw anything

b. * A student saw anything

(21) a. No student budged an inch

b. * A student budged an inch (with the idiomatic reading)

What determiners can occur in this kind of sentence with the negative polarity items like *ever*? We say in (16) that a "negative polarity" YP must be c-commanded by a negative phrase, but which phrases are "negative phrases" in the relevant sense?? Now we can provide a partial answer.

We did not get to this on Monday, but the usual answer is this: The determiners D that can occur in a sentence of the form [D N ever laugh] are the "decreasing" determiners, where this is again defined in terms of a certain pattern of entailment relationships:

(22) A determiner D is **decreasing** if whenever we have two verb phrases T'1 and T'2 where ⟦T'1⟧ is a always subset of ⟦T'2⟧, then [D N T'2] entails [D N T'1].
In these cases we will say that [D N] forms a decreasing DP.

With this definition, we can see that the following determiners form decreasing DPs: *no, less than 3, at most 30, fewer than 6, no more than 2,. . . .* These are also the determiners that can occur with negative polarity items.

The complete story about NPIs goes beyond what we can cover here, and has some suprises, but this is a good start:

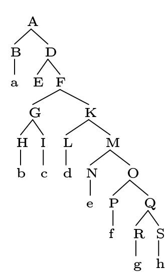
(23) **NPI licensing (revised):**
An NPI must be c-commanded by a negative phrase XP, and
when XP=DP, then XP=DP is a "negative phrase" **only if it's decreasing.**

(To pursue this some more, you will want to take our semantics class, Linguistics 125!)

15.3 Exercises not assigned, just for practice

(answers on next page, but don't look! First, try these problems yourself!)

(1) Which nodes labeled with capital letters c-command node N in the following tree?



(2) If the determiner *keek* is defined as follows, is it conservative? (defend your answer)

[keek NP T'] is true if and only if |⟦NP⟧|=|⟦T'⟧|

References

[Barwise & Cooper1981] Barwise, Jon and Robin Cooper (1981) Generalized quantifiers and natural language. *Linguistics and Philosophy 4*: 159–219.

[Keenan & Faltz1985] Keenan, Edward L. and Leonard M. Faltz (1985) *Boolean Semantics for Natural Language.* Boston: Reidel.

[Keenan & Stavi1981] Keenan, Edward L. and Jonathan Stavi (1986) A semantic characterization of natural language quantifiers. Linguistics and Philosophy 9: 253–326.

Answers to the exercises on the previous page

(1) capitalized nodes that c-command N (including the direct ancestors):
O, L, G, E, B

(2) With the given definition of *keek*, the sentence [keek students run] means that the number of students is the same as the number of runners. But then [keek students are students who run] means that the number of students is the same as the number of students who run – something obviously different!

For example, suppose there are two students and neither of them run, and there are two runners. Then it is true that keek students run since

$$|[\![\text{NP}]\!]| = |[\![\text{VP}]\!]| = |[\![\text{students}]\!]| = |[\![\text{run}]\!]| = 2.$$

But in this case it is not true that keek students are students who run, since

$$|[\![\text{NP}]\!]| = |[\![\text{students}]\!]| = 2$$
$$|[\![\text{are students who run}]\!]| = 0$$

Lecture 16 Interpretation and inference

[This class mainly reviewed the idea from last time that some subject DPs are "decreasing", and that these are the ones can c-command and license negative polarity items like *ever, yet,....* The only new thing this class is pronouns, which also seem to be sensitive to whether they are c-commanded by their antecedents!]

16.1 Names, pronouns and binding

Many names apply to many different people.[1] Consider the sentence:

(1) Every student knows that Ed laughed

Obviously, on various occasions of use, the proper name will refer to different people. The things that decide which person is referred to are in large part non-linguistic.

Pronouns are a little different. Consider the sentence:

(2) Every student knows that he laughed

Here, we can distinguish two different ways to interpret the pronoun. One possibility is that the pronoun just refers to someone mentioned earlier or someone pointed to. This is sometimes called the **referential** use of the pronoun. When used referentially, a pronoun is similar to a proper name: its referent is determined by non-linguistic considerations. But the pronoun has another option that the proper name did not have: it can refer to each person, each thing that *every student* picks out. The sentence seems to be ambiguous between these two readings. Let's use the following notation to refer to the latter reading:

(3) Every student$_i$ knows that he$_i$ laughed

This means that it is part of the meaning of the sentence (on one reading) that *he* refers to each of the individuals picked out by *every student*. In this kind of situation, we say that the pronoun is **bound** by the antecedent *every student*.

These ways in which a pronoun picks up its referent is what makes it distinctive. It has certain options that proper names do not have. The proposition expressed by the "bound" reading of (3) cannot be expressed without pronouns!

Pronouns have more interpretive options that other DPs, but these options are also restricted in certain ways. Consider the following for example:

(4) * Every student$_i$ knows the joke. He$_i$ laughed.

[1] Here we cover material in Chapter 8 of the text, esp. pp.399-406. These sections elaborate on the story about pronouns and NPIs that we mentioned very briefly a couple of weeks ago in syntax.

(5) * He_i knows that every student_i laughed.

(6) * Every student_i and every teacher_j knows that he_i laughed.

This raises the question, in what cases can a pronoun have its meaning given by the linguistic context, being "bound" by an antecedent? (4) suggests that *he* cannot be bound to a DP *every student* when that DP in in another sentence. (5) suggests that *he* cannot be bound to a DP *every student* when the pronoun is "higher" in some sense. (6) suggests that *he* cannot be bound to a DP *every student* when that DP not "high enough" in some sense – and this example might remind you of some of the NPI examples! Let's try an idea that is similar to the one we proposed for NPIs.

The examples clearly suggest that whether a pronoun can have a certain antecedent depends on details of the structural position of the pronoun relative to its antecedent. The required relation is c-command (mentioned earlier), defined in the following way:

(7) (no change from before:) DP1 **c-commands** DP2 if either DP1 and DP2 are sisters, or a sister of DP1 includes DP2.

Binding requirement:
An antecedent must c-command a pronoun in order to bind it.

Checking our earlier examples, notice that this Binding Requirment allows the binding in 3, and explains why binding is not possible in 4, 5, and 6.

(Make sure you can draw the trees for 4, 5, and 6 to show why the binding is not possible!)

This all seems fine. One other complication is illustrated by examples like the following:

(8) * Jim_i hurt him_i.

(9) Jim_i hurt himself_i

(10) * John_i knows that [Jim_j hurt himself_i]

(11) John_i knows that [Jim_j hurt him_i]

It seems that reflexive pronouns are distinguished from other pronouns in the way they can get their meaning. Very roughly,

Binding principle A.
A reflexive pronoun must be bound (= must have a c-commanding antecedent) in the smallest TP that contains it.

Binding principle B.
A non-reflexive pronoun cannot be bound in the smallest TP that contains it.

Binding principle C.
Names and phrases like *every student* cannot be bound.

So we see that pronouns are very sensitive to whether and where they find their antecedents. Reflecting on this fact, it is natural to worry about whether these requirements apply before or after movements, or both. We saw in our work on syntax that subcategorization requirements apply before movements. For example, we check to see which kind of complement a verb takes before moving the verb or the complement. What about the binding principles? Do they apply before or after movements? To decide this, we need to consider examples where the movement could be relevant – movements that change the position of a pronoun or its antecedent. Consider these examples:

(12) John really likes that story about himself

(13) Which story about himself does John really like?

(14) I know which story about himself John really likes

we have not formulated the rule for the following kind of preposing yet, but it looks similar:

(15) With himself in mind, he wrote a good story.

(16) * With him in mind, John wrote a good story.

So it appears that, at least in some cases, it is the original position that matters for binding purposes.

(The whole story about how pronouns find their antecedents is one of the most complicated parts of syntax, but these first versions of principles A,B,C are a step in the right direction.)

16.2 Summary

We assume that meanings of sentences are determined compositionally. That is, the "meaning" of a sentence is calculated from the meanings of the phrases and words from which it is built. What is the meaning of a sentence? We assume that the meaning of a sentence is given by a network of relationships that the sentence has to other things. Some of the most important relationships depend on the possible circumstances in which the sentence is true. So we want to see how the circumstances in which a sentence is true depends on the meanings of its parts.

We began with simple 2 word sentences like *Maria sings.* In this sentence it seems that the subject DP serves to name an object, the T' names a property which a set of things have, and the sentence says that Maria is in that set. So one aspect of the meaning of a subject DP like *Maria* is that (in a given context) it refers to something, and one aspect of the meaning of a T' is that it names a property which a set of things have. But it is not always true that the subject of a sentence names something which the T' tells us about! This is very important! Proper names typically serve to name something, but DPs of the form [D N] are more complicated. They do not simply name objects. Instead, they describe a relation the set of things with the property named by N, $[\![N]\!]$, and the set of things with the property named by the T', $[\![T']\!]$. When an (intersective) adjective A modifies a noun N, we are talking about the things which are in <u>both</u> of the sets $[\![A]\!]$ and $[\![N]\!]$, that is,

$$[\![A]\!] \cap [\![N]\!].$$

This kind of combination of sets can be repeated any number of times: When two intersective adjectives A1 and A2 modify a noun N (and this is allowed by our syntax), then we are talking about the things which are in <u>all</u> of the sets $[\![A1]\!]$, $[\![A2]\!]$ <u>and</u> $[\![N]\!]$, that is,

$$[\![A1]\!] \cap [\![A2]\!] \cap [\![N]\!].$$

In summary, we have so far talked about semantic properties of sentences, proper names, determiners, adjectives, nouns and T's.

You should know the definitions of "conservative determiners" and you should know that all determiners in normal English (or any other language) are conservative.

You should know what an NPI is. You should also be able to understand and apply (but you do not need to memorize) the definition of "decreasing determiners." And you should memorize the definition of c-command, and know binding principles A and B.

Lecture 17 Review

17.1 Summary review

(The contents of this section is collected out of the preceding lectures.)

To start, we observed that human languages are “productive,” “compositional” and “flexible,” where these terms are used in slightly technical senses. Know how to defend each of these claims.

