LING 100 Lecture Notes

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Contents

1 What is Language?

1.1 Understanding Language

1.1.1 What is language?

Everyday conceptions of language:

- Specific languages
- Tool of communication
- Language arts; e.g. literature/poetry
- Style of language use: "Watch your language!"

Scientific conceptions of language:

- An inherent biological trait of human beings
    - All humans can learn language, and is automatic in children
    - Non-human animals don't have language (in the wild); but some of our closest relatives (primates) are similar, but only when they come into contact with humans
- A complex system of systems encoded in the brain
    - System of hierarchical subsystems; from small to large, phonetics → phonology → morphology → syntax → semantics
    - They're also interacting with each other; there is no clean subdivision between these subfields, and there's a lot of ways in which they interact with each other.
    - These systems are also encoded in the brain; when we use language, specific parts of our brain begin to light up.
- A social construct that is constantly changing
    - Language varies between individuals and groups of individuals
        * ex. Native English speakers from different parts of the world all speak differently
        * ex. Your language differs from your parents'
    - Language varies within individuals; your language differs in different contexts
    - It's constantly changing
        * English, Icelandic, and Yiddish all descend from "Proto-Germanic"
        * Language use by individuals can also change over their lifespan (experiences you have, people you interact with)

1.1.2 What is linguistics?

Linguistics is the **scientific** study of language.

Starting with the notion that language is a system of hierarchical subsystems, those 5 systems make up about 2/3 of the course.

- Phonetics: study of speech/sound
- Phonology: study of how speech sounds and represented in the brain
- Morphology: how sounds are combined into units of meaning, which are then combined into larger units of meaning
- Syntax: sentences and phrases, made up of words
- Semantics: meaning of sentences and phrases

Psycholinguistics is how language is encoded in the brain; but we're also interested in how it gets in the brain, i.e. how people learn language (language acquisition).

Thinking about language as a social construct, let's think about it as a specific variety of language that a person speaks. People speak similar languages to each other, and overlap in different ways; if you have a group of people

that speak similarly enough, you get a *variety* of a language. This inevitably ends up with some varieties becoming more powerful and dominant.

Studying what happens when people who speak different varieties of languages come into contact is *sociolinguistics*

Thinking about language as constantly changing—historical linguistics. In studying this transformation, linguistics like to reconstruct the changes that happened along the way.

1.2 Language, Power, and Privilege

1.2.1 Prescriptivism

Linguistics involves the description and analysis of how language is used and how it varies. When we say "users of language X do Y", we mean that we *observe* that this happens, not that it must always happen.

It's also important to highlight how languages change; there is no linguistic ideal that languages evolve toward, and there is no notion of "better" than older languages.

All languages are equal in their ability to be learned and encoded in the brain. This is shown by how a child will be able to learn any language that is presented to them.

All of this comes together to form the idea that there is no such thing as "correctness". Why is this?

Before we go into that, we have to touch three uses of the word "grammar":

1. Grammar (1) — the encoding of language in a language user's mind (the thing most linguists study)
    - Set of rules and representations that describes the use of language and predicts the production of language
2. Grammar (2) — a written work describing the grammar(1) of a language of variety of a language
    - Basically a written form of grammar(1)
3. Grammar (3) — *prescriptive grammar*, the socially embedded notion of "proper" or "correct" language use

Your English teacher was misled in giving rules like 'Don't split infinitives" and "Ain't isn't a real word". Why do we have these rules? Who gets to make these rules?

1866 text called "A plea for the Queen's English" says how a person says that he splits an infinitive and a verb, and goes on to say that "surely this is a practice entirely unknown to English speakers and writers."

Going back to grammar(3), "socially embedded" is often interchanged with "standard"; SAE is an abbreviation for Standard American English—this could meant that it's "typical" American English, or that it's a model for English.

The first meaning is descriptive, and the second is more judging (prescriptive), but even the first meaning begs the question: "typical of whom?" Who does that leave out?

1.2.2 Language Bias and Power

Linguistic privilege: not all people come from the same background and have different experiences with language.

A story of a study: Prof. Lin was a part of a pilot study, and recorded her saying some sentences. When just the sound was played back to a group of undergraduate students, they had no indication of any accent or irregularities. However, after showing them a picture of an East Asian woman, saying that she was the one who was speaking, they all thought that she did have a noticeable accent, but just "not as bad" as some other East Asian people they know.

This behavior shows that discrimination of race (and other characteristics like age, gender, ethnicity, etc.) can lead to language bias. But does language bias lead to discrimination?

2016: Rickford and King on the testimony of the witness Rachel Jeantel for the trial regarding Trayvon Martin. Jeantel spoke a perfectly fine language variety, but the lack of familiarity the jury had with her variety of English, they found her to be confusing and incomprehensible. The jurors then basically dismissed/ignored her testimony/evidence—because of their preconceived notion on her language use.

The paper notes that people speaking a vernacular are often misunderstood or misjudged by people with systemic power (ex. police, judges, doctors, etc.). This clearly shows that yes, it is evident that language bias *can* lead to discrimination, and furthermore can exacerbate other injustices. Because of this, this cycle is self-perpetuating.

Linguists' goal is to describe language structure, use, and variation—we have tools and approaches to help us do that (i.e. the International Phonetic Alphabet, IPA). But it's not just about learning how to use these tools, but also to

ensure that the work we do is not colored by our biases (which is really hard to do).

2 Phonetics

2.1 The IPA

2.1.1 IPA, Motivation, and History

Why do we need a phonetic alphabet? Why not use the writing systems for each language? Because writing systems are not transparent to pronunciation—pronunciations change but orthography is fixed. Additionally, some writing systems are not phonetic—some languages don't have any way of telling how to pronounce a word from its character. Some languages also have no formal writing system. It's also impossible to compare languages without a consistent phonetic notation. That's why the IPA was created.

Two main principles of phonetic alphabets:

1. There should be a separate sign for each distinctive sound

   - English would be a terrible system for this; ⟨ph⟩, ⟨f⟩, ⟨gh⟩ all refer to the same sound [f], and the character ⟨t⟩ can be [ɾ], [t], or silent.

2. When any sound is found in several languages, the same sign should be used in all of them

Text or symbols in angle brackets refers to the literal orthography of the language.

See section 11 for the full IPA table.

Between 2012 to 2015, the IPA chart expanded quite a lot—to cover all of the possible sounds humans can make.

Why *this* phonetic alphabet? The International Phonetic Association was established in 1886 under Paul Passy. The mission statement was to create phonetic notation for use in schools to assist in instructing children to read and in teaching of foreign languages.

Bell's Visible Speech: one of the alphabets, based on what it should look like to make the sound. This never took off because the goal was to help deaf people speak—and didn't really work. The characters used were also very different, so typewriters would have needed to be modified.

2.1.2 Principles of the IPA

- All natural languages draw from the same set of possible sounds
- Some aspects of speech are structurally relevant while others are not
- Segments can be divided into consonants and vowels
- Segments can be described and categorized with reference to their articulatory characteristics

The consonants (pulmonic consonants) are organized by places of articulation (front to back, from left to right) and by manner of articulation (closed to open, from top to bottom). Symbols that appear in pairs are voiced/voiceless sounds.

The vowels are organized similarly, by places of articulation and manner of articulation (sometimes said to be organized from high to low, referring to the position of the tongue). The third dimension is not voicing (all vowels are voiced unless otherwise noted); it's to do with the lips—whether it's spread or round.

In 1912, the consonants and vowels are placed in the same chart, just with a more constricted range for vowels.

There are some blank spaces on the chart where there are no symbols. The spaces with symbols are physically possible and attested in languages; the white spaces without symbols are physically possible but not attested to in languages; the gray spaces are physically impossible to most people.

There are nonpulmonic consonants and this "other" box of symbols/sounds. The "other" sounds just don't fit neatly into any space in the main chart.

Diacritics are used to add more detail, especially when transcribing sounds—it's extra information. There's symbols for relative pitch (no absolute pitch), and relative length (no absolute length); as thus speed, pitch, etc. shouldn't need to be transcribed and aren't important to the structural nature of the language.

2.2   GAE Consonants and Vowels

For the moment, we'll focus on SAE/GAE (General American English) as a foundation. But, we'll also listen to speech from other varieties of English including regional American varieties, AAE, and varieties from overseas.

2.2.1   GAE Consonants and Voicing

What does voicing mean? Whether a sound is voiced or voiceless depends on whether or not the vocal folds are vibrating. The vocal folds sit in the larynx, and separates the subglottal (below) and the supraglottal (above) systems.

Voicing occurs when the vocal folds are brought really close together such that when air passes through them they start to vibrate. When vocal folds are adducted (close), voicing can occur, and when vocal folds are abducted (open), voicing cannot occur.

How do you know when your vocal folds are vibrating or not? You can put your hand on your throat and feeling for vibrations.

2.2.2   Place of Articulation

The place of articulation refers to where the consonants are produced.
  • Bilabial: [p] and [b]—using both lips
  • Labiodental: [f] and [v]—using lips and teeth; in particular, the bottom lip and top teeth
  • Dental: [θ] and [ð]—tongue is touching the teeth
  • Alveolar: [s] and [z]—lift of tongue is lifted toward the alveolar ridge
  • Postalveolar: [ʃ] and [ʒ]—further back than alveolar and the part of the tongue that is raised is further back too
  • (Retroflex aren't typically found in GAE)
  • Palatal: [j] (only one in English, ex. ⟨y⟩ as in *yellow*)—tongue is making contact with the hard palate
  • Velar: [k] and [g]—similar to palatal sounds, but more toward the soft palate (also called the velum)
  • (Uvular and Pharyngeal sounds aren't found in GAE)
  • Glottal: [h]—sounds that involve the constriction of the vocal folds

2.2.3   Manner of Articulation

  • Oral stop: [p], [b], [t], [d], [k], [g], [ʔ]
    – [ʔ] is a glottal stop, as in *uh-oh* [ʌʔoʊ], *apple* [ʔæpəl]; the vocal folds come completely closed
  • Affricates (not on the table, but on some IPA charts): stop + fricative, ex. *tch* [tʃ] in *wretched* [ɹɛtʃɨd] and *j* and *dg* in *judge* [dʒʌdʒ]
  • Nasal stop: [n], as in *coconut* [koʊkənʌt]—the velum is lowered (it's raised as in the [k])
    – Also [m] as in *seem* [sim] and *mead* [mid], [ŋ] as in *sing* [siŋ]
  • Trill (not in GAE): [r]
  • Tap: [ɾ], as in *butter* [bʌɾɚ] or *pudding* [pʌɾɪŋ]
  • Fricative: [f], [v], [θ], [ð], etc.—there's some airflow; not completely closed but not too far apart.
  • Approximant: [j], as in *Yale* [jeɪl], or [l] (lateral approximant)—air flows around or through the tongue
  • Voiced labial-velar approximant (not in chart): [w], as in *weather* [wɛðɚ]

2.2.4   GAE Vowels

The vowel space is continuous, unlike consonants; vowels' articulations are more challenging to describe.

One of the things we can do is try to provide example words; for monophthongs, this is

	Front	Central	Back
High / Close	[i] *bead* [ɪ] *bid*	[ɨ] *beaded*	[u] *booed* [ʊ] *book*
Mid	[e(ɪ)] *bait* [ɛ] *bed*	[ə] ***about*** [ʌ] *but*	[o(ʊ)] *boat* [ɔ] *caught*
Low / Open	[æ] *bat*		[ɑ] *cot*

Though *caught* and *cot* are usually pronounced the same, with [ɑ], as [kɑt]

Diphthongs:

- [e(ɪ)] *bait*
- [o(ʊ)] *boat*
- [ɑɪ] *buy*
- [ɔɪ] *boy*
- [ɑʊ] *pout*
- [ɪu] *cue*

The schwa vowel (r-coloring): [ɚ] *bird*, though we'll accept [əɹ] or [ʌɹ] in this class, though [ɚ] exists because it doesn't seem like two separate parts.

2.3 Transcribing English

2.3.1 Other Symbols

Diacritics/Suprasegmentals that may occur in English:

- Length: [ː]

  Seize/Cease: could be [siz] and [sis], or could be [siːs] and [sis]; either is okay.

  There are a lot of vowels in other varieties of English where length *is* contrastive, unlike GAE.

- Syllables: [.]

  interesting: [ɪn.təɹ.ɛs.θŋ], [ɪn.əɹ.ɛs.tɪŋ], [ɪn.tɹəs.tɪŋ] are all valid

  Unless we ask you to, you are not required to transcribe syllables.

- Stress: [ˈ] (primary stress), [ˌ] (secondary stress)

  - Stress can change the meaning of English words:

    project: [pɹoʊ.ˈdʒɛkt] vs. [ˈpɹɑ.dʒəkt]

    phonetics [ˌfə.ˈnɛ.ɾɪks] vs. *phonetician* [ˌfoʊ.nə.ˈtɪ.ʃən]

    octopus [ˈɑk.tə.pʌs] vs. *octopodes* [ɑk.ˈtɑ.pədɪz]

  - Note that other transcribable changes occur too!

  - Unless we ask you to, you are not required to transcribe stress.

- Syllabic consonants [X̩]

  Syllables usually have a vowel (i.e. the nucleus of the syllable), but sometimes consonants act like vowels:

  - *phonetic* [fn̩.ɛɾɪk] vs. [fə.nɛɾɪk]
  - *rhythm* [ɹɪð.əm] vs. [ɹɪ.ðm̩]
  - *apple* [æ.pl̩] vs. [æ.pəl]

  Try to notice these! Sometimes there will be ambiguity (and we will accept either if there is).

- "Missing" and "extra" segments

  - *huge*: [hjudʒ] vs. [judʒ]
  - *walk*: [wɑk] vs. [wɑlk]

– *the*: [ðə] vs. [də] vs. [ð̟] (the last is just ⟨th⟩, with no ⟨e⟩)
– *hamster*: [hæmpstɚ] vs. [hæmstɚ]
– *prince*: [pɹɪnts] vs. [pɹɪns] (vs. *prints* [pɹɪnts])

Do try to listen for these!

2.3.2 Transcription Strategies

Start with citation forms (what you would see if you look in the dictionary), and then listen to what the speech is and transcribe it.

Try playing chunks of audio out of context; this will prevent our own experiences/pronunciations from affecting the transcription.

Keep an IPA chart with sounds open, and sound things out to yourself and feel out your articulators.

There are a lot of right ways to transcribe something (and plenty of wrong ways too)!

For midsagittal diagrams, try and answer the following:

• voiced or voiceless? (glottus squiggly or straight line)
• tongue and lip constrictions?
• strength of constriction (complete vs. partial)
• nasal or oral

2.4 Phonetics of Languages other than English

2.4.1 Consonants of the world

As a reminder, the pulmonic consonant chart is organized by place (front to back) from left to right, and by manner (closed to open) from top to bottom. When two symbols are next to each other in the chart, the voiceless is on the left and voiced is on the right.

Looking at some of the sounds that we haven't visited:

• Bilabials not in English:
  – Fricatives [ɸ] and [β]
  – Trill [ʙ]

    A trill occurs when you have two articulators next to each other or up against another such that one or both articulators vibrate.

• Labiodental [ɱ]
• Alveolar (tongue tip on alveolar ridge)
  – Trill [r]
  – Lateral fricatives [ɬ] and [ɮ]
• Velar (tongue body on soft palate)
  – Fricatives [x] and [ɣ]

    You may sometimes hear [x] instead of [h] in English (especially when somebody is trying to emphasize that sound)

  – Approximant [ɰ]

    This is just a [w] without the labial articulation!

• Palatals (tongue blade/front at hard palate)
  – English palatal glide [j]
  – Stops [c], [ɟ]
  – Nasal stop [ɲ]
  – Fricatives [ç] and [ʝ]

    – Lateral [ʎ]
- Uvular (tongue body at very back of soft palate)
    – Stops [q] and [ɢ]
    – Nasal stop [ɴ]
    – Fricatives [χ] and [ʁ]
    – Trill [ʀ]

      Not the tongue that vibrates; it's the uvula that vibrates! For many speakers, this alternates with the fricative [ʁ]
- Retroflex (underside of tongue tip on alveolar ridge); listen for the transition *into* the retroflex consonant
    – Stops [ʈ] and [ɖ]
    – Nasal [ɳ]
    – Fricatives [ʂ] and [ʐ]
    – Lateral [ɭ]
- Pharyngeal (tongue root at posterior pharyngeal wall)
    – Fricatives [ħ] and [ʕ]
- Glottal
    – English glottal fricative [h] and stop [ʔ]
    – Voiced fricative [ɦ]
- Epiglottal (Epiglottis on entrance to larynx)
    – [ʜ] (Voiceless epiglottal fricative)
    – [ʢ] (Voiced epiglottal fricative)
    – [ʡ] (Epiglottal plosive)

2.4.2 Airstream Mechanisms and Non-pulmonic consonants

Three drivers:
- pulmonic — air moved by lungs
- glottalic — air moved by the glottis
- velaric — air moved by the tongue

Two directions:
- egressive — out
- ingressive — in

There are six logical combinations;
- Pulmonic egressive (most sounds)
- Glottalic egressive (ejectives)
- Glottalic ingressive (implosives)
- Velaric ingressive (clicks)
- Pulmonic ingressive: do occur rarely in speech, and usually paralinguistically (i.e. affirmative response, or "conversational intimacy")

Glottalic sounds are not uncommon in world languages; ejectives are when air is moved by a closed glottis rising, and implosives are when air is moved by the glottis lowering during voicing.

What does this mean? With a glottalic ejectives, the glottis is closed, and there is an oral constriction, and when the glottis is raised, air pressure rises, and when the oral constriction is released, a burst of air is released.

Velaric ingressive—"clicks" are often associated with African languages. Similar to the glottalic ejectives, there are two oral constrictions (one posterior and an anterior), and the tongue lowers, creating a lower air pressure; when the

front constriction is released, air comes in, causing the click.

2.4.3 Some useful diacritics

Previously introduced the voiceless and syllabic diacritics; [X̥] and [X̩]

Others you may come across is

- Aspirated [Xʰ]

  For almost all English speakers, "voiceless" stops are aspirated in some contexts (i.e. syllable initially before vowel); in the example below, the [p] is aspirated

  pat vs. *bat* — /pæt/ [pʰæt] vs. /bæt/ [bæt] or [pæt]
- Breathy — voiced aspiration
- No audible release [X˺] — comes in handy when transcribing English too!
- Secondary articulations:
    - Labialized [Xʷ]
    - Palatalized [Xʲ]
    - Velarized [Xˠ]
    - Pharyngealized [Xˤ]

  In many cases, the [l]s at the end of words are velarized or pharyngealized ("dark l"s).

2.5 Vowels of the World's Languages

In GAE, front vowels tend to be unrounded and back vowels tend to be rounded. [ʌ] is generally considered central in GAE.

However, front rounded vowels are not uncommon! Many languages do have them as well. Back unrounded vowels are also not uncommon; languages still have them (as per principles of the IPA).

2.5.1 Diacritics and Suprasegmentals

Two sounds are *contrastive* to speakers of a language if by exchanging only those two sounds, a difference in meaning is achieved. For example, *cat* and *kite*—[æ] and [ɑɪ] are contrastive in GAE.

- Length [X:]

  GAE is not thought to contrast long and short vowels (despite evidence that vowel duration matters in GAE). But, lots of languages contrast vowel or consonant length.
- Voice Quality
    - breathy [X̤]
    - creaky/laryngealized/tense/pressed [X̰]

      Also called "vocal fry", and is contrastive in some languages too; lots of other symbols are also used around the world for this type of feature.
- Vowel Nasalization [X̃]

  When the velum is low during a vowel. In English, this is present but not considered contrastive, i.e. *pop* [pɑp] vs. *mom* [mɑ̃m].

  It's a common contrast in other languages though.
- Lexical tone

  Nearly all languages utilize pitch variation to convey linguistic meaning. Lexical tone is when pitch variation affects meaning of a *word*.

2.6   Signed Languages and their Phonetics

2.6.1   Signed Languages

Modality is the mechanism for language transmission; speech is the majority (≈6000 known languages), and visual-gestural (signed) is the minority (≈200 known languages)

We typically don't consider writing to be a mechanism for language transmission, as they're tied to speech or signed languages.

Back from module 1.1, the three aspects of language apply to signed languages as well.

- **Inherent**: signed languages are naturally acquired by babies in signing homes, just as naturally as spoken languages

  As an aside, in 1980 a vocational school for the deaf was established, bringing together previously isolated deaf children, and the goal was to teach the kids Spanish, finger signing, and manual codes (a direct correspondence for spoken language) for Spanish.

  However, there was very little success, as these were all based in a spoken language, and not at all natural. What is amazing about this story is that by the mid-1980s, the children had birthed their own signed language!

- **Complex system of systems**: signed languages have systems of phonology, morphology, syntax, etc. just as spoken languages do

- **Constantly changing social construct**: Signed languages change over time, and show individual and dialectical variation, in the exact same ways spoken languages do

Note that ASL is far from the only signed language in the world; there are signed languages found on every continent.

Signs in signed languages can be arbitrary (i.e. *possible* in ASL and *weigh* in Finnish Sign Language are the same), but some gestures can be iconic, linked to their meaning as well (i.e. a snap-like motion for *dog* derived from its spelling).

2.6.2   Phonetics of ASL

Although "phonetics" is etymologically related to sound (i.e. *phone*), it has come to mean the subfield of linguistics relating language production to the physical world. In spoken languages, this is about how speech sounds are produced and perceived, and in signed languages, it's about how signs are produced and perceived.

We can have articulatory descriptions in signed languages as well. In speech, this is place, manner, and voicing. In signed languages, this is hard shape, position, motion, orientation, and non-manual markers (the latter is not always included in lists).

Similarly, there are phonetic units in signed languages as well. In speech, there are phones, linked sequentially in time (based on how sound works). In signed languages, there are primes, effectively all occur at once.

In speech, we need all three of place, manner, and voicing to describe a phone. On the other hand, each of the 5 dimensions correspond to their own prime. Signs are made up of these different primes.

The International SignWriting Alphabet is the analogue to the IPA for signed languages.

Going through some of the different dimensions of signed languages,

- Hand shape

  This is the shape the hand takes in the formation of a sign. There are many possible handshapes in ASL (and other signed languages) in addition to those corresponding to English letters.

  Single signs can utilize multiple handshapes, just like single phones can utilize multiple places of articulation.

- Position/location

  This is where the hands are located in the "signing space", and the signing space varies by language (just like the vowel space in different languages). Signing space also varies by context; rapid/casual signing or whispered signing just have a reduced or compacted space, just like spoken vowels!

- Non-manual markers

  This isn't always included as one of the dimensions, but there are a lot of different kinds of non-manual markers available to signers. This can involve head movement, facial expressions, eyebrow movement, or lip position.

3   Phonology

3.1   Sound Patterns

3.1.1   Phonotactics

The *phonemic inventory* of a language is the set of phones that speakers of a language produce. This differs from phonotactics in that phonotactics is about the ways in which the phones of a language can be combined.

Phonotactics also differs greatly from language to language, even if their phonemic inventory is similar.

To look at a few examples, which of the following are words or possible words in English?

<p align="center">Fricatives: [zɪp] [sɪp] [ʃɪp] [z̺ɪp] [ʒɪp]</p>

The first three are the words *zip*, *sip*, and *ship*, but the last two are not.

[z̺ɪp] isn't, because [z̺] is not in the phonemic inventory of English, and [ʒɪp] isn't, because [ʒ] never appears in the beginning of a word.

We'll mark ungrammatical forms with an asterisk: *[ʒɪp]

Let's look at another example. Which of the following are words or possible words in English?

<p align="center">Clusters: [bɹɪk] [nɪk] [bɪk] [blɪk] [bnɪk]</p>

The first two are actual words, the middle two are unattested but sensible in English, and the last contains an ungrammatical onset cluster [bn] in GAE.

As such, [blɪk] is unattested, but *[bnɪk] is ungrammatical.

Another example:

<p align="center">Ordering: [pleɪ] [peɪ] [leɪ] [ploʊ] [lpeɪ]</p>

The first three are perfectly fine; [p], [l], and [pl] are attested at the onsets of English words, but [lp] is not.

Going back to phonotatics and foreignness, let's look at loanwords—words borrowed from other languages.

- *chutzpah* from Yiddish, but we have [hʌtspə], not [xʊtspə]; this is a substitution.
- *psalm* from Old French, but we have [sɑm], not [psalmus]; this is a deletion.
- *tsunami* from Japanese, but we have [sunɑmi], not [tsɯnɑmