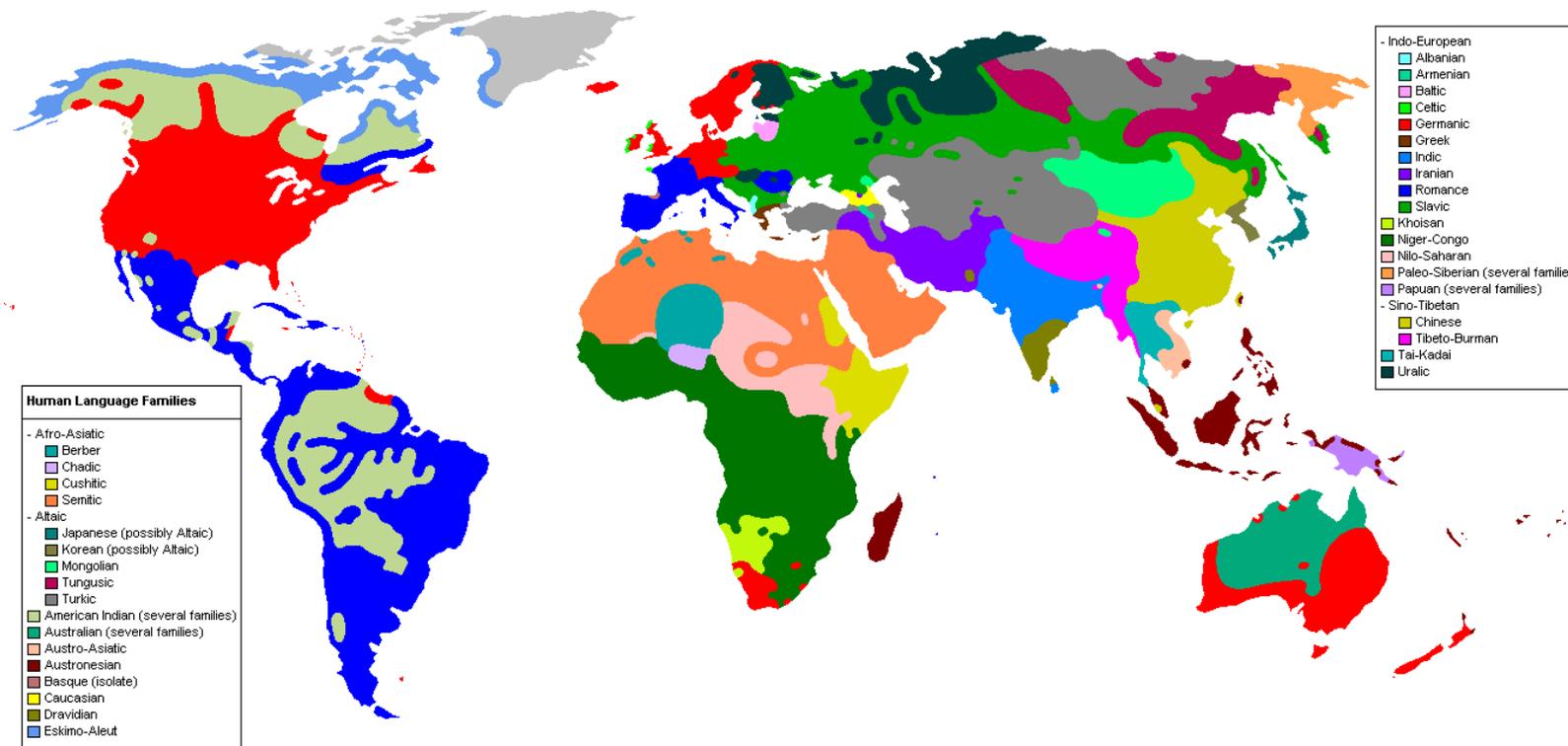


Lecture Notes: Linguistics

Edward Stabler, Winter 2014



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Linguistics 20

Introduction to Linguistics

Lecture MW2-4 in Bunche 2209A

Office Hours: M4-5, by appt, or stop by

Prof. Ed Stabler

Office: Campbell 3103f

stabler@ucla.edu

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.

Text: *Linguistics: An introduction to linguistic theory*. V. Fromkin (ed.), which is available new and used [here](#), [here](#), [here](#), [here here](#), and [here](#).

Notes and homework will be posted at <http://linguistics.ucla.edu/people/stabler/20/>

Requirements and grades: There will be 4 homework assignments, assigned on Wednesdays and due the following Monday in lecture, at the beginning of class. The homework will be graded by the TAs and discussed in the discussion sections. There will be 3 mid-term quizzes during the quarter, and an in-class final exam. The exams will be analytic problems very similar to those given in the homework.

The final exam will have 4 parts, 1 part corresponding to each of the 3 earlier quizzes, and 1 part for the new material. So for each of the first 3 parts of the class, we will have 2 grades: the original quiz and the grade on corresponding section of the final. Your grade will be the higher of those 2. The part of the final on new material will be worth 16%. The idea is to make the quizzes much less stressful (and a better indication of what you have learned) than just 1 or 2 huge exams. You get a second shot at first 3 parts of the material.

Quiz and final exam dates (all held in class) are posted on the website,

<http://linguistics.ucla.edu/people/stabler/20/>,

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

Lecture 1 The nature of human languages

These lecture notes will contain the required reading for the class, and for supplementary reading the text edited by Fromkin (2000), *Linguistics: An Introduction to Linguistic Theory*, is recommended (That text was written specifically for this class, but it has 747 pages!) In this class, I will be clear about which things you are expected to understand completely – basically, it will be everything in these notes. This lecture is based on Chapter 1 of Fromkin, but if you compare you will see that we select just some parts and extend other parts.

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 account of how sounds relate to meaning separate parts (which you may have seen already in the syllabus), 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 words? are they the basic units of phrases and of meaning?
4. syntax - how are phrases built from those basic units?
5. semantics - how is the meaning linguistic units and complexes determined?

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 should 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. The ideas are relatively new: that an appropriate grammar will be a component of psychological and neurophysiological accounts of linguistic abilities, and that it should be divided into something like the 5 components above. But our descriptive goals are similar to ancient ones.

Considering the first two components of grammar listed above, note the indication that we will focus on spoken languages, and particularly on American English since that is the language we all share in this class. But of course not all human languages are spoken. There are many sign languages. American Sign Language (ASL) is the most common in the US, but now, at the beginning of 2014, the online Ethnologue¹ lists 137 sign languages. The phonetics and phonology of sign languages involves manual and facial gestures rather than oral, vocalic ones. The “speech” in these languages is gestured. As we will see, the patterns of morphology, syntax,

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Pāṇini (600-500 BCE) wrote a grammar of 3,959 rules for Sanskrit, and is said to have been killed by a lion. He is the only linguist I know of who has been killed by a lion. And he is the only linguist I know of who has been put on a postage stamp.

¹http://www.ethnologue.com/show_family.asp?subid=23-16

and semantics in human languages are remarkably independent of the physical properties of speech, in all human languages, and so it is no surprise that the morphology, syntax, and semantics of sign languages exhibit the same kinds of structure found in spoken languages.

In each of the 5 pieces of grammar mentioned above, there is an emphasis on the basic units (the basic sounds, basic units of phrases, basic units of meaning), and how they are assembled.

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.

1.1 Productivity, and Zipf’s law

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

Using our commonsense notion of sentence (which will be refined with various technical concepts later), 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. Fromkin (2000, p.8) says 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, it depends on what a word is, and on what counts as knowing one – both tricky questions.) But suppose that you know 50,000 words. Then the number of different sequences of those words is very large. Of course, many of those word sequences are not sentences, but quite a few of them are, so most sentences are going to be very rare. Empirical sampling confirms that 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 (from the ‘Penn Treebank’) – 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.

The fact that most words are rare, but the most frequent words are very frequent, is often called **Zipf’s law**. For example, with those newspaper articles again, plotting the actual 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

If word w is the n 'th most frequent word, then we say its ‘rank’ $r(w) = n$. Zipf (1949) proposed that in natural texts the frequency of w ,

$$\text{freq}(w) = \frac{k}{r(w)^\alpha}.$$

for some constants k and α .

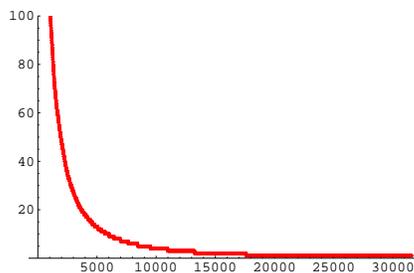


Fig. 1.1: Word frequency vs rank

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.

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:

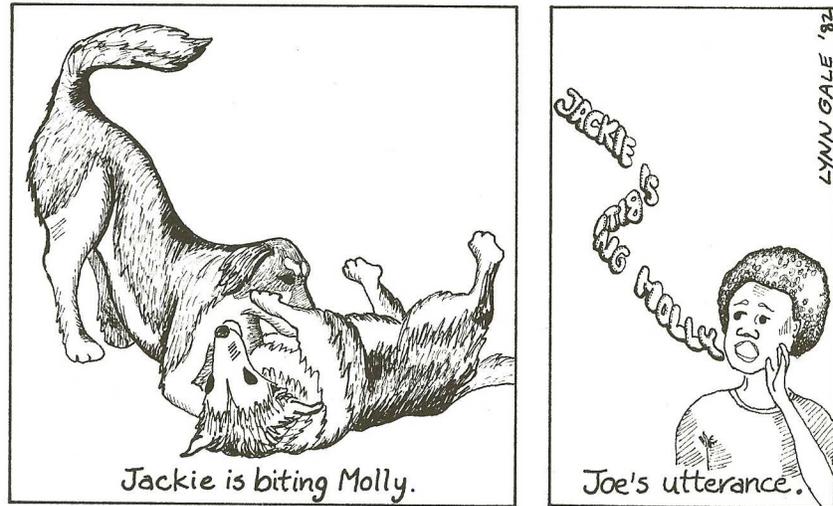
Semantic Compositionality: New sentences are understood by recognizing the meanings of their basic parts and how they are combined.

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.

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 of the early 1900's (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.”



From Barwise and Perry (1983). Here the words mirror the visual scene, but how often does that happen?

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, p138)

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. What we say depends in complex ways on our internal, psychological states which represent the context in various ways, still poorly understood. Chomsky (2014, p4) says “There has been great progress in understanding the finite means that make possible infinite use, but the latter remains largely a mystery.”

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 and change

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, 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 Words and rules

If you have never studied language, the common idea is that the atoms of a language are its words. To learn a language, you learn the words and the rules for putting them together. Let’s begin with this idea. Fromkin (2000,p.26) says the following sentence from Shakespeare has 13 words (12 different words, since 1=11):

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

All of these words are meaningful, and some of them are **complex** in the sense that their meanings are composed from meanings of their parts:

- (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 standard answer is:

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

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? Fromkin (2000,p25): “Words are meaningful linguistic units that can be combined to form phrases and sentences.” But all morphemes are by definition meaningful, and they can be combined to form phrases – but we are told (p.26) that words are not the smallest units of meaning. So what is a word? One standard idea is that words are meaningful units that can be ‘freely reordered’ (Fromkin 2000, p.320). Prefixes and suffixes are morphemes that cannot ‘occur freely’ in this sense – they are sometimes said to be ‘bound’. Words can ‘stand on their own’. Of course, phrases and sentences like the one dissected into 17 different morphemes above, are meaningful units that can stand on their own too. We see that when roots and affixes are combined, as in *care-ful-ly* or *promis-ed*, the result is a word that contains many morphemes. Two words can combine as in *school-master* to form a new word that contains two words that are each morphemes. This is a ‘compound’ word. But when Shakespeare combines the 16 words to form our example sentence about Bianca, although this is a meaningful unit that can occur freely, it is not a word. So let’s tentatively adopt this definition:

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

To understand this definition exactly, we would need to explain more carefully what it means “to occur freely.” This interesting idea is not easy to pin down. What is special about the breaks between words, which we do not find between roots and affixes (and perhaps not between the words in a compound)? There are various ideas about this, but let’s rely on our intuitions for the moment.

1.5.1 Roots and affixes

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

ðə frɛnd -z 'prɪəmɪs -t tu m'kwɔːrɪ keɪ -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. Pronouncing the following examples, you will hear 3 different pronunciations. (We use a phonetic alphabet to indicate speech sounds, as dictionaries do. This notation will be introduced later. – For now, it is enough to hear the different pronunciations of the past tense.)

<u>spelling</u>	<u>sound</u>	<u>spelling</u>	<u>sound</u>	<u>spelling</u>	<u>sound</u>
promis-ed	pɹɑmɪs-t	penn-ed	pɛn-d	load-ed	lɒd-əd
dropp-ed	dɹɑp-t	hugg-ed	hʌg-d	nett-ed	nɛt-əd
kick-ed	kɪk-t	snar-ed	sner-d	fat-ed	fɛt-əd

The way the past tense is pronounced is not random! We will consider this more carefully later. These variant pronunciations of the morpheme are sometimes called **allomorphs** – that just means: alternative form of the morpheme.

1.5.2 Are irregular forms complex?

Many English verbs have irregular past tense forms that are not root+suffix combinations, some of them falling into groups like this:

- i. blow, grow, know, throw, draw, withdraw, fly
- ii. take, mistake, shake, forsake
- iii. bind, find, grind, wind
- iv. bend, send, spend, lend, build
- v. swear, tear, wear, bear, get, forget
- vi. keep, sleep, sweep, weep, creep, leap, feel, deal, mean, dream, leave, lose
- vii. ring, sing, spring, drink, shrink, run, swim, begin
- viii. sink, stink, spin, win
- ix. string, swing, sting, cling, sling, wring, fling, stick, dig
- x. bleed, read, breed, feed, meet, lead, mislead, speed
- xi. teach, catch, buy, bring, seek, think

In many of these cases, forming past tense involves not adding a suffix, but changing the vowel. Should the vowel change be regarded as a kind of morpheme? When we hear a verb like *grew*, do we decompose it into *grow*+PAST where the PAST is pronounced not as a suffix, but as a vowel change? And if we say yes, should we say the same thing about the past tenses of even more irregular verbs like the verb *be*?

And should we say the same about verbs whose irregularity is that nothing gets added to form the past?

- xii. hit, slit, split, quit, knit, bid, rid, shed, spread, wed, let, set, upset, beset, wet, cut, shut, put, burst, cast, cost, thrust, hurt

There are various kinds of evidence bearing on these questions.

First, notice that the irregular past tense forms, like the regular ones, never allow an additional affix:

- (6) * He was promis-ed-ing everything
- (7) * He was knew-ing everything
- (8) * He was found-ing everything
- (9) * He was taught-ing everything

Fromkin (2000,p.67) says that we need to “memorize irregularly related pairs like *ran* and *run*,” but these sub-regularities (i-xii) suggest that maybe there is a rule for a collection of verbs that includes *run*. What would that rule say?

Why do the verbs in (xii), verbs that do not change in the past, all end in [t] or [d]? Do any verbs ending in [t] or [d] have regular past tenses?

This is true with irregular plurals too:

- (10) a. * He looks mice-y
b. * He looks mouse-y

Second, notice that forming a yes-no question seems to involve splitting the tense away from the verb, and this happens for both regular and irregular forms:

- (11) a. You promis-ed Bianca
b. Di-d you promise Bianca?
(12) a. You knew Bianca
b. Di-d you know Bianca?
(13) a. You found Bianca
b. Di-d you find Bianca?
(14) a. You taught Bianca
b. Di-d you teach Bianca?

We see a similar thing when we use *do* emphatically, as in these cases:

- (15) a. I never promised Bianca, but you **di-d** promise her
b. I never knew Bianca, but you **di-d** know her
c. I never found Bianca, but you **di-d** find her
d. I never taught Bianca, but you **di-d** teach her

In these cases, when the past tense is expressed on *do*, the verb takes its usual bare form, whether it is regular or not. This suggests that both regular and irregular forms really are complex, with a verb morpheme and a PAST morpheme.



The processes of word recognition are very rapid. In ordinary fluent speech, we often are able to recognize words before hearing the end of them. In both listening to speech and reading, word recognition is influenced by many factors, and it is hard to disentangle effects of finding the stem from the effects orthographic/auditory similarity and frequency. But there is some evidence of decomposition of stem and affix even in the earliest stages of word recognition. Monitoring magnetic fields on the scalp (with MEG, magnetoencephalography), there is evidence of a response to lexical recognition of a stem in forms like *farmer* and *refill* as compared with simple forms like *winter* and *resume* (Zweig and Pykkänen, 2008). Another, slightly slower response may indicate recognition of the stem, which happens with regulars and irregulars alike (Stockall and Marantz, 2006; Morris and Stockall, 2012).

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?

You will understand something about each of these by the end of the class.

We begin with the most familiar topic: morphology, the theory of words and their parts. We introduced words and morphemes, roots and affixes (suffixes, prefixes, infixes). Words with parts are called “complex.” English has some complex words, traditionally separated into “regular” and “irregular” examples. Even the irregular forms seem to be complex in the sense that the speaker recognizes the relation between related forms (e.g. the forms in different tenses or different ‘conjugations’). Obviously, these complexes can only go together in certain ways – more on this next time.

Questions:

Questions about lecture material will be addressed in discussion sections, but you can also stop by my office M4-5 or anytime. Short questions can also be emailed to me.

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?

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 and further reading

- Barwise, Jon and John Perry. 1983. *Situations and Attitudes*. MIT Press, Cambridge, Massachusetts.
- Chomsky, Noam. 1968. *Language and Mind*. Harcourt Brace Javonovich, NY.
- Chomsky, Noam. 1975. *Reflections on Language*. Pantheon, NY.
- Chomsky, Noam. 2014. Minimal recursion: Exploring the prospects. In Tom Roeper and Margaret Speas, editors, *Recursion: Complexity in Cognition*. Springer, NY, pages 1–15.
- Frege, Gottlob. 1923. Gedankengefüge. *Beträge zur Philosophie des deutschen Idealismus*, 3:36–51. Translated and reprinted as ‘Compound thoughts’ in *Mind* **72**(285): 1-17, 1963.
- Fromkin, Victoria, editor. 2000. *Linguistics: An Introduction to Linguistic Theory*. Blackwell, Oxford.
- Morris, Joanna and Linnaea Stockall. 2012. Early, equivalent ERP masked priming effects for regular and irregular morphology. *Brain and Language*, 123(2):81–93.
- Stockall, Linnaea and Alec Marantz. 2006. A single route, full decomposition model of morphological complexity: MEG evidence. *The Mental Lexicon*, 1(1):85–123.
- Zipf, George K. 1949. *Human Behavior and the Principle of Least Effort: An Introduction to Human Ecology*. Houghton-Mifflin, Boston.
- Zweig, Eytan and Liina Pykkänen. 2008. A visual M170 effect of morphological complexity. *Language and Cognitive Processes*, 24(3):412–439.

Lecture 2 Morphology

In 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 does not work like that. (Even our English names for decimal numbers do not work like that!) Many sequences of morphemes cannot go together at all. Let's consider how this might work.

2.1 Assembling words, morphemes, roots, and affixes

Last time we considered the idea that 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. But when we try to describe how they can be assembled, it turns out that we need to refer not just to their meanings, but also to their roles in building phrases.

- (1) The regular past tense affix *-ed* attaches only to verbs.
- (2) The regular plural affix *-s* attaches only to nouns.
- (3) The adverb-forming affix *-ly* attaches only to adjectives and nouns.

Morphemes have particular “parts of speech:” they are nouns, verbs, adjectives, etc. These notions refer to the function of the morpheme 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:

part of speech:	noun = N	verb = V	adjective = A	adverb = Adv	determiner = D	preposition = P
example, spelling:	<i>friend</i>	<i>say</i>	<i>happy</i>	<i>quickly</i>	<i>the</i>	<i>with</i>
pronunciation:	[fɹɛnd]	[se]	[hæpi]	['kwɪkli]	[ðə]	[wɪð]

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
 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
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 basic elements of syntax. The parts of speech formed by the morphology are **syntactic atoms**. These parts of speech are familiar from dictionaries, and now we notice that having a part of speech seems, at least at first, to go with being a semantic atom. So we can ask:

- Q1 Are morphemes syntactic atoms?
 (= Are the smallest units of meaning also the smallest units of phrases?)
- Q2 How do morphemes relate to the units relevant to pronunciation (basic speech sounds, 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 internal to 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.

2.2 English morphology

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

2.2.1 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

2.2.2 Roots + affixes

Some suffixes can combine quite freely

phon	spelling	effect	examples
-ɹ	-er	changes V to N	kill-er
-əbəl	-able	changes V to A	manage-able
-nes	-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

Notice how the brackets indicate how the elements combine together. The restrictions on these combinations are not just memorized on a word-by-word basis, but apply to whole collections of similar elements. If we invent a new verb *glark*, and say that Schwarzenegger is *glarkable*, then we immediately know that this means that Schwarzenegger 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):

<u>phon</u>	<u>spelling</u>	<u>effect</u>	<u>examples</u>
-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
-ifaɪ	-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
-mənt	-ment	changes V to N	establish-ment
-ɔɪ	-ory	changes V to A	advis-ory
-əs	-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

<u>phon</u>	<u>spelling</u>	<u>effect</u>	<u>examples</u>
-eɪ	-ary	changes N-ion to N	revolut-ion-ary
-eɪ	-ary	changes N-ion to A	revolut-ion-ary, legend-ary
-ɪ	-er	changes N-ion to N	vacat-ion-er, prison-er
-ɪk	-ic	changes N-ist to A	modern-ist-ic, metall-ic
-(eɪ)ʌn	-(at)ion	changes N-ize (etc) to N	symbol-iz-ation, impress-ion, realiz-ation
-(ət)ɔ:ɪ	-(at)ory	changes V-ify to A	class-ifi-catory, advis-ory

Some suffixes combine with a specific range of suffixed items

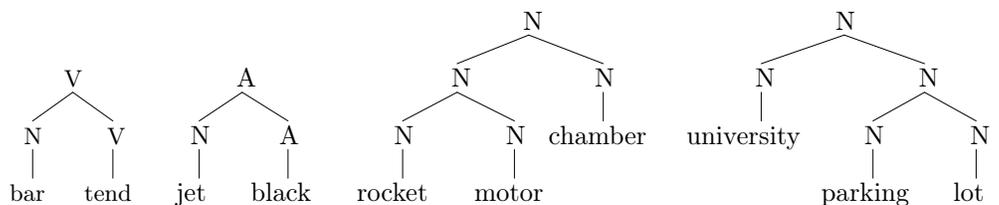
<u>phon</u>	<u>spelling</u>	<u>effect</u>	<u>examples</u>
-əl	-al	changes N to A	natur-al
		sometimes allows -ion, -ment, -or	
-jən	-ion	changes V to N	rebell-ion
		sometimes allows -ize, -ify, -ate	
-ɪti	-ity	changes A to N	profan-ity
		sometimes allows -ive, -ic, -al, -an, -ous, -able	
-ɪzəm	-ism	changes 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	

2.2.3 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]]
- [N_{pl} [N_{sg} part] [N_{pl} suppliers]]
- [N_{sg} [N_{pl} parts] [N_{sg} supplier]]
- [N [N [N rocket] [N motor]] [N chamber]]

Instead of using brackets to show how these words are formed, it is often easier to use "tree diagrams", like this:



These trees are upside down: the point at the top is the **root**, along the bottom we have the pronounced **leaves**. The root, the leaves, and the other labeled constituents in the tree are called **nodes** of the tree. There is always just one root, and The branches never cross.

Notice that the different structures of the last two examples, what modifies what, is figured out by considering what makes the most sense.¹ 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:

$$V \rightarrow N V$$

$$N \rightarrow N N$$

$$A \rightarrow N A$$

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:

- (4) In English, the rightmost element of a compound is the **head**.
- (5) A compound word has the category and features of its head.

This is called the **English right hand head rule** or the **head-final principle**²

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

- (6) an English suffix often changes category, but prefixes rarely do
- (7) 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 head-final too. Then, considering the most productive affixes first, we can use rules like the following to describe their requirements and their effects:

$$N \rightarrow \text{-er} / [V_____] \quad (\text{manager})$$

$$A \rightarrow \text{-able} / [V_____] \quad (\text{manageable})$$

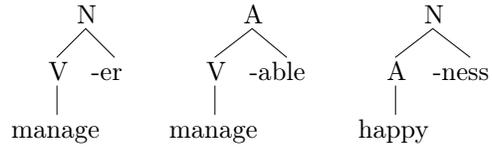
$$N \rightarrow \text{-ness} / [A_____] \quad (\text{happiness})$$

The first rule says that the N -er is allowed when it can form a complex with a verb. And by the head-final rule, we know that the resulting complex will be a noun N. We read the other rules similarly. We can draw the resulting structures with trees.

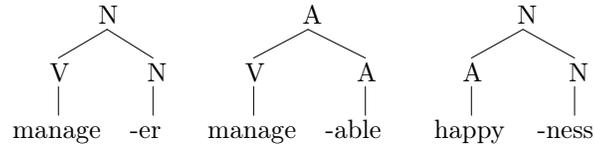
¹This and other kinds of ambiguity are discussed in Fromkin (2000, pp9-10,14). We will have much more to say about it later.

²In 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 head-final rule for syntactic heads in English. Cf. Fromkin (2000, p68).

For affixation structures, some texts present trees like the following, which assign no part of speech at all to the suffixes (cf. Fromkin 2000 pp54ff):



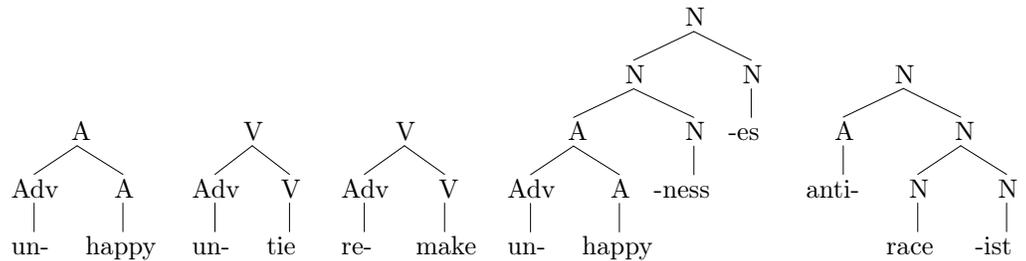
But if we use the rules given above, then INSTEAD, we can provide categories for the affixes, conforming to the English head-final rule:



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 conform to the same generalization that we had for compounds: the right sister determines category.

In fact, applying the head-final 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
 The friend -s promis -ed to inquire care -ful -ly about a school -master for the fair Bianca

2.3 How morphology relates to other things

OK. Now let's reflect again on the general questions Q1 and Q2 from page 12 about how morphological elements compare to the basic elements of speech sound, of phrases (syntax), and of meaning (semantics).

2.3.1 Morphology and pronunciation

Sequences of sounds form syllables, but most syllables do not mean anything – they are often just parts of morphemes. But it can also happen that a morpheme is a single speech sound, smaller than a syllable.

- (8) **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

It is sometimes proposed that a morpheme can be completely unpronounced (Fromkin, 2000, pp75-78,279,322-3).

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

- (10) **Morphemes may be pronounced in different ways in different contexts: allomorphs.** As discussed in class, past tense *-ed* is pronounced in various ways. Plural *-s* is pronounced in different ways.

- (11) **Some morphemes may be unpronounced.** We mentioned last time that the past tense sometimes has no pronunciation when it is on the verb, though it may be pronounced again when it is separated from the verb to attach to *do*:

You wed Bianca yesterday Di-d you wed Bianca yesterday?

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

gogs	gogogs		'uvi	'u'uvi		jiosh	jijosh		toobi	totobi
dog	dogs		woman	women		god	gods		rabbit	rabbits

2.3.2 Syntactic atoms, semantic atoms, and morphemes

We asked earlier, in Q1 (on page 12), 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: a semantic atom can have many syntactic atoms in it.** 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:** pick-pocket, scare-crow, push-over, try-out, cut-throat, pain-taking, pig-head-ed, carpet-bagg-er, water-melon, sun-flower, under-stand, with-stand, down-load, under-take, under-tak-er, over-come, for-sake, red-wood, black-bird, hot-dog, white cap, cold cream, looking glass.
- (15) **idiomatic root+affix:** librar-ian, material-ist, wit(t)-y, ignor-ance, mis-take, sweat-er.

It is natural to say that, in these idiomatic uses, the parts of these expressions are syntactic atoms, but they do not have their usual meanings (i.e. they can be meaningful in other contexts, with different meanings). Since we have to learn what these whole expressions mean, rather than figuring the meanings out from the parts, so these are semantic atoms.

A related thing seems to happen in examples like these, where we seem to have morpheme-like elements that cannot occur in any other context:

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

This seems to be another kind of idiom, where one component is meaningful only in a unique or narrow range of morphological complexes.

Second: a syntactic atom can have many semantic atoms in it, or so it seems. Since we have not studied how phrases are formed, we are not really in a position to rigorously assess this claim. But in the case of a compound noun like *sunflower seed package*, it seems that the rules of the syntax never need to see the morphemes, only the whole word. The compound itself is an atom in the rules for building phrases. Similarly for root-affix complexes like the verb *de-institut-ion-al-ize*. The syntax does not need to see its parts (or so it seems).

With these puzzles, it is no surprise that the notions of *word* and *morpheme* are given only a rough definition in most texts. Some say simply that “morphemes can be defined as the smallest meaningful unit,” (Haspelmath 2002, p.16; Lieber 2010, p.3). Others say that morphemes are the syntactic atoms, whether or not they have semantic or phonological content (Halle and Marantz, 1993, p114). Fromkin (2000, p703) implies a mixed view, saying a that the morpheme is the “smallest meaningful linguistic unit,” but also assigning each morpheme a part of speech – suggesting that morphemes are both semantic atoms and syntactic atoms. The examples just above show that is not quite right. Another text says it is “the smallest unit of language which carries information about meaning or function” (O’Grady et al., 2010, p117). But strictly speaking, an initial [b] (or any other sound) on an English word carries some information about both meaning and function, since it narrows down the possibilities (very roughly, to those meanings and functions in the [b] section of the dictionary). Linguists working more carefully conclude that the traditional notions of *morpheme* and *word* mix various considerations that do not quite go together. The basic units of meaning (semantic atoms) and the basic units of grammatical functions, of phrase structure (syntactic atoms), are not quite the same.³ The notions of morpheme and word do not quite fit either characterization. It is not quite clear how to resolve these problems, but these ideas are clear enough for us to proceed.

“The conclusion drawn by many, if not most, morphologists is that the morpheme concept is inappropriate except as a crude approximation. Instead,...morphemes are taken to be markers serving to realize some feature specification...not listed lexical entries in their own right.” (Spencer, 2006, p110)

³See for example Spencer (2006), or the introduction to Spencer and Zwicky (1998), or Di Sciullo and Williams (1987), or Anderson (1992, pp51-6) for discussion of the ongoing controversy surrounding these issues.

2.4 Other languages

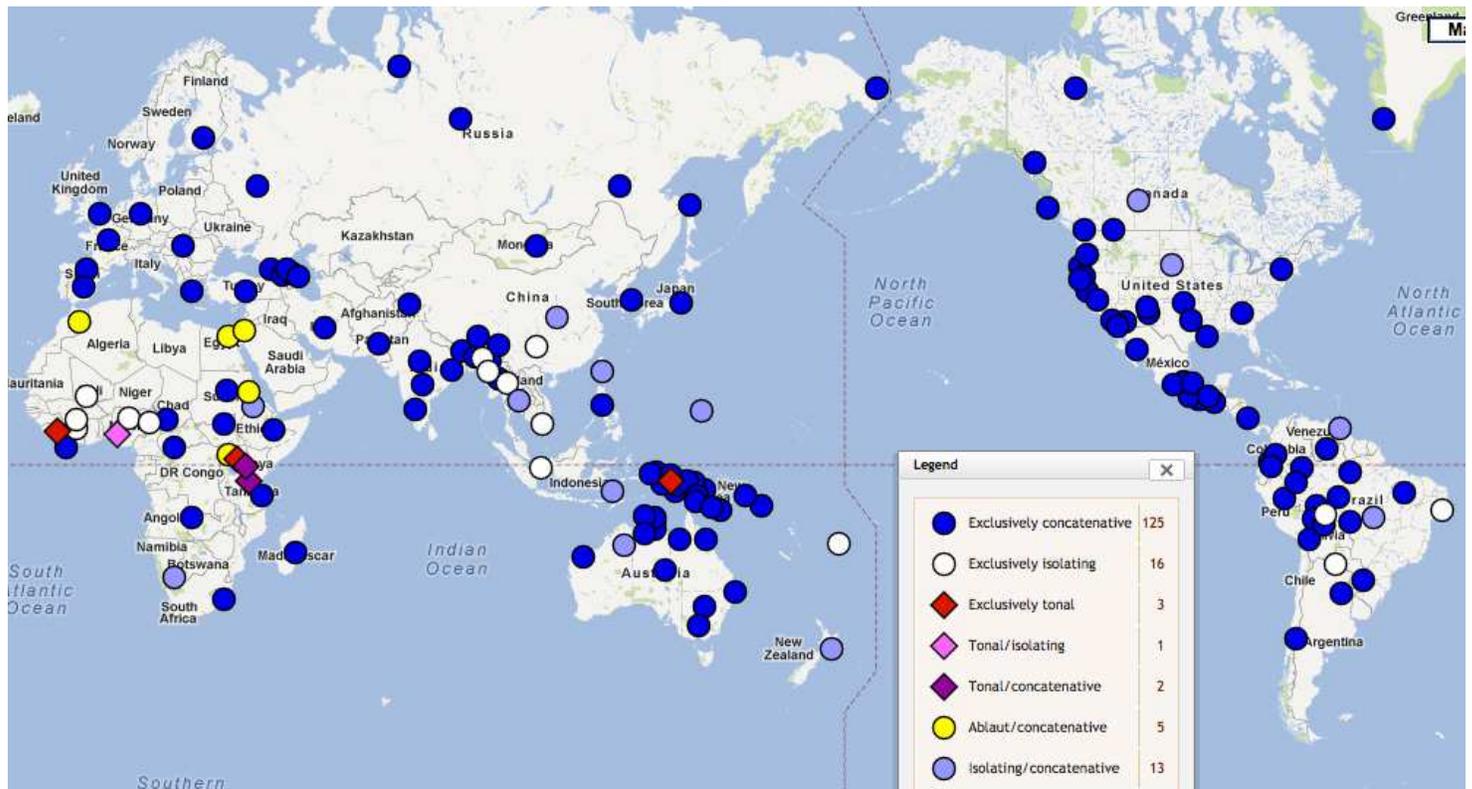
Is the situation for words and morphemes different in other languages? Well, all languages have semantic atoms and word-like units of course, but languages vary quite a lot in how much gets put into a word. Languages that avoid combining many grammatical markers onto a stem are sometimes called *isolating* or *analytic*, as in this example from **Fijian** (Bickel and Nichols, 2005):

- (17) Au aa soli-a a=niu vei ira
 1SG PST give-TR ART=coconut to 3PL
 ‘I gave the coconut to them.’

Languages that tend to combine many grammatical morphemes with a stem can do so by concatenating affixes, or by altering the morphemes, or with tones, as in this one word example from the South American language **Quechua** (Stabler, 1994):

- (18) wañu-chi-chi-lla-sa-nku-ña-puni.
 die-make-make-DEL-PROG-3PL-DUR-EMP
 ‘they are still just having people killed as always’

Languages of this latter sort are sometimes called *fusional* (or *agglutinating* or *polysynthetic*). When we look at a map, we see that these tendencies are localized in certain areas.



Many examples of various sorts of languages are discussed in Fromkin (2000, ch2).

2.5 Summary

The traditional view is that **morphemes** are **semantic atoms**, and morphology is about how words are built from morpheme roots, morpheme affixes, and other words. (We stick with this picture for now.)

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 English head-final 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 syllables or basic speech sounds like vowels or consonants. 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 that this presents puzzles for the traditional view that morphemes are semantic atoms).

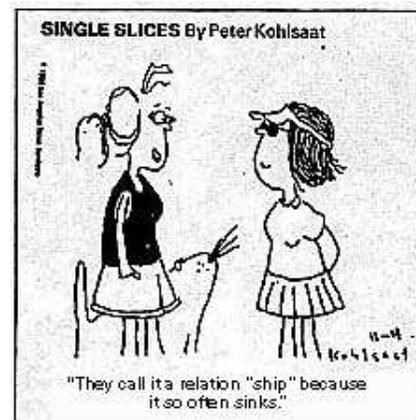
In this lecture, we introduced rules like: $X \rightarrow Y X$. That means that inside an X, another X can recur – in this sense, these rules are **recursive**. In building root-affix complexes, these rules tend to be tightly restricted, and sometimes we indicate the restrictions on their applicability with conditions after a slash:

$$X \rightarrow Y X/\text{conditions.}$$

In English noun compounds, the recursion is quite free and much easier to see. With free recursion, the number of possible words becomes **infinite**. And this is just the beginning. Recursion of roughly the sort we see in compounding appears in many parts of the grammar.

References and further reading

- Anderson, Stephen R. 1992. *A-Morphous Morphology*. Cambridge University Press, NY.
- Bickel, Balthasar and Johanna Nichols. 2005. Fusion of selected inflectional formatives. In M. Haspelmath, M.S. Dryer, D. Gil, and B. Comrie, editors, *The World Atlas of Language Structures*. Oxford University Press, NY.
- Di Sciullo, Anna Maria and Edwin Williams. 1987. *On the Definition of Word*. MIT Press, Cambridge, Massachusetts.
- Fabb, Nigel. 1988. English suffixation is constrained only by selection restrictions. *Linguistics and Philosophy*, 6:527–539.
- Fromkin, Victoria, editor. 2000. *Linguistics: An Introduction to Linguistic Theory*. Blackwell, Oxford.
- Halle, Morris and Alec Marantz. 1993. Distributed morphology and the pieces of inflection. In *The View from Building 20*, pages 111–176, MIT Press.
- Haspelmath, Martin. 2002. *Understanding Morphology*. Hodder Education, London.
- Lieber, Rochelle. 2010. *Introducing Morphology*. Cambridge University Press, NY.
- O'Grady, William, John Archibald, Mark Aronoff, and Janie Rees-Miller. 2010. *Contemporary Linguistics: An Introduction (Sixth Edition)*. Bedford, Boston.
- Spencer, Andrew. 2006. Morphological universals. In R. Mairal and J. Gil, editors, *Linguistic Universals*. NY, Cambridge.
- Spencer, Andrew and Arnold M. Zwicky, editors. 1998. *The Handbook of Morphology*. Elsevier, NY.
- Stabler, Edward P. 1994. The finite connectivity of linguistic structure. In Charles Clifton, Lyn Frazier, and Keith Rayner, editors, *Perspectives on Sentence Processing*. Lawrence Erlbaum, Hillsdale, New Jersey, pages 245–266.



Lecture 3 Syntactic constituents and categories

3.1 Productivity begins in morphology

3.1.1 First: morphemes, words and ‘parts of speech’ are different!

As we noticed already, there is a mix of views about what should count as “morphemes”, some of them conflicting with the basic idea that morphemes are semantic atoms:

- Fromkin (2000, p89) 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* (see p.6 of lecture notes), though, we might conclude that in the sentence “He’s bad!” [hiz’bæd], 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*.
- Fromkin (2000, p98) 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, since we count compounds as words, the number of English nouns infinite. And even root+affix structures 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.
- Fromkin (2000, p99) says “. . . within the mental lexicon of any single speaker, there is a pronunciation associated with each morpheme.” But we have seen that some morphemes are not associated with pronounced material. It seems that the PAST morpheme in English has various pronunciations (‘allomorphs’), but more dramatically, there can be ‘reduplicative’ morphemes. Reduplicative morphemes get their pronunciations by copying all or parts of the morphemes they are attached to.

3.1.2 productive affixation

The following are among the most “productive” affixes – meaning that these elements combine with the wide range of elements:

<u>phon</u>	<u>spelling</u>	<u>effect</u>	<u>meaning</u>	<u>examples</u>
-ɪ	-er	changes V to N	one who Vs	kill-er
-ɪ	-er	changes A to A	more A	light-er
-əbəl	-able	changes V to A	capable of being V-ed	manage-able
-nes	-ness	changes A to N	state of being A	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**, most often to syllables with no final consonant:

happy-er	tidy-er	friend-ly-er	mellow-er	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

number of syllables		cold-er	happi-er	?water-y-er	*temporary-er
weight of final syllable			happi-er	*hapless-er	
non-initial stress			un-happi-er	*slippery-er	
historical group ('linate')			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

3.1.3 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.

¹Fromkin (2000) notes that stress works in an interesting way in compounds. There is an exercise later in the text (we will get to this in a few weeks) on how 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 briefly 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 as part	
	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 controversy	about	

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

N _[N V]	a.	heart massage	obj
	b.	sound synthesizer	obj
	c.	child behavior	subj
	d.	car lover	obj
	e.	soccer competition	(at in? modifier)
	f.	government promotion	subj obj
	g.	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

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

²The number of different binary branching trees for n leaves is $\frac{(2(n-1))!}{(n)!(n-1)!}$ (Catalan, 1838). For $n = 2, 4, 8, 16, \dots$ leaves, the number of possible trees is 1, 5, 429, 9694845, \dots 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.

³Jackendoff 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.

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

Chinese	[[duǎ]N[fàn]N]	drug-criminal	(Ceccagno and Basciano, 2009; Packard, 2000)
	[[hán]N[shòu]V]	letter-sell	‘order by mail’
	[[jìn]V[duǎ]N]	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	container soap liquid	liquid soap container
Spanish	abre-latas	opens cans	can opener
	saca-corchos	removing corks	corkscrew
English	[jump-rope]V	[jump-rope]N	
	[pick-pocket]V	[pick-pocket]N	
	[break-fast]V	[break-fast]N	
	[cut-throat]N	[scatter-brain]N	[twinkle-toes]N

3.2 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. To begin the study of phrases, let’s review again some of basic units of phrase structure introduced to understand how words are assembled, and then extend that list.⁴

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.

⁴Compare Fromkin (2000, ch3). Although the whole chapter is good reading, we will focus initially on the introductory pp.89-101.

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.

3.3 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, singular 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.

3.4 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 pronouns 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 (nominative or accusative) 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!

3.5 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 of 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.
 - 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

References and further reading

- Bickerton, Derek. 1990. *Language and Species*. University of Chicago Press, Chicago.
- Booij, Geert. 2009. Compound construction: Schemas or analogy? a construction morphology perspective. In Sergio Scalise and Irene Vogel, editors, *Compounding*. Benjamins, Philadelphia.
- Catalan, Eugène Charles. 1838. Note sur une équation aux différences finies. *Journal de Mathématiques Pures et Appliquées*, 4:79–91.
- Ceccagno, Antonella and Bianca Basciano. 2009. Sino-Tibetan: Mandarin Chinese. In R. Lieber and P. Stekauer, editors, *The Oxford Handbook of Compounding*. Oxford University Press, Oxford, pages 478–490.
- Downing, Pamela. 1977. On the creation and use of English compound nouns. *Language*, 53(4):810–842.
- Fromkin, Victoria, editor. 2000. *Linguistics: An Introduction to Linguistic Theory*. Blackwell, Oxford.
- Jackendoff, Ray S. 2009. Compounding in the parallel architecture and conceptual semantics. In Rochelle Lieber and Pavol Štekauer, editors, *The Oxford Handbook of Compounding*. Oxford University Press, NY, pages 105–128.
- Lapata, Maria. 2002. The disambiguation of nominalizations. *Computational Linguistics*, 28(3):357–388.
- Levi, Judith. 1978. *The Syntax and Semantics of Complex Nominals*. Academic Press, NY.
- Packard, Jerome. 2000. *The Morphology of Chinese: A Linguistic and Cognitive Approach*. Cambridge University Press, NY.

Lecture 4 The anatomy of a phrase

We will try to figure out more of the structure of determiner phrases (DPs), with particular attention to modifiers (adjective phrases, adverb phrases, prepositional phrases) generally. To check whether the structures we propose are correct, we will begin with the tests that we proposed last time, and add a few more.

4.1 More constituency tests

So far we have seen these basic tests:

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

We noted that some of these categories are not “finest categories” – that is, we will need to draw some finer distinctions later, but they provide a preliminary grouping into the basic categories of words.

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

A word or sequence of words that can be replaced by a (nominative or accusative) pronoun, keeping the meaning (roughly) the same, is probably a DP. So Proper names are usually DPs, but so are some very long phrases. Some DPs do not have Ds in them (or at least it appears that way). (We postpone discussing possessive pronouns like *my*, *his*, *their*, to later.)

We can also identify elements by “manipulations:”

(3) **Preposing test for phrases:** A sequence of words that can be moved to the front of a sentence, (roughly) preserving meaning, is probably a phrase. (Sometimes preposing is called ‘topicalization’.)

(4) **Postposing test for phrases:** A sequence of words that can be moved to the end of a sentence, (roughly) preserving meaning, is probably a phrase.

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

Again, it is very important to remember that the role played by a phrase is sometimes played by a single word, but sometimes that same role is played by a long complex sequence of words. Calling it a phrase tells us about its role in sentences, not about how long it is. 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:

(5) **Sentence fragment test for phrases:** A sequence of words that can answer a question is probably a phrase:

- a. Who came? Maria
- b. Who came? the president of the student union
- c. Who came? * the
- d. Who came? * the president of
- e. When did she do it? last year
- f. How did she do it? with lots of hard work
- g. How did she do it? quickly
- h. How did she do it? * with

In English, coordination (with *and*, *or*, *but*) provides a way to check to see whether two things are playing the same role in a sentence:

- (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. [DP The old man] and [DP 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]

With these tests, now let's look at DPs more carefully.

4.2 Determiner phrases: first thoughts

Coordination gives us some reason to think that black dogs is a constituent in

- (7) I like those black dogs
- (8) I like those black dogs and orange cats

These elements also seem to allow substitution by *one* or *ones*, preserving meaning, and interestingly, *ones* can replace the noun by itself too?

- (9) I like those black dogs
- (10) I like those ones
- (11) I like those black ones

The ones in this last sentence can be replaced by black dogs again:

- (12) I like those black black dogs

So there is some reason to assume that all these underlined things have the same category. What should we call that constituent? It is a noun phrase, NP. So we see that NPs, like DPs, can be one word or many words. And let's take note of this additional clue for finding NPs:

- (13) **One substitution for noun phrases (NPs):** Phrases that can be replaced by *one* or *ones*, (roughly) preserving meaning, are probably NPs.

Notice that we are not saying that all NPs can be replaced by *one*:

- (14) I like a black dog
- (15) I like a black one
- (16) * I like a one

It's not true that "if something is an NP, it can be replaced by *one*". Instead, the rule goes the other direction: "if something can be replaced by *one*, it is probably an NP."

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

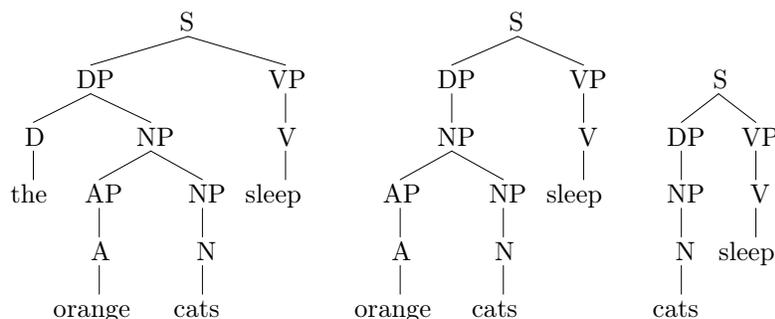
- (17) [Cats] sleep
- (18) [Those [cats]] sleep
- (19) I saw [cats]
- (20) I saw [those [cats]]
- (21) [Orange orange cats] sleep
- (22) [Orange orange orange cats] sleep
- (23) ...
- (24) I saw [orange cats]
- (25) Those [terrifying orange cats] sleep
- (26) I saw [terrifying orange cats]
- (27) [Big terrifying orange cats] sleep
- (28) I saw [big terrifying orange cats]
- (29) ...

Note that [orange cat] is not a noun. It does not enter into compounding the way nouns do.

- (30) * I saw tiger orange cats
- (31) I saw orange [tiger cats]

Instead, [orange cat] is analyzed as being build on the phrasal level, from two things that can both be modified, two phrases, [orange] and [cat]. An NP like [cat] is also a category that can be modified by adjective phrases like [orange]. When we add a modifying AP to a NP, we get another NP, another category that can be modified in the same way. So this modification is 'recursive'.

So what we want to say here is that a NP can form a DP either by itself or with modifiers. This is getting complicated, so let's start drawing out the situation with trees:



Notice that, in all of these trees,

(32) *the* is a D

(33) *orange* is an A

(34) *cats* is a N

But only in the third tree is *cats* a DP. Notice also that I labeled *sleep* as a V, but also as a VP, because it could have been modified (even though it isn't modified in this sentence).

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. And similarly for the V *sleep*. It could have been a modified phrase like *sleep soundly* – a VP modified by an AdvP. The AdvP could have had a modifier in it too, like *very*, in

(35) [Cats] [sleep very soundly]

These examples suggest that the way adjectives and nouns combine in English is this (read → as 'can be formed from'):¹

NP → AP NP

And similarly for other categories, as we saw in class:

NP → AP NP

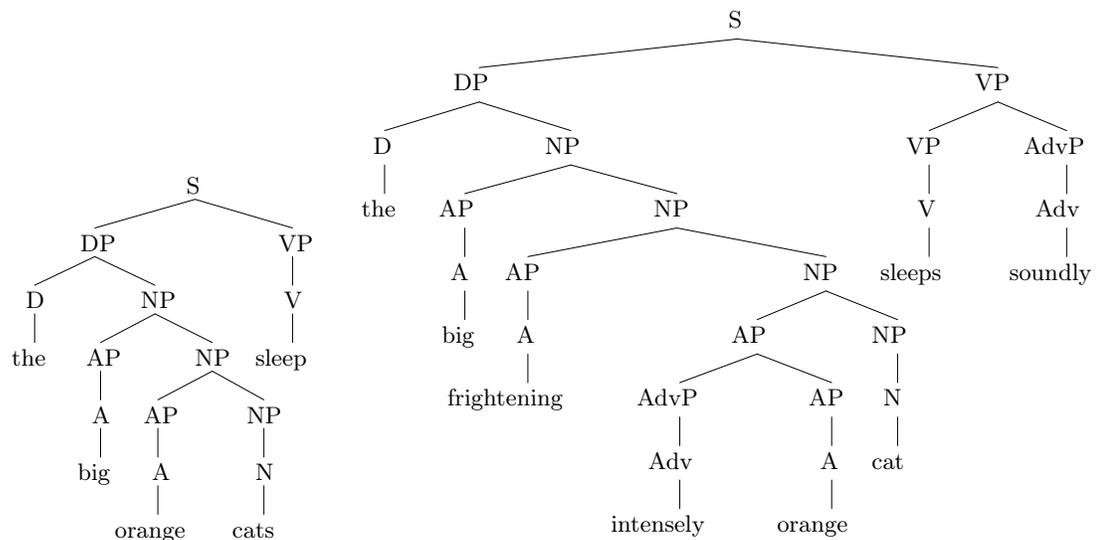
VP → AdvP VP

VP → VP AdvP

VP → VP PP

AP → AdvP AP

With this idea, we get structures like this:

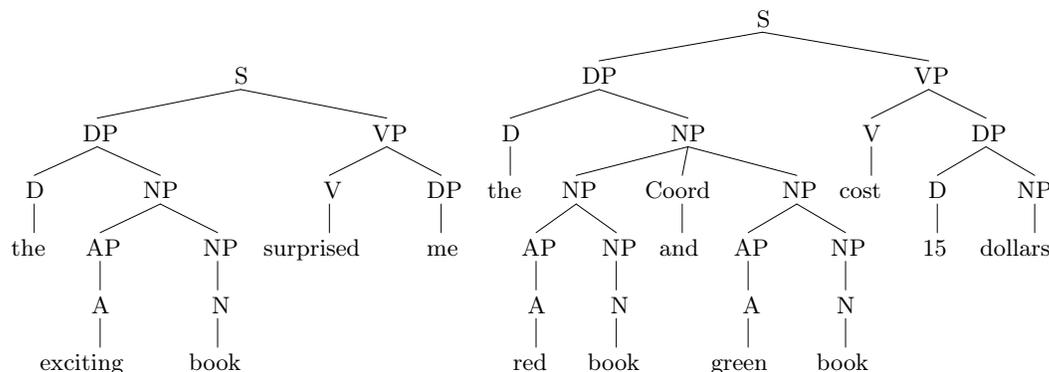


Coordination tests confirm the idea that the adjectives and noun form a constituent to the exclusion of the determiner:

¹Compare Fromkin (2000, p165).

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

And we show this in our trees:



4.3 Summary: Constituency and the first glimpse at what it reveals

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.

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 are **heads** in the syntax. To begin, we will assume that these basic elements, the syntactic atoms, are words. They form DP, NP, VP, AP, AdvP, PP.

The heads, the words, are given to us by morphology, and there are infinitely many of them (because some rules in morphology are already recursive, like N compounding). Notice that whenever we have a noun N, we will have an NP. And in the class, we will assume that the same goes for D, V, A, P, Adv.

- **Modifiers** are optional.
- Some modifiers can appear either before or after the thing they modify

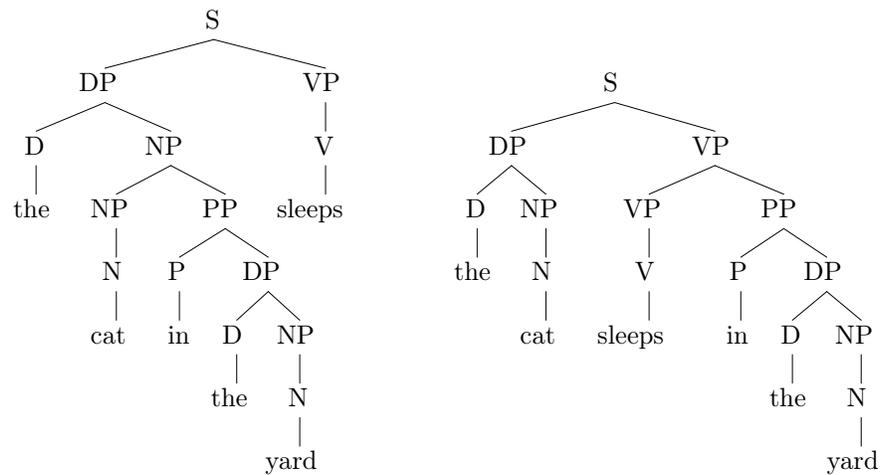
They carefully hunt for mice
They hunt carefully for mice

but some modifiers can only appear on one side or the other:

Lazy cats sleep
* Cats lazy sleep
They sleep in the yard
* They in the yard sleep

As discussed in class, we can enforce these restrictions, for the moment, simply by writing the rules in the right way. (Preposed phrases are a special case that we will discuss later).

Notice that prepositional phrases like *in the yard* can modify both NPs and VPs, as we saw in class too:



And notice that, while the rules for modifiers are recursive (the category on the left also appears on the right side of the rule), some of the rules we have used are not recursive.

$$\begin{aligned} S &\rightarrow DP VP \\ DP &\rightarrow D NP \\ VP &\rightarrow V DP \\ PP &\rightarrow P DP \end{aligned}$$

We will talk more about the non-recursive rules next time!

References and further reading

- Fromkin, Victoria, editor. 2000. *Linguistics: An Introduction to Linguistic Theory*. Blackwell, Oxford.
- Schütze, Carson T. 1995. PP attachment and argumenthood. In Carson T. Schütze, Jennifer B. Ganger, and Kevin Broihier, editors, *Papers on language processing and acquisition*. Working Papers in Linguistics 26, MIT, pages 95–151.
- Sportiche, Dominique. 1994. Adjuncts and adjunctions. Presentation at 24th LSRL, UCLA.
- Williams, Edwin. 1994. Remarks on lexical knowledge. *Lingua*, 92:7–34. Reprinted in Lila Gleitman and Barbara Landau, eds., *The Acquisition of the Lexicon*, MIT Press, 1994.

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. That store with the cool stuff has closed
 - b. It has closed
- (3) **One substitution for noun phrases (NPs):**
 - a. That store with the cool stuff has closed
 - b. That one with the cool stuff has closed
 - c. That one has closed
- (4) **Preposing test for phrases:** Only phrases can be preposed. (But we do not claim that all phrases can be preposed!)²
 - 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
- (5) **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
- (6) **Sentence fragment test for phrases:**
 - a. Who came? Maria
 - b. Who came? the president of the student union
 - c. Who came? * the

²Fromkin (2000, p152) says that nouns, adjectives, and adverbs can be preposed. 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!

- (7) **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]

Lecture 5 Heads and non-recursive combinations

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. We saw that **modification** is optional and recursive. There are *red roses*, and then there are *red red roses*, especially in poetry and songs, maybe even *red red red roses*:

Robert Burns. 1759–1796

503. A Red, Red Rose

O MY Luv'e 's like a red, red rose
That 's newly sprung in June:
O my Luv'e 's like the melody
That's sweetly play'd in tune!

from <http://www.bartleby.com/101/503.html>

It's a Red, Red, Red, Red World

Design

It's a Red, Red, Red, Red World
by Andrew Fischler | March 26, 2013 | 10 Comments

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Viewing the World Through Red-Colored Glasses

If you're a frequent visitor to our site, you may have noticed something diff page today. After years of living with a blue color scheme we affectionatel "redaver blue" we've finally gone and put the "red" into Redfin. The new!

from <http://blog.redfin.com/devblog/2013/03/its-a-red-red-red-red-world.html>

 Get the ringtone	Chew tobacco, chew tobacco, chew tobacco, spit
 Play Video	Aw heck Red red red red red red red redneck
 Share	Well the boys 'round here, they're keeping it country ain't a damn one that who knows how to do the dougie
	(You don't do the dougie?) No, not in Kentucky

from <http://www.metrolyrics.com/boys-round-here-lyrics-blake-shelton.html>

AP modification of NP is recursive. We do not treat *red red red* as a word level object, a compound, because each adjective can be modified, as in *very red very red very red rose*. But there are other kinds of rules in the grammar besides modifier rules like

NP → AP NP.

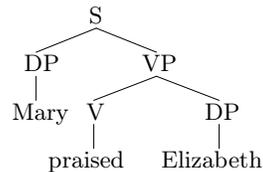
There are rules that are not recursive. (We have seen them already in the trees drawn last week.) One place we see non-recursive rules is in forming verb phrases.

5.1 Arguments of VP

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

- (1) Mary [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).



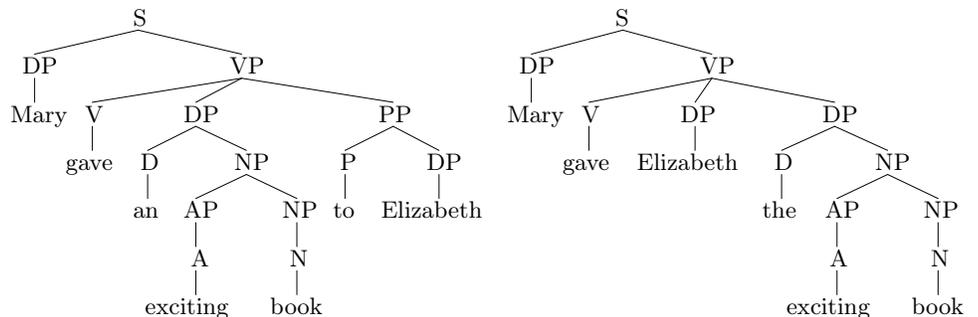
Notice that the DP *Elizabeth* is a **sister** of the head V. In this configuration, the pattern VP → V DP is not recursive.

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

- (2) I [VP gave an exciting book to Elizabeth]

- (3) I [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*).

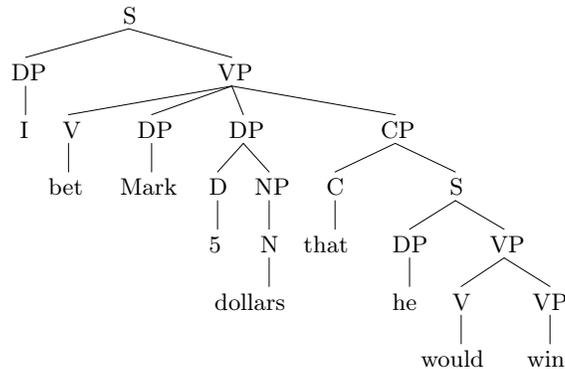


Notice that, in the tree on the right, the DP *Elizabeth* is again a **sister** of the head V. In this configuration, the pattern VP → V DP DP is still not recursive, which fits with the fact that we cannot just stick more DPs into the VP:

- (4) * I [VP gave Elizabeth the book the door Friday Mary Hamlet]

So just a limited number of DP arguments are possible in VPs, in a certain sense which we will try to get clear about.

Some English verbs require 2 complements, like *put*, but I do not know of any that require 3.¹ But some verbs appear to allow a subject and 3 complements, as in *I bet [Mark] [5 dollars] [that they would win]*.



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!

5.2 Modifiers in VP

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

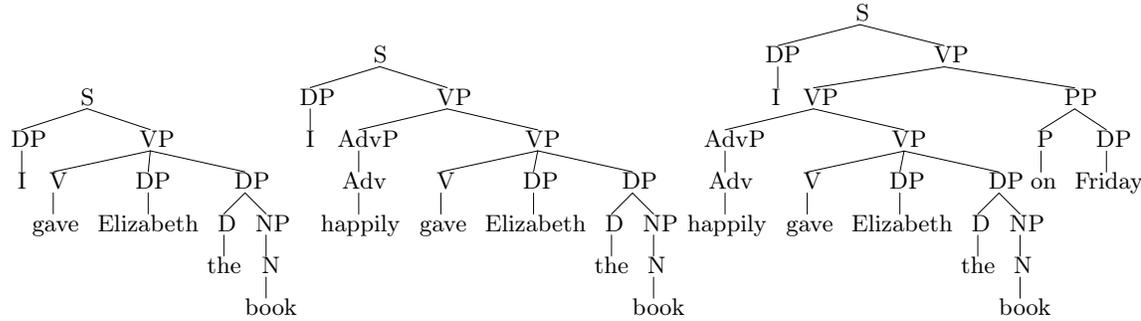
- (9) I [VP gave Elizabeth the book]
- (10) I [VP happily gave Elizabeth the book]
- (11) I [VP happily gave Elizabeth the book on Friday]
- (12) I [VP happily gave Elizabeth the book on Friday in class]
- (13) I [VP happily gave Elizabeth the book on Friday in class with the rest of my notes]
- (14) ...

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

¹It is hard to think of verbs other than *put* which require 2 complements. I know only a few: *hand*, maybe also *set*, *lodge*. In fact, in all languages, the maximum number of obligatory arguments seems to be 3, a subject and two objects, in all human languages. See e.g. Pesetsky 1995, p.183.

- VP → AdvP VP
- VP → VP AdvP
- VP → VP PP
- VP → PP VP

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



Now let's 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.

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 we can list some preliminary indications, some tests to help us distinguish arguments from modifiers.

Tests for modifiers and arguments in VP beginning with the easiest...

- (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 coordinated XPs:**
- a. Robin [_{VP} wrote a book] and [_{VP} sang three songs] [with Sandy.]

Linguists sometimes try trickier kinds of “manipulation” tests – more tests where we consider the possible ways of rephrasing a sentence by rearranging its parts. (You do not need to remember the following ones, and they will not be on the quizzes, but they should be understandable, and we might mention them in class.)

- (23) **modifiers can be left behind in VP-preposing:** Is [with Sandy] a complement of V in [Robin said she would sing a song with Sandy]? No!
- 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].
- (24) **modifiers can modify “do so” VPs:** Is [with Mary] a complement of V in [I sang a song with Mary]? No!
- a. I sang a song with Mary while you did so [with Bill]. (modifier)
 - b. * I saw Bill while you did so [Mary]. (argument)
- (25) **unlike arguments, modifiers are OK in “do what” pseudoclefts:** Is [with Bill] a complement of V in [Mary sang a song with Bill]? No!
- a. What Mary did [with Bill] was sing a song. (modifier PP)
 - b. * What Mary did [Bill] was give a book. (argument NP)

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.²

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.

5.3 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. I think of these as “shortcuts” – These will not be on the quizzes, but it is often useful to think about what the sensible elements of phrases are. For example, 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 that sentences like the following are very odd (Fromkin (2000, pp.129,227) uses ! to mark these odd sentences):

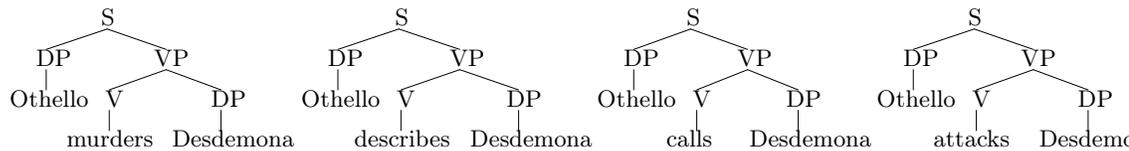
²For those who want to do more reading, there is a big literature on this rather tricky distinction between modifiers and arguments. See for example Tutunjian and Boland (2008); Koenig, Maurer, and Bienvenue (2003); Schütze (1995).

(26) ! the rock murdered the tree

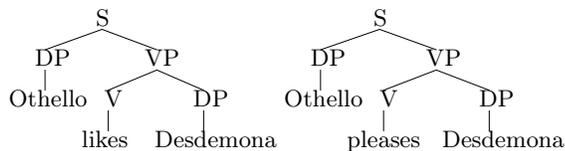
(27) ! the forest described Macbeth

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(ematic)-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 – Fromkin (2000) 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.

5.4 Syntactic rules

In class, we showed how the tree structures we draw correspond to rules that tell us how each constituent can be formed. For example, we see in each of the trees just displayed above that each S “node” has two children – a DP and a VP. We represent this fact with a “phrase structure rule”: $S \rightarrow DP VP$. 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)	$S \rightarrow DP VP$	
(124a)	$DP \rightarrow \left\{ \begin{array}{l} (D) NP \\ \text{Name} \\ \text{Pronoun} \end{array} \right\}$	
(123)	$NP \rightarrow N \left(\left\{ \begin{array}{l} PP \\ CP \end{array} \right\} \right)$	
(130)	$VP \rightarrow V (DP) \left(\left\{ \begin{array}{l} PP \\ CP \\ VP \\ AP \end{array} \right\} \right)$	
(120)	$PP \rightarrow P (DP)$	
(122)	$AP \rightarrow A (PP)$	
(138)	$CP \rightarrow C S$	
	$AdvP \rightarrow Adv$	
	(123')	$NP \rightarrow (A) N (PP)$
	(73c.iii)	$NP \rightarrow AP NP$
		$NP \rightarrow NP PP$
		$VP \rightarrow AdvP VP$
		$VP \rightarrow VP AdvP$
		$VP \rightarrow VP PP$
		$AP \rightarrow AdvP AP$
	$\alpha \rightarrow \alpha \text{ Coord } \alpha$	(for $\alpha=S,D,V,N,A,P,C,Adv,VP,NP,AP,PP,AdvP,CP$)

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.³ And **remember that the non-recursive rule like $VP \rightarrow V DP$ can only apply when it respects the lexical requirements of the head.** Each head must ‘select’ its complement. The requirements of a head are both syntactic, having to do with categories, and semantic, having to do with meaning.

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

³These rules are slightly simpler and more general than the “complete list of phrase structure rules” on page 175 of Fromkin (2000). Our rules differ primarily in these respects:

- the “complete list” given by Fromkin (2000, p175) 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.
- Fromkin (2000) does provide rule (123’) on page 165, but once we have (73c.iii) also from page 165, we can eliminate (123’).
- To allow sentences like *cats sleep*, we need to allow the determiner in rule (124a) to be either unpronounced (“empty”) or optional.
- We add a rule for coordinate structures. This rule is special, because it works on so many categories.

the policy of underlining the subject argument, so that we will not distinguish it from the complements.

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

(28) John knows [CP that [S Mary laughs]]

(29) 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:

(30) John knows [S her to be a dedicated linguist]

(31) 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 Fromkin (2000, p231) except that we will indicate the subject by underlining, so that it can be distinguished from the complements. (Here I also indicate the “roles” of the subject and object.)

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

5.5 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:

- (32) He looked [PP up]
 (33) He looked [PP up [DP the chimney]]
 (34) He walked [PP up [PP to the chimney]]
 (35) He is [PP beside [DP me]]
 (36) He walks [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:

- (37) They destroyed Sarajevo in 1993

In a similar way, the phrase [PP *of Sarajevo*] seems to be an of N in the sentence:

- (38) The destruction of Sarajevo in 1993 was terrible

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

- (39) * They destroyed in 1993 Sarajevo
 (40) ?? 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

- (41) The argument [of the noun] [in this sentence] is familiar
 (42) ?? The argument [in this sentence] [of the noun] is familiar

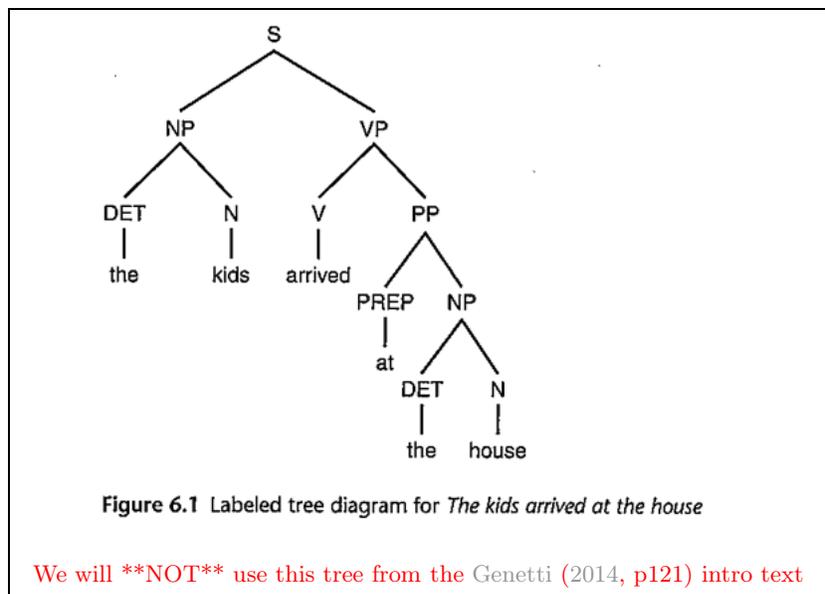
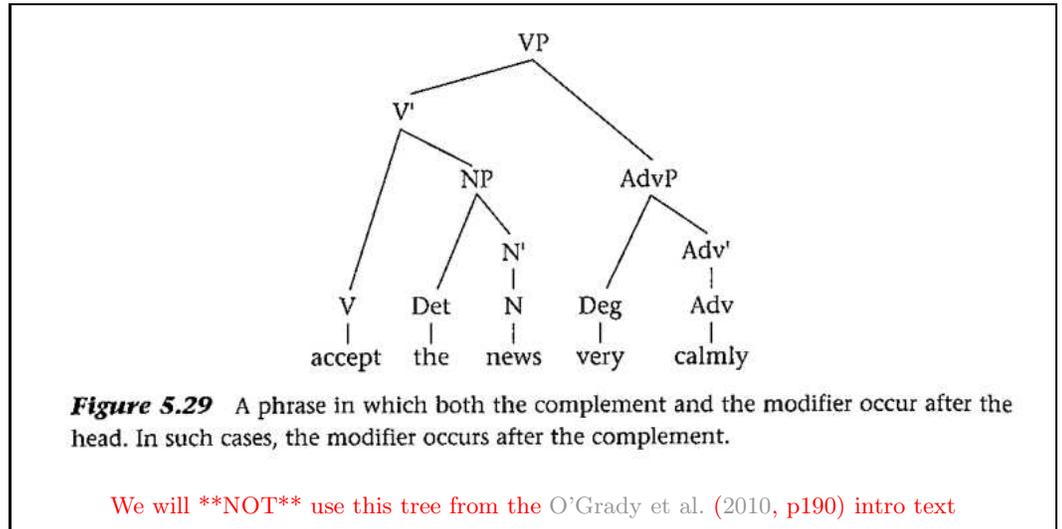
In this case too, we say [*of the noun*] is a argument, a sister of the N *argument*, but [*in this sentence*] is a modifier, a sister of NP.

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

- (43) That was [AP clever]
 (44) That was [AP clever [PP of Mary]]
 (45) It is [AP important]
 (46) It is [AP important [PP to Bill]]

5.6 Digression: Some intro texts are not careful

Most introductory texts do not draw trees in a way that indicates which rules are recursive:



If you do not see what is wrong with these trees, re-read this chapter of the notes!

5.7 Review so far.

Considering VPs, we went over the distinction between complements and adjuncts (arguments and modifiers). Usually this distinction is easy – roughly, the complements name ‘participants’ in the event while the modifiers say something about why, where, when, or how. But the distinction between argument and modifier can be 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.

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 46.

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 the syntax so far. The things traditionally called the subject and the (direct or indirect) objects of the verb are **arguments**, typically naming **participants** in some sense. The object and indirect object are **complements**, sisters of the V. An argument can be a DP, PP, CP, or other category:

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:

- (47) **Optionality:** arguments are sometimes required, sometimes optional. Modifiers are always optional.
- (48) **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
- (49) **modifiers can modify coordinated VPs:**
 - a. Robin [_{VP}[_{VP}wrote a book] and [_{VP} sang three songs]] with Sandy.
- (50) **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}].

References and further reading

- Fromkin, Victoria, editor. 2000. *Linguistics: An Introduction to Linguistic Theory*. Blackwell, Oxford.
- Genetti, Carol, editor. 2014. *How Languages Work: An Introduction to Language and Linguistics*. Cambridge University Press, NY.
- Koenig, Jean-Pierre, Gail Mauner, and Breton Bienvenue. 2003. Arguments for adjuncts. *Cognition*, 89:67–103.
- O’Grady, William, John Archibald, Mark Aronoff, and Janie Rees-Miller. 2010. *Contemporary Linguistics: An Introduction (Sixth Edition)*. Bedford, Boston.
- Pesetsky, David. 1995. *Zero Syntax: Experiencers and Cascades*. MIT Press, Cambridge, Massachusetts.
- Schütze, Carson T. 1995. PP attachment and argumenthood. In Carson T. Schütze, Jennifer B. Ganger, and Kevin Broihier, editors, *Papers on language processing and acquisition*. Working Papers in Linguistics 26, MIT, pages 95–151.
- Tutunjian, Damon and Julie E. Boland. 2008. Do we need a distinction between arguments and adjuncts? *Language and Linguistics Compass*, 2(4):631–646.

Lecture 6 Sentences and first glimpse of movement

We have talked about various kinds of phrases: DPs and VPs, with brief mention of APs, AdvPs, PPs. Now let's consider more carefully how these let us build sentences. The sentences we have seen so far have a DP and a VP, a 'subject' and a 'predicate'. We will call sentences 'clauses', along with a whole range of constructions that have a subject and predicate, and we will assign them more specific categories.

6.1 Clauses as complements of a verb

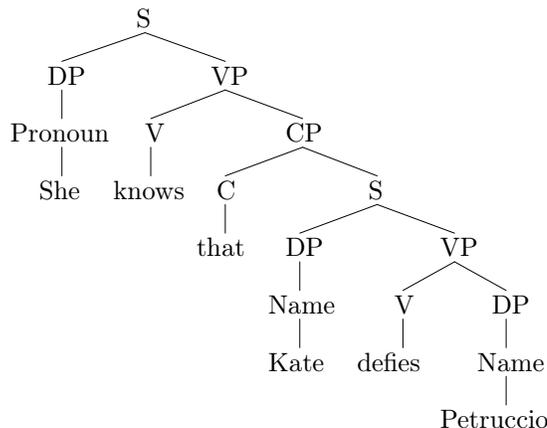
Consider the sentence-like phrases, the clauses, in brackets:

[_S Kate defies Petruccio]	simple clause
She knows that [_S Kate defies Petruccio]	tensed clausal complement of V
She wonders whether [_S Kate defies Petruccio]	tensed clausal complement of V
She prefers for [_S Kate to defy Petruccio]	infinitival clause complement of V
She prefers [_S Kate's defying Petruccio]	'possessive-ing clause complement of V
The claim that [_S Kate defies Petruccio] is true	clausal complement of N
She sees [_S Kate defy Petruccio]	small clause complement of V

Let's consider *that*-clause complements of V first:

She knows that [_S Kate defies Petruccio]

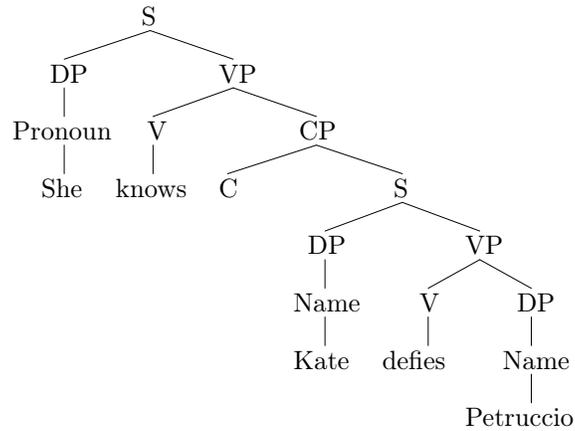
What is the complement of the verb *knows* here? This particular kind of *that* is called a **complementizer** and so a standard idea is that here we have the verb selecting a **complementizer phrase (CP)**:



The important point about this tree is the phrase CP formed from the C *that*: this kind of complementizer phrase is selected by *knows*. The phrase structure rule that allows this can be formulated this way:

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

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:



(If C can be silent, it could be that *cats sleep* is really $[_{CP} C [_{S} \textit{cats sleep}]]$, where C is not pronounced. As we will see later, this does slightly simplify things.)

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

$$\begin{aligned} CP &\rightarrow C S \\ VP &\rightarrow V CP \end{aligned}$$

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

- He dives from the cliff
- * He dives the ocean
- * 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*:

- He knows whether Kate defies Petruccio
- He knows that Kate defies Petruccio
- He knows 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 each verb, and so we assume it is represented in the lexicon:

word	category	arguments
<i>laugh</i>	V	<u>DP</u>
<i>devour</i>	V	<u>DP</u> DP
<i>put</i>	V	<u>DP</u> DP PP
<i>know</i>	V	<u>DP</u> CP

6.2 Auxiliary verbs and c-selection

When we consider sentences with auxiliary verbs, a simple pattern is easy to see:

He eats.	He is eating.	He has been eating.	He might have been eating.
		He has eaten.	He might have eaten.
			He might be eating.
			He might eat.

We 3 auxiliary verbs in the top right, and we can see that other orders of those auxiliaries are no good:

- * He have might been eating
- * He might been eating
- * He is have eaten
- * He has will eat

So the regularities can be stated informally as follows:

- (1) English auxiliary verbs occur in the order MODAL HAVE BE. So there can be as many as 3, or as few as 0.
- (2) A MODAL (when used as an auxiliary) is followed by a tenseless verb, [-TNS]
- (3) HAVE (when used as an auxiliary) is followed by a past participle, [PASTPART]
- (4) Be (when used as an auxiliary) is followed by a present participle, [PRESPART]
- (5) 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:¹

word	category	complements
<i>will, would, shall, should, may, might, must, can, could</i>	V[+TNS]	VP[-TNS]
<i>has, have, had</i>	V[+TNS]	VP[PASTPART]
<i>is, are, was, were</i>	V[+TNS]	VP[PRESPART]

Previously, we have discussed tensed forms of various verbs, but now we will consider infinitive forms, and present and past participles.

While it is natural to think of the verb in a simple sentence like *he dived off the cliff* as having a subject, the **agent** of the diving, it is not so natural to think of the auxiliary in *he is diving* as having a subject. Auxiliary verbs do not have subjects (at least, not in the way that

¹Many of these auxiliary verbs have other uses too, which will require other entries in the lexicon. Consider, for example:

He willed me his fortune. His mother contested the will.	(WILL as main V, or N)
They can this beer in Canada. The can ends up in California.	(CAN as main V, or N)
The might of a grizzly bear is nothing to sneeze at.	(MIGHT as N)
I have hiking boots.	(HAVE as main V)
I am tall.	(BE as main V)

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). We also list here the participle forms that do not need to be in the lexicon since they can be derived by regular morphological processes:

word	category	arguments
<i>have</i>	V[-TNS]	VP[PASTPART]
<i>having</i>	V[PRESPART]	VP[PASTPART]
<i>had</i>	V[PASTPART]	VP[PASTPART]
<i>be</i>	V[-TNS]	VP[PRESPART]
<i>being</i>	V[PRESPART]	VP[PRESPART]
<i>been</i>	V[PASTPART]	VP[PRESPART]
<i>laugh</i>	V[-TNS]	<u>DP</u>
<i>laughing</i>	V[PRESPART]	<u>DP</u>
<i>laughed</i>	V[PASTPART]	<u>DP</u>
<i>murder</i>	V[-TNS]	<u>DP</u> DP
<i>murdering</i>	V[PRESPART]	<u>DP</u> DP
<i>murdered</i>	V[PASTPART]	<u>DP</u> DP
<i>give</i>	V[-TNS]	<u>DP</u> DP (DP)
<i>giving</i>	V[PRESPART]	<u>DP</u> DP (DP)
<i>given</i>	V[PASTPART]	<u>DP</u> DP (DP)

6.3 Yes/no-questions

Turning to simple yes/no questions, we see that they seem to simply put the first auxiliary verb in front:²

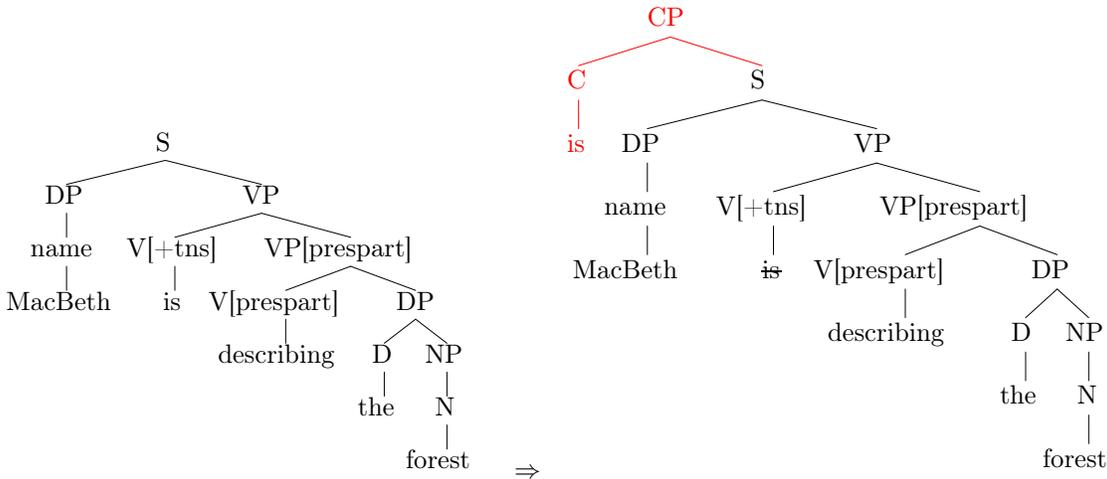
He is diving.	He has dived.	He has been diving.	He might have been diving.
Is he diving?	Has he dived?	Has he been diving?	Might he have been diving?

Importantly, the verb following the auxiliary is not changed, so it is natural to propose that the auxiliary verb moves after its selection requirements have been met. In the tree, 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): The highest auxiliary in a tensed sentence can be preposed to C to make a question.

If we are not already assuming that the sentence begins with an empty C, we add one, like this:

²Cf. Fromkin (2000, pp257-300).



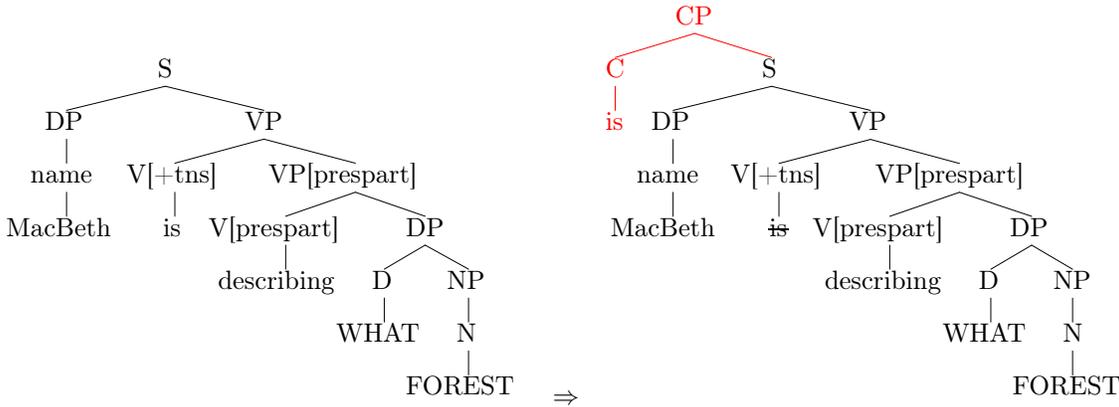
(Draw an arrow from V[+tns] to to make clear what happened here!)

The structure added by the rule is shown in red.

What about questions with wh-words? Well, notice first that, with stress and question intonation (rising pitch), English allows “echo questions” like this, where the wh-phrase is right where we expect an object to be:

Macbeth is describing WHAT FOREST?
 Is Macbeth describing WHAT FOREST?

Notice that the first question not a yes/no question, but the second one is.



But that kind of question is very unusual. With normal question intonation, we would of course just say

What forest is Macbeth describing?

What is the structure of this more normal wh-question?

6.4 Wh-questions

It is natural to regard *which problem* as the object, the theme of *describe*, in both:

I know [he is describing WHICH PROBLEM]?

I know [which problem John is describing].

And that idea fits with the lexical requirements of *describe*, a verb that requires both a subject and an object. And if *which problem* is the object in the second sentence, that explains why it is no good to put another object in that position too:

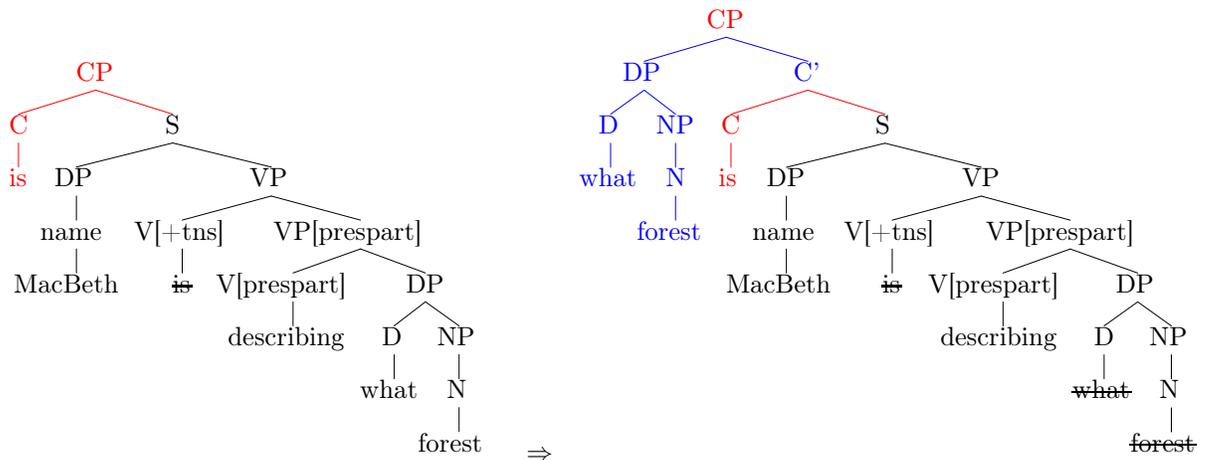
* Which problem is John describing the book?

In the embedded question above, we want to say that *which problem* is still the object of *describe*, even though it is not in the usual object position. **The wh-phrase is preposed.**

We allow this with the following rule for forming (non-echo) wh-questions:

wh-movement: A phrase containing a wh-word can be preposed to attach to CP.

When we draw the structure that results from wh-movement, we cross out the original unpronounced material, and we also introduce an intermediate phrase C', shown in blue here:



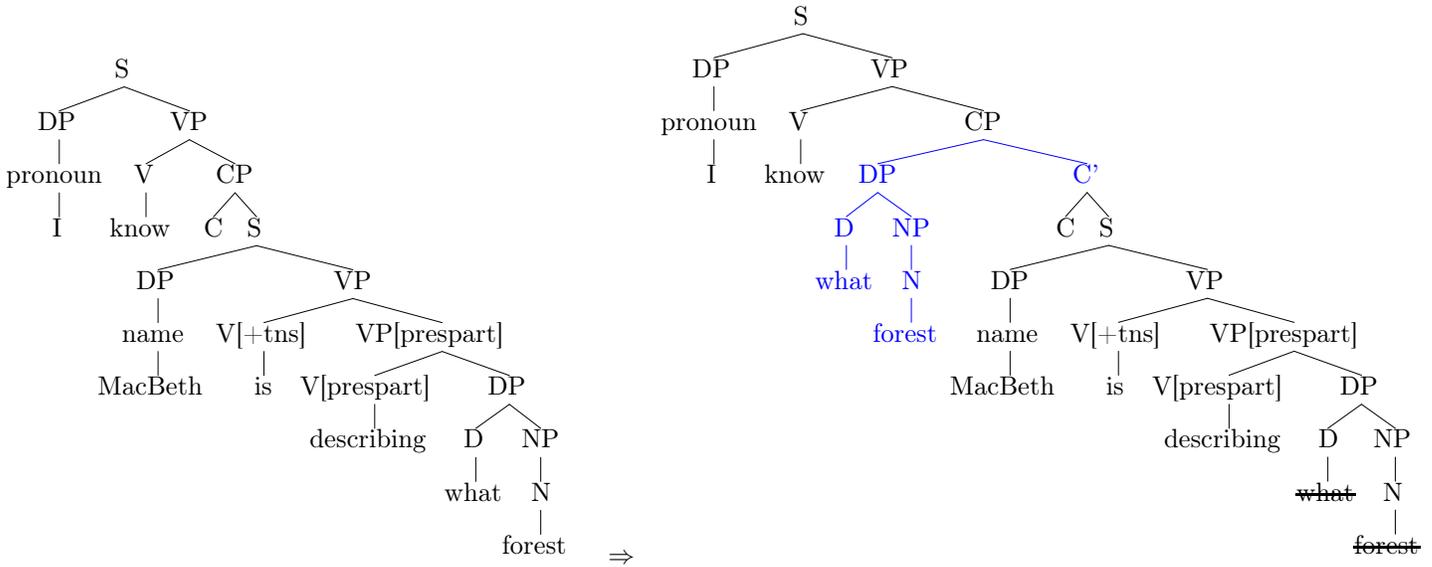
Notice that in the on the left tree above, subj-aux inversion has already applied (shown in red). When the same question is embedded, subj-aux inversion does not apply:

What forest is Macbeth describing?

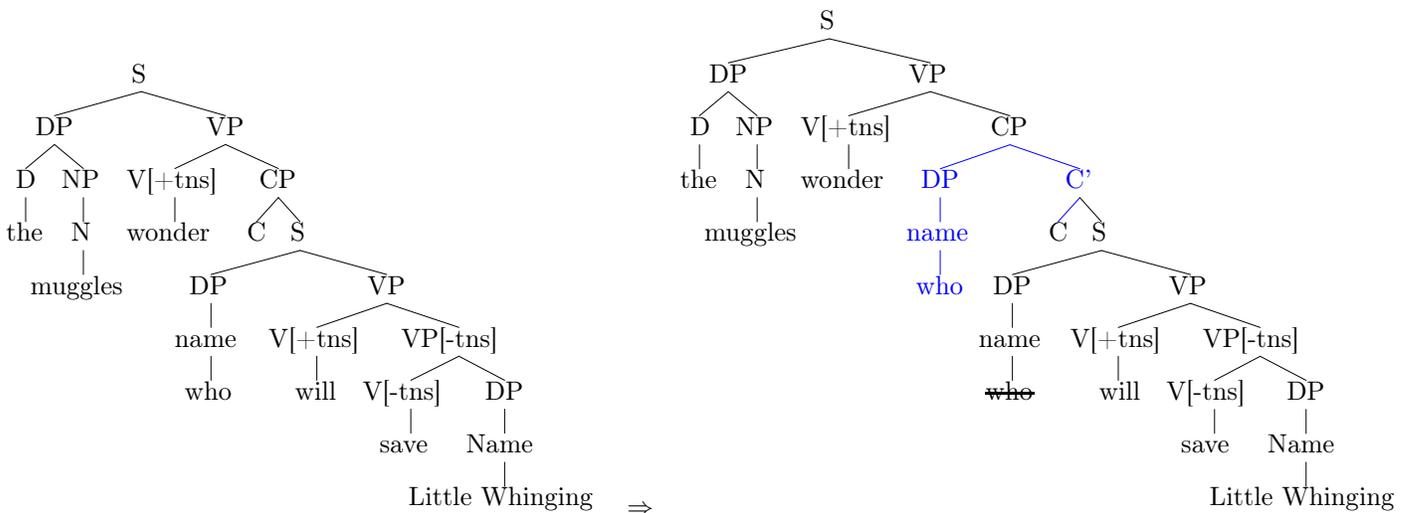
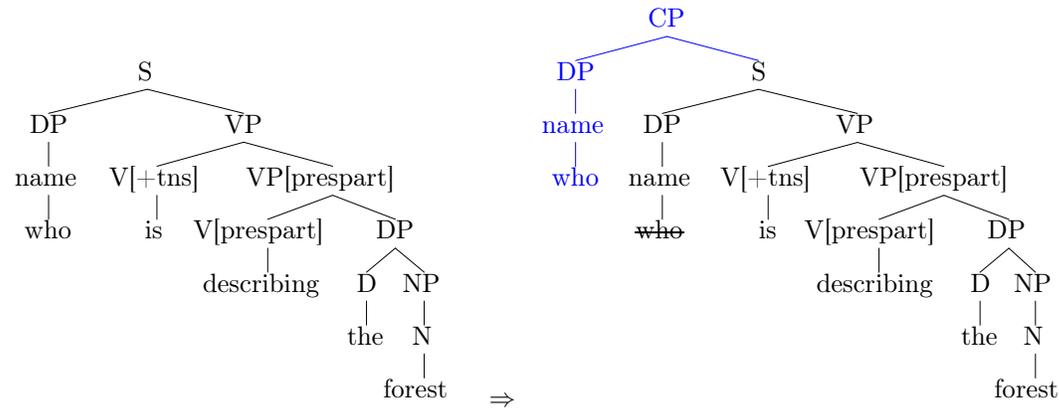
* I know [what forest is Macbeth describing].

I know what forest Macbeth is describing.

So in this latter case we have a structure like this, where we cross out the ~~moved material~~:



Let's assume that wh-questions are always CPs. So when the question is about the subject, and not an echo question with special stress, let's assume that there is movement in this case too:



6.5 Summary

6.5.1 Lexical requirements

This page, page 60 of these notes, will be provided during quiz1. You do not need to memorize it! You just need to be able to use it.

	word	category	arguments
	<i>laugh, cry</i>	V	<u>DP</u>
	<i>devour</i>	V	<u>DP</u> DP
	<i>eat</i>	V	<u>DP</u> (DP)
	<i>drink</i>	V	<u>DP</u> (DP)
	<i>consume</i>	V	<u>DP</u> DP
	<i>write</i>	V	<u>DP</u> (DP) (PP)
	<i>draft</i>	V	<u>DP</u> DP (PP)
	<i>pen</i>	V	<u>DP</u> DP (PP)
	<i>put</i>	V	<u>DP</u> DP PP
	<i>give</i>	V	<u>DP</u> (DP) (PP)
	<i>think, know, believe</i>	V	<u>DP</u> CP
	<i>wonder, question, doubt</i>	V	<u>DP</u> CP[+wh]
	<i>will, would, shall, should, may, might, must, can, could</i>	V[+TNS]	VP[-TNS]
	<i>has, have, had</i>	V[+TNS]	VP[PASTPART]
	<i>be, is, are, was, were</i>	V[+TNS]	VP[PRESPART]
	<i>with, without, to, from, into</i>	P	DP
	<i>up, down, around</i>	P	(DP)
	<i>that</i>	C	S
	<i>that</i>	D	(NP)
	<i>the</i>	D	NP

6.5.2 Phrase structure

<u>selection</u>	<u>modification</u>
S → DP VP	NP → AP NP
DP → $\left\{ \begin{array}{l} \text{(D) NP} \\ \text{Name} \\ \text{Pronoun} \end{array} \right\}$	NP → NP PP
NP → N (PP)	NP → NP CP
VP → V (DP) $\left(\left\{ \begin{array}{l} \text{PP} \\ \text{CP} \\ \text{VP} \end{array} \right\} \right)$	VP → AdvP VP
PP → P (DP)	VP → VP PP
AP → A (PP)	AP → AdvP AP
CP → C S	
CP → C'	
C' → C S	
AdvP → Adv	
$\alpha \rightarrow \alpha \text{ Coord } \alpha$	for $\alpha = \text{D, V, N, A, P, C, Adv, VP, NP, AP, PP, AdvP, CP}$

6.5.3 Movement rules

wh-movement: A phrase containing a wh-word can be preposed to attach to CP.

Subj-Aux inversion: A tensed auxiliary Verb can move to attach to C

6.5.4 Case

We have seen various examples of DPs:

Mary, Elizabeth, Bill	(proper names)
I, you, he, she, it, we, they	(nominative case pronouns)
me, you, him, her, it, us, them	(accusative or objective case pronouns)
my, your, his, her, its, our, their	(genitive case or possessive pronouns)
an exciting book, the door, the car, the garage	(descriptions)

Now it is easy to be more precise about how the form of the pronominal DP depends on its position in the structure. In English:

English case marking

- A DP subject of a tensed clause is nominative case.
- A DP complement of a verb is accusative (objective) case.
- A DP complement of a preposition is accusative (objective) case.

6.5.5 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,

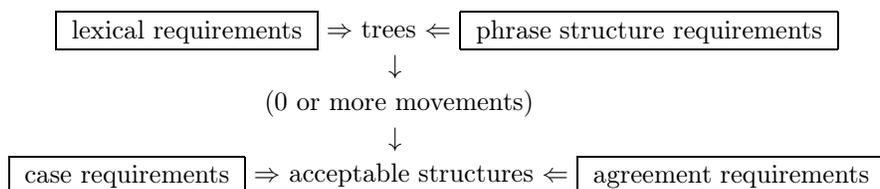
- She is[+TNS] smart!
 * She are[+TNS] smart!
 She is[+TNS] describing[prespart] the solution
 * She are[+TNS] describing[prespart] the solution
 She prefers[+TNS] for us to solve[-TNS] it
 * She prefer[+TNS] for us to solve[-TNS] it

Looking at just the highest verb for the moment, we see that it agrees with the subject. This is a completely familiar idea:

English subject-verb agreement: A present tense verb must agree with its subject.

6.5.6 The big picture, so far

Our goal is not a complete grammar for English or any other language, but just to understand what grammars are like, what kinds of rules they must have. The picture so far looks something like this, where we see that several different kinds of requirements must all be met:



Chomsky (1956) noticed that we need more than phrase structure rules to describe the patterns in human languages in a reasonable way, and pioneered the first steps toward ‘generative’ conceptions of grammar. More recent studies of grammars with movement show that

they can describe patterns that no set of phrase structure rules can describe, no matter how complex the phrase structure rules are (Peters and Ritchie, 1973; Savitch et al., 1987; Koble, 2010). Defining simple languages of arithmetic or standard programming languages does not require movement rules, but human languages do need these (or something with equivalent descriptive power).

References and further reading

- Chomsky, Noam. 1956. Three models for the description of language. *IRE Transactions on Information Theory*, IT-2:113–124.
- Fromkin, Victoria, editor. 2000. *Linguistics: An Introduction to Linguistic Theory*. Blackwell, Oxford.
- Koble, Gregory M. 2010. Without remnant movement, MGs are context-free. In *MOL 10/11, Lecture Notes in Computer Science 6149*, pages 160–173.
- Peters, P. Stanley and R. W. Ritchie. 1973. On the generative power of transformational grammar. *Information Sciences*, 6:49–83.
- Savitch, Walter J., Emmon Bach, William Marsh, and Gila Safran-Naveh, editors. 1987. *The Formal Complexity of Natural Language*. Reidel, Boston.

Lecture 7 Clauses, tense, and questions

We have observed that simple sentences have tense, but some other clauses don't. If we just add the requirement [+tns] to our sentences, then we need a separate account for infinitival clauses. Is there a better way to say what's going on with tense? Why does it always show on the "first" verb (in some sense of "first")?

- Marie will[+tns] have been eating cake
- * Marie will[+tns] has[+tns] been eating cake
- * Marie will[+tns] have is[+tns] eating cake
- Marie has[+tns] been eating cake
- * Marie has[+tns] is[+tns] eating cake

But this is not always the case:

The desire to succeed[-tns] in business drove[+tns] her on
 For Marie to succeed[-tns] is[+tns] all that matters

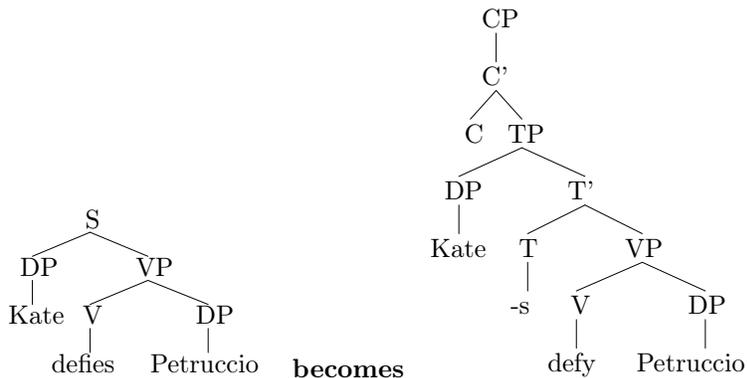
What's going on here?

One standard proposal is that simple sentences are Tense Phrases, TPs (Fromkin, 2000, pp160,181-2).

(1) sentences are TPs

This idea may seem rather surprising, but as we will see, it allows sentences to look very similar to DPs, CPs, PPs and other phrases. And it explains why the first verb in a sequence of auxiliaries and main verbs is always the tensed one.

Putting the TP proposal together with our earlier idea about CPs, the idea is that T precedes the VP and that we should elaborate our tree structures like this:

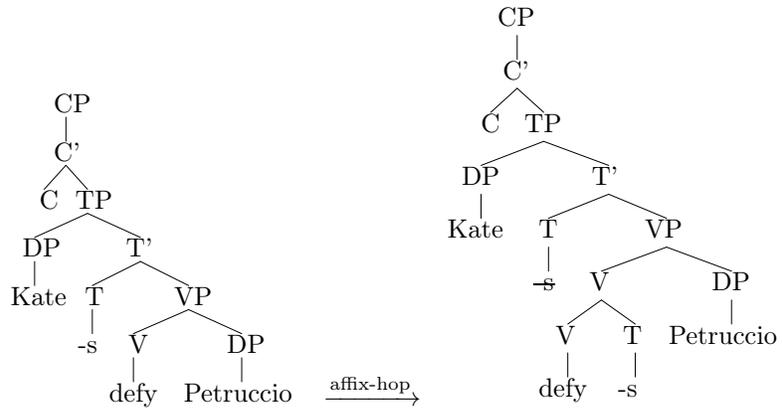


The idea then is that somehow, *-s defy* gets pronounced as the appropriate, tensed form *defies*. How is this possible when they are in the wrong order?

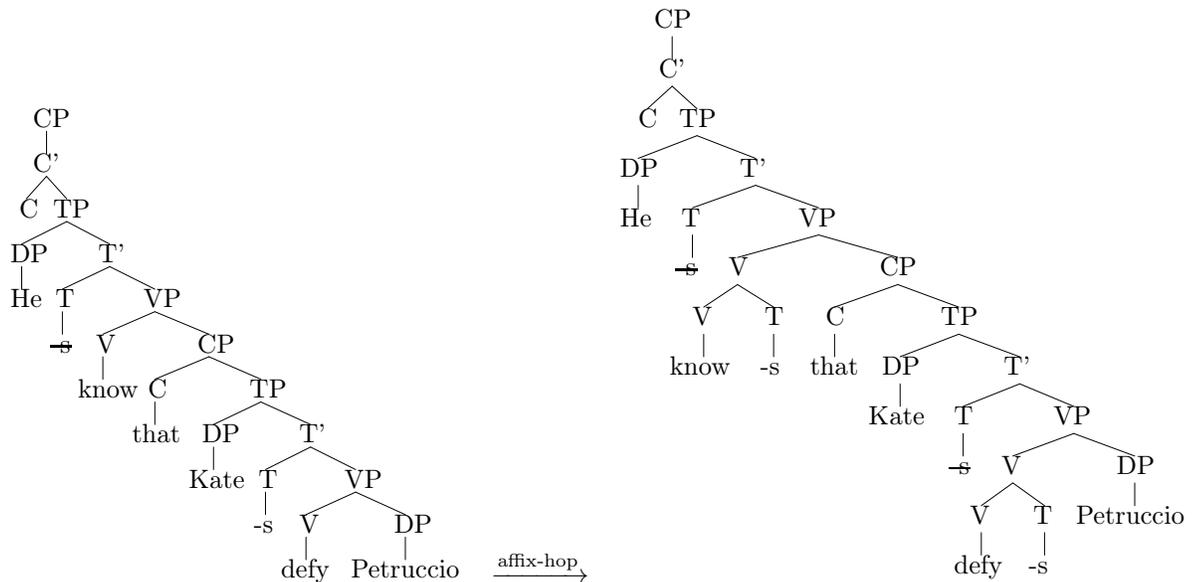
How does the tense affix get onto the verb? The simplest idea is that an affix can just hop onto an adjacent verb, so let's propose this new movement rule, restricting it to this particular case:

Affix hopping: A tense suffix can move down to the main verb, if the main verb is the head of the VP that T selects.

So affix hopping applies in our example:¹

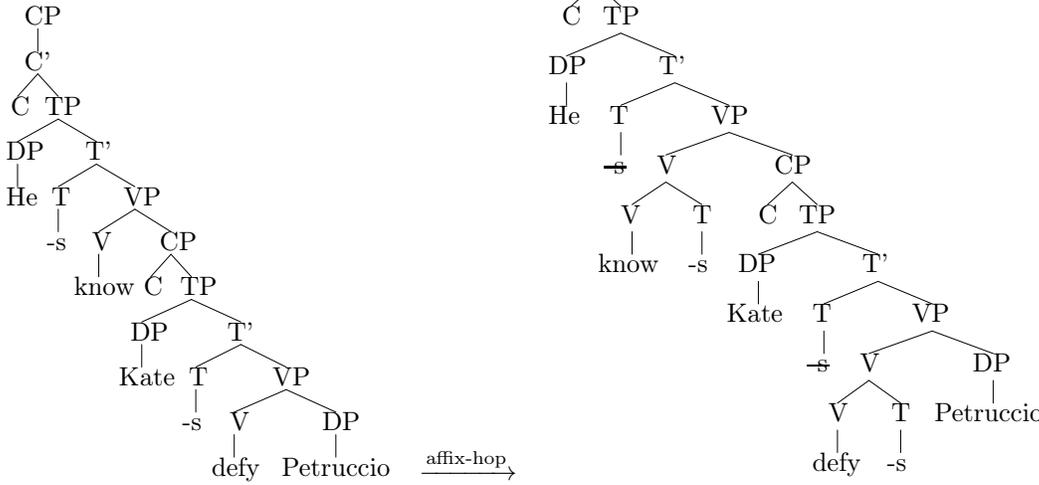


This structure is exactly the same when it appears as the complement of a verb:



And of course the structure is exactly the same even when the complementizer position C does not have *that* in it:

¹In the trees on this page I label “defy -s” and “know -s” simply V, but in class I wrote V[+tns] and included the original categories V and T too. These morphological details will be untangled if you take more syntax classes. For now, this simple labelling (or the one in class) is good enough.

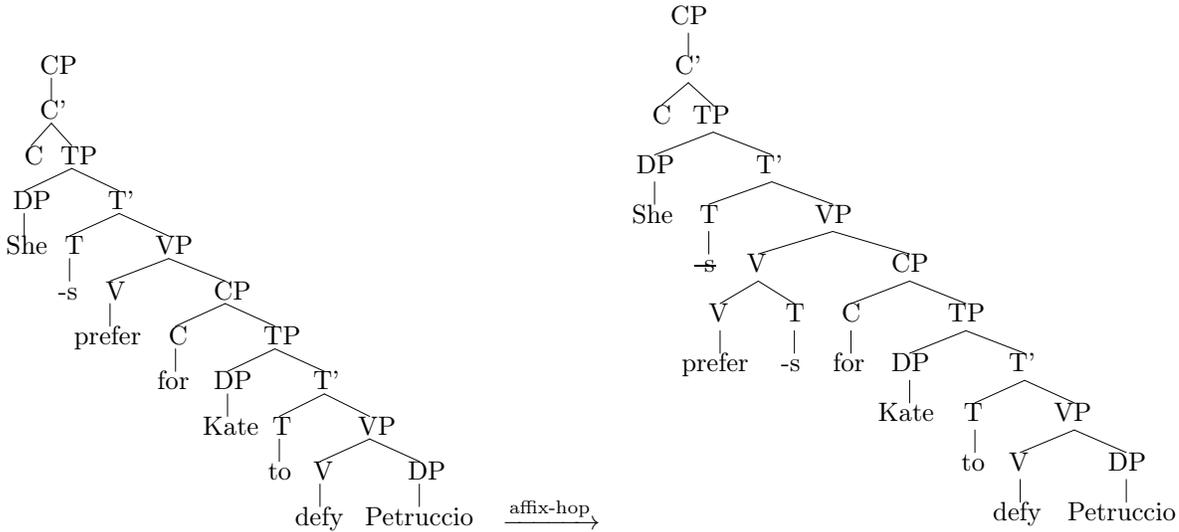


(Especially in these trees where you must look carefully to see which affixes are crossed out, it is a good exercise to draw arrows in these trees from the T where -s starts, to the position where it ends up after affix hopping!)

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 (30) on page 48?

With the new structures we are drawing for sentences, we can assume that the structure of (30) is almost exactly the same, if *for* can be a complementizer:



Notice that we cannot put prepositions like *to*, *with*, *by*, *up*, *down* in place of *for*. This fits with the idea that *for* is playing a different kind of role. We will assume that it is a C. And 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.

7.1 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?

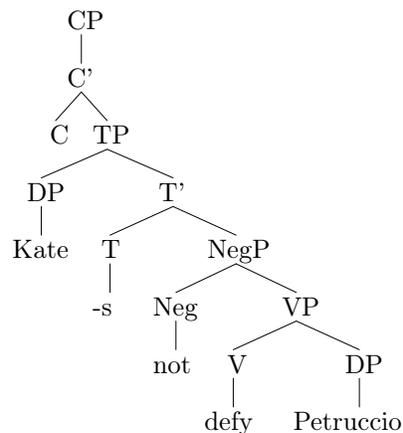
So what about DO? It does not act like the other auxiliaries:

- (8) Othello did it
- (9) *Did Othello it?

It is also easy to see that when an object is questioned, as in (??), 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]

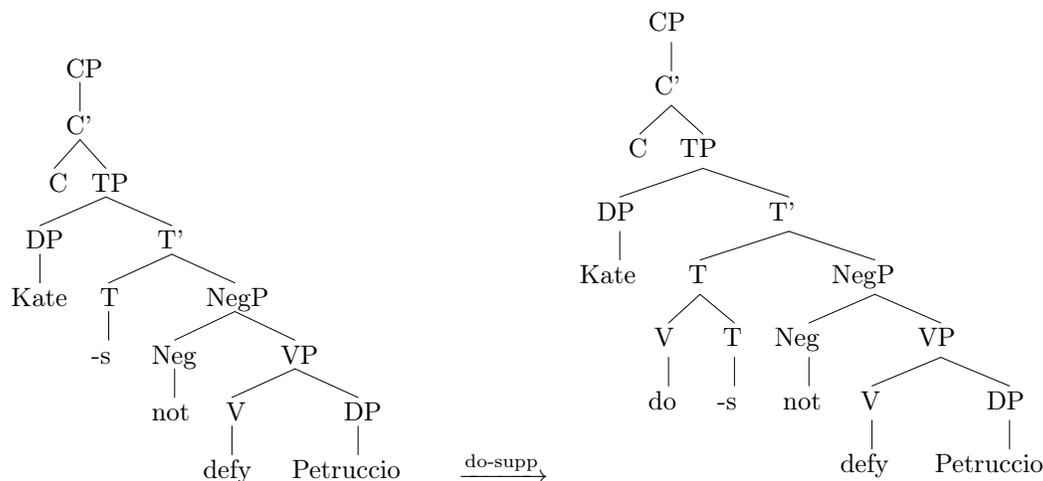
Why is this? When we look at the structure here, it suggests the simple idea that the *not* gets in the way of affix hopping:



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.

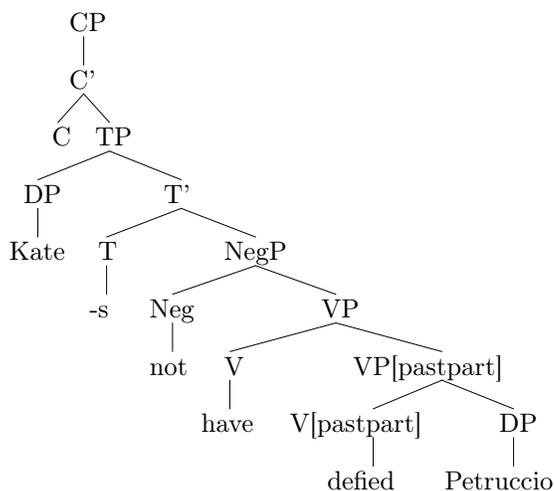
So we get:



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

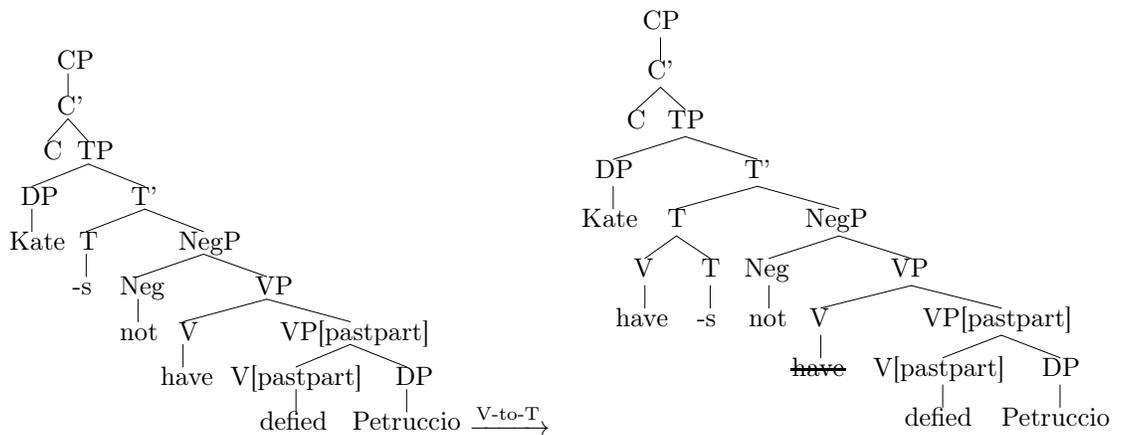
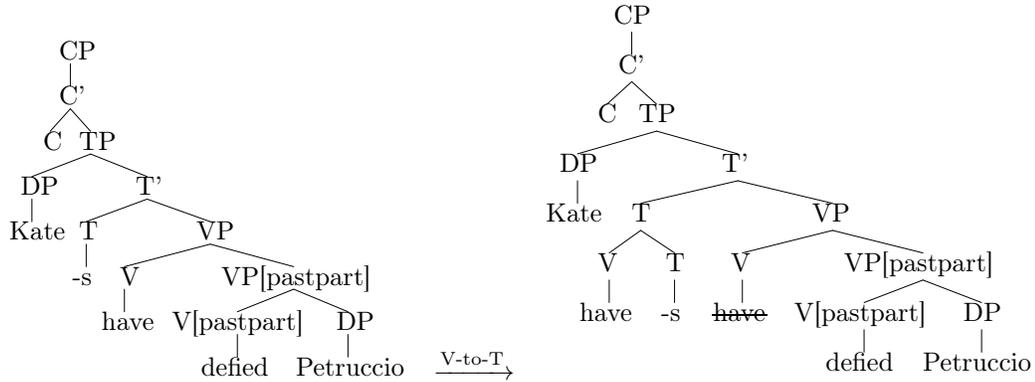
These examples suggest that the way an auxiliary verb gets associated with tense suffixes is different from the way that main verbs do. How could these auxiliaries get associated with T properly, even when there is a *not*. Consider the structure:



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 the aux verb is the head of the VP that T selects.

If we assume that this rule is not blocked by negation, then we get:



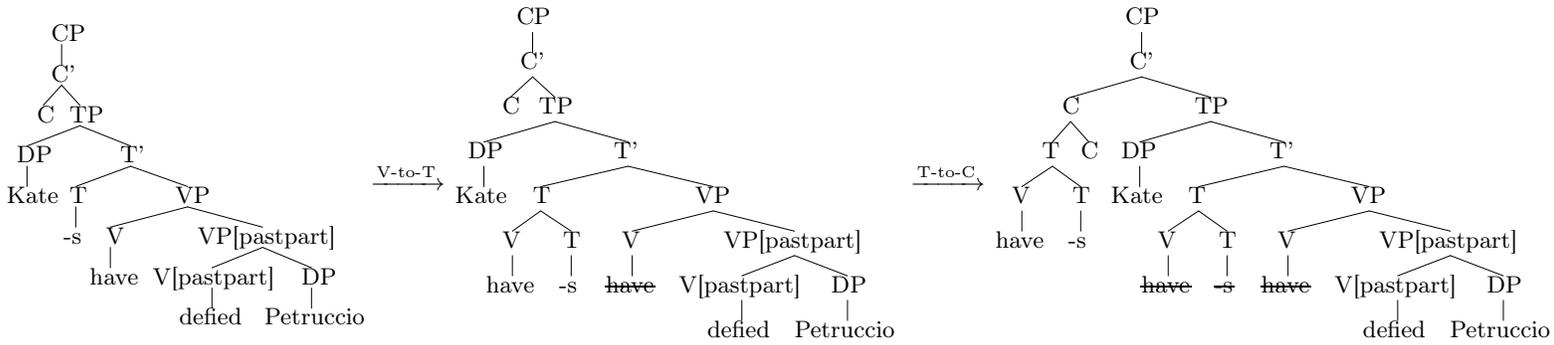
(It's a good exercise to draw an arrow again to indicate the movement from V to T.)

7.1.1 Subject-Auxiliary inversion again

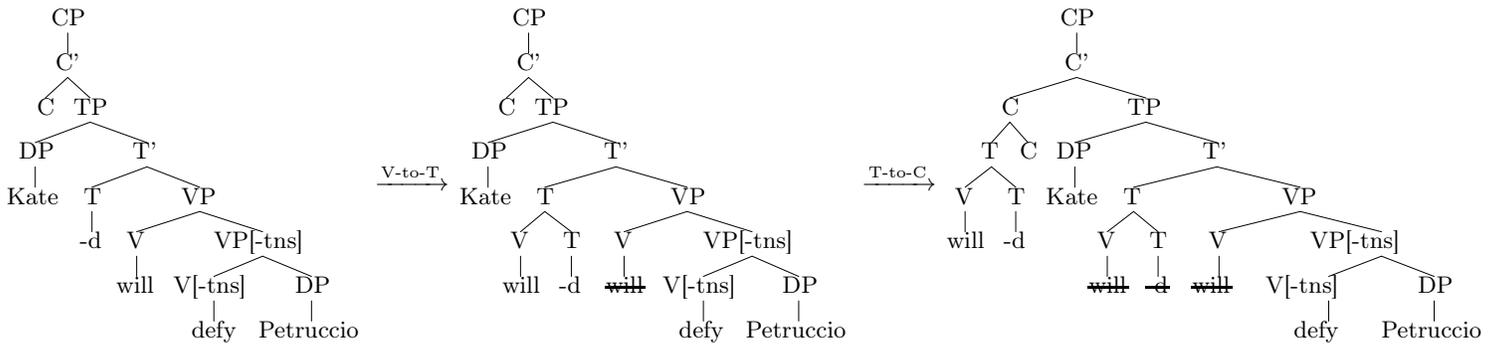
Now that we have modified our structures (using CP and TP instead of S), and we have put the tense suffixes under T, it is worth considering Subject-Auxiliary inversion again. It can now be expressed in this very simple form!

T-to-C head movement T can raise to empty C,
if T is the head of the TP that C selects.

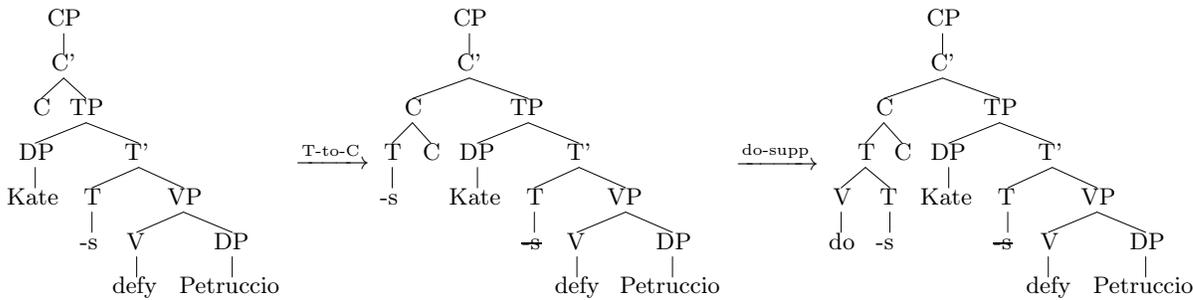
So the steps in deriving *Has Kate defied Petruccio* are these:



Some auxiliaries contain both a verb or modal and the past tense morpheme. For example, will can be analyzed as will + -d. So we derive:



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.



(Here we could have labeled the verb V[-tns], since it does not combine with T. For practice, make sure again that you can draw the arrows in the derived trees indicating all the movements that have been done.)

A tricky detail. Usually main verbs cannot move, as we expect if V-to-T movement does not apply to them:

- (21) * Runs she ____ the marathon?
- (22) * Has she ____ a knee injury? (acceptable in some dialects, not standard American)

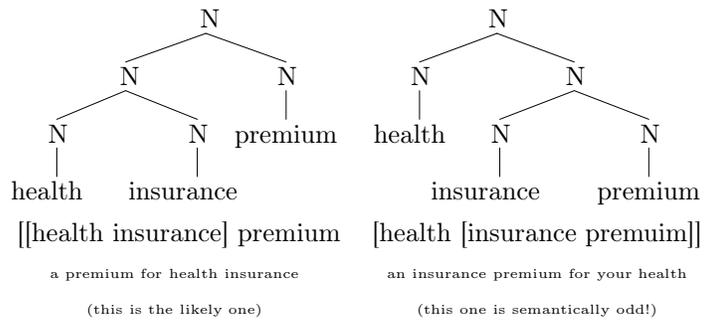
But BE seems special – it acts like an auxiliary verb even when it is the only verb in the sentence, as in (24):

- (23) Is she ____ running the marathon? (BE as aux verb)
- (24) Is she ____ a runner? (BE as main verb)

So we need to assume that, unlike HAVE in (22), when BE is the only verb in the sentence, as in (24), it acts an auxiliary: V-to-T, and possibly also T-to-C, can apply. In contrast, in American English, HAVE acts like a main verb when it is the only verb.

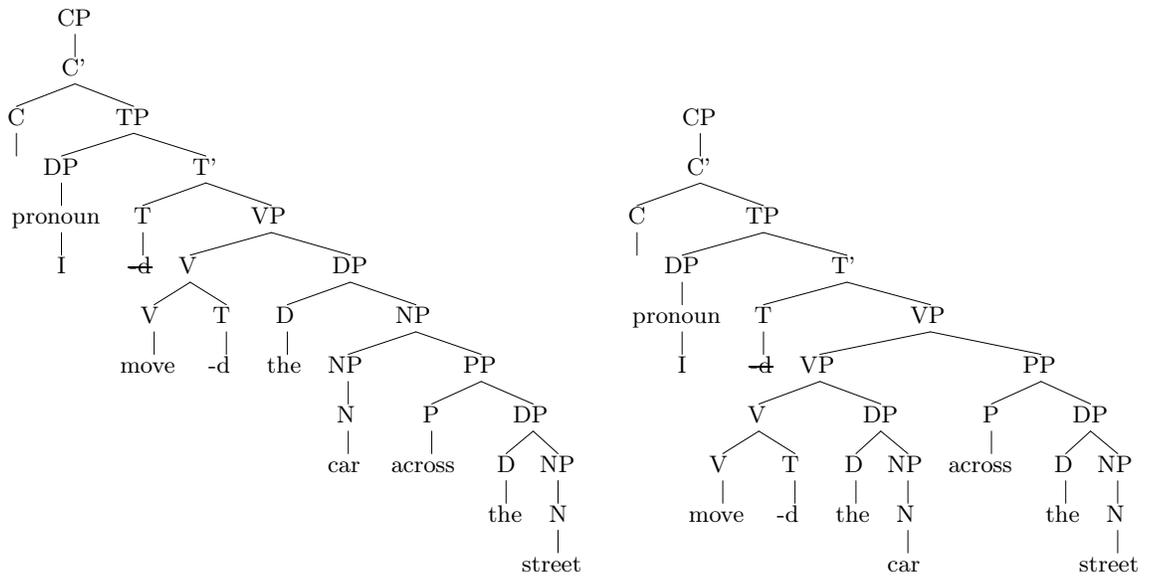
7.2 Ambiguity again

We observed that noun compounds can be interpreted different ways. For example, the phrase *health insurance premium* can have two different structures with slightly different interpretations:

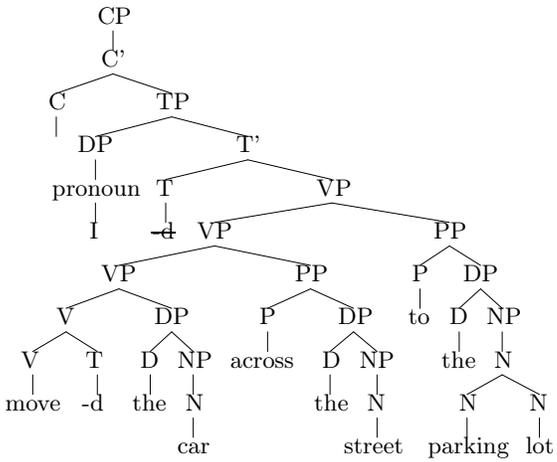
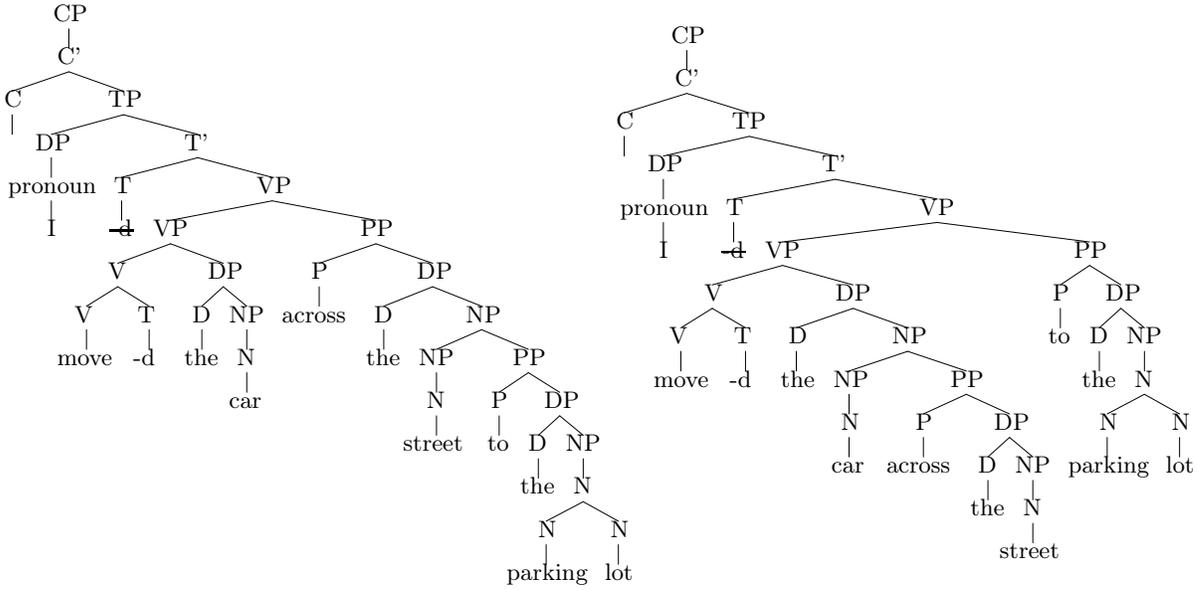
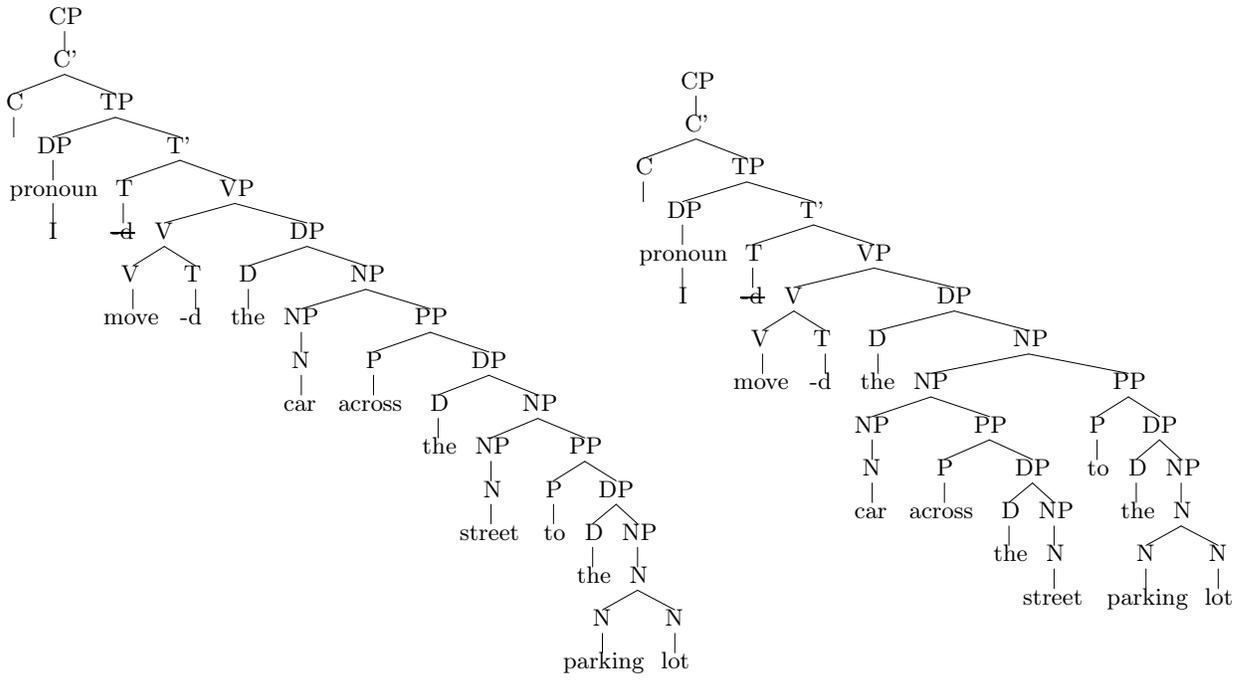


This noun compound with 3 nouns has 2 different trees. If you check, you will see that a compound with 4 nouns, like *air -port terminal security* has 5 possible trees. A noun compound with 5 nouns like *air -port terminal security officer* has 14 possible trees.

We also saw that phrasal modifiers can be attached in various positions. In the sentence *I moved the car across the street*, the PP *across* can modify either the car or the moving. Let's look at this kind of syntactic ambiguity with our revised clause structures:



With the rules we have so far, a sentence with more 2 prepositional phrases has 5 different structures:



Linguists and computer scientists have studied this ambiguity carefully, and shown that when this kind of sentence has n PPs, the number of structures is the n 'th Catalan number (Church and Patil, 1982; Langendoen, McDaniel, and Langsam, 1989):

$n =$	0	1	2	3	4	5	6	7	8	9	10
$\#trees =$	1	2	5	14	42	132	469	1430	4862	16796	1053686

For noun compounds with n nouns, we find the same numbers (but starting with 2):

$n =$	2	3	4	5	6	7	8	9	10	11	12
$\#trees =$	1	2	5	14	42	132	469	1430	4862	16796	1053686

The same numbers? That's wierd! Is someone playing games with us, making our language into some game that we don't even notice when we are using it? Yes, the universe is playing games with us. The Catalan numbers are found in many different recursive structures in many different non-linguistic domains too (Graham, Knuth, and Patashnik, 1989, p180).

7.3 Summary

We have now introduced a few "little" changes to handle tense. (1) Sentences are phrases with tense; they are TPs under CPs. And then, (2) to get T and V together, we have one rule for main verbs (Affix hop) and one for auxiliary verbs (T-to-C). With (2), we simplify (2a) Subject-Aux inversion and add (2b) Do-support.

	selection, projection	modifiers
(137)	S → DP VP	
(new!)	TP → DP T'	
(new!)	T' → T $\left\{ \begin{array}{l} VP \\ NegP \end{array} \right\}$	
(124a)	DP → $\left\{ \begin{array}{l} (D) NP \\ Name \\ Pronoun \end{array} \right\}$	
(123)	NP → N (PP)	
(130)	VP → V (DP) $\left(\left\{ \begin{array}{l} PP \\ CP \\ VP \end{array} \right\} \right)$	
(120)	PP → P (DP)	
(122)	AP → A (PP)	
(138)	CP → C S	
	CP → C'	
	C' → C TP	
	AdvP → Adv	
(new!)	NegP → Neg VP	NP → (A) N (PP)
	(123')	NP → AP NP
	(73c.iii)	NP → NP PP
		VP → AdvP VP
		VP → VP PP
		AP → AdvP AP
	$\alpha \rightarrow \alpha \text{ Coord } \alpha$ (for $\alpha = D, V, N, A, P, C, Adv, VP, NP, AP, PP, AdvP, TP, CP$)	

movement and insertion rules:

Wh-movement: A phrase containing a wh-word can be preposed to attach to CP.

T-to-C head movement (subj-aux inversion): T can raise to an empty C, if T is the head of the TP that C selects.

V-to-T head movement: an auxiliary verb can raise to T (possibly over Neg) if the aux verb is the head of the VP that T selects.

Affix hopping: T affix can move down to the main V (not over Neg), if the main verb is the head of the VP that T selects.

Do-support: Insert DO to save a stranded affix in T.

This list is incomplete, but a very good start. These rules now cover many English structures (infinitely many, of course, since they are recursive)!

References and further reading

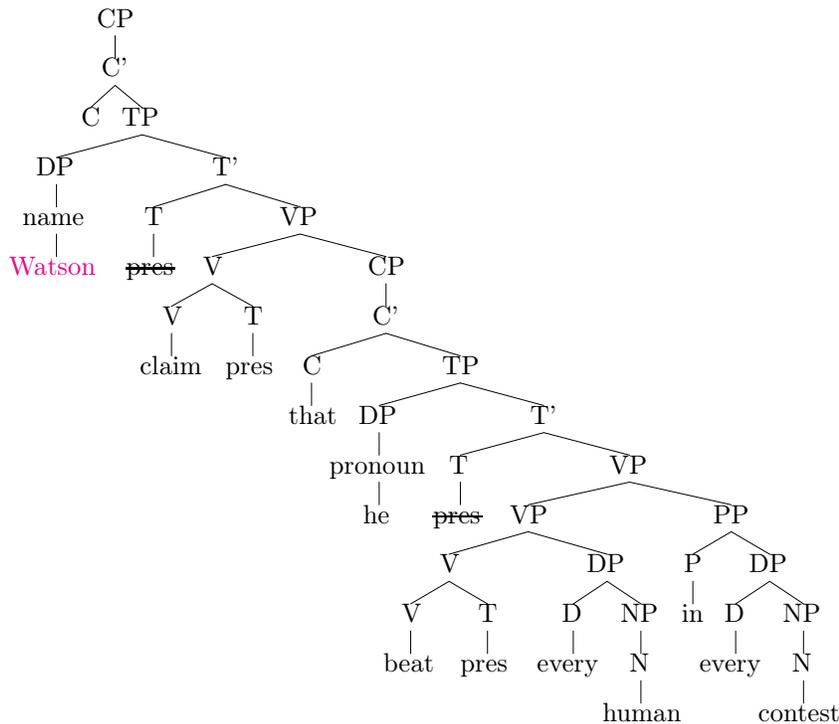
- Benincà, Paola and Cecilia Poletto. 2004. A case of do-support in Romance. *Natural Language and Linguistic Theory*, 22(1):51–94.
- Bjorkman, Bronwyn. 2011. *BE-ing default: the morphosyntax of auxiliaries*. Ph.D. thesis, MIT.
- Church, Kenneth and Ramesh Patil. 1982. How to put the block in the box on the table. *Computational Linguistics*, 8:139–149.
- Fromkin, Victoria, editor. 2000. *Linguistics: An Introduction to Linguistic Theory*. Blackwell, Oxford.
- Graham, Ronald L., Donald E. Knuth, and Oren Patashnik. 1989. *Concrete Mathematics*. Addison-Wesley, Menlo Park, California.
- Harwood, Will. 2013. Rise of the auxiliaries: A case for auxiliary raising vs. affix lowering. [Http://ling.auf.net/lingbuzz](http://ling.auf.net/lingbuzz).
- Langendoen, D. Terence, Dana McDaniel, and Yediyah Langsam. 1989. Preposition-phrase attachment in noun phrases. *Journal of Psycholinguistic Research*, 18:533–548.
- Lasnik, Howard. 1995. Verbal morphology: *Syntactic Structures* meets the minimalist program. In H. Campos and P. Kempchinsky, editors, *Evolution and Revolution in Linguistic Theory: Essays in Honor of Carlos Otero*. Georgetown University Press, Baltimore, pages 251–275. Reprinted in H. Lasnik, editor, *Minimalist Analysis*, NY: Blackwell, 1999.
- Pollock, Jean-Yves. 1989. Verb movement, universal grammar, and the structure of IP. *Linguistic Inquiry*, 20:365–424.
- Schütze, Carson T. 2003. When is a verb not a verb? *Nordlyd*, 31:400–415.
- Wurmbrand, Susi. 2012. The syntax of valuation in auxiliary-participle constructions. In *West Coast Conference on Formal Linguistics, WCCFL 29*, pages 245–254, Tucson.

Lecture 8 Review: The perspective so far

Last class we introduced a standard analysis of English tense and auxiliaries. Today we **review** a range of structures, connecting various ideas from the past few weeks together without adding any new rules or principles.

8.1 Noun complements

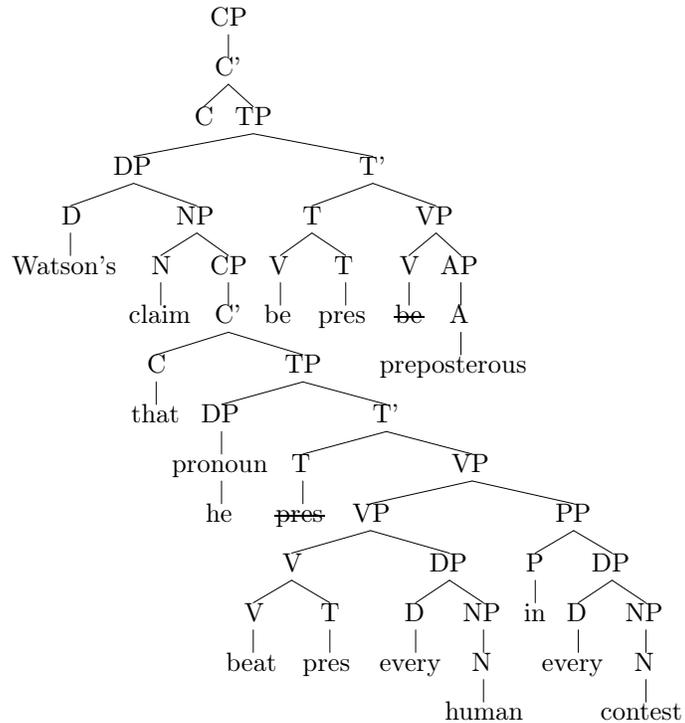
We spent some time talking about verb complements (sisters of V, not recursive) versus verb modifiers (sisters of VP, recursive). For example, in the following sentence, the DP *every human* is a complement while *in every game* is a modifier:



To check your understanding, make sure you can correctly draw the arrows from the original position of T to its position next to *claim*, and from the original position of PRES to its position next to *beat*.

We will continue to label possessives as D, since they seem to appear in the D position. But a better idea is the 's part of the possessive is D, and the other part, here the name *Watson*, is a DP.

It is natural to assume that the relation between the noun *claim* and the embedded CP in the following sentence is also a head-complement relation, even though the embedded CP becomes optional. Still, the embedded CP tells us what was claimed:

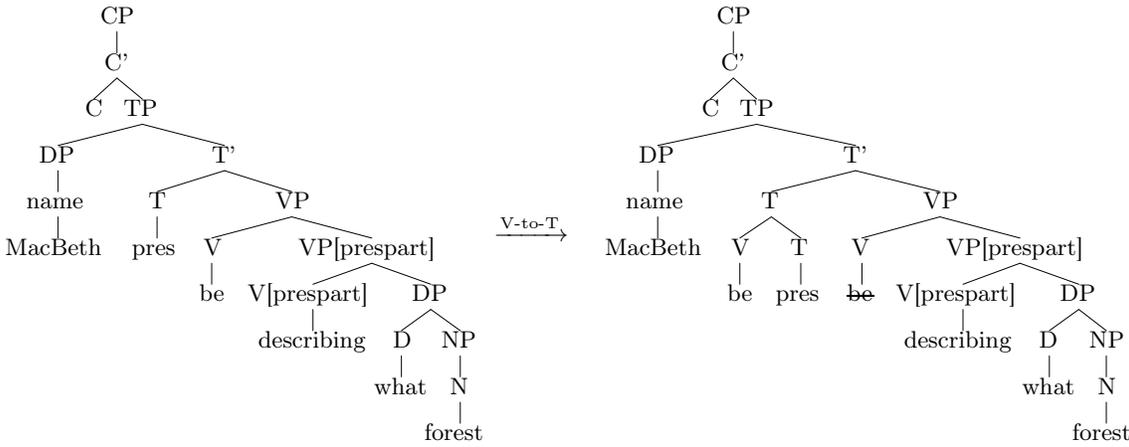


The question of whether this is the right idea – whether nouns really have complements the way verbs do – deserves more attention than we can give it here. But the basic idea is roughly that when the relation between a N and a phrase is similar to the relation between a related V and its complement, we may want to say that the N is taking a complement too.

8.2 Wh-questions

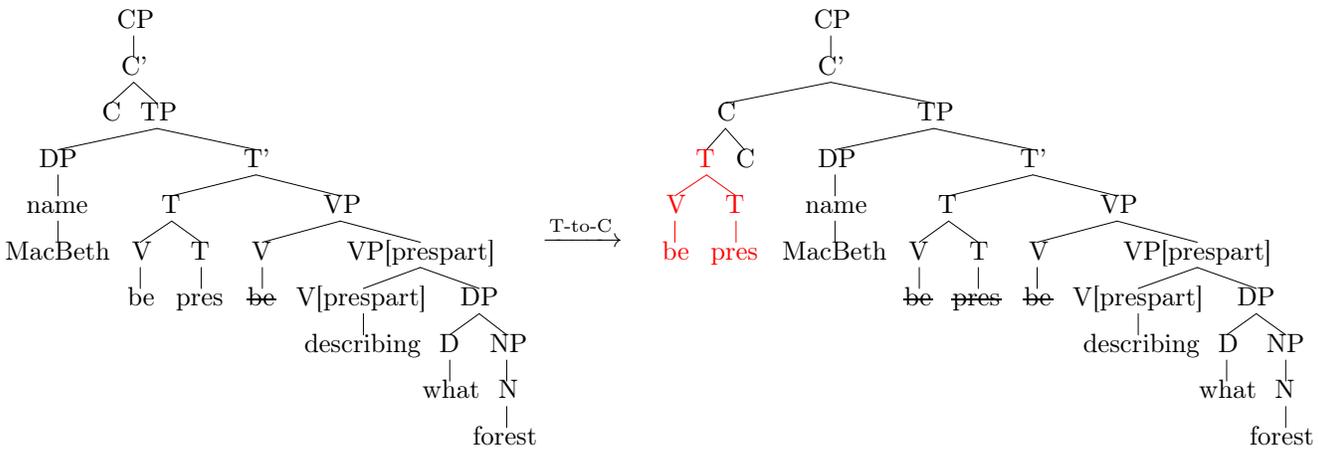
Last week we mentioned the idea that wh-phrases can be preposed. Now, if we treat these phrases as the “subjects” of the CP, just like regular subjects are related to TP, we get the following simple 3-step analysis of a question like *What forest is Macbeth describing?*

STEP 1: move the auxiliary verb up to Tense using "V-to-T",

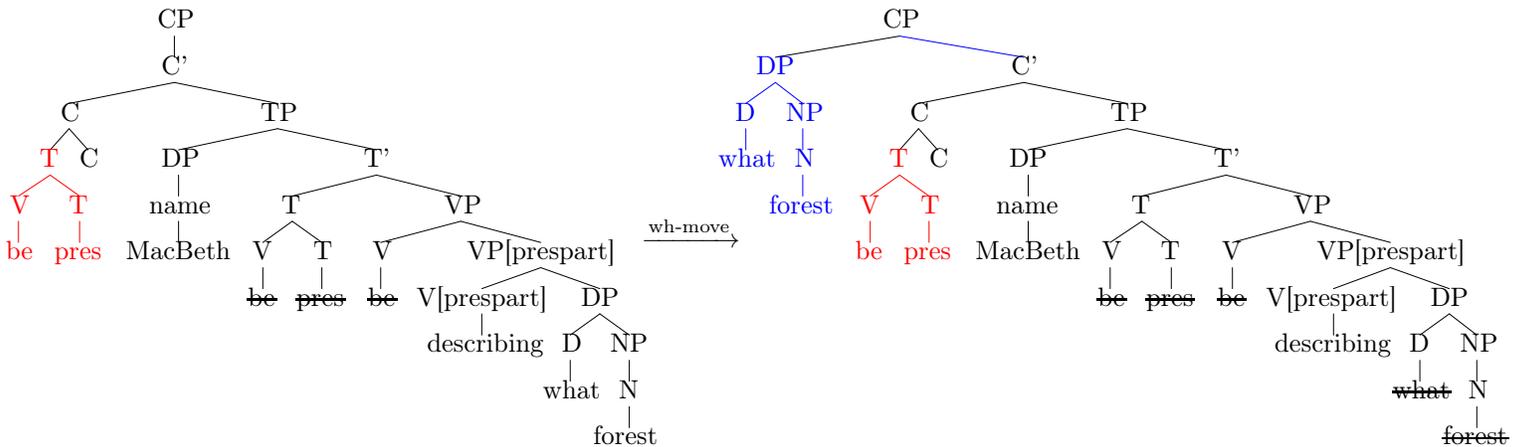


Make sure you could draw arrows for these movements!

STEP 2: move aux verb + tense to C using "T-to-C":

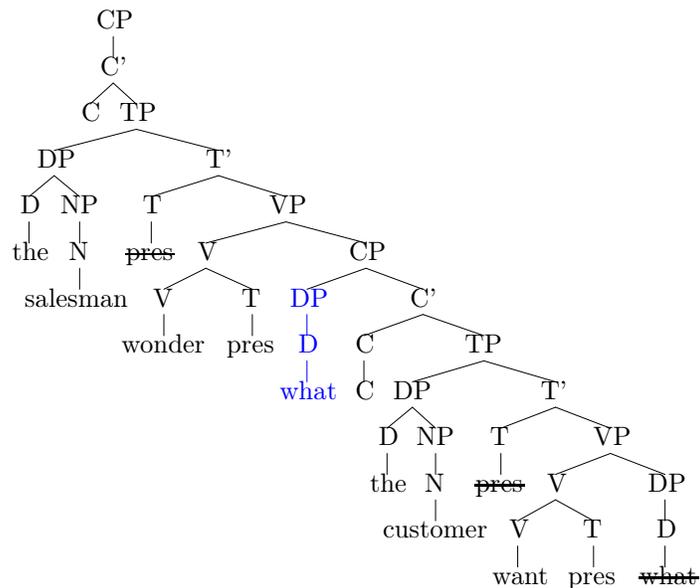


STEP 3: move the wh-phrase to attach to CP, using the "wh-question formation" rule:

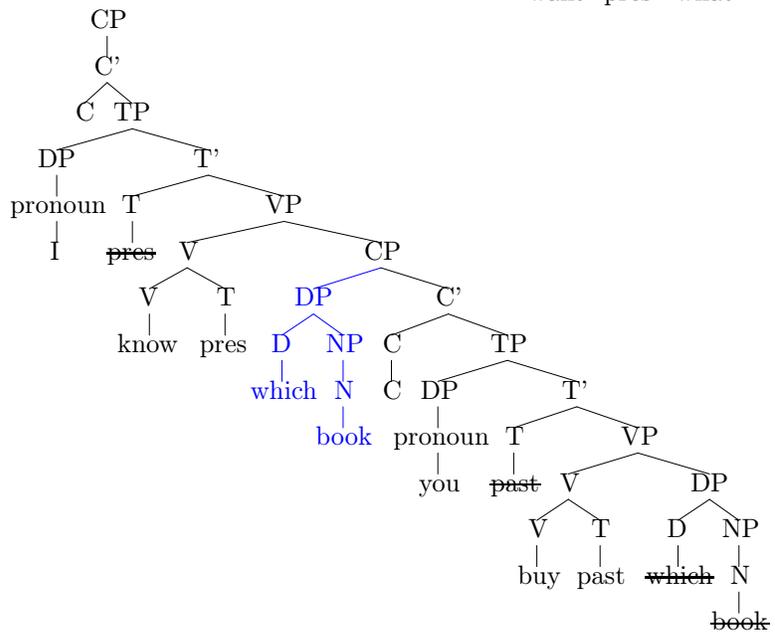


8.3 Wh-questions as complements

A wh-question can be a complement of V, as in *The salesman wonders what the customer wants*. Here, *what the customer wants* is a question CP, where *what* is the direct object of the verb *want*. We can capture these facts with this structure:



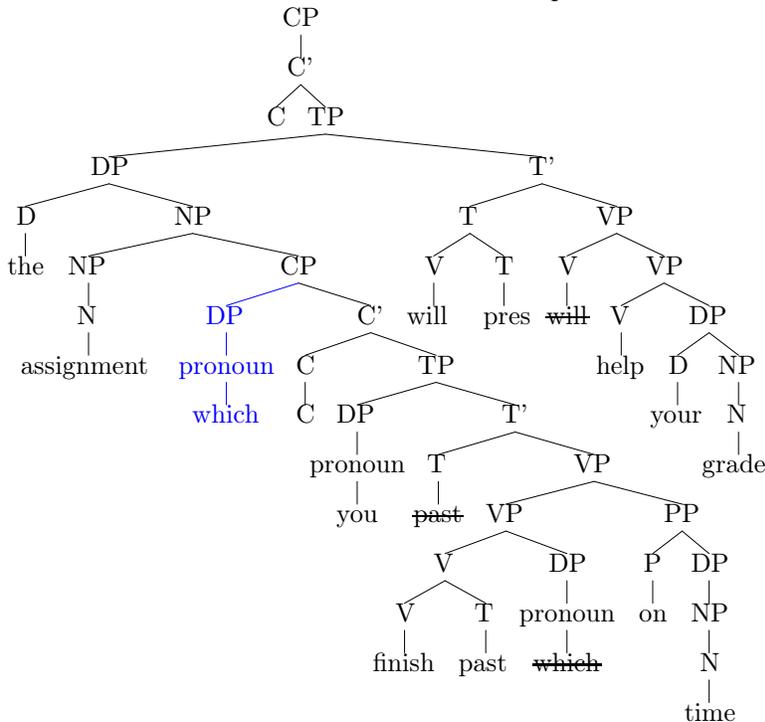
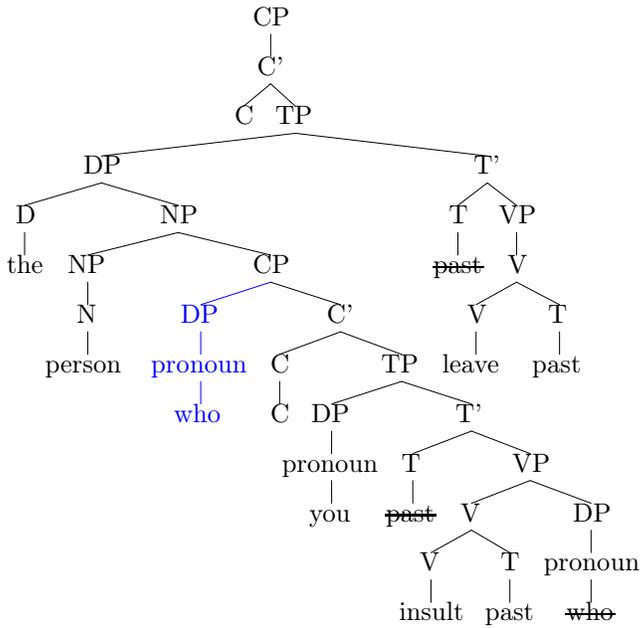
Draw arrows for 2 affix hops and 1 wh-movement.



Draw arrows for 2 affix hops and 1 wh-movement.

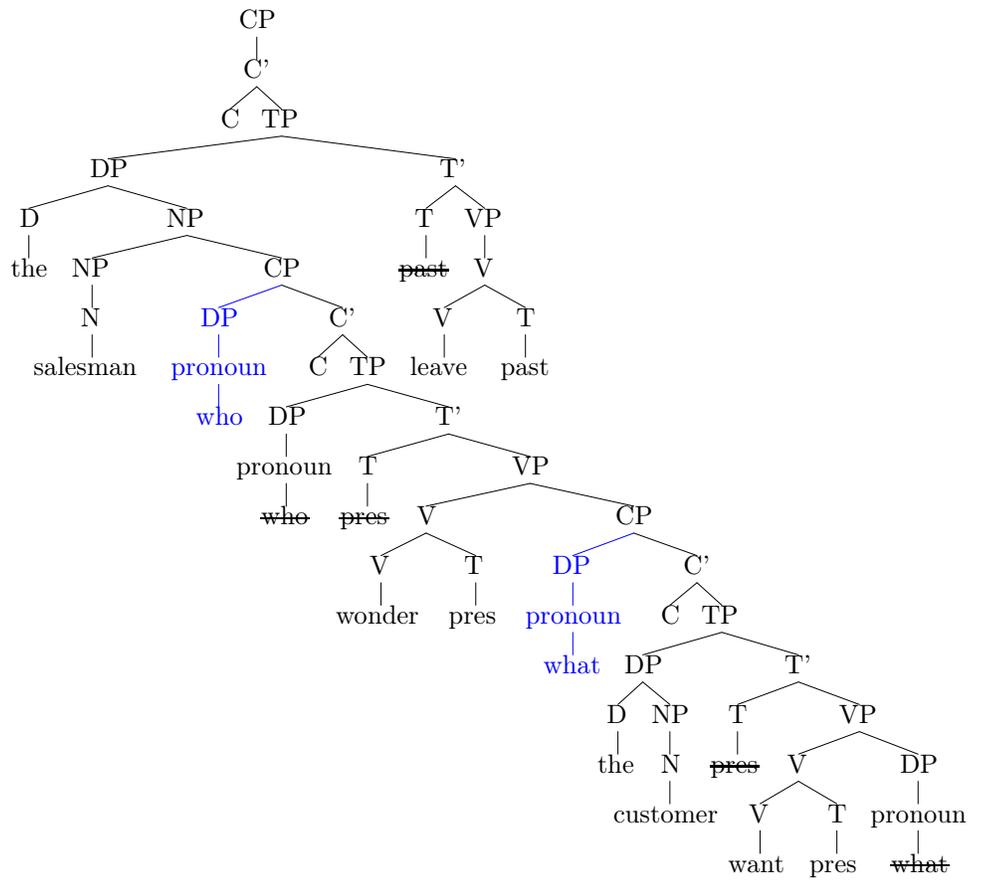
8.4 Wh-questions as modifiers: relative clauses

In *the person who you insulted left*, the question *who you insulted* modifies *person*. This question is called a relative clause. Intuitively, the question modifies *person* to tell us which person left.

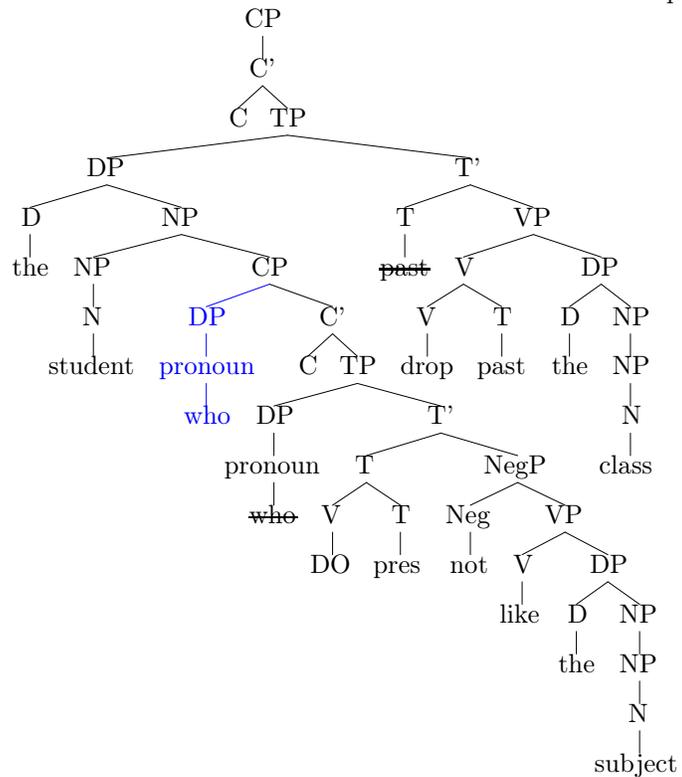


Draw arrows for 2 affix hops and 1 wh-movement.

Draw arrows for 1 affix hop, 1 V-to-T, 1 wh-movement.



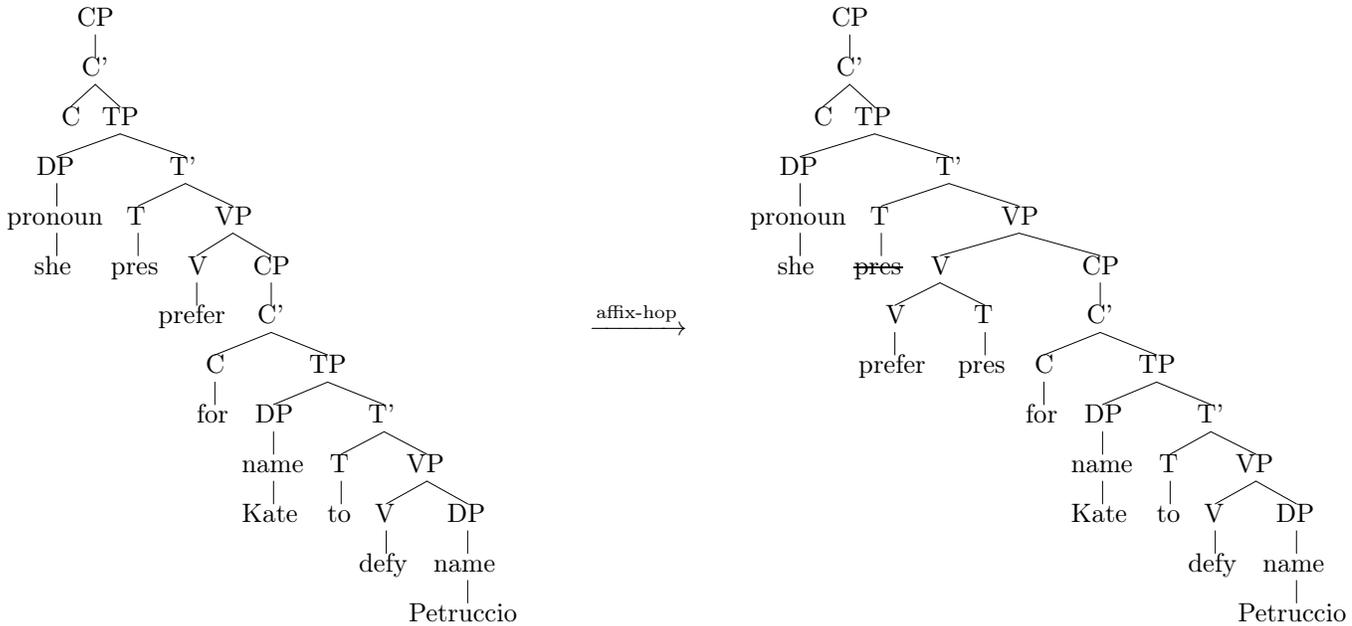
Draw arrows for 3 affix hops, 2 wh-movements.



Draw arrows for 1 affix hop, 1 wh-movement. And notice that DO-support applies since affix hop is not allowed across NegP, leaving the tense affix stranded.

8.5 Infinitival clauses, very briefly!

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 does not apply in the embedded sentence because there is no affix! Instead, we have the word *to*. It is not an affix, so it does not move.

(There are other types of infinitival clauses too, but we leave them to your next syntax class...)

Syntax review

We list the syntax rules again, with the revisions we made for tense this week.

- 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 coordinations, VP preposing (leaving modifier behind)
- c-selection:** a lexical item can impose category restrictions on its complements.
- s-selection:** a lexical item can impose semantic restrictions on its arguments.
- Case assignment to DPs**
 - the subject of a tensed clause is nominative case
 - the complements of V and P are accusative case
- Subject-verb agreement:** A present tense verb must agree with its subject
- lexical entries:** (with subject arguments underlined)

<i>laugh</i>	V[-TNS]	agent	
<i>laughing</i>	V[PRESPART]		
<i>laughed</i>	V[PASTPART]	<u>DP</u>	
<i>execute</i>	V[-TNS]	agent	patient
<i>executing</i>	V[PRESPART]		
<i>executed</i>	V[PASTPART]	<u>DP</u>	DP
<i>executed</i>	V[PASTPART]	patient	<u>DP</u>
<i>like</i>	V[-TNS]	experiencer	theme
<i>liking</i>	V[PRESPART]		
<i>liked</i>	V[PASTPART]	<u>DP</u>	DP
<i>have</i>	V[-TNS]		
<i>having</i>	V[PRESPART]	VP[PASTPART]	
<i>had</i>	V[PASTPART]		
<i>be</i>	V[-TNS]	VP[PRESPART]	
<i>being</i>	V[PRESPART]	or	
<i>been</i>	V[PASTPART]	V[PASTPART]	

8.5.1 Lexical requirements

word	category	arguments
<i>laugh, cry</i>	V	<u>DP</u>
<i>follow, see, devour</i>	V	<u>DP</u> DP
<i>eat</i>	V	<u>DP</u> (DP)
<i>write</i>	V	<u>DP</u> (DP) (PP)
<i>put</i>	V	<u>DP</u> DP PP
<i>give</i>	V	<u>DP</u> (DP) (PP)
<i>think, know, believe</i>	V	<u>DP</u> CP
<i>wonder, question, doubt</i>	V	<u>DP</u> CP[+wh]
<i>will, would, shall, should, may, might, must, can, could</i>	V[+tns]	VP[-tns]
<i>has, have, had</i>	V[+tns]	VP[pastpart]
<i>be, is, are, was, were</i>	V[+tns]	VP[prespart]
<i>with, without, to, from, into</i>	P	DP
<i>up, down, around</i>	P	(DP)
<i>that</i>	C	TP

8.5.2 Phrase structure: S replaced by CP and TP

<u>selection</u>	<u>modification</u>
CP → C'	NP → NP CP
C' → C TP	NP → AP NP
TP → DP T'	NP → NP PP
T' → T $\left\{ \begin{array}{l} \text{VP} \\ \text{NegP} \end{array} \right\}$	
DP → $\left\{ \begin{array}{l} \text{(D) NP} \\ \text{Name} \\ \text{Pronoun} \end{array} \right\}$	VP → VP AdvP
NP → N (PP)	VP → AdvP VP
VP → V (DP) $\left(\left\{ \begin{array}{l} \text{PP} \\ \text{CP} \\ \text{VP} \end{array} \right\} \right)$	VP → VP PP
PP → P (DP)	
AP → A (PP)	AP → AdvP AP
NegP → Neg VP	
AdvP → Adv	
$\alpha \rightarrow \alpha \text{ Coord } \alpha$	for $\alpha = \text{D, V, N, A, P, C, Adv, VP, NP, AP, PP, AdvP, CP}$

NOTE: We used the top,right modifier rule to allow questions to modify NPs, as in [man [who you like ~~who~~]].

8.5.3 Movement rules

Wh-movement: A phrase containing a wh-word can be preposed to attach to CP.

T-to-C head movement (subj-aux inversion): T can raise to an empty C, if T is the head of the TP that C selects.

V-to-T head movement: an auxiliary verb can raise to T (possibly over Neg) if the aux verb is the head of the VP that T selects.

Affix hopping: T affix can move down to the main V (not over Neg), if the main verb is the head of the VP that T selects.

Do-support: Insert DO to save a stranded affix in T.

(**Tricky detail:** English *be* acts like an auxiliary, even when it's the main verb.)

Now that we are beginning to get a rough understanding of how English sentences are put together, at least in some simple cases, a question that might begin to haunt you is: Why do humans find it natural to do things this way? Wouldn't a simpler system work just as well?

References and further reading

Fromkin, Victoria, editor. 2000. *Linguistics: An Introduction to Linguistic Theory*. Blackwell, Oxford.

Lecture 9 Semantics: 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 if “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

¹Here we cover material Fromkin (2000, ch7).

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.

9.1 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:

²These 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.

³The “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, $\llbracket\text{Socrates}\rrbracket$ refers to a person, and we will regard $\llbracket\text{laughs}\rrbracket$ as referring to the set of things with the property of being something that laughs. Then we can say:

- (8) The sentence $\llbracket\text{Sophia laughs}\rrbracket$ is true just in case the person $\llbracket\text{Sophia}\rrbracket$ is in the set $\llbracket\text{laughs}\rrbracket$.

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 $\llbracket\text{DP T}'\rrbracket$ is true just in case $\llbracket\text{DP}\rrbracket$ is in $\llbracket\text{T}'\rrbracket$.

We can also notice that the set of things in the set $\llbracket\text{sings beautifully}\rrbracket$ is a subset of (is completely included in) the set $\llbracket\text{sings}\rrbracket$. Whenever we have this kind of subset relation, we have a corresponding entailment relation. Since $\llbracket\text{sings beautifully}\rrbracket$ is a subset of $\llbracket\text{sings}\rrbracket$, 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 $\llbracket\text{T}'1\rrbracket$ is a always subset of $\llbracket\text{T}'2\rrbracket$, then the sentence $\llbracket\text{DP T}'1\rrbracket$ entails $\llbracket\text{DP T}'2\rrbracket$.

Since the set $\llbracket\text{laughs}\rrbracket$ is completely included in the set $\llbracket\text{either laughs or doesn't laugh}\rrbracket$, the sentence *Sam laughs* entails *Sam either laughs or doesn't laugh*.

9.2 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. That would fit with the idea that an utterance is an acoustic picture, with parts of the utterance corresponding to the things we are talking about, as in the picture in lectures notes 01a on page 4. But most of human language is not like that! That simple idea 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. Gottlob Frege had an idea about this. He suggests that these sentences are not about particular objects, rather, the determiners specify a relation that holds between the concept represented by the subject and the concept represented by the rest of the sentence, the T'.

Frege found this puzzling at first. He says,

It is true that at first sight the proposition

“All whales are mammals”

seems to be not about concepts but about animals; but if we ask which animal then we are speaking of, we are unable to point to any one in particular. . . If it be replied that what we are speaking of is not, indeed, an individual definite object, but nevertheless an indefinite object, I suspect that “indefinite object” is only another term for concept. . . (Frege, 1884, §47)

So what we say is that *All whales are mammals* tells us something about how the collection of whales is related to the collection of mammals, namely, the first collection is a subset of the second.

For the different determiners D in sentence of the form $[[D \text{ NP}] \text{ T}']$, we have rules like the following:

- (15) [*No* NP T'] is true just in case nothing in $[[\text{NP}]]$ is also in $[[\text{T}']]$.
- (16) [*Every* NP T'] is true just in case $[[\text{NP}]]$ is a subset of $[[\text{T}']]$.
- (17) [*The* NP T'] is true just in case there is a particular thing (determined according to context) in $[[\text{NP}]]$, and that thing is also in $[[\text{T}']]$.
- (18) [*Most* NP T'] is true just in case the set of things in both $[[\text{NP}]]$ and $[[\text{T}']]$ is larger than the set of things that are in $[[\text{NP}]]$ but not in $[[\text{T}']]$.
- (19) [*Less than 5* NP T'] is true just in case the set of things in both $[[\text{NP}]]$ and $[[\text{T}']]$ 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 $[[\text{NP}]]$ and $[[\text{T}']]$.

9.3 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 $\llbracket \text{student} \rrbracket$ is a subset of the set $\llbracket \text{laughs} \rrbracket$. The second sentence is true when the set of things that are in both $\llbracket \text{student} \rrbracket$ and $\llbracket \text{Transylvanian} \rrbracket$ is a subset of $\llbracket \text{T}' \rrbracket$. 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 $\llbracket \text{AP} \rrbracket$ and $\llbracket \text{NP} \rrbracket$ is a subset of $\llbracket \text{T}' \rrbracket$.

The reason for the name “intersective” is obvious: the set of things that are in both $\llbracket \text{AP} \rrbracket$ and $\llbracket \text{NP} \rrbracket$ is the **intersection** of $\llbracket \text{AP} \rrbracket$ and $\llbracket \text{NP} \rrbracket$. The intersection of $\llbracket \text{AP} \rrbracket$ and $\llbracket \text{NP} \rrbracket$ is sometimes written $\llbracket \text{AP} \rrbracket \cap \llbracket \text{NP} \rrbracket$.

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 $\llbracket \text{Transylvanian} \rrbracket$ and $\llbracket \text{student} \rrbracket$. A *female Transylvanian student* is something that is in the sets $\llbracket \text{female} \rrbracket$, $\llbracket \text{Transylvanian} \rrbracket$ and $\llbracket \text{student} \rrbracket$. A *Republican female Transylvanian student* is something that is in the sets $\llbracket \text{Republican} \rrbracket$, $\llbracket \text{female} \rrbracket$, $\llbracket \text{Transylvanian} \rrbracket$ and $\llbracket \text{student} \rrbracket$. 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.

9.4 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), (15-19) and (22) more simply, like this:

(9')	$\llbracket \text{Name T}' \rrbracket = \text{true}$	just in case	$\llbracket \text{Name} \rrbracket \in \llbracket \text{T}' \rrbracket$
(15')	$\llbracket \text{No NP T}' \rrbracket = \text{true}$	just in case	$\llbracket \text{NP} \rrbracket \cap \llbracket \text{T}' \rrbracket = \emptyset$
(16')	$\llbracket \text{Every NP T}' \rrbracket = \text{true}$	just in case	$\llbracket \text{NP} \rrbracket \subseteq \llbracket \text{T}' \rrbracket$
(17')	$\llbracket \text{The NP T}' \rrbracket = \text{true}$	just in case	$ \llbracket \text{NP} \rrbracket = 1$ (interpreting NP in context) and $ \llbracket \text{NP} \rrbracket \cap \llbracket \text{T}' \rrbracket = 1$
(18')	$\llbracket \text{Most NP T}' \rrbracket = \text{true}$	just in case	$ \llbracket \text{NP} \rrbracket \cap \llbracket \text{T}' \rrbracket > \llbracket \text{NP} \rrbracket - \llbracket \text{T}' \rrbracket $
(19')	$\llbracket \text{Less than 5 NP T}' \rrbracket = \text{true}$	just in case	$ \llbracket \text{NP} \rrbracket \cap \llbracket \text{T}' \rrbracket < 5$
(22')	$\llbracket \text{AP NP} \rrbracket = \llbracket \text{AP} \rrbracket \cap \llbracket \text{NP} \rrbracket$	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 $\llbracket \text{NP} \rrbracket$ are also in $\llbracket \text{T}' \rrbracket$. That is, we can divide $\llbracket \text{NP} \rrbracket$ into the things that are also in $\llbracket \text{T}' \rrbracket$,

$$\llbracket \text{NP} \rrbracket \cap \llbracket \text{T}' \rrbracket,$$

and the things that are in $\llbracket \text{NP} \rrbracket$ but not in $\llbracket \text{T}' \rrbracket$,

$$\llbracket \text{NP} \rrbracket - \llbracket \text{T}' \rrbracket,$$

and then the claim is that the first set has twice as many elements as the second:

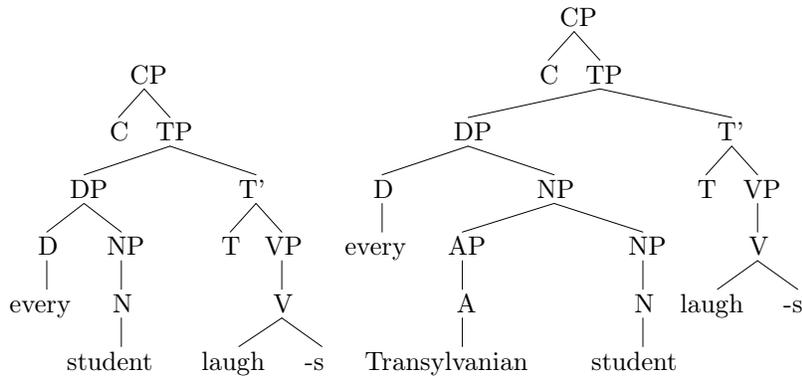
$$\text{(new)} \quad \llbracket \text{2 out of 3 NP T}' \rrbracket = \text{true} \quad \text{just in case} \quad |\llbracket \text{NP} \rrbracket \cap \llbracket \text{T}' \rrbracket| = |\llbracket \text{NP} \rrbracket - \llbracket \text{T}' \rrbracket| \times 2.$$

(Fromkin (2000) 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:

$$\underline{\text{if}} \quad \llbracket \text{student} \rrbracket \subseteq \llbracket \text{laughs} \rrbracket \quad \underline{\text{then}} \quad (\llbracket \text{Transylvanian} \rrbracket \cap \llbracket \text{student} \rrbracket) \subseteq \llbracket \text{laughs} \rrbracket.$$

So we have an entailment relation between these sentences:



We have not talked yet about definitions, or about synonymy or vagueness. Instead we have taken a first look at one perspective on meaning, one that looks like it can help us explain how we reason with sentences. Notice that this kind of account doesn't require us to say what or who [[Molly]] actually is, or what property [[be fearless]] really is. This turns out to be an advantage, since those matters can be very complicated, and they are (at least partly!) beyond the scope of linguistic theory.

References and further reading

- Bach, Emmon. 1989. *Informal Lectures on Formal Semantics*. State University of New York Press, Albany, New York.
- Elbourne, Paul. 2011. *Meaning: A Slim Guide to Semantics*. Oxford University Press, NY.
- Frege, Gottlob. 1884. *Die Grundlagen der Arithmetik*. Koebner, Breslau. J.L. Austin's translation available as *The Foundations of Arithmetic*, Evanston, Illinois: Northwestern University Press, 1980.
- Fromkin, Victoria, editor. 2000. *Linguistics: An Introduction to Linguistic Theory*. Blackwell, Oxford.

Lecture 10 Semantic perspectives on determiners etc

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 $[[D]]$. Here, we notice first that determiners do not denote just any relation: they are all “conservative.” And second, we use similar reasoning about what determiners mean to describe the distribution of English “negative polarity items”, defining “decreasing” determiners.

10.1 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*.

See the slides for more examples.

It is easy to make up a determiner that is not conservative in this sense. Let’s make up the plural determiner *aln*, so that we can say *aln 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 *aln* as follows:

- (2) $[Aln\ N\ T']$ is true just in case everything that isn’t in $[[N]]$ is in $[[T']]$.

So it is true to say: *aln 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 *Aln squares are striped* just means that everything that is not a square is striped.

The important point is that the determiner *aln* is not conservative. We see this by observing that *aln squares are striped* does not entail *aln squares are squares that are striped*. The latter sentence, *aln squares are squares that are striped*, means that everything that is not a square

¹The 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.

is a square that is striped – that’s absurd! So the special entailment relation that identifies conservative determiners does not hold in the case of this made up determiner *aln*. That is, *aln* is not conservative.

The surprising thing is that, at least to a very good approximation, no human language has determiners that are non-conservative like *aln* is (Keenan and 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 *aln* is conservative or not from its phonological or syntactic properties – whether it is conservative or not depends on what it means.

See the slides for more examples.

10.2 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.)

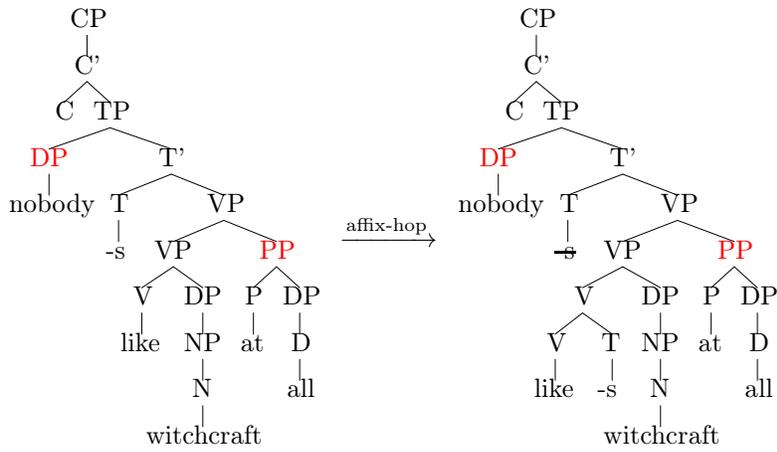
- (4) The fairies do not like witchcraft at all/much/one bit
 (5) Nobody likes witchcraft at all/much/one bit
 (6) The fairies will never like witchcraft at all/much
 (7) No fairies like witchcraft at all/one bit/much
 (8) * The fairies like witchcraft at all/much/one bit
 (9) * The fairies will like 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:

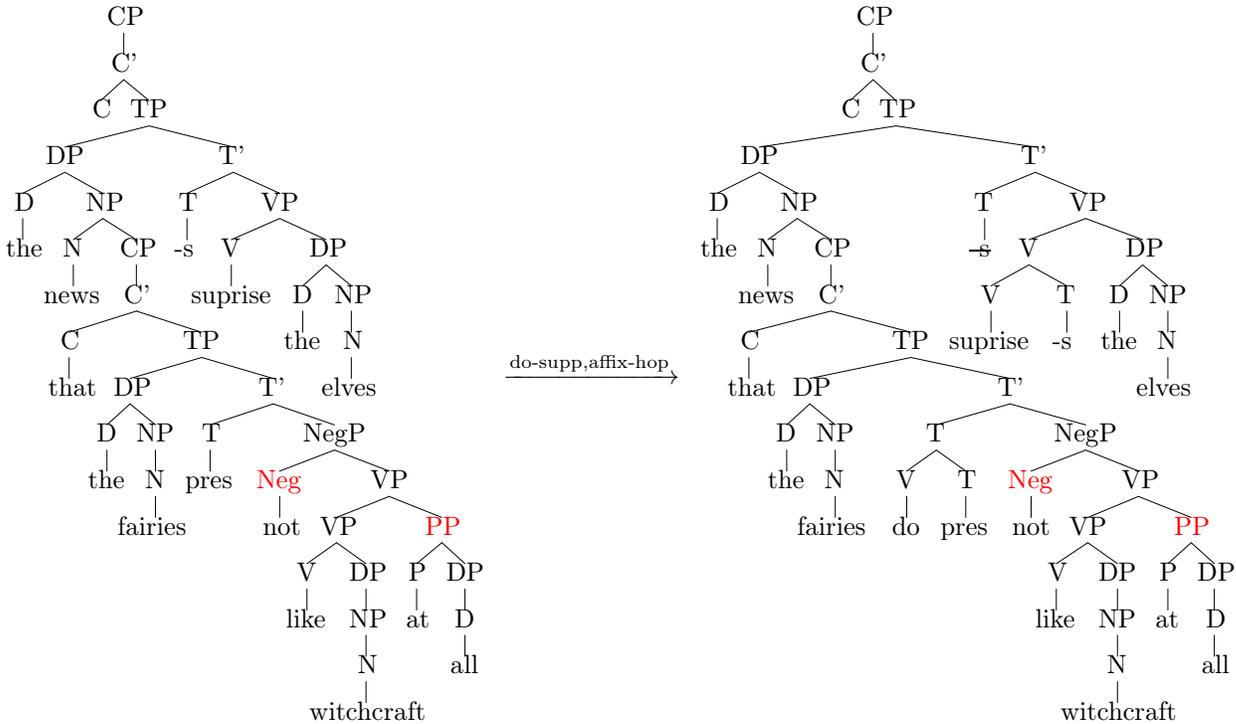
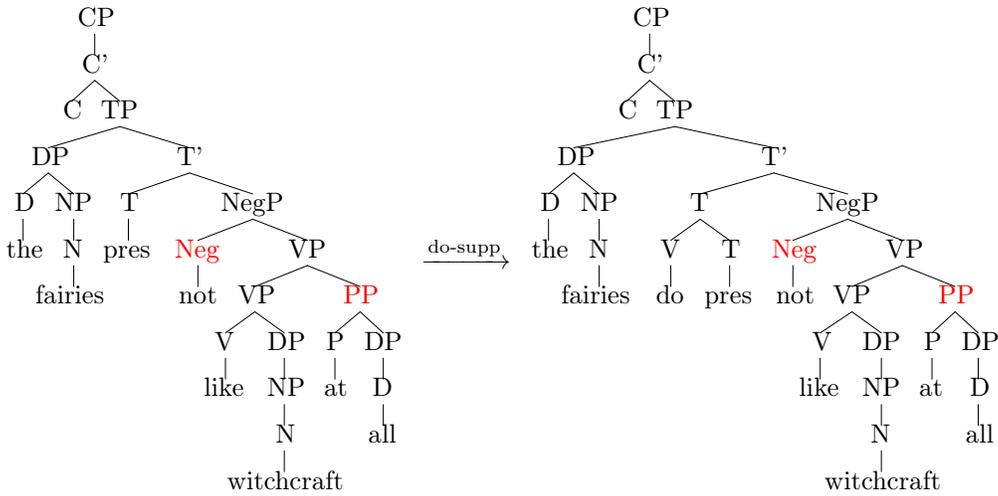
- (10) Nobody told the elves [that [the fairies would care at all]]
 (11) The news [that [the fairies do not like witchcraft]] surprises the elves.
 (12) The news [that [the fairies do not like witchcraft at all]] surprises the elves.
 (13) * The news [that [the fairies do not like witchcraft]] surprises 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.



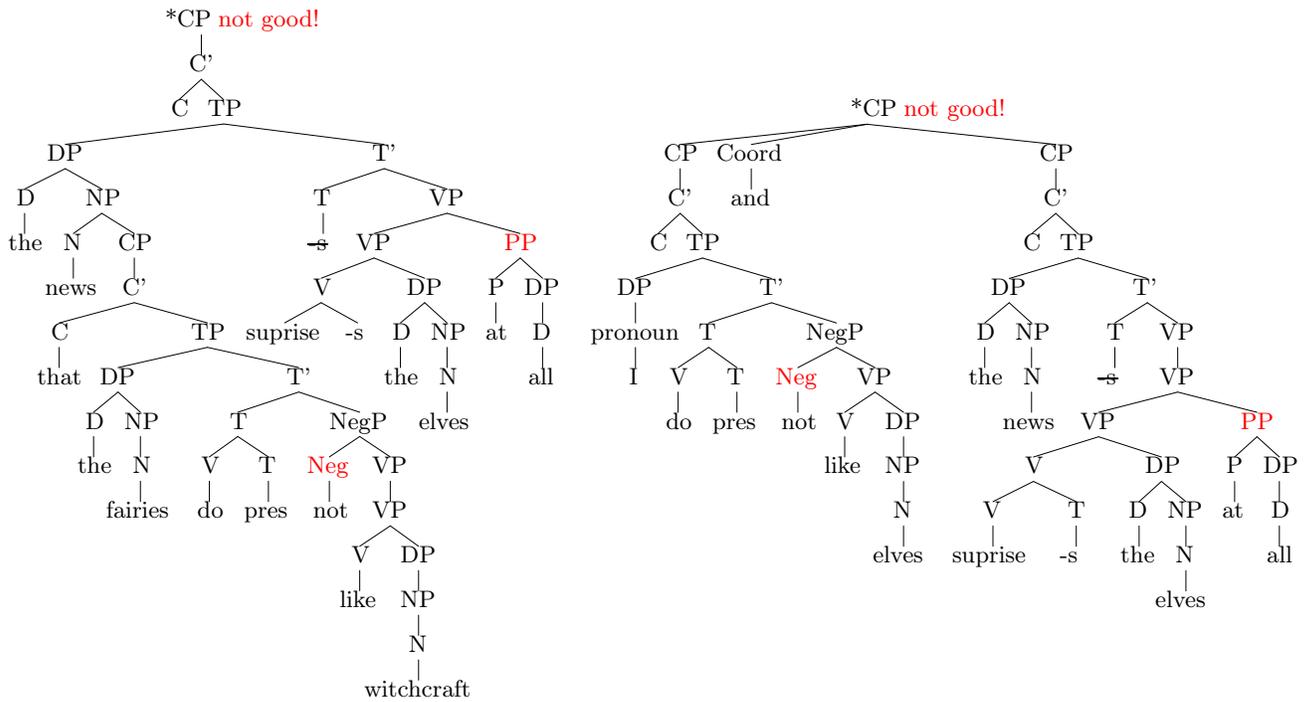
The NPI *at all* is allowed in this example. The following examples are also good:



But the following examples with NPIs are not good.

See the slides for more examples.

Here we show only the trees after movement:



So what is wrong with these last examples? It seems that the negative element needs to be in the same tree but ‘higher up’ in some sense. The standard idea is that the negative element must ‘c-command’ the negative polarity item in the sense of being a sister or an aunt or a great aunt or... The required relationship is c-command:²

X **c-commands** Y just in case either Y is a sister of X or Y is contained in a sister of X.

(14) **NPI licensing (first version):** An NPI must be c-commanded by a negative element.

So then X c-commands Y if X is a sister or an aunt of Y, as we wanted. And we have seen that the negative element X can be 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 the NPI adverb *ever* can occur in a sentence that does not have any explicitly negative item:

(15) a. Less than 3 students ever laugh.

b. * Some student ever laughed.

(16) a. At most 30 students ever laugh.

b. * 30 students ever laugh.

(17) a. No student likes anyone

b. * A student likes anyone

(18) a. No student saw anything

²This is formulated slightly differently in Fromkin (2000, p.223). Their slightly more complicated definition agrees with ours on all the cases we will consider here.

- b. * A student saw anything
- (19) 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 (14) 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.

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:

- (20) 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.

For example, notice that adding a modifier usually restricts it, so in every situation:

$$\begin{aligned} [[\text{sings beautifully}]] &\subseteq [[\text{sings}]] \\ [[\text{eats hamburgers}]] &\subseteq [[\text{eats}]] \\ [[\text{laughs on Wednesdays}]] &\subseteq [[\text{laughs}]] \end{aligned}$$

And we can see that when we move to the more restricted predicate on the right below, with certain determiners, the result is always entailed, truth is preserved:

no student laughs	<u>entails</u>	no student laughs on Wednesdays
few students laugh	<u>entails</u>	few students laugh on Wednesdays
less than 20 students laugh	<u>entails</u>	less than 20 students laugh on Wednesdays

The determiners *no, few, less than 20* are decreasing. With other determiners, we have a different pattern:

every student laughs	<u>does not entail</u>	every student laughs on Wednesdays
some students laugh	<u>does not entail</u>	some students laugh on Wednesdays
most students laugh	<u>does not entail</u>	most students laugh on Wednesdays
more than 20 students laugh	<u>does not entail</u>	more than 20 students laugh on Wednesdays

The determiners *every, some, most, more than 20* are **not** decreasing. And we see that when D is decreasing, then the phrase [D NP] is negative in the sense of licensing NPIs.

The complete story about NPIs goes beyond what we can cover here, and has some surprises, but this is a good start:

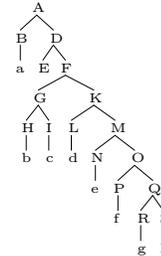
- (21) **NPI licensing (revised):**
An NPI is allowed if it is c-commanded by a negative element, where the negative element is either Neg or a DP with a decreasing D.

(To pursue this some more, you will want to take our semantics class, Linguistics 125!)

10.3 Exercises not assigned, just for practice

(answers below, 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)

$$[\text{keek NP T}'] \text{ is true if and only if } \|\llbracket \text{NP} \rrbracket\| = \|\llbracket \text{T}' \rrbracket\|$$

Answers

- (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

$$\|\llbracket \text{NP} \rrbracket\| = \|\llbracket \text{VP} \rrbracket\| = \|\llbracket \text{students} \rrbracket\| = \|\llbracket \text{run} \rrbracket\| = 2.$$

But in this case it is not true that keek students are students who run, since

$$\begin{aligned} \|\llbracket \text{NP} \rrbracket\| &= \|\llbracket \text{students} \rrbracket\| = 2 \\ \|\llbracket \text{are students who run} \rrbracket\| &= 0 \end{aligned}$$

References and further reading

- Etxeberria, Urtzi. 2012. Quantification in Basque. In *Handbook of Quantifiers in Natural Language*. Springer, NY, pages 83–164.
- Fodor, J.A., M.F. Garrett, E.C.T. Walker, and C.H. Parkes. 1980. Against definitions. *Cognition*, 8:263–367.
- Fromkin, Victoria, editor. 2000. *Linguistics: An Introduction to Linguistic Theory*. Blackwell, Oxford.
- Keenan, Edward L. and Jonathan Stavi. 1986. A semantic characterization of natural language determiners. *Linguistics and Philosophy*, 9:253–326.
- Vasishth, Shrvan. 2004. Surface structure constraints on negative polarity and word order in English and Hindi. *Research on Language and Computation*, 2(1):127–146.

Lecture 11 Names, pronouns and binding

You might have thought that semantics would be about important words like *life* and *language* or *student* and *teacher*, but here we have focused first on words that tend to be smaller, the determiners *the*, *every*, *all*, *some*, *no*, *many*, *most*, *three*, If we are interested in how you reason with language, this is maybe not a surprise, since the philosophers noticed a long time ago that if you know

All As are Bs

and

Some C is an A

then you know

Some C is a B.

Here the A, B, C can be almost anything, but the little determiners *all* and *some* cannot be changed. If you change *some* to *no*, then the patterns of reasoning change completely. We noticed two things about determiners that Aristotle never told us about:

- In all languages, Ds are conservative (at least to a good first approximation)
- In English, NPIs can be licensed by a c-commanding [D NP] when D is ‘decreasing’

Now let’s explore some other rather little words that are important for expressing various kinds of things: pronouns.

11.1 Pronouns

Many person 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. We can also refer to Ed with a pronoun and say

- (2) Every student knows that he laughed

But pronouns are importantly different from names. Consider the sentence:

¹Here we cover material discussed in the bkgd text Fromkin (2000, Ch8), esp. pp.399-406.

- (3) 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:

- (4) 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 DP *every student*. The two DPs are “co-indexed” to indicate this reading.

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 (4) cannot be expressed without pronouns.

Pronouns have more interpretive options than other DPs, but these options are also restricted in certain ways. Consider the following for example:

- (5) * Every student_{*i*} knows the joke. He_{*i*} laughed.
 (6) * He_{*i*} knows that every student_{*i*} laughed.
 (7) * 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? (5) suggests that *he* cannot be bound to a DP *every student* when that DP is in another sentence. (6) suggests that *he* cannot be bound to a DP *every student* when the pronoun is “higher” in some sense. (7) suggests that *he* cannot be bound to a DP *every student* when that DP is 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:

- (8) (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 Requirement allows the binding in 4, (Make sure you can draw the trees for 5, 6, and 7 to show why the binding is not possible!) and explains why binding is not possible in 5, 6, and 7. This all seems fine. One other complication is illustrated by examples like the following:

- (9) * [Every student]_{*i*} helped him_{*i*}.
 (10) [Every student]_{*i*} helped himself_{*i*}

- (11) * [Every student]_i knows that [Jim_j helped himself_i]
(12) [Every student]_i knows that [Jim_j helped 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:

- (13) John really likes that story about himself
(14) Which story about himself does John really like?
(15) 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:
(16) With himself in mind, he wrote a good story.
(17) * 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.)

11.2 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, $\llbracket N \rrbracket$, and the set of things with the property named by the T', $\llbracket T' \rrbracket$. When an (intersective) adjective A modifies a noun N, we are talking about the things which are in both of the sets $\llbracket A \rrbracket$ and $\llbracket N \rrbracket$, that is,

$$\llbracket A \rrbracket \cap \llbracket N \rrbracket.$$

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 $\llbracket A1 \rrbracket$, $\llbracket A2 \rrbracket$ and $\llbracket N \rrbracket$, that is,

$$\llbracket A1 \rrbracket \cap \llbracket A2 \rrbracket \cap \llbracket N \rrbracket.$$

In summary, we have so far talked about semantic properties of sentences, proper names, determiners, adjectives, nouns and T's.

You should understand these claims (explained more carefully above):

- (1) Ds are conservative, in English (and perhaps every human language)
- (2) NPIs are OK if they are c-commanded by a decreasing DP
- (A) Reflexive pronouns must be c-commanded by an antecedent DP in same TP
- (B) Non-reflexive pronouns cannot be c-commanded by an antecedent DP in same TP
- (C) Other DPs (*John, every student, ...*) cannot have c-commanding antecedents

where the underlined phrases are defined this way:

- D is conservative = [D N T'] entails [D N is/are N that T']
- NPI = negative polarity item like *ever, budge an inch*, some uses of *any*
- D is decreasing = [D NP VP1] entails [D NP VP2] whenever $\llbracket VP2 \rrbracket \subseteq \llbracket VP1 \rrbracket$
- A c-commands B = B is a sister of A or is contained in a sister of A
- A is the antecedent of B = B gets its reference from A

There are some challenges to (1), but it is at least a very good first approximation to the truth. For (A-C), there are quite a few tricky issues, but these basic claims are fairly simple and you should be able to apply them to the syntactic trees that we learned about earlier in the class.

References and further reading

- Bach, Emmon. 1989. *Informal Lectures on Formal Semantics*. State University of New York Press, Albany, New York.
- Elbourne, Paul. 2011. *Meaning: A Slim Guide to Semantics*. Oxford University Press, NY.
- Fromkin, Victoria, editor. 2000. *Linguistics: An Introduction to Linguistic Theory*. Blackwell, Oxford.

Lecture 12 Phonetics

As discussed in lecture 1, human languages are productive and compositional, like many other much simpler representational systems. We saw that meanings (semantic values) for complex expressions can be calculated from the syntactic structures (trees) for those expressions. We encountered some puzzles about the basic elements of these theories that we did not completely resolve, but very roughly, it seems that morphemes (or possibly smaller units, like the parts of idioms) combine to form syntactic expressions. We noticed that sometimes those morphemes are less than a whole syllable long, but we did not give much attention to how morphemes get pronounced. That is the focus of the last part of the class.

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Obviously, morphemes typically have parts. They are pronounced with sequences of oral or gestured movements, so the “most basic” elements must be smaller than typical morphemes. For example, the pronounced forms of the words *class* and *glass* 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 morphemes of the lexicon.

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:

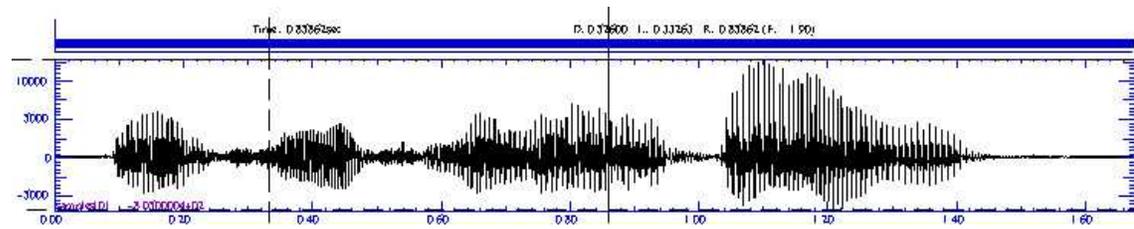
pluralize with [z]	pluralize with [s]
load	loot
mood	moat
code	coat
mode	mote
road	root
food	foot

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 usually 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.

12.1 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 12.1.



“t h e r e ’ s u s u a l l y a v a l v e”

Fig. 12.1: “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 12.2. 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 gray 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*.

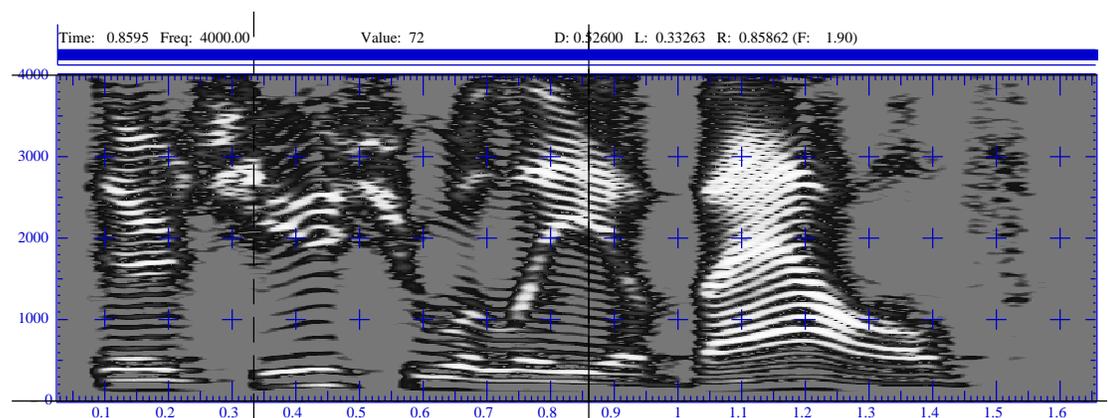
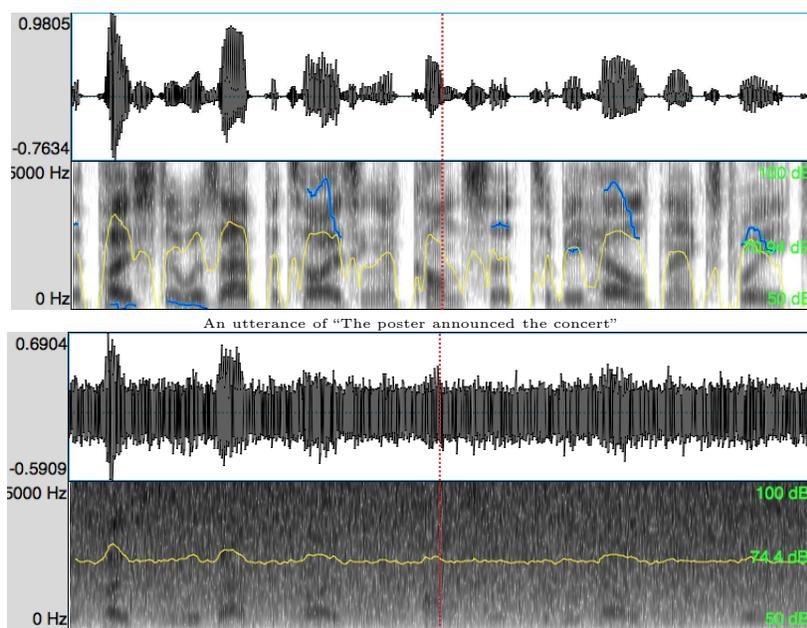


Fig. 12.2: frequency vs. time, amplitude indicated by shading

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 the acoustic signal. We also hear quite diverse acoustic events as 'the same sound'. For one thing, absolute pitch as perceived in singing can change while the sequence of speech sounds in some sense remains the same. And 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. People are quite good at discerning speech through noise and distortions of various kinds that significantly change acoustic properties (Mattys et al., 2012).



Acoustically very different, the same utterance is recognizable in this hissing noise!
This example from (Davis and Johnsruide, 2007). See [here](#).

A typical [i] sound has formants at 280 cps (cycles per second), 2250Hz and 2890Hz (Ladefoged, 1993).¹ We can see this sound in the spectrogram shown in Figure 12.2, 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 and 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!

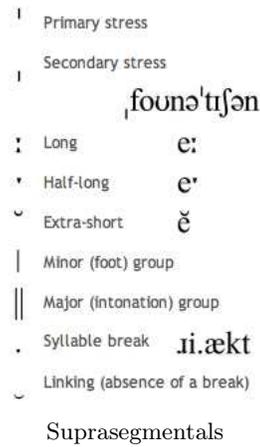
12.2 Articulation and transcription

The basic structure of the human vocal tract is shown in Figure 12.3. 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.

¹These 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 221.63Hz; the highest C on a piano keyboard is 4186Hz. So the main formants of [i] are at frequencies higher than the pitch of the first partial of any normal speech. 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).

²Fromkin (2000) 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.

marked:



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]	spit	plosive stop	–voice	labial
1a.	[p ^h]	pit	plosive stop	–voice	labial
2.	[b]	bit	plosive stop	+voice	labial
6.	[t]	stuck	plosive stop	–voice	alveolar
6a.	[t ^h]	tick	plosive stop	–voice	alveolar
20.	[k]	skip	plosive stop	–voice	velar
20a.	[k ^h]	keep	plosive stop	–voice	velar
7.	[d]	dip	plosive stop	+voice	alveolar
21.	[g]	get	plosive stop	+voice	velar
	[ʔ]	but 'n (button)	glottal stop	–voice	glottal
			manner	voice	place
3.	[m]	moat	nasal stop	+voice	labial
8.	[n]	note	nasal stop	+voice	alveolar
22.	[ŋ]	sing	nasal stop	+voice	velar
4.	[f]	fit	fricative	–voice	labiodental
5.	[v]	vat	fricative	+voice	labiodental
10.	[θ]	thick	fricative	–voice	interdental
11.	[ð]	though	fricative	+voice	interdental
12.	[s]	sip	fricative	–voice	alveolar
13.	[z]	zap	fricative	+voice	alveolar
14.	[ʃ]	ship	fricative	–voice	alveopalatal
15.	[ʒ]	azure	fricative	+voice	alveopalatal
24.	[h]	hat	fricative	–voice	glottal

The **stops** (plosive and nasal) momentarily block the airflow through the mouth. They are sometimes called -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** [tʃ 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.	[l̥] or [əl]	bottle	syllabic lateral approximant	+voice	alveolar
9.	[ɹ]	reef	(central) approximant	+voice	retroflex
37.	[ɹ̥] or [əɹ] or [əʃ]	bird	syllabic (central) approximant	+voice	retroflex
	[ɾ]	butter	flap	+voice	alveolar
19.	[j]	yet	(central) approximant	+voice	palatal
23.	[w]	weird	(central) approximant	+voice	labiodental

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: [ɹ̥ l̥].

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 ɹ ʒ tʃ ʤ]. (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?)

³As indicated, we use [ɹ] for the American “r” sound, following the standard IPA notation, though Fromkin (2000) 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.

⁴In 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 [ɹ̥ l̥] 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.

Let's consider the English vowels.

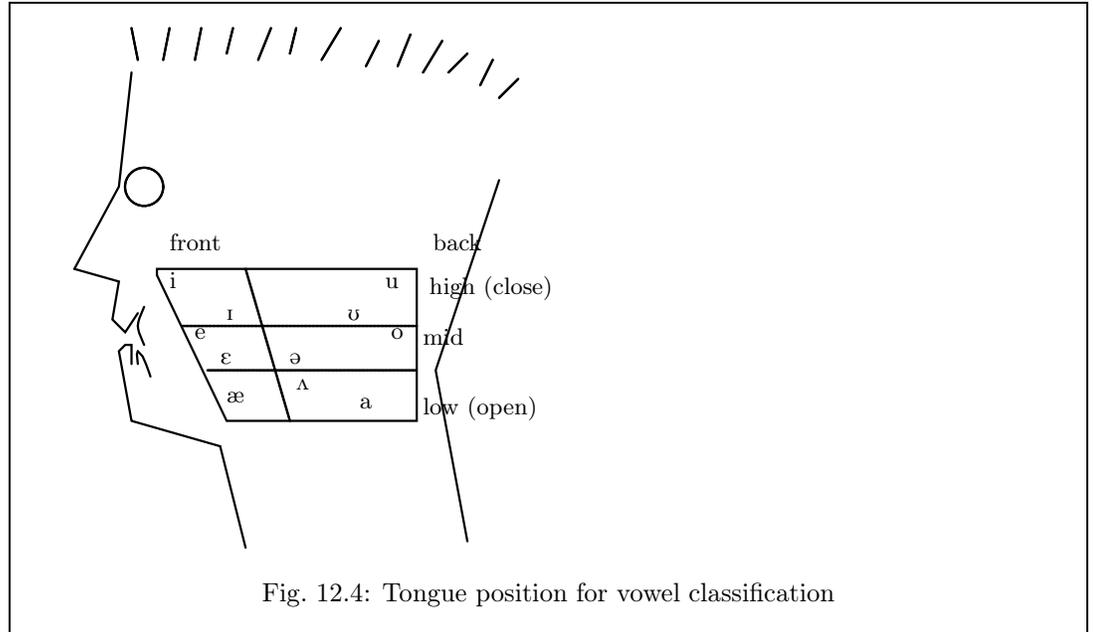


Fig. 12.4: Tongue position for vowel classification

Simple vowels:

			tongue body height	tongue body backness	lip rounding	tongue root tense (+ATR) or lax (-ATR)
25.	[i]	beat	high	front	unrounded	+ATR
26.	[ɪ]	fit	high	front	unrounded	-ATR
34.	[u]	boot	high	back	rounded	+ATR
33.	[ʊ]	book	high	back	rounded	-ATR
28.	[e]	let	mid	front	unrounded	-ATR
32.	[o]	road	mid	back	rounded	+ATR
31.	[ɔ]	caught	mid	back	rounded	+ATR
36.	[ʌ]	shut	low	back	unrounded	-ATR
27.	[ɛ]	ate	mid	front	unrounded	+ATR
29.	[æ]	bat	low	front	unrounded	-ATR
30.	[ɑ]	pot	low	back	unrounded	+ATR
35.	[ə]	roses	mid	central	unrounded	-ATR

Diphthongs: vowels which change in quality in a single syllable

38.	[aɪ]	lies	+ATR
39.	[aʊ]	crowd	+ATR
40.	[ɔɪ]	boy	+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 [ɑ] 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 [oi ai au].⁵

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

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], [sai], [naʊ]

NOT: [sɪ], [seɪ], [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], [sɑŋ], [soŋ]

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

12.3 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).

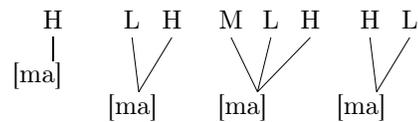
Notice, for example, that the sounds [t] and [t^h] do not distinguish any two words in English. But [t] and [t^h] do distinguish words in Hindi, and so we mark the distinction in our classification system. The ideal is that the classification system should be a notation for the sounds of any spoken human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

⁵The 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.

⁶One 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 and Maddieson (1986, pp17ff) 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.

THINK! 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.

12.4 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 [læɾəɪ] or [læɾ.ɪ]. But this misses something important: the words do not sound exactly the same because the

⁷You 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>

⁸In 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.

⁹This kind of proposal is discussed in Fromkin (2000, §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 [læ:^ːrɪ]
latter [læ:^ːrɪ]

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 [r] as voiced, but it seems that the [r] in [læ:^ːrɪ] is really a voiced [d], while the [r] in [læ:^ːrɪ] really a voiceless [t]. We will resolve this problem with our theory of phonology, according to which the [r] 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: **dis-similation** (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 [pəsketɪ]), 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.

12.5 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^ht]), vowel shortening (as in [læ:^ːrɪ]), and nasalization (as in [mæ̃n]).

References and further reading

- Davis, Matthew H. and Ingrid S. Johnsrude. 2007. Hearing speech sounds: Top-down influences on the interface between audition and speech perception. *Hearing Research*, 229:132–147.
- Fromkin, Victoria, editor. 2000. *Linguistics: An Introduction to Linguistic Theory*. Blackwell, Oxford.
- Halle, Morris. 1977. Tenseness, vowel shift, and the phonology of the back vowels in Modern English. *Linguistic Inquiry*, 8:611–625.
- Ladefoged, Peter. 1993. *A Course in Phonetics (3rd Edition)*. Harcourt Brace Javonovich, NY.
- Ladefoged, Peter and D.E. Broadbent. 1957. Information conveyed by vowels. *Journal of the Acoustical Society of America*, 29:98–104.
- Ladefoged, Peter and Ian Maddieson. 1986. Some of the sounds of the world's languages. *UCLA Working Papers in Phonetics*, 64.
- Liberman, A., F.S. Cooper, D.P. Shankweiler, and M. Studdert-Kennedy. 1967. Perception of the speech code. *Psychological Review*, 74:431–461.
- Mattys, Sven L., Matthew H. Davis, Ann R. Bradlow, and Sophie K. Scott. 2012. Speech recognition in adverse conditions: A review. *Language and Cognitive Processes*, 27(7/8):953–978.
- Perlmutter, David. 1992. Sonority and syllable structure in American Sign Language. *Linguistic Inquiry*, 23:407–442.
- Schatz, C.D. 1954. The role of context in the perception of stops. *Language*, 30:47–56.

Lecture 13 Phonology introduced

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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 ‘underlying’ sounds we will call **phonemes**. Perhaps the phonemes (or the features defining them) are really the basic elements of the language, and 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.

If a given sound, a phoneme, can be pronounced in various ways, how can we tell what the phonemes are and what its variants are? The following basic procedure is the first thing to try:

1. Collect a variety of utterances (words) containing elements X,Y that may be related
2. Identify the local environments of X,Y in your data
3. If X,Y have complementary distributions, then maybe they are ‘underlyingly’ the same.
 - the one in most environments may be basic, the **phoneme**
 - define each variant with a **rule**, as simply as possible
4. Repeat steps 1-3, looking for counterexamples, to check the result with more data.

Note that ‘complementary’ means ‘different’, no local environments in common. And obviously, this procedure can only work if the influences on variation are local – this is often but *not always* true. We practice this procedure with some examples here, but later these steps will often be left more or less implicit.

13.1 Aspirated voiceless stops

Step 1 is just to think about where the sounds [t] and [t^h] occur. Similarly for [k] and [k^h], and also for [p] and [p^h].

spelling	transcription	spelling	transcription
top	[t ^h ɑp]	stop	[stɑp]
tack	[t ^h æk]	stack	[stæk]
tick	[t ^h ɪk]	stick	[stɪk]
cat	[k ^h æt]	scat	[skæt]
kid	[k ^h ɪd]	skid	[skɪd]
pit	[p ^h ɪt]	spit	[spɪt]

It could be 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 *poev* and *spoev*, we automatically pronounce them as [p^hov] and [spov], 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, one phoneme, which we will call /p/, which gets aspirated automatically in certain contexts and not in others. The variant pronunciations of a phoneme are called **allophones**. Similarly for /t/ and /k/. They may be phonemes with predictable aspirated allophones. 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 p,t,k get aspirated?

Step 2. We can compile the local environments of the respective sounds. We do this because the most common determinant of sound variation, allophony, is the immediate context of the sound – what is to the left and to the right, just before and just after. With the data above, we have:

local	transcription	local	transcription
[___] ɑ	[t ^h ɑp]	s___ ɪ	[stɑp]
[___] æ	[t ^h æk]	s___ æ	[stæk]
[___] ɪ	[t ^h ɪk]	s___ ɪ	[stɪk]
[___] æ	[k ^h æt]	s___ æ	[skæt]
[___] ɪ	[k ^h ɪd]	s___ ɪ	[skɪd]
[___] ɪ	[p ^h ɪt]	s___ ɪ	[spɪt]

Step 3. Identify the phonemes and specify the rules for allophones. Looking at this table, we could describe the facts by saying:

- /t/ becomes [t^h] at the beginning of words
- /p/ becomes [p^h] at the beginning of words
- /k/ becomes [k^h] at the beginning of words

But this idea is unappealing, because it makes it look like p,t,k are randomly chosen to have this property, when we have already noted that they are not a random group! They are the voiceless, non-nasal stops! So we could propose:

Voiceless non-nasal stops are aspirated word-initially.¹

In symbols, we could write:

$$\left[\begin{array}{l} +\text{stop} \\ -\text{voice} \\ -\text{nasal} \end{array} \right] \rightarrow \left[+\text{aspirated} \right] / [\text{---}]$$

With this idea, we now go back to step 1 and look to see if there is data to show that this proposal is incorrect or less general than it should be.

We can see that the proposal is less general than it should be because it does not cover data like this:

upon $\text{ʌp}^h\text{ɔn}$
 attack $\text{ət}^h\text{æk}$
 untie $\text{ʌnt}^h\text{aɪ}$
 retake $\text{rɪt}^h\text{ek}$

What's going on in these cases? Well, as discussed in class, the last examples suggest that the aspirated consonants here are not at the beginnings of words but they are at the beginnings of syllables! So a simple improvement of our previous rule is:

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

In our rule notation, (1) can be expressed like this:

(stop aspiration – second try)

$$\left[\begin{array}{l} +\text{stop} \\ -\text{voice} \end{array} \right] \rightarrow \left[+\text{aspirated} \right] / [_{\text{syllable}} \text{---}]$$

This idea still has a couple of problems. In the first place, it makes the wrong prediction in some words, like these examples:

prey $[\text{p}^{\circ}\text{ɹ}^{\circ}\text{e}]$
tray $[\text{t}^{\circ}\text{ɹ}^{\circ}\text{e}]$
clay $[\text{k}^{\circ}\text{l}^{\circ}\text{e}]$
clever $[\text{k}^{\circ}\text{l}^{\circ}\text{ɛ}\text{v}^{\circ}\text{ɹ}]$
Trevor $[\text{t}^{\circ}\text{r}^{\circ}\text{ɛ}\text{v}^{\circ}\text{ɹ}]$

The sounds [r,l] are approximants, but more specifically, they are the liquids. So in these examples, the aspiration associated with the stop seems to just become part of the following liquid, causing the liquid to sound less voiced – this is indicated by the small circle diacritics. (The other approximants are [j,w]. Do they have the same property? In my dialect, they do not seem to swallow the aspiration in the same way: [k^hwɪk].) So we can restrict our description of the aspiration context a little bit more, as follows:

¹The +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 – third try)

$$\begin{bmatrix} +\text{stop} \\ -\text{voice} \end{bmatrix} \rightarrow \begin{bmatrix} +\text{aspirated} \end{bmatrix} /_{[\text{syllable}] \text{ — } \begin{bmatrix} -\text{liquid} \end{bmatrix}}$$

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

happy [ˈhæpi]
upper [ˈʌpɪ]
walking [ˈwɑkiŋ]

For these, 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)

$$\begin{bmatrix} +\text{stop} \\ -\text{voice} \end{bmatrix} \rightarrow \begin{bmatrix} +\text{aspirated} \end{bmatrix} /_{[\text{stressed syllable}] \text{ — } \begin{bmatrix} -\text{liquid} \end{bmatrix}}$$

In clear English, what this rule says is:

A voiceless stop is aspirated if it appears at the beginning of a stressed syllable and is not followed by a liquid.

Being able to state the rule in clear English is more important than the notation, but the notation is useful as a kind of abbreviated form.

So the basic idea here is that various words with /p/, /t/ or /k/ have predictable variations. The basic sounds /p/, /t/ or /k/ are **phonemes** of American English, indicated by our slashes, to contrast them with the predictable variants, the **allophones**, [p^h], [t^h], [k^h]. The term we used earlier, **phone**, applies to all of these speech sounds.

On this view, lexical items 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. [t̚] often the t is unreleased in fluent speech, as in “she wen’ home” – it can disappear 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.

13.2 Vowel length

Another predictable variation in American English is found in vowel length (cf Fromkin (2000, p522)). We mentioned vowel length only very briefly when looking at speech sounds, but now let's proceed as we did with aspiration and flapping: we look for examples to show how vowel length varies. This time we will be more brief, but make sure you can see how we are taking the steps that were explicitly proposed.

For variations in vowel length, there are a couple of notational conventions. We could indicate a shortened vowel by placing a cup-like mark right over the vowel in the phonetic representation.

bad	[bæd]	bat	[bæ̃t]
Abe	[eb]	ape	[ẽp]
phase	[fez]	face	[fẽs]
leave	[liv]	leaf	[lĩf]
tag	[t ^h æg]	tack	[t ^h æ̃k]
...			

Here we use indicate a shortened [e] as [ẽ]. An alternative would be to indicate lengthening [e:], marking the words on the left above as lengthened. Both marks are included in the IPA chart.

It could be that vowel length is just stored as part of each lexical entry, but that does not seem likely in this case. We can show that the variation in vowel length is not arbitrary by noting the similar comparison in the way we would pronounce non-words:

gad	[gæd]	gat	[gæ̃t]
mabe	[mẽb]	mape	[mẽp]
naze	[nez]	nace	[nẽs]
meave	[miv]	meaf	[mĩf]
kag	[k ^h æg]	kack	[k ^h æ̃k]
...			

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

(V-shortening – first try)

$$\left[\begin{array}{c} +\text{vowel} \end{array} \right] \rightarrow \left[\begin{array}{c} +\text{short} \end{array} \right] / \text{---} \left[\begin{array}{c} -\text{voice} \\ +\text{consonant} \end{array} \right]$$

This rule makes predictions about many cases we have not considered, so it would be good to check them! And we could also have written this as a lengthening rule – what would that look like?

See the slides.

13.3 Flapping

Now we can now consider flapping, discussed briefly 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:

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

Exercise: write each of these words phonetically.

(This list uses standard spelling – but think of the local phonetic environment of the flap in each case!) 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 +consonant, +alveolar, –nasal. Putting all of this together, we can express our idea about flapping this way:

(flapping – first try)

$$\left[\begin{array}{l} +\text{stop} \\ +\text{alveolar} \\ -\text{nasal} \end{array} \right] \rightarrow \text{ɾ} / \left[\begin{array}{l} +\text{syllabic} \\ \text{ } \end{array} \right] \text{ ____ } \left[\begin{array}{l} +\text{syllabic} \\ \text{ } \end{array} \right]$$

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	infinite
attorney	attempt	attack
attentive	attention	detest
undertone	undertake	return
retroactive	retire	retouch
retort	retain	retaliate
attract	fatigue	eternal
material	maternal	pretested

Exercise: write each of these words phonetically.

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

Exercise: write each of these words phonetically.

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

rider	[ˌɹaɪr.ɹ]
radar	[ˌɹedaɹ], NOT: [ˌɹeraɹ]
atom	[æɾəm]
atomic	[ət ^h a mɪk], NOT: [əɾamɪk]
proton	[pɹɔt ^h an], NOT: [pɹɔɾan]
rattle	[ˌɹæɾəl]
retail	[ˌɹiːt ^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 (cf Fromkin (2000, p.496)), using the vertical mark above for primary stress and the vertical mark below for secondary stress, then the data is this:

rider	[ˌɹaɪr.ɹ]	radar	[ˌɹe.daɹ]
atom	[ˌæɾəm]	atomic	[ət ^h a mɪk]
proton	[pɹɔ.t ^h an]		
rattle	[ˌɹæɾəl]	retail	[ˌɹiːt ^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)

$$\left[\begin{array}{l} +\text{stop} \\ +\text{alveolar} \\ -\text{nasal} \end{array} \right] \rightarrow r / \left[\begin{array}{l} +\text{syllabic} \end{array} \right] \text{---} \left[\begin{array}{l} +\text{syllabic} \\ -\text{stress} \end{array} \right]$$

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

13.4 A list of American English phonemes

Now let's compare the perspective developed here to the list of **phonemes** from Fromkin (2000, p520). (No surprise: It is a little shorter than the list of phones that was given in the previous chapter of that text!)

24 consonants		bilabial	labio-dental	dental	alveolar	palato-alveolar	palatal	velar	glottal
	voice								
plosives	-	/p/			/t/	/tʃ/		/k/	
	+	/b/			/d/	/dʒ/		/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	central	back	back
	unrounded	unrounded	unrounded	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
/ɾ/ or /ɻ/

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 text writes the American [r] right side up, so I will too).

The vowel chart lists 11 simple vowels, 3 diphthongs, and 1 syllabic consonant. Comparing this to the list of phones, we see that the /l/ of the previous chapter is not listed as a phoneme, nor is /ɔ/. I think the /ɔ/ is left out because it is becoming rather rare. And Fromkin (2000, p490) says that /l/ 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 !Xóó; some other languages like the Caucasian language Ubykh have a good number of consonants).

13.5 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 sounds (defined in terms of their features) are the basic units in the sound system of a spoken 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 right, whether there is a word or syllable boundary, whether there is stress, ...)

Like every good story, this one raises more puzzles, which we have started to answer.

Q1. What are the phonemes of English, and how can we defend the idea that something is a phoneme? We defined a procedure in the slides, and practiced it here. More practice coming too.

Q2. Considering long [e] and short [ɛ], Fromkin (2000, p.522) says:

The very fact that the appearance of [e] and [ɛ] 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?²

²For 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. – Given the standard meaning of ‘all’, the opposite assumption makes no sense. So the question is: when we define variants (allophones) as we have done, would it be possible for them to distinguish one word from another?

13.6 Practice exercises

- Transcription.** At several places in the margins of this chapter, it is suggested that you write the phonetic transcriptions of lists of (spelled) words. Do that, and make sure you can explicitly take the steps for determining phonemes and rules in the examples discussed there.
- Nasalization.** English vowels are sometimes nasalized. The vowel [æ] in [t^hæk] sounds very different from the [æ̃] in [t^hæ̃n]. Here is some data:

Ted	[tɛd]	ten	[tɛ̃n]	net	[nɛt]		
hat	[hæt]	hand	[hæ̃nd]	gnat	[næt]		
pant	[p ^h æ̃nt]	pat	[pæt]	Frank	[fɪæ̃ŋk]	frack	[fɪæk]
frame	[fɪɛ̃m]	fray	[fɪɛ]	lamp	[læ̃mp]	lap	[læp]

- List the local environments for the nasalized and unnasalized vowels respectively.
 - Are the local distributions complementary?
 - Which vowel(s) do you think should be treated as basic, as the phoneme(s)? (Briefly explain)
 - Write a rule (or rules, if necessary) to define the alternation, first in clear English, and then in the notation introduced above.
- Velar stops.** There is a slight difference in the sound and pronunciation of [g] and [k] in the following English words, indicated by the IPA “advanced” or “fronting” diacritic [̟]:

gill	[g̟ɪl]	got	[gət]	grog	[grag]
geese	[g̟is]	goose	[gus]	glimmer	[glɪmɹ]
game	[g̟em]	go	[go]	Gwendolyn	[ˈgwɛdələn]
gag	[g̟æg]	good	[gud]	eggs	[ɛgz]
soggy	[ˈsag̟i]	Gus	[gʌs]	Muggsy	[ˈmʌgz̟i]
kitten	[k̟ɪt̟n]	cop	[kəp]	crack	[kræk]
kin	[k̟ɪn]	cool	[kul]	clock	[klak]
cake	[k̟ek]	cope	[kɒp]	quick	[kwɪk]
lucky	[ˈlʌk̟i]	cup	[kʌp]	Exxon	[ˈɛksən]

- In what environments do the fronted sounds [g̟] and [k̟] occur?
- Based on the previous answer, which of [k̟] and [k] is the underlying phoneme, and why? Which of [g̟] and [g] is the underlying phoneme, and why?
- State in clear and precise English a phonological rule that derives the variants, as simply as possible.
- Use the formal notation introduced in class and in the text to express the same rule.

References and further reading

Fromkin, Victoria, editor. 2000. *Linguistics: An Introduction to Linguistic Theory*. Blackwell, Oxford.

Lecture 14 Phonemes and rules of variation

14.1 Recap: Phones, features, phonemes and rules

We started with **phones**, distinct speech sounds. We noticed that these sounds share various **features** which are relevant to the contexts in which the sound is produced. If we choose enough features, then every pair of phones will differ in some feature or other. One feature specification is given in Figure 14.1 on page 126. When we notice that some variations in phones are predictable, we proposed that there are basic **phonemes** that can vary, and we saw how to write precise rules about those variations.

Identifying phonemic contrasts

1. Find pairs of different words that differ in a single sound. If they differ in meaning, the contrast is phonemic. The differing sounds are different phonemes.

Complications for this method:

- Sometimes a minimal pair cannot be found, just because of accidental gaps in the lexicon. For example, there are rather few words with the sounds /ɜ/ and /ð/, so minimal pairs are difficult or impossible to find (Fromkin, 2000, pp533,534-535).

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 /ɜ/, it can be hard to find perfect minimal pairs, but we can come close:

seizure	/ˈsiːʒə/	neither	/ˈniːðə/
adhesion	/ədˈhiːʒən/	heathen	/ˈhiːðən/

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:

IPA	manner							laryngeal			place							long	stress	syllabic										
	consonantal	sonorant	continuant	delayed release	approximant	tap	trill	nasal	voice	spread	glottis	constricted	glottis	labial	round	labiodental	coronal				anterior	distributed	strident	lateral	dorsal	high	low	front	back	tense
p	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	0	0	0	-	-	0	0	0	0	0	0	-	-	-
b	+	-	-	-	-	-	-	-	+	-	-	-	+	-	-	-	0	0	0	-	-	0	0	0	0	0	0	-	-	-
m	+	+	-	0	-	-	-	+	+	-	-	-	+	-	-	-	0	0	0	-	-	0	0	0	0	0	0	-	-	-
f	+	-	+	+	-	-	-	-	-	-	-	-	+	-	+	-	0	0	0	-	-	0	0	0	0	0	0	-	-	-
v	+	-	+	+	-	-	-	-	+	-	-	-	+	-	+	-	0	0	0	-	-	0	0	0	0	0	0	-	-	-
θ	+	-	+	+	-	-	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	0	0	0	0	0	0	-	-	-
ð	+	-	+	+	-	-	-	-	+	-	-	-	-	-	-	+	+	+	-	-	-	0	0	0	0	0	0	-	-	-
t	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	0	0	0	0	0	0	-	-	-
d	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	+	+	-	-	-	-	0	0	0	0	0	0	-	-	-
s	+	-	+	+	-	-	-	-	-	-	-	-	-	-	-	+	+	-	+	-	-	0	0	0	0	0	0	-	-	-
z	+	-	+	+	-	-	-	-	+	-	-	-	-	-	-	+	+	-	+	-	-	0	0	0	0	0	0	-	-	-
n	+	+	-	0	-	-	-	+	+	-	-	-	-	-	-	+	+	-	-	-	-	0	0	0	0	0	0	-	-	-
l	+	+	+	0	+	-	-	-	+	-	-	-	-	-	-	+	+	-	-	+	-	0	0	0	0	0	0	-	-	-
tʃ	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	+	-	+	+	-	-	0	0	0	0	0	0	-	-	-
dʒ	+	-	-	+	-	-	-	-	+	-	-	-	-	-	-	+	-	+	+	-	-	0	0	0	0	0	0	-	-	-
ʃ	+	-	+	+	-	-	-	-	-	-	-	-	-	-	-	+	-	+	+	-	-	0	0	0	0	0	0	-	-	-
ʒ	+	-	+	+	-	-	-	-	+	-	-	-	-	-	-	+	-	+	+	-	-	0	0	0	0	0	0	-	-	-
r	-	+	+	0	+	-	-	-	+	-	-	-	-	-	-	+	-	+	-	-	-	0	0	0	0	0	0	-	-	-
j	-	+	+	0	+	-	-	-	+	-	-	-	-	-	-	-	0	0	0	-	+	+	-	+	-	+	-	-	-	-
k	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	-	+	+	-	0	0	0	-	-	-	-
g	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	0	0	0	-	+	+	-	0	0	0	-	-	-	-
ŋ	+	+	-	0	-	-	-	+	+	-	-	-	-	-	-	-	0	0	0	-	+	+	-	0	0	0	-	-	-	-
h	-	-	+	+	-	-	-	-	-	+	-	-	-	-	-	-	0	0	0	-	-	0	0	0	0	0	0	-	-	-
w	-	+	+	0	+	-	-	-	+	-	-	-	+	+	-	-	0	0	0	-	+	+	-	-	+	+	-	-	-	-
i	-	+	+	0	+	-	-	-	+	-	-	-	-	-	-	-	0	0	0	-	+	+	-	+	-	+	+	-	-	-
u	-	+	+	0	+	-	-	-	+	-	-	-	+	+	-	-	0	0	0	-	+	+	-	-	+	+	+	-	-	-
I	-	+	+	0	+	-	-	-	+	-	-	-	-	-	-	-	0	0	0	-	+	+	-	+	-	-	+	-	-	-
ʊ	-	+	+	0	+	-	-	-	+	-	-	-	+	+	-	-	0	0	0	-	+	+	-	-	+	-	+	-	-	-
ə	-	+	+	0	+	-	-	-	+	-	-	-	-	-	-	-	0	0	0	-	+	-	-	-	-	-	+	-	-	-
ɛ	-	+	+	0	+	-	-	-	+	-	-	-	-	-	-	-	0	0	0	-	+	-	-	+	-	-	+	-	-	-
ʌ	-	+	+	0	+	-	-	-	+	-	-	-	-	-	-	-	0	0	0	-	+	-	-	-	+	-	+	-	-	-
ɔ	-	+	+	0	+	-	-	-	+	-	-	-	+	+	-	-	0	0	0	-	+	-	-	-	+	-	+	-	-	-
æ	-	+	+	0	+	-	-	-	+	-	-	-	-	-	-	-	0	0	0	-	+	-	+	+	-	0	+	-	-	-
ɑ	-	+	+	0	+	-	-	-	+	-	-	-	-	-	-	-	0	0	0	-	+	-	+	-	-	0	+	-	-	-
e	-	+	+	0	+	-	-	-	+	-	-	-	-	-	-	-	0	0	0	-	+	-	-	-	-	+	+	-	-	-
o	-	+	+	0	+	-	-	-	+	-	-	-	+	+	-	-	0	0	0	-	+	-	-	-	+	+	-	-	-	-

Fig. 14.1: 36 phonemes of American English from Hayes (2009, pp.95-9), with 3 extra features added in the right columns for a total of 28. Note +aspirated = +spread glottis. And notice 3 things: (1) Diphthongs are not included here. (2) Some features like trill are not used in English, and the features are not independent. Hayes (2009) lists 82 sounds for the world’s languages, which could be specified with 7 binary features, since $2^7 = 128$. But this table has 28 features with 3 values. The third value, the 0, is sometimes described as a “don’t care” value, but is also used for features which are cannot be either + or - given the rest of the feature settings. $2^{28} = 268,435,456$ and $3^{28} = 22,876,792,454,961$. (3) Even with the 3 extra columns, we do not have everything we might want in a grammar of English. E.g. this table does not have the dental feature mentioned on pages 127-128 below. For more precise accounts of English and other languages, many more features are needed.

Identifying phonemes and phonological rules

1. Identify the relevant 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**.^a (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 accidental gaps in the lexicon.

^aIn practice we sometimes encounter sounds that are *almost always* in different environments. For example, the [t]/[t^h] contrast is nearly complementary except perhaps at the ends of words, where there is a lot of free variation. To predictive conditioned allomorphy, it is enough to have some contexts only one variant occurs and some where only the other occurs.

Example: English n dentalization One of the English sound changes that we did not mention yet is illustrated by comparing the pronunciation of /n/ in examples like this:

no	[no]	tenth	[tɛn̪θ]
annoy	[ə'noɪ]	month	[mʌn̪θ]
onion	[ˈʌnjən]	panther	[ˈpæn̪θɹ]

Here we use a diacritic to indicate when /n/ is ‘dentalized’, pronounced with the tongue at the teeth instead of farther back on the alveolar ridge. Let’s go through the steps that pin down this variation and define it:

1. Identify the relevant environments for the sounds [n n̪]

If we thought the full environments of [n n̪] could be relevant, we would list:

n	n̪
____o	tɛ____θ
ə____oɪ	mʌ____θ
ʌ____jən	pæ____θɹ

But usually the relevant things immediately precede or follow the sound, and so we can first consider these simple “local” environments:

chapters 4-7, we saw that the basic phrase structure rules and lexical requirements must apply before the movements, and that at least some of the binding principles must apply after the movements. When grammars of that style are developed further, the ordering requirements get considerably more elaborate, and this is one reason that linguists have moved to slightly more abstract systems where long sequences of ordered rules do not need to be specified to learn a grammar. (You will see them if you take more syntax! Or you could get [this text](#) to read over the summer with friends and family!)

When phonology is developed in the way described here, we can see that rule ordering matters by considering a dialect that has the following pronunciations:

	phoneme sequence	phone sequence
ladder	/lædr̩/	[lærr̩]
latter	/læt̩r̩/	[læ̃rr̩]

In this language, we will get the wrong result for the word *latter* if we apply first flapping and then shortening:

/læt̩r̩/
 ↓ flapping
 [lærr̩]
 vowel shortening does not apply (because r is voiced)

We can avoid this result if by requiring that vowel shortening applies before flapping.

There is a dialect of English which provides clearer data that is relevant to these questions about rule ordering. In this dialect, mentioned by Fromkin (2000, pp566-570), we have a diphthong [ʌɪ] heard in words like the following:

write	[rʌɪt]	ride	[raɪd]
tripe	[tɹʌɪp]	tribe	[tɹaɪb]
rice	[rʌɪs]	rise	[raɪz]
sight	[saɪt]	side	[saɪd]

This difference can be seen in the spectrogram, this one from Moreton and Thomas (2007):

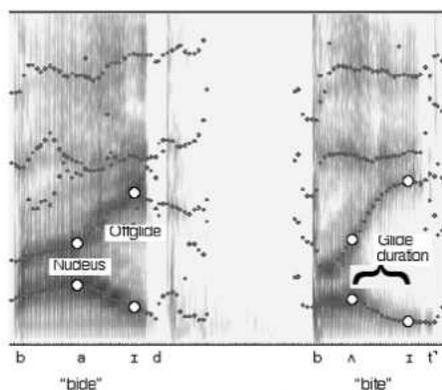


Figure 5. Measurement points (nuclear F1 and F2, offglide F1 and F2, and glide duration) for examples of *bide* and *bite*. Frequency range shown is 0 to 5000 Hz. The window is 1.00 s wide.

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 [aɪ aɪ]:

aɪ	Aɪ
r____t	r____d
r____p	r____b
r____s	r____z
s____t	s____d

2. In this data, the environments for [aɪ] and [Aɪ] 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 [Aɪ] is an allophone derived by the following rule:

(aɪ-raising)

$$aɪ \rightarrow Aɪ / ____ \left[\begin{array}{l} +\text{consonant} \\ -\text{voice} \end{array} \right]$$

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* contrast):

	phonemes	actual phones
writer	/raɪt̬r̩/	[rAɪt̬r̩]
rider	/raɪd̬r̩/	[raɪd̬r̩]

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

$$\begin{array}{l} /raɪt̬r̩/ \\ \downarrow \text{flapping} \\ [raɪt̬r̩] \\ \text{aɪ-raising cannot apply because } r \text{ is voiced} \end{array}$$

We can avoid this result by requiring 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 [Aɪ], we did not include the *writer/rider* pair,

$$[rAɪt̬r̩] \quad [raɪd̬r̩]$$

If we had included it, we would have noticed that [aɪ] and [Aɪ] 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	/læd̬r̩/	[læɹ̩t̬r̩]
latter	/læt̬r̩/	[læɹ̩t̬r̩]

it could appear that there is a phonemic contrast between [æ] and [æ̃], 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.

14.3 Syllable boundaries in phonological rules

In formulating our phonological rules, we have referred to syllables several times. See for example our rule for voiceless stop aspiration on page 117. But we have not talked about what syllables are.

Syllables are relevant to many aspects of speech sounds. One other kind of example is illustrated by the following. English allows the word

[pɪŋk] but not *[pɪnk]
[driŋk] but not *[driŋk]

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, . . .

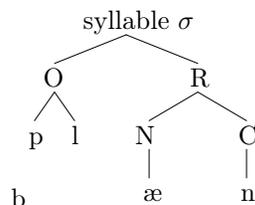
The relevance of syllables to these facts is obvious because we have other words with the wierd sequences [ŋk], [mk]:

[ɛŋkɒd] [ɛŋkʌmpəs] [pʌmkɪm]

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

[ɛn.kɒd] [ɛn.kʌm.pəs] [pʌm.kɪm]

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. These three parts of a syllable are called the **onset** (O), the **nucleus** (N) and the **codā** (C), respectively, with the nucleus as the only obligatory part, and with the **tree** structure:



Here the syllable “ σ ” is the **root node** of the tree – In this tree, the syllable has two parts, the onset and the rime. The right daughter is the rime, which is in turn the **mother** of two more daughters: the nucleus and the coda.

Why assume that the elements of the syllable group in this way, as [onset [nucleus coda]] rather than as [[onset nucleus] coda]? 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 on sound sequences which hold syllable-internally, as suggested by the *[pʌmk], [pʌm.km] 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 ɲ, and maybe ʒ.¹
(Remember that ? 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 (Fromkin, 2000, p591):

Some of these onsets are uncommon. Try writing the phonetic transcriptions for the words: equal, cute, guava, jaguar, regular, beauty, tubular. In class we also discussed examples like: pure, huge, muse, music.

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

This chart leaves out some unusual onsets, 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 onset. Never ʃ, ʒ, 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:

Write, for example, the phonetic transcriptions for the words: pewter, spew, splash, fume, ambiguity, Gwen, regular, fume, thwart.

	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].

¹Maybe 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.

- (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 procedure for getting a preliminary syllable structure in English is the following: **First**, each syllabic phone (each vowel, diphthong or syllabic consonant) is a nucleus. **Second**, we have the preferences (Fromkin, 2000, p592):

- (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.

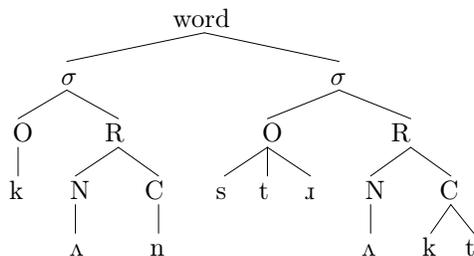
When consonants occur between two vowels, then, we typically prefer to associate the consonants with the onset of the second syllable if possible. In other words, each onset should include the longest possible sequence of consonants preceding a nucleus. **Finally**, any remaining consonants must be codas of the preceding nuclei. For obvious reasons, this idea is sometimes called the “onsets before codas” or “avoid coda” rule; what it amounts to is: “maximize onsets.”

So, for example, consider the word *construct*
/kʌnstɹʌkt/.

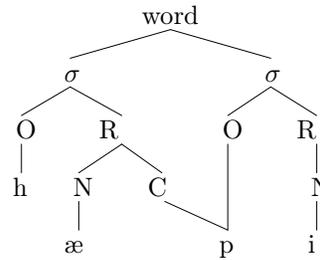
We parse this into two syllables as follows:

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*, Fromkin (2000, p588) presents a structure 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:



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.

14.3.1 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.

Fromkin (2000, p588) says: “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.” What does that mean?

‘Homorganic’ means ‘pronounced in the same place’. Remember 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.

Fromkin (2000, p588) also says: “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.sɜd], and “Hudson” [hʌd.sən], for example. We also have words like these:

[gɪmpst]	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 [r] in it? Maybe not. Consonant clusters in other languages pose similar problems (Cho and King, 2003).

A more restricted version of this idea is sometimes considered:²

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

Another possibly related question is: why do we have

skits [skɪts] trailed [treɪld] 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.

14.3.2 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 (=obstruent)			+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:³

Sonority principle (SP): onsets 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.

To be more precise about the SP, we might wonder whether onsets and codas could have two consonants of the “same sonority”. For example, should we count the /sf/ in ‘sphere’, two fricatives, as a sonority violation? Let’s assume that this is OK. What SP rules out is decreases in sonority in onsets, and increases in sonority in codas.

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:

²This principle and the next one are from Fromkin (2000, pp.612ff).

³Fromkin (2000, p591) provides slightly more restricted observations, saying: “... English, like many other languages, does not allow sonorant-obstruent sequences at the beginning of a word...”

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)

14.4 Word boundaries in phonological rules

Adding a prefix or suffix can change the relevant environment for phonemes in ways that affects pronunciation (Fromkin, 2000, §12.10). For example, adding “-able” /əbəl/ to “note” /not/ triggers flapping. Using ' to mark primary stress,

note	'not
notable	'norəbəl or 'norəbɫ
notation	nə'teɪʃən

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

not a mistake 'norə,mɪ'stek

Prefixes and suffixes interact with phonology in many interesting ways – we may have time to return to this next week.

14.5 A question

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

I have a question about the Fromkin 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!

14.6 Summary

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

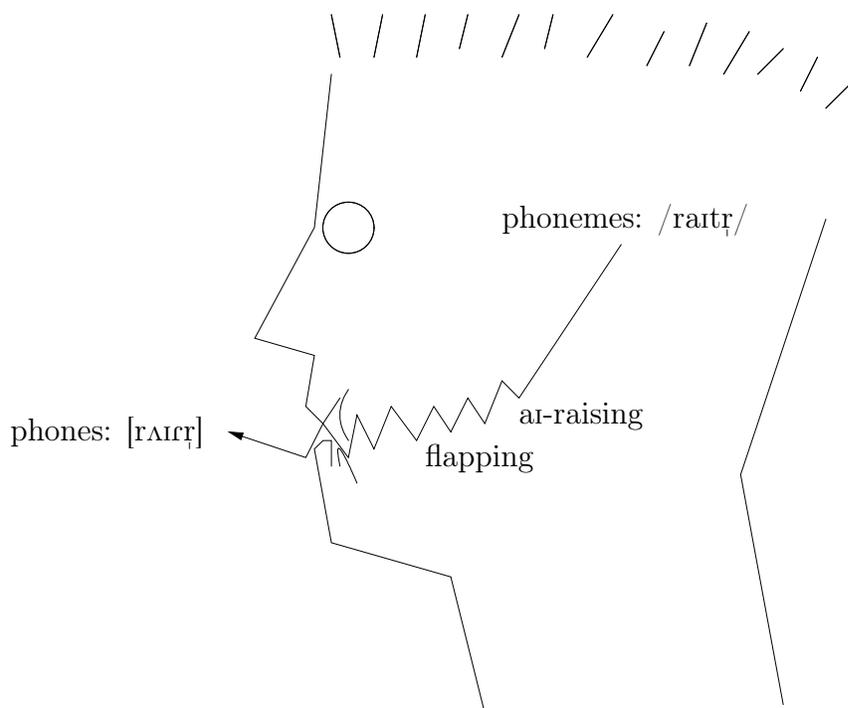
- the minimal pair procedure for identifying (variants of) different phonemes
- the procedure for identifying phonemes and phonological rules

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. We also introduced

- a procedure for identifying syllable boundaries.

We have gotten to a surprising picture of how language works. We have split our first simple idea of a “basic speech sound” into basic “underlying” **phonemes** with **allophones**, the variant **phones** that are triggered by linguistic context. As we noted at the outset, there is a great deal of **unconditioned variation** by which we mean variation in the speech sounds that is not predictable just from the linguistic context (but rather by the size of the speaker and other non-linguistic factors).

Notice that the list of Standard English phones that we began with is much too small – we did not list the sounds [ɹ̥, ɹ̄] or many others that we might want to be more precise about. Really there is a great deal of regular, linguistically conditioned variation, though the changes are usually, intuitively ‘small’. The collection of phonemes is much smaller than the collection of phones, and allophones can then be derived. When you think of a word or phrase to say, you have a phoneme sequence like /raɪrɪ/ in mind. Then, rules apply, *with some ordered before others*, to make some adjustments in how the phonemes sound when they are pronounced, so that the result might be [rʌɪrɪ]:



References and further reading

- Bloomfield, Leonard. 1933. *Language*. University of Chicago Press, Chicago.
- Cho, Young-mee Yu and Tracy Holloway King. 2003. Semisyllables and universal syllabification. In C. Féry and R. van de Vijver, editors, *The Syllable in Optimality Theory*. Cambridge University Press, NY.
- Fromkin, Victoria, editor. 2000. *Linguistics: An Introduction to Linguistic Theory*. Blackwell, Oxford.
- Hayes, Bruce. 2009. *Introductory Phonology*. Wiley-Blackwell, Malden, Massachusetts.
- Moreton, Elliott and Erik R. Thomas. 2007. Origins of Canadian Raising in voiceless-coda effects: A case study in phonologization. *Laboratory Phonology*, 9.
- Steriade, Donca. 1999. Alternatives to the syllabic interpretation of consonantal phonotactics. In O. Fujimura, B. Joseph, and B. Palek, editors, *Proceedings of the 1998 Linguistics and Phonetics Conference*. Karolinum Press, Oxford, pages 205–242.

Lecture 15 Stress and intonation

In formulating our phonological rules, we have noticed that stress is often relevant, but we have not considered what stress is or how it works. Let's finish our discussion of phonology by catching this difficult but important loose end.

15.1 Stress

In spoken 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:¹

ə, sɪm.ə'le.fən

One notation for stress, or perhaps prominence more generally, is to use a “pile” of **grid marks** to indicate the prominence of each syllable (Fromkin, 2000, §13.3):

```

                x
            x      x
    x  x  x  x  x
    ə  sɪ mə le fən
```

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

0. each syllable has a grid mark x,
1. syllables with more stress have more grid marks, and
2. we use no more grid marks than necessary.

These rules also allow us to represent prominence distinctions that go beyond single words. Consider for example the phrase *maintain assimilation* in which the second word has more stress on its most stressed syllable than the first word does. In fact, in this case, the stressed syllable of the first word might have a prominence that is somewhere between the secondary stress and primary stress of the second word. We can represent this as follows:

```

                x
            x      x
            x      x
    x  x  x  x  x  x  x
    men ten ə sɪ mə le fən
```

¹The [m] in this example immediately follows the stressed lax vowel [ɪ] so it is really “ambisyllabic” in the sense mentioned on page 133 of these notes, and shown by the tree for *happy* in Fromkin (2000, p588).

The main idea here is simply that there are different levels of prominence in words, phrases and sentences. These levels of prominence seem to correspond to structure and interpretation. One famous example from Chomsky and Halle (1968, p21) is the various pronunciations of “black board eraser”. Using 1 for the most prominent word, 3 least prominent:

					prominence						interpretation					
					213						‘board eraser that is black’					
					132						‘eraser for a blackboard’					
					312						‘eraser of a black board’					
					x						x					
x	x				x				x	x	x	x	x	x		
x	x	x			x	x	x	x	x	x	x	x	x	x		
x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
blæk	bo:ɪ	də	.ɛ	sɪ	blæk	bo:ɪ	də	.ɛ	sɪ	blæk	bo:ɪ	də	.ɛ	sɪ		

Is that correct? As a native speaker, it seems to me that these different ways of pronouncing ‘black board eraser’ may signal something, but I don’t think it’s as simple as Chomsky and Halle propose.

Stepping back, though, what are we marking here? What is this prominence? That is, what are the differences that we are indicating in these grids?

One of the first, simple ideas is that ‘stress’ and ‘prominence’ are the same thing, and that it is indicated by loudness, amplitude in the acoustic signal, or something like that (Bloomfield, 1933, p111). Unfortunately, when you measure the signals and watch whether perceived stress and amplitude can pull apart, we find that they can. Another idea is that stress is pitch, with higher pitches on the more stressed syllables, or something like that. But again, pitch and prominence can pull apart. That is, sometimes the syllable that we perceive clearly as most prominent does not have highest pitch. So stress/prominence is not pitch.² Fromkin (2000, p598) says:

...stress cannot be identified by any one acoustic or articulatory feature: it is manifested variously, depending on the language, as the assignment of a particular tone to a syllable, or as the possibility of realizing a variety of tones, or as increased duration and loudness associated with the stressed syllables, or as the possibility of a richer set of contrasts among the segments of the stressed syllables than among those of the unstressed ones.

One important factor that is important in English which is not explicitly mentioned in this list is rather surprising: the choice of the vowel.

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 [ɪ] or [ʌ] are permitted only under stress. (Fromkin, 2000, p598)

These vowels do not always have main stress, of course, and other vowels can have secondary stress, as we have seen in some examples already, and we can collect more from any text like these from Fromkin (2000):

²For a review of these older views and how they were toppled, see for example Gussenhoven (2011).

(p598)	[i] in <i>nuclear</i>	['nu.kli.ɹ]
(p572)	[i] in <i>lucky</i>	['lʌ.ki]
(p572)	[ɛ] in <i>extract</i>	[ɛk'strækt]
(p572)	[a] in <i>Exxon</i>	['ɛksən]
(p572)	[ɛ i] in <i>mentality</i>	[mɛn'tæli.ɹi]
(p535)	[æ] in <i>adhesion</i>	[æd'hiʒən]
(p535)	[a] in <i>automatic</i>	[arə'mætɪk]

Another similar generalization about stress placement is based on light and heavy syllables. Notice that the list of vowels mentioned above for stressed syllables includes the tensed vowels. One idea about stress says that we can get a more specific claim if we also look at the codas of the syllables:

A syllable is said to be **light** if its rime consists of just one short (-ATR) vowel, with no coda; otherwise, it is **heavy**.³ In these terms, we can observe that in English:

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

In any case, it is clear that vowel quality and stress are related, and this connects with the following generalization which was briefly mentioned on page 111 of these lecture notes, when we introduced phonetics:

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].

Another idea about stress in English that may be surprising is that it seems to be related to pitch, or intonation, in the following way:

The location of main stress is testable in English in part through the observation that a main-stressed syllable attracts nuclear tones: these are the distinctive pitch values that form the central unit of any intonational melody. For instance, the intonational melody marking questions in English contains a low pitch value (a low tone) associated with the main stressed syllable of the relevant word. (Fromkin, 2000, p598)

We see this for example in the low tones associated with the main stressed vowels in the following one-word questions, and in the second word of the phrase in the last example (Fromkin, 2000, p598). Saying these (or having a local American native say them for you), you will notice the low tone of the indicated stressed syllable, followed by a rise:

nuclear?	['nu.kli.ɹ]?
arboreal?	[a.ɹ.'bo.ɹi.əl]?
aboriginal?	[æ.bo.'ɹi.ʒə.nəl]?
nuclear plant location?	['nu.kli.ɹ 'plænt lo.'ke.ʃʌn]?

³As discussed on page 111 of the notes for Lecture 12, the short (-ATR), lax vowels of our local Californian English are [ɪ ɛ æ ʊ]. Cf Halle (1977).

15.2 Word stress

Narrowing our consideration to just word stress in English, what decides where the stress should go? It turns out that the rules of English stress assignment are not simple, and they vary with dialects, so we will just observe some of the main tendencies:

First, English stress assignment varies with the “syntactic category” of a word.

Examples. the verb *digest*, as in *Did you digest that chapter?*,

has stress on the second syllable [daɪˈdʒɛst];

the noun *digest*, as in *Let’s get the “Reader’s digest” version!*,

has stress on the first syllable [ˈdaɪdʒɛst].

A similar thing happens in pairs like *ábstract/abstráct*, *éscort/escórt*, *súrvey/survéy*, *tórment/tormént*, *cónvict/convíct*.

So when we try to state what ‘usually’ happens in American English word stress, syntactic categories are relevant, and it also matters whether the word has affixes or not. Setting words with affixes aside, most unsuffixed words respect the following rules (Burzio, 1994), 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* /əˈdʒɛndə/, but *America* /əˈmɛrɪkə/
- In verbs, if the final syllable is superheavy it gets stressed, and otherwise the penultimate syllable gets stress.
 - for example, *prevent* /prɪˈvɛnt/, but *imagine* /ɪˈmædʒɪn/

Even with the restrictions to unaffixed words, these principles have exceptions. Stress in English seems to be a messy business, but somehow the complicated system persists – kids learn it.

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):

More details in the slides!

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

15.3 Reflecting on the big picture: Speech perception

Reflecting on the whole picture of phones, phonemes, syllables, and stress, 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, p210)

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. 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 vxvxn 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. (Pinker, 1994, p181)

15.4 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.

Our discussion of stress has been very brief, but probably surprising. We observed first that what is perceived as stress seems to be surprisingly diverse in the acoustics. It is not just loudness or just high pitch or any such thing, and it seems to vary with context, and yet

stress, whatever it is, is not hard for speakers to perceive. Then we observed that in English: stress is realized on syllables; it is influenced by vowel choice; it interacts with intonation; it sometimes seems to correlate with meaning, focussing some elements over others as in the Chomsky and Halle example; it depends sometimes on the presence of a coda; and it depends on syntactic category. (A complicated business!) The tendencies for English stress stated on page 142 should be understandable (but you don't need to memorize them).

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 (stated in the notes on page 135). Human languages are very unlike simple systems like the decimal numerals, where all sequences of the basic elements are allowed. In some cases, we can see that phonological restrictions on speech sounds ('phonotactics') relate to difficulty of pronunciation, in some sense. But describing the relevant 'difficulty of pronunciation' is not an easy task!

References and further reading

- Bloomfield, Leonard. 1933. *Language*. University of Chicago Press, Chicago.
- Burzio, Luigi. 1994. *Principles of English Stress*. Cambridge University Press, Cambridge.
- Chomsky, Noam and Morris Halle. 1968. *The Sound Pattern of English*. MIT Press, Cambridge, Massachusetts.
- Fromkin, Victoria, editor. 2000. *Linguistics: An Introduction to Linguistic Theory*. Blackwell, Oxford.
- Gordon, P. 2004. Numerical cognition without words: Evidence from amazonia. *Science*, 306(5695):496–499.
- Gussenhoven, Carlos. 2011. Sentential prominence in English. In Marc van Oostendorp, Colin J. Ewen, Elizabeth V. Hume, and Keren Rice, editors, *The Blackwell Companion to Phonology*. Wiley-Blackwell, Malden, Massachusetts.
- Halle, Morris. 1977. Tenseness, vowel shift, and the phonology of the back vowels in Modern English. *Linguistic Inquiry*, 8:611–625.
- Halle, Morris and William Idsardi. 1995. General properties of stress and metrical structure. In John Goldsmith, editor, *Handbook of Phonology*. Blackwell, Cambridge, Massachusetts, pages 403–433.
- Hayes, Bruce. 1982. Extrametricality and English stress. *Linguistic Inquiry*, 13(2):227–276.
- Hockett, Charles F. 1955. A manual of phonology. *International Journal of American Linguistics*, Memoir 11.
- Pinker, Steven. 1994. Verb syntax and verb semantics. In Lila Gleitman and Barbara Landau, editors, *The Acquisition of the Lexicon*. MIT Press, Cambridge, Massachusetts.

Lecture 16 Universals, and review

Linguistics is not the business of writing complete grammars for particular languages. I don't think that project is feasible or interesting. Rather, linguistics is about how languages work in general. This way of putting it presumes that there is a way that they work, in general. Languages must have certain kinds of properties that make them the sorts of things kids can learn when they are acquiring a language, a universal grammar (UG). Our understanding of these things has been changing recently.

In the 1960's and 1970's, I think there was a consensus that we would find that human languages have lots of very special properties. Greenberg (1963) had a famous list of universals, things like

- i. Languages with dominant VSO order are always prepositional.
- ii. Inversion of statement order so that verb precedes subject occurs only in languages where the question word or phrase is normally initial.
- iii. If languages allow syllables with codas, they allow syllable with onsets.
- iv. Every human language has transitive and intransitive sentences, but the constituents (Subject Object Verb) occur in different orders:

SOV (Turkish, Japanese, Navajo, Hopi, Mojave, Burmese, Somali, Walbiri)

SVO (English, Czech, Mandarin, Thai, Vietnamese, Indonesian)

VSO (Welsh, Irish, Tahitian, Chinook, Squamish)

rare: VOS (Malagasy, Tagalog, Tongan), OVS (Hixkaryana), OSV ?

Many linguists thought this kind of list would be extended and refined. But instead, most of Greenberg's proposed universals have been refuted, and the few that remain from that early work are just statistical tendencies.¹

Claims about language universals in introductory texts have mainly not kept up with the developing understanding of these matters. Either they ignore the subject or their discussions are rather vague and out-of-date.² After a recent paper suggesting that no such universals could be maintained (Evans and Levinson, 2009), the universals that were proposed in response are more carefully stated, and more abstract. What is meant by 'abstract' here? Well, as we

¹There is a big online database of proposed language universals and refutations of them <http://typo.uni-konstanz.de/archive/intro/>. For a survey and critical appraisal of claims like Greenberg's, see Evans and Levinson (2009).

²For example, the well-regarded text O'Grady et al. (2010) makes many remarks about universals, but the controversies are not mentioned. E.g. they suggest that "CV and V syllable types are unmarked..." (p309) and mention a number of related universal claims, without mentioning apparent counterexamples – see e.g. Breen and Pensalfini (1999) and the discussions of onset-sensitivity in Berry (1998), Gordon (2005), Topintzi (2011). The general suggestions about universals in O'Grady et al. (2010) might be on the right track, but are too vague to assess: "Perceptual factors play a role in shaping language universals... At least some syntactic universals may be explained in terms of the way the human brain processes sentence structure" (pp317,318).

have seen over and over in this class, the facts require us to analyze language as being the product of many different factors. The surface properties of language arise from many different causes, and we have tried to dig into some few of them. So recently proposed universals involve those factors: the underlying forms and the various kinds of mechanisms that affect how these influence language as it is spoken. Since understanding this is central to understanding what linguistic theory is about, let's follow recent developments and try to be careful about these things.

One universal property of human languages mentioned at the beginning of the class is

- (1) (**Zipf, 1949**). In normal discourse, the relation between word frequency and rank is an inverse exponential.

This evidence for this claim is empirically robust (though the claim is imprecise about what counts as "normal" discourse). But after the first mention, this idea was not touched in this class, for a reason. If linguistic theory is about which structures are possible, not which ones you use on any occasion, or on most occasions, then Zipf's law is irrelevant to linguistic theory. The reason the theory focuses on which structures are possible is that the possible structures seem to depend largely on a very restricted range of properties of the sequences of elements in our utterances, properties that can be listed in the lexicon. On the other hand, which expressions will be used on any occasion depends on the creativity of the speaker and many other non-lexical factors, outside the scope of linguistic theory. Statistical, social regularities may emerge, but they are not due to properties listed in the lexicon.

- (2) (**Frege, 1923**)

- i. Every human language is compositional in at least the sense that the meanings of infinitely many complexes are determined by the meanings of their parts and their manner of composition (where the number of basic parts and manners of composition are finite). For recent discussion, see (Hodges, 2001; Westerstahl, 2004).
- ii. Human languages are 'unbounded', 'infinite' at least in the sense that they are characterized by patterns that extend size without limit.³

For every human language, we have this kind of compositional, derivational picture of language in the phonology, morphology, syntax and semantics.⁴

³Languages are 'recursive', in this sense – infinite but definable with recursion. This does not distinguish 'recursion' (one function calling itself, or one category dominating another in a data structure) from 'iteration' (loops) in the computer scientists' sense. Recursion and loops are expressively equivalent but treated differently in programming languages. This terminological issue has confused many discussions of recursion in human languages!

⁴Some linguists seem to say that even these most basic claims are mistaken. For example, Levinson (2013) suggests that they may be threatened by recent work on Piraha (Everett, 2005). But this misinterprets the claims about Piraha. Everett (p.c.) clarifies that his claim is that there is no recursion of full clauses in Piraha, but there is of course iteration of elements. And he adds that of course there is also iteration at the discourse level. For ongoing discussion, see for example Legate, Pesetsky, and Yang (2013).

In this class we have seen

(3) Various kinds of factors are distinguished in the grammars of all human languages:

- a. in morphology: restrictions on compounding and affixation
- b. in syntax: phrase structure, movements, agreement
- c. in semantics: restricted semantic values for each syntactic category
‘higher order’ relations among concepts
- d. in phonology: phonemes, stress, adjusted according to context

We can make the empirical impact of some of these approaches more precise, below.

The particular complexity found in the patterns of human languages has been extended have been clarified by a series of proposals dating from the 1950’s.

(4) (Chomsky, 1956) Some human languages have unbounded nested and crossing ‘dependencies’.

This claim can be made mathematically precise, but intuitively, the ‘dependencies’ can be visualized by drawing a line under a sentence to connect elements where one element requires (or determines the form of) the other:

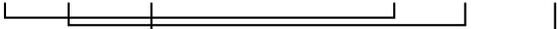
Nested dependencies with relative clauses (Chomsky, 1956):

the men who the student likes laugh

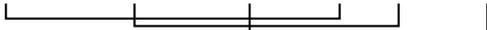

Crossing dependencies in subject-auxiliary inversion (Chomsky, 1956):

will Marie have -∅ be -en prais -ing Pierre


Crossing dependencies in Dutch (Huybregts, 1976; Bresnan et al., 1982):

... because I Cecilia Henk the hippo saw help feed
 ... omdat ik Cecilia Henk de nijlpaarden zag helpen voeren


Crossing case-marked dependencies in Swiss-German (Shieber, 1985):

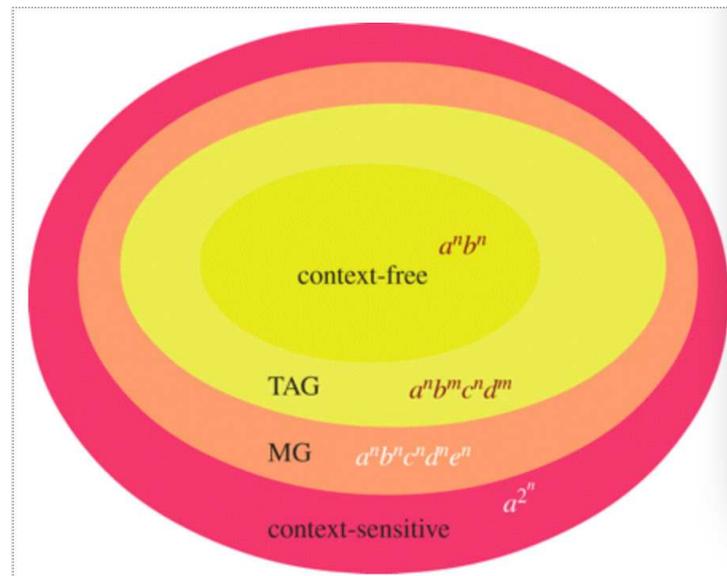
... that we the children Hans the house let help paint
 ... das mer d'chind em Hans es huus lönd hälfe aastrüiche


Most grammars of English and most other languages allow dependencies of these sorts. Various proposals try to pin this down more precisely:

(5) (Joshi, 1985) All human languages are ‘mildly context sensitive’ in this sense:

- a. the range of possible dependencies is restricted
- b. they have the constant growth property
- c. they are ‘efficiently’ recognizable

A language has ‘constant growth’ if there is a finite number k such that for any sentence s , if there is any sentence longer than s , then there is a sentence that is longer by k words or less. And by ‘efficient’, Joshi means that there is a polynomial complexity algorithm that can decide whether a sentence is in the language. One way of making the restrictions on possible dependencies precise is with a precise version of the idea (3.b) that languages can be defined with phrase structure rules and movement. In recent work in ‘Minimalist’ syntax, Chomsky suggests that phrase structure and movement should be taken together and called Merge, and he says “In the ideal case, [Merge] would be...the only principle of UG” (Chomsky, 2012). Minimalist grammars (MGs) make that kind of idea precise to define a class of languages that has a place in the Chomsky hierarchy of language complexity:



- (6) **Jäger and Rogers (2012, p1961)** Referring to the different complexity classes shown in this figure, Jäger and Rogers say: “Most experts... assume at this time that all natural languages are MG languages.”

There are some challenges to this claim too, but the claim is precise and the challenges are fairly well understood. They depend in part on whether languages really contain certain constructions that are quite difficult to accept. For ongoing discussion, see (Michaelis and Kracht, 1997; Bhatt and Joshi, 2002; Kobele, 2006; Chen-Main and Joshi, 2008).

There are still claims about the possible orders of elements, but they are much more carefully stated than the ones we had in the 1960’s.

- (7) **Baker (2009)**: Although languages show all orders of subject, verb, and object, in fact, all empirically justifiable grammars assume that (i.e. before movements) the verb combines first with the object.
- (8) **Pesetsky (2009)**: Although various positions of wh-elements is seen in the world’s languages, always (underlyingly, before movements) ‘left peripheral’.

16.1 ‘Cheat sheets’: some basic grammatical assumptions

For the understanding of linguistics that is important in this class, there is no need to memorize lots of things. The important thing is to understand what kinds of grammars seem to be needed, and how we go about constructing them. We will provide something like the following incomplete lists of rules in the exams (the next 2 pages) for your reference. . .

Phonetics and phonology. Phonemes (typically identified by ‘minimal pairs’):

			manner	voice	place
1.	/p/	spit	plosive stop	–	labial
2.	/t/	stuck	plosive stop	–	alveolar
3.	/tʃ/	chip	plosive stop affricate	–	alveopalatal
4.	/k/	skip	plosive stop	–	velar
5.	/b/	bit	plosive stop	+	labial
6.	/d/	dip	plosive stop	+	alveolar
7.	/dʒ/	jet	plosive stop affricate	+	alveopalatal
8.	/g/	get	plosive stop	+	velar
9.	/f/	fit	fricative	–	labiodental
10.	/θ/	thick	fricative	–	interdental
11.	/s/	sip	fricative	–	alveolar
12.	/ʃ/	ship	fricative	–	alveopalatal
13.	/h/	hat	fricative	–	glottal
14.	/v/	vat	fricative	+	labiodental
15.	/ð/	though	fricative	+	interdental
16.	/z/	zap	fricative	+	alveolar
17.	/ʒ/	azure	fricative	+	alveopalatal
18.	/m/	moat	nasal stop	+	labial
19.	/n/	note	nasal stop	+	alveolar
20.	/ŋ/	sing	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.	/ɹ/ or /ʁ/ or /əɹ/	bird	central approximant	+	retroflex

			height	backness	rounded	tense
1.	/i/	beat	high	front	unrounded	+
2.	/ɪ/	fit	high	front	unrounded	–
3.	/u/	boot	high	back	rounded	+
4.	/ʊ/	book	high	back	rounded	–
5.	/ɛ/	let	mid	front	unrounded	–
6.	/o/	road	mid	back	rounded	+
7.	/ʌ/	shut	low	back	unrounded	–
8.	/e/	ate	mid	front	unrounded	+
9.	/æ/	bat	low	front	unrounded	–
10.	/ɑ/	pot	low	back	unrounded	+
11.	/ə/	roses	mid	central	unrounded	–
12.	/aɪ/	lies	diphthong			
13.	/aʊ/	crowd	diphthong			
14.	/ɔɪ/	boy	diphthong			

liquids = /l,ɹ,ɹ̄/, glides = /j,w/

coronals = dental, alveolar and alveopalatal stops, fricatives, affricates, liquids, and alveolar nasals

sonorants = vowels,glides,liquids,nasals, obstruents=non-sonorants

Sonority Hierarchy: stops < affricates < fricatives < nasals < liquids < glides < vowels

Sonority principle: Onsets increase in sonority towards the nucleus, and codas fall in sonority away from the nucleus.

Rules deriving allophonic variations. E.g. for [no] vs. [nʌŋθ], and [ə'noi] vs. ['pæŋθɹ]:

(n dentalization) n → [+dental] / ____θ

Rules of syllable structure. $\sigma \rightarrow (\text{Ons}) \text{Rime}, \text{Rime} \rightarrow \text{Nuc} (\text{Coda})$

Morphology. Right hand head rule, and specific rules for affixes. E.g. $N \rightarrow \text{-er} / [V____]$

Syntax. constituency tests: substitution for word level categories, substitution by a pronoun, substitution by *do* or *do so*, phrasal preposing, coordination, sentence fragments

basic rules for selected elements	rules for modifiers
$CP \rightarrow C'$	
$C' \rightarrow C \text{ TP}$	
$TP \rightarrow DP \text{ T}'$	$NP \rightarrow AP \text{ NP}$
$T' \rightarrow T \left\{ \begin{array}{l} VP \\ \text{NegP} \end{array} \right\}$	$NP \rightarrow NP \text{ CP}$
$\text{NegP} \rightarrow \text{Neg} \text{ VP}$	$VP \rightarrow \text{AdvP} \text{ VP}$
$DP \rightarrow \left\{ \begin{array}{l} (\text{D}) \text{NP} \\ \text{Name} \\ \text{Pronoun} \end{array} \right\}$	$VP \rightarrow VP \text{ PP}$
$NP \rightarrow N (\text{PP})$	$AP \rightarrow \text{AdvP} \text{ AP}$
$VP \rightarrow V (\text{DP}) \left(\left\{ \begin{array}{l} \text{PP} \\ \text{CP} \\ \text{VP} \end{array} \right\} \right)$	
$PP \rightarrow P (\text{DP})$	
$AP \rightarrow A (\text{PP})$	
$\text{AdvP} \rightarrow \text{Adv}$	
$\alpha \rightarrow \alpha \text{ Coord } \alpha \quad (\text{for } \alpha = \text{D, V, N, A, P, C, Adv, VP, NP, AP, PP, AdvP, TP, CP})$	

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.

(Tricky detail: English *be* acts like an auxiliary, even when it's the main verb.)

Semantics:

$\llbracket \text{Name T}' \rrbracket = \text{true}$	just in case	$\llbracket \text{Name} \rrbracket \in \llbracket \text{T}' \rrbracket$
$\llbracket \text{No NP T}' \rrbracket = \text{true}$	just in case	$\llbracket \text{NP} \rrbracket \cap \llbracket \text{T}' \rrbracket = \emptyset$
$\llbracket \text{Every NP T}' \rrbracket = \text{true}$	just in case	$\llbracket \text{NP} \rrbracket \subseteq \llbracket \text{T}' \rrbracket$
$\llbracket \text{AP NP} \rrbracket = \llbracket \text{AP} \rrbracket \cap \llbracket \text{NP} \rrbracket$	just in case	AP is intersective (not, e.g. relational)

- NPI = negative polarity item like *ever, one bit, at all*, some uses of *any*
 - D is conservative = $[D \text{ N T}'] \leftrightarrow [D \text{ N is/are N that T}']$
 - D is decreasing = $[D \text{ NP T}'_1]$ entails $[D \text{ NP T}'_2]$ whenever $\llbracket \text{T}'_2 \rrbracket \subseteq \llbracket \text{T}'_1 \rrbracket$
(When D is decreasing, we sometimes say that the whole DP, the $[D \text{ NP}]$, is decreasing too.)
 - A c-commands B = A is a sister or aunt of B in the tree
 - A is the antecedent of B = B gets its reference from A
- (1) To a good first approximation, all Ds are conservative
 - (2) NPIs must be licensed by a c-commanding decreasing DP or other negative element
- (A) Reflexive pronouns must be c-commanded by an antecedent DP in same TP
 - (B) Non-reflexive pronouns cannot be c-commanded by an antecedent DP in same TP
 - (C) Other DPs (like *John* or *every student*) do not have antecedents

Notation:	$x \in A$	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 $	the number of things in set A

16.2 Review: Ambiguity and homophony

One thing that seems to have surprised many students at the beginning of the class is the ways ambiguity creeps into the language. Every human language allows different things to be pronounced the same way, or very nearly so. We find this at the lexical level, in single morphemes. ‘Will’ can be a noun referring to a document, or to a personality trait, or it can name a person. But a word with (almost) the same pronunciation can be an auxiliary verb expressing future or a ditransitive verb meaning something like ‘leave as inheritance’.⁵ We also find that at the phrasal level. Most pronounced utterances can have multiple structures which mean different things.

- a. **Ambiguity caused by phonological rules:** ladder and latter both pronounced

/læɹɹ/

Is the first vowel slightly longer for ‘ladder’? Perhaps for some speakers.

- b. **Ambiguity in the lexicon:**

After the break, he went to the bank

If *break* meant just 3 things (pause, fracture, severance), and *bank* meant just 3 things (financial institution, riverside, physical building housing a financial institution), then this utterance would have $3 \times 3 = 9$ meanings.

- c. **Ambiguity in the syntax:** In the following sentence, [Ma’s cooking] can be a DP or a CP, the [’s] can be a possessive case marker or a contracted form of the verb *be*, and [cooking] could be a V[pastpart] or a N:

I know [Ma’s cooking]

But the number of syntactic structures coming from those different choices is not $2 \times 2 \times 2 = 8$ but just 2, since each choice depends on the others.

- d. **Ambiguity in the semantics:** Can a given phonological, morphological, syntactic structure have different meanings, other than those coming from the lexicon? The controversial, best known example of this ‘scope’ ambiguity:

Some student likes every teacher

This sentence seems to allow two different possible meanings:

- a. For some student y , for every teacher x , x likes y
- b. For every teacher x , there is some student y , x likes y

There is controversy about whether these two different meanings come from different syntactic structures. We did not cover this in our short time on semantics, because we did not get to transitive sentences! You might want to take a semantics class, or consult the big literature on this topic. See for example (Keenan, 1992; Beghelli and Stowell, 1996; Barker, 2002).

⁵Here we use ‘ditransitive’ to mean that it takes two objects, like ‘give’ does, as in *He willed them all his lands*.

16.3 Summary summary

Since the chart of speech sounds and list of syntax rules given on pages 150-151 of these lecture notes (or something very similar) will be provided with the exam, you do not need to memorize them. You just need to understand what they mean!

Quiz 4 will have a question about how you figure out what the phonemes are, and about the rules that derive allophones. Relating to the **basics** of Lecture 1 (mentioned just below), there may be a question about how many phonemes there are in American English (roughly 40), how many syllables (a lot, but not millions),⁶ compared to how many words, how many phrases, and how many sentences (∞).

The Quiz 1 makeup is likely to have a question about constituency tests in syntax. For Quiz 1, you should also 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.

The Quiz 2 makeup will ask you to draw trees for sentences with auxiliary verbs and maybe relative clauses.

The Quiz 3 makeup will have questions 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.

Those things are predictable! We have covered quite a lot of material. I hope it makes you think about your language in new ways.

References and further reading

- Baker, Mark C. 2009. Language universals: Abstract but not mythological. *Behavioral and Brain Sciences*, 32(5):448–449.
- Barker, Chris. 2002. Continuations and the nature of quantification. *Natural Language Semantics*, 10:211–242.
- Beghelli, Filippo and Tim Stowell. 1996. Distributivity and negation. In Anna Szabolcsi, editor, *Ways of Scope Taking*. Kluwer, Boston.
- Berry, Lynn. 1998. *Alignment and Adjacency in Optimality Theory: Evidence from Warlpiri and Arrernte*. Ph.D. thesis, University of Sydney.
- Bhatt, Rajesh and Aravind Joshi. 2002. Semilinearity is a syntactic invariant: a reply to Michaelis and Kracht. University of Texas, University of Pennsylvania, 2002, forthcoming.
- Breen, G. and R. Pensalfini. 1999. Arrernte: A language with no syllable onsets. *Linguistic Inquiry*, 30(1):1–26.
- Bresnan, Joan, Ronald M. Kaplan, Stanley Peters, and Annie Zaenen. 1982. Cross-serial dependencies in Dutch. *Linguistic Inquiry*, 13(4):613–635.
- Chen-Main, Joan and Aravind K. Joshi. 2008. Flexible composition, multiple adjoining and word order variation. In *Proceedings of the 9th International Workshop on Tree Adjoining Grammars and Related Frameworks, TAG+9*.

⁶NYU linguist Chris Barker wrote [this](#) computer program to calculate an estimate of the number of American English syllables, and that program says there are 15831.

- Chomsky, Noam. 1956. Three models for the description of language. *IRE Transactions on Information Theory*, IT-2:113–124.
- Chomsky, Noam. 2012. Poverty of the stimulus: Unfinished business. *Studies in Chinese Linguistics*, 33(1):3–16.
- Evans, Nicholas and Stephen Levinson. 2009. The myth of language universals: Language diversity and its importance for cognitive science. *Behavioral and Brain Sciences*, 32(5):429–448.
- Everett, Daniel L. 2005. Cultural constraints on grammar and cognition in Piraha: Another look at the design features of human language. *Current Anthropology*, 46:621–646.
- Frege, Gottlob. 1923. Gedankengefüge. *Beträge zur Philosophie des deutschen Idealismus*, 3:36–51. Translated and reprinted as ‘Compound thoughts’ in *Mind* 72(285): 1-17, 1963.
- Fromkin, Victoria, editor. 2000. *Linguistics: An Introduction to Linguistic Theory*. Blackwell, Oxford.
- Gordon, Matthew. 2005. A perceptually-driven account of onset-sensitive stress. *Natural Language and Linguistic Theory*, 23:595–653.
- Greenberg, Joseph. 1963. Some universals of grammar with particular reference to the order of meaningful elements. In Joseph Greenberg, editor, *Universals of Language: report of a conference held at Dobbs Ferry, New York, April 13-15, 1961*. MIT Press, Cambridge, Massachusetts.
- Hodges, Wilfrid. 2001. Formal features of compositionality. *Journal of Logic, Language and Information*, 10:7–28.
- Huybregts, M.A.C. 1976. Overlapping dependencies in Dutch. Technical report, University of Utrecht. Utrecht Working Papers in Linguistics.
- Jäger, Gerhard and James Rogers. 2012. Formal language theory: Refining the Chomsky hierarchy. *Philosophical Transactions of the Royal Society B*, 367:1956–1970.
- Joshi, Aravind K. 1985. How much context-sensitivity is necessary for characterizing structural descriptions. In D. Dowty, L. Karttunen, and A. Zwicky, editors, *Natural Language Processing: Theoretical, Computational and Psychological Perspectives*. Cambridge University Press, NY, pages 206–250.
- Keenan, Edward L. 1992. Beyond the Frege boundary. *Linguistics and Philosophy*, 15:199–221.
- Kobele, Gregory M. 2006. *Generating Copies: An Investigation into Structural Identity in Language and Grammar*. Ph.D. thesis, UCLA.
- Legate, Julie, David Pesetsky, and Charles Yang. 2013. Recursive misrepresentations: a reply to levinson (2013). <http://ling.auf.net/lingbuzz>.
- Levinson, Stephen. 2013. Recursion in pragmatics. *Language*, 89:149–162.
- Michaelis, Jens and Marcus Kracht. 1997. Semilinearity as a syntactic invariant. In *Logical Aspects of Computational Linguistics*, pages 37–40, Springer-Verlag (Lecture Notes in Computer Science 1328), NY.
- O’Grady, William, John Archibald, Mark Aronoff, and Janie Rees-Miller. 2010. *Contemporary Linguistics: An Introduction (Sixth Edition)*. Bedford, Boston.
- Pesetsky, David. 2009. Against taking linguistic diversity at ‘face value’. *Behavioral and Brain Sciences*, 32(5):464–465.
- Shieber, Stuart M. 1985. Evidence against the context-freeness of natural language. *Linguistics and Philosophy*, 8(3):333–344.

- Topintzi, Nina. 2011. Onsets. In Marc van Oostendorp, Colin J. Ewen, Elizabeth V. Hume, and Keren Rice, editors, *The Blackwell Companion to Phonology*. Wiley-Blackwell, Malden, Massachusetts.
- Westerståhl, Dag. 2004. On the compositional extension problem. *Journal of Philosophical Logic*, 33(6):549–582.
- Zipf, George K. 1949. *Human Behavior and the Principle of Least Effort: An Introduction to Human Ecology*. Houghton-Mifflin, Boston.

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