17.1.1 Phonetics

			manner	voice	place
1.	/p/	s**p**it	plosive stop	−	labial
2.	/t/	s**t**uck	plosive stop	−	alveolar
3.	/ʧ/	**ch**ip	plosive stop affricate	−	alveopalatal
4.	/k/	s**k**ip	plosive stop	−	velar
5.	/b/	**b**it	plosive stop	+	labial
6.	/d/	**d**ip	plosive stop	+	alveolar
7.	/ʤ/	**j**et	plosive stop affricate	+	alveopalatal
8.	/g/	**g**et	plosive stop	+	velar
9.	/f/	**f**it	fricative	−	labiodental
10.	/θ/	**th**ick	fricative	−	interdental
11.	/s/	**s**ip	fricative	−	alveolar
12.	/ʃ/	**sh**ip	fricative	−	alveopalatal
13.	/h/	**h**at	fricative	−	glottal
14.	/v/	**v**at	fricative	+	labiodental
15.	/ð/	**th**ough	fricative	+	interdental
16.	/z/	**z**ap	fricative	+	alveolar
17.	/ʒ/	a**z**ure	fricative	+	alveopalatal
18.	/m/	**m**oat	nasal stop	+	labial
19.	/n/	**n**ote	nasal stop	+	alveolar
20.	/ŋ/	si**ng**	nasal stop	+	velar
21.	/w/	weird	central approximant	+	labiovelar
22.	/j/	yet	central approximant	+	palatal
23.	/l/	leaf	lateral approximant	+	alveolar
24.	/ɹ/	reef	central approximant	+	retroflex
25.	/ɹ̩/ or /ɚ/ or /əɹ/	bird	central approximant	+	retroflex

			tongue body height	tongue body backness	lip rounding	tongue root tense (+ATR) or lax (−ATR)
1.	/i/	b**ea**t	high	front	unrounded	+
2.	/ɪ/	f**i**t	high	front	unrounded	−
3.	/u/	b**oo**t	high	back	rounded	+
4.	/ʊ/	b**oo**k	high	back	rounded	−
5.	/ɛ/	l**e**t	mid	front	unrounded	−
6.	/o/	r**oa**d	mid	back	rounded	+
7.	/ʌ/	sh**u**t	low	back	unrounded	−
8.	/e/	**a**te	mid	front	unrounded	+
9.	/æ/	b**a**t	low	front	unrounded	−
10.	/a/	p**o**t	low	back	unrounded	+
11.	/ə/	ros**e**s	mid	back	unrounded	−
12.	/aɪ/	l**ie**s	dipthong			
13.	/aʊ/	cr**ow**d	dipthong			
14.	/oɪ/	b**oy**	dipthong			

liquids	=	/l,ɹ,ɹ̩/
glides	=	/j,w/
coronals	=	dental, alveolar and alveopalatal stops, fricatives, affricates, liquids, and alveolar nasal
sonorants	=	vowels,glides,liquids,nasals
obstruents	=	non-sonorants

17.1.2 Phonology

We use the features mentioned in the previous section to describe sound changes. It is not important to memorize the details of these rules, but you should remember how and why we wrote rules like the following. Practice by reviewing the problems on the midterm review and the midterm.

Voiceless stops are aspirated:

(stop aspiration)

$$\begin{bmatrix} -\text{continuant} \\ -\text{voice} \end{bmatrix} \rightarrow \begin{bmatrix} +\text{aspirated} \end{bmatrix} / [_{\sigma}\_\_\_ \begin{bmatrix} -\text{liquid} \end{bmatrix}$$

Vowels are lengthened when they appear before voiced sonorants:

(V-length)

$$\begin{bmatrix} +\text{vocalic} \\ -\text{consonantal} \end{bmatrix} \rightarrow \begin{bmatrix} +\text{long} \end{bmatrix} / \_\_\_ \begin{bmatrix} -\text{sonorant} \\ +\text{voice} \end{bmatrix}$$

Flapping reduces a t and d between vowels to the a voiced tap of the tongue, a ‘flap’:

(flapping)

$$\begin{bmatrix} -\text{continuant} \\ +\text{alveolar} \\ -\text{nasal} \end{bmatrix} \rightarrow \text{ɾ} / \begin{bmatrix} +\text{syllabic} \end{bmatrix} \_\_\_ \begin{bmatrix} +\text{syllabic} \\ \text{-stress} \end{bmatrix}$$

(Flapping is sensitive to stress assignment too, but we will not worry about that on the final.)

In general, the picture we end up with is this:

(1) We assume that words are listed in in the lexicon not as sequences of phones, but as sequences of **phonemes** – sounds which may be altered according to context.

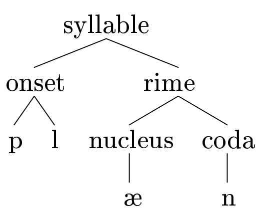
(2) The phonemes are defined as sound **segments** with particular features, features which may be altered in certain contexts. So a segment with the features of a /t/ may be altered to surface as a [ɾ] or as a [ʔ], for example.

(3) **Rules** apply to underlying segments, altering features of specific segments on the basis of context.

(4) With this picture, it can end up that there are more different pronounced sounds than there are phonemes. For example, we assume that [ɾ] or as a [ʔ] are not phonemic, and neither are the reduced vowels [ə ɨ].

(5) There are roughly 40 English phonemes altogether. (NOT an infinite number!) Some languages have as few as 11 phonemes (Polynesian) and as many as 141 phonemes (Khoisan).

Syllables have the structure we see in the following for the word *plan*:



(6) Any single consonant is a possible onset

(7) Only certain 2-consonant onsets are possible

(8) Even fewer 3-consonant onsets are possible

Why are the possible onsets and codas so restricted? There are various theories. One simple idea that provides roughly the right predictions is based on the idea that there are degrees of sonority. Listing sounds in order of increasing sonority we get an order like the following:

The Sonority Hierarchy:

−sonorant			+sonorant			
stops	affricates	fricatives	nasals	liquids	glides	vowels (high,mid,low)

In most cases, the onsets and codas in English seem to respect this ordering according to the following principle:

Sonority principle (SP): onsets usually rise in sonority towards the nucleus, and codas fall in sonority away from the nucleus.

This accounts for the impossibility of words with onsets like *rtag*, while allowing *trag*. And it accounts for the impossibility of words with codas like *gatr* while allowing words like *gart*.

We did not say very much about stress in English, but noticed

(9) Stress can change one word into another: *ábstract/abstráct, éscort/escórt, súrvey/survéy, tórment/tormént, cónvict/convíct.*

(10) Stressed syllables must be heavy, though not all heavy syllables are stressed, where:

- a syllable is **light** if its rime consists of just one short (-ATR) vowel, with no coda; otherwise, it is **heavy**.

(You don't need to memorize these, but you should understand what they mean.) Since monosyllabic nouns and verbs are stressed, this last idea makes sense of the generalization mentioned in the last chapter, that monosyllabic nouns and verbs in English cannot end in lax vowels: we do not have nouns like [sɪ], [sɛ], [sæ], [sʊ].

17.1.3 Morphology

Some words are **simple roots or affixes** (not made up from other words) while other words are **complex** (made up from other words).

The notion of a word as a part of speech, a basic element in the construction of phrases, is different from the notion of a phonological word, as we see in

(11) He's happy

Notice that *He's* is not a noun, verb, adjective, adverb, preposition, or any other type of word. Although it is a single "phonological word," it consists of two separate words in syntax.

(The categories of proper names, of nouns and verbs, are regarded as **open** in the sense that newly coined and borrowed words are easily added to these categories all the time. On the other hand, other categories are **closed**: coordinators like *and, or*, pronouns like *you, she, he*, determiners like *a, the*, auxiliary verbs like *have, be.* These words are sometimes called **grammatical words.** We do not easily coin new words of these sorts. Certain sorts of brain injuries that affect language seem to affect the grammatical words most severely – mentioned briefly on the midterm.)

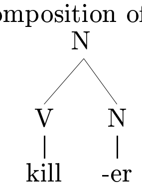
In English, the rightmost element of a word is (almost always) its **head**. This rule of word formation can be written X → Y X. This is the **right hand head rule**.

Because of this, a compound word has the category and features of its rightmost element. And word with a suffix gets its category and features assigned by that suffix.

Heads are fussy about what they combine with. To describe the English suffix *-er*, which will combine only with certain verbs, we used rules like

N → -er/[V____]

to encode the fact that the *-er* attaches to a verb V like *kill* to form a noun, according to the right hand head rule of English morphology. We can draw a tree structure that represents the composition of this word:



17.1.4 Syntax

Everything in syntax is based on what we think the constituents are, what the parts of sentences are, so it is important to know the constituency tests. Many of our assumptions about structure get encoded in trees. Know how each part of the tree can be represented by rules.

1. **constituency tests:** substitution for word level categories, substitution by a pronoun, substitution by *do* or *do so*, phrasal preposing, coordination, sentence fragments (phrasal answers to questions)

   tests for VP modifiers: optionality, iteration, modification of *do so*, modification of "*do what* pseudoclefts", modification of coordinations, VP preposing (leaving modifier behind)

2. **c-selection:** a lexical item can impose category restrictions on its complements.
3. **s-selection:** a lexical item can impose semantic restrictions on its arguments.
4. **Case assignment to DPs**
   a. the subject of a tensed clause is nominative case
   b. the complements of V and P are accusative case
5. **Subject-verb agreement:** A present tense verb must agree with its subject
6. **lexical entries:** (with subject arguments underlined)

laugh	V[-TNS]	agent
laughing	V[PRESPART]	—
laughed	V[PASTPART]	DP

execute	V[-TNS]	agent	patient
executing	V[PRESPART]	—	—
executed	V[PASTPART]	DP	DP

		patient
executed	V[PASSPART]	—
		DP

like	V[-TNS]	experiencer	theme
liking	V[PRESPART]	—	—
liked	V[PASTPART]	DP	DP

have	V[-TNS]	
having	V[PRESPART]	VP[PASTPART]
had	V[PASTPART]	

be	V[-TNS]	VP[PRESPART]
being	V[PRESPART]	or
been	V[PASTPART]	V[PASSPART]

7. **phrase structure rules: sentences are TPs inside CPs formed by these rules**

	basic rules for selected elements		rules for modifiers
(137)	~~S → DP VP~~		
	TP → DP T'		
	T' → T NegP		
	T' → T VP		
	NegP → Neg VP		
(124a)	$\mathrm{DP} \rightarrow \left\{ \begin{array}{c} \mathrm{(D)\ NP} \\ \mathrm{Name} \\ \mathrm{Pronoun} \end{array} \right\}$		
(123)	NP → N (PP)		
(130)	$\mathrm{VP} \rightarrow \mathrm{V\ (DP)\ (} \left\{ \begin{array}{c} \mathrm{PP} \\ \mathrm{CP} \\ \mathrm{VP} \end{array} \right\} \mathrm{)}$		
(120)	PP → P (DP)		
(122)	AP → A (PP)		
(138)	~~CP → C S~~		
	CP → C'		
	C' → C TP		
	AdvP → Adv		
		(123')	~~NP → (A) N (PP)~~
		(73c.iii)	NP → AP NP
			NP → NP PP
			NP → NP CP
			VP → AdvP VP
			VP → VP PP
			AP → AdvP AP
	$\alpha \rightarrow \alpha$ Coord α		(for α=D,V,N,A,P,C,Adv,VP,NP,AP,PP,AdvP,TP,CP)

8. **<u>After</u> phrase structure and lexical reqs are met, then movement and insertion rules:**

Wh-movement: A phrase containing a wh-word can be preposed to attach to CP.

Affix hopping: A tense suffix can move to the main verb of an adjacent VP (not over Neg).

V-to-T head movement: an auxiliary verb can raise to T (possibly over Neg).

T-to-C head movement (subj-aux inversion): T can raise to an empty C.

Do-support: Insert DO to save a stranded suffix in T.

9. X **c-commands** Y if the parent of X includes Y.
10. **NPIs:** An NPI must be c-commanded by a negative element X (Neg, or a negative DP)
11. **Reflexives:** A reflexive DP must be c-commanded by its antecedent DP, in the same (smallest) clause

(Languages are often classified according to the basic order of the Subject Verb and Object. There are 6 possible orders. 3 are by far more common than the others, namely, the ones in which the Subject precedes the Object.)

17.1.5 Semantics

(12) The sentence *The old man laughs* entails the sentence *The man laughs.*

We recognize simple relations like this compositionally, according to the parts of the sentences. In general, we know things like:

(13) When DP is a proper name, and whenever we have two verb phrases T'1 and T'2 where ⟦T'1⟧ is always a subset of ⟦T'2⟧, then the sentence [DP T'1] entails [DP T'2].

It is not always true that the subject of a sentence names something which the T' tells us about: DPs of the form [D N] are more complicated.

Determiners indicate various kinds of relationships between the set of things with the property named by N, ⟦N⟧, and the set of things with the property named by the T', ⟦T'⟧.

(14) [*No* NP T'] is true just in case nothing in ⟦NP⟧ is also in ⟦T'⟧.

(15) [*Every* NP T'] is true just in case ⟦NP⟧ is a subset of ⟦T'⟧.

(16) [*The* NP T'] is true just in case there is a particular thing (determined according to context) in ⟦NP⟧ that is also in ⟦T'⟧.

(17) [*Most* NP T'] is true just in case the set of things in both ⟦NP⟧ and ⟦T'⟧ is larger than the set of things that are in ⟦NP⟧ but not in ⟦T'⟧.

(18) [*Less than 5* NP T'] is true just in case the set of things in both ⟦NP⟧ and ⟦T'⟧ has less than 5 things in it.

Moving on to DPs of the form [D A NP], we considered just one kind of adjective: **Intersective adjectives** name a property that a set of things ⟦A⟧ has. When an intersective adjective A modifies a noun N, we are talking about the things which are in both of the sets ⟦A⟧ and ⟦NP⟧. This kind of combination of sets can be repeated any number of times: When two intersective adjectives A1 and A2 modify a noun N (and this is allowed by our syntax), then we are talking about the things which are in all of the sets ⟦A1⟧, ⟦A2⟧ and ⟦NP⟧. Many adjectives like *big* or *pretty* are not intersective.

Pronouns have special properties. They can refer **deictically** to someone mentioned earlier or someone pointed to. Or they can have a **bound** reading as in:

(19) Every student$_i$ knows that he$_i$ laughed

This means that it is part of the meaning of the sentence (on one reading) that *he* refers to each of the individuals picked out by *every student.* In this kind of situation, we say that the pronoun is **bound** by the antecedent *every student.*

This kind of binding is not always possible:

(20) * Every student$_i$ knows the joke. He$_i$ laughed.

(21) * He$_i$ knows that every student$_i$ laughed.

(22) * Every student$_i$ and every teacher$_j$ knows that he$_i$ laughed.

To a first approximation, it depends on details of the structural position of the pronoun relative to its antecedent. The required relation is sometimes called c-command, where that is defined in the following way:

(23) DP1 **c-commands** DP2 if the parent of DP1 includes DP2.

Binding requirement:

An antecedent must c-command a pronoun in order to bind it.

This allows the binding in 19, and explains why binding is not possible in 20, 21, and 22. (Make sure you can draw the trees that show why this is so.)

One other complication is illustrated by examples like the following:

(24) * Jim_i hurt him_i.

(25) Jim_i hurt himself_i

(26) * John_i knows that [Jim_j hurt himself_i]

(27) John_i knows that [Jim_j hurt him_i]

Reflexive pronouns are distinguished from other pronouns in the way they can get their meaning:

Binding principle A.

A reflexive pronoun must have an antecedent in the smallest S that contains it.

Binding principle B.

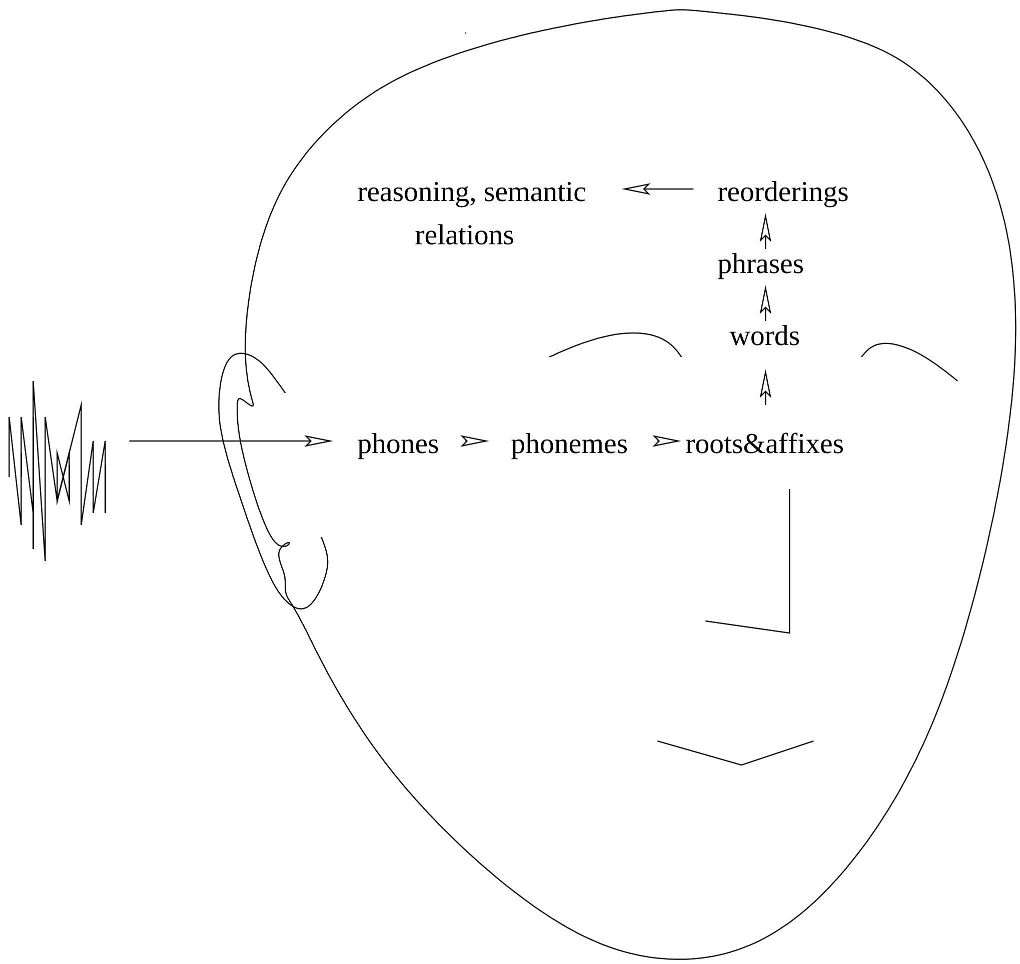
A non-reflexive pronoun cannot have an antecedent in the smallest S that contains it.

You should know and know how to apply the definitions of "entailment," "conservative determiners," and "c-command." You should know that all determiners are conservative, and you should understand how to apply the binding principles A and B.

17.1.6 The big picture

We have assembled various parts of a picture of the language understander.

This picture is intended only to cover certain aspects of our language. For example, we say nothing about the "creative" aspect of language, to use Chomsky's term (see Chapter 1). We have also said almost nothing about how language could be learned by kids, how languages change in time, how the poets can make you cry with their marks on the paper or vibrations in the air.



Certain parts of this picture do not fit together neatly. For example, the units of syntax do not correspond neatly with any units of morphology or phonology. The units of morphology do not correspond neatly with any units of phonology.

Still, we get a perspective on the generative nature of language, a perspective which allows for the play of creative language use within the restrictions imposed by the language system.

17.2 Example1: using the structures to take a new step

With the skills developed in this class, you are ready to take the "next step" in quite a few different areas! The emphasis in this class is supposed to be on these skills, not on memorizing.

One natural way to test for those skills is to ask for an analysis of something that is similar to, but not quite the same as, things we have already studied. (For problems like this, there is sometimes a range of reasonable answers, not just one!)

In this section, we consider an example like this – it requires some small steps beyond what we have already done.

Consider the following utterance, using || to mark an intonation break or pause – the edge of an 'intonational phrase' of some kind (this symbol is mentioned on page 496 in the text):

(28) [aɪwãnəlaɪk||gɪvðəgaɪzəhæ̃nd]

I wanna, like, give the guys a hand

'I want to give the guys a hand' or 'I want to help the guys'

In this utterance, we see a number of interesting things happening that we have talked about already, plus a couple of new things:

i. we see the action of phonological rules – nasalizing the vowels, for example
ii. we see words that are root+affix: *guy -s*, with the regular plural pronounced [-z]
iii. we see a 'slang' use of the expression *like*
iv. we see an embedded clause of the sort that came up in some of the syntax homework problems
v. we see the contraction *wanna*
vi. and we see the idiom *give a hand*

(This example is actually harder in some ways than any that will be on the test, but it will be good for review, and it provides the opportunity to mention a few things from the reading that were not yet discussed in class. Remember that the focus of this class, mentioned in the syllabus, is on the methods used to analyse sentences.)

17.2.1 Phones, phonemes, and phonological rules

In (28), we gave the sequence of phones in the utterance. Adding spaces between the morphemes we have:

(29) [aɪ wãnə laɪk gɪv ðə gaɪ z ə hæ̃nd]

We can see that these are phones, not phonemes, not only because we put them between square brackets rather than between slashes, but also because the sequence contains elements that are not included in the list of American phonemes. What are the phonemes in this utterance? Well, we already talked about how vowels get nasalized. (Make sure you remember the reasons for assuming that [æ] and [æ̃] are not different phonemes.)

If we assume in addition that *wanna* comes from *want to* (more on this later), then we might guess that the phonemes are these (separating morphemes with spaces):

(30) /aɪ want tu laɪk gɪv ðə gaɪ z e hænd/

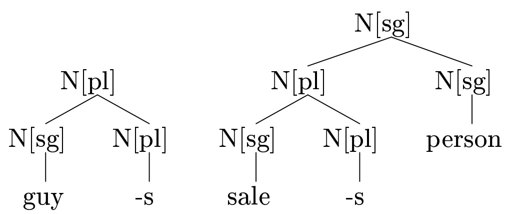
The simple rule we had for nasalizing the vowels was something like this (compare p545 in the text):

(31) A vowel becomes nasalized when it is followed by a nasal consonant

(32) $$\begin{bmatrix} +\text{vowel} \end{bmatrix} \rightarrow \begin{bmatrix} +\text{nasalized} \end{bmatrix} / \_\_\_ \begin{bmatrix} +\text{nasal} \\ +\text{consonant} \end{bmatrix}$$

17.2.2 Morphology: root+affix

We have the plural affix *-s* attaching to the noun *guy*. This gives us the simple word structure, where we assume that the affix is a noun pluralizer Npl in order to correctly predict the category of the result using the right hand head rule, a rule which also applies in compounds like *sales person*:



17.2.3 Syntax: *like*

We have not talked about the syntax of *like* as it occurs in this utterance (but we have talked about its use as a transitive verb). There are actually quite a few studies of the use of *like* that we see in our example – I'll put some references at the end of these lecture notes. But since we have not discussed it, I will just develop one simple idea about this word.

My idea is that the places where *like* can occur look quite similar to places where adverbs can occur. Consider the adverb *really* for example:

(33) a. Really, the students want to know

b. * The really students want to know

c. The students really want to know

d. ? The students want really to know

e. The students want to really know

f. The students want to know, really

(34) a. Like, the students want to know

b. *? The, like, students want to know

c. The students, like, want to know

d. ? The students want like to know

e. The students want to, like, know

f. ? The students want to know, like

Assuming this data, we have some evidence that *like* is in adverb positions. Our phrase structure rules are incomplete, but the ones we had for adverbs were these:

basic rules for selected elements	rules for modifiers
AdvP → Adv	
	VP → AdvP VP
	AP → AdvP AP

To get the other positions we find, we need to add rules like these:

basic rules for selected elements	rules for modifiers
	TP → AdvP TP
	VP → VP AdvP

17.2.4 Syntax: a clausal complement of *want*

We have already studied the structure of questions like *I prefer for Mary to leave.* Sentences like *I prefer to leave* seem similar except that the verb *leave* seems to be missing a subject: it is understood to be the same as the subject of *prefer*. We get a similar thing happening in complements of *want*:

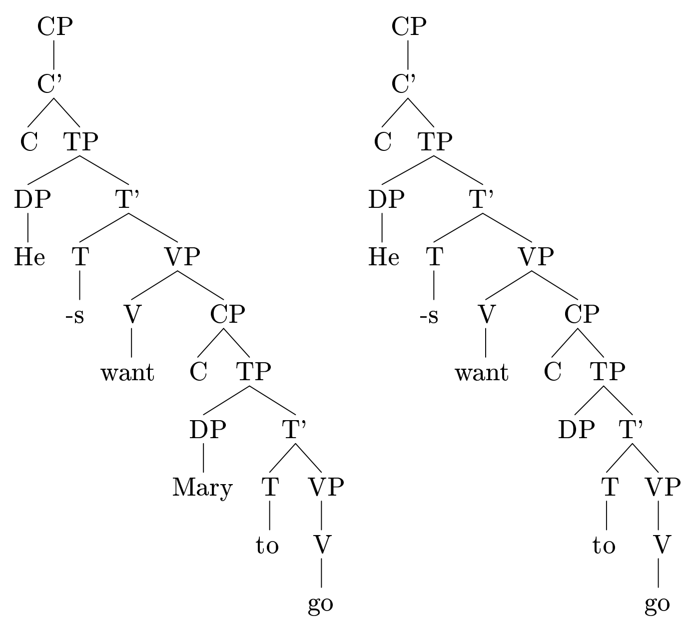
(35) I want John to do it

(36) I want to do it

(37) He wants John to go

(38) He wants to go

The complements of *want* in these examples has a verb, and has the infinitive *to* which we treated as a tense marker T, so we expect there to be a clause, but there is no subject. We can get structures for these examples by just assuming that the subject is left out:



(Though I saw that this kind of construction got mentioned in the syntax review for quiz2, it is tricky, and will not be on the test. You can look forward to hearing more about it if you take another class on syntax!)

17.2.5 Contraction: *wanna*

Contractions like *wanna* have also been studied quite a lot by linguists. (I'll put some references in the bibliography at the end.) For this class, we'll adopt a simple approach, and notice just a couple of interesting things.

The simplest idea is just that the sounds */want tu/* can optionally be changed to [wanə], in any context. But this is not right. Notice that we cannot contract

(39) /ai want tulz/
I want tools

cannot contract to

(40) * [ai wanəlz]

So maybe the contraction can only apply when both [want] and [tu] are words. But this is not right either – this example shows the point:

(41) I want two tools

cannot contract to

(42) * I wanna tools

A final example, this time with infinitival but using *want* as a noun:

(43) We cannot expect that want to be satisfied

cannot contract to

(44) * We cannot expect that wanna be satisfied

The contraction only seems to apply when *want* is the verb V, and *to* is the tense marker T. So a better idea is this:

(45) /$[_V$want] $[_T$tu]/ $\rightarrow$ [wanə]

It seems that we do not need to say anything about the context in which this rule applies, since it does not depend on which sounds appear before [want] or after [to]. And notice that the rule is "optional" for most speakers: we apply it in "relaxed" and "informal" settings.

(The other phonological rules we have talked about are not restricted to specific morphemes. For this reason, a rule like this is sometimes called "morpho-phonological" – it is a sound change that depends on the specific identities of the morphemes involved.)

This rule (45) works pretty well, but it still is not quite right. Consider the questions:

(46) I want John to give the guys a hand

(47) I want WHO to give the guys a hand?

(48) Who do you want to give this guys a hand?

For many speakers of English (like me) you cannot contract in this last example:

(49) * Who do you wanna give the guys a hand

Other examples which show the same kind of thing:

(50) a. I want (the child) Teddy to sleep
b. Teddy is the child I want to sleep
c. * Teddy is the child I wanna sleep

It seems that you cannot contract *want + to* if there has been an extraction from between them!

We leave other difficulties aside for the moment. The rule (45) is pretty good, but it still needs some work!

17.2.6 *give DP a hand*: idioms

There phrase *give DP a hand* is an idiom:

(51) **idiomatic phrases:** He threw in the towel, He kicked the bucket, His goose is cooked.

(52) **idiomatic compounds:** cut-throat, pick-pocket, scare-crow, push-over, try-out, pain-s-taking, pig-head-ed, carpet-bagg-er, water-melon, sun-flower

(53) **idiomatic root+affix:** librar-ian, material-ist, wit(t)-y.

An idiom is a complex expression whose meaning is not determined by the meanings of its parts in the usual way. So: **how are their meanings determined?**

The simple idea sketched in class is just that we store this specific knowledge about particular expressions in the lexicon. That means that we have lexical entries for *scare, crow* and for the compound *scarecrow*. And similarly, we have lexical entries for *throw, in, the, towel* and for the idiom *throw in the towel*.

Some people think that idioms were going to be a real problem for getting computers to use language in a human-like way. Why would this be true? It **is** true that resolving ambiguity in the proper way is difficult – we don't know much about how that is done, because it involves our creative ability to use and understand language. But idioms are no more difficult in this respect than ordinary, literal sentences where their is lots of ambiguity about what the modifiers are attaching to, like in the example *I saw the man with a telescope in the park*, or *I brought the lock with the keys from the store* or *Time flies like an arrow*. In these cases, there are just many many possible structures, and the proper interpretations seem to depend on knowing a lot about how the world works.

17.3 Summary summary

The final exam will be comprehensive, but there will be a strong emphasis on the material covered nearer to the end of the course. Syntax and semantics will be emphasized, but there will be a little bit of everything.

I will provide the same chart of speech sounds that I provided on the first exam, and a chart of phrase structure rules. So you do not need to memorize those, but you need to understand what they mean!

There will be a question about how you figure out what the phonemes are, and the rules that change them into sometimes slightly different phones. There will be a question about constituency tests in syntax. And there will probably be a question about the semantics of determiners, about how antecedents c-command pronouns and reflexives (or negative elements c-command negative polarity items), and maybe even a question about when determiners are conservative.

Also you should know the very **basics** from Lecture 1. In our language use we see a kind of “creativity,” which Chomsky thinks we may never really understand, even when we understand the “productivity” and “compositionality” in language. Make sure you know what that means. And there may be a question about how many phonemes there are in English (39), and about how many syllables (a lot, but finitely many), words, phrases, and sentences (∞) there are.

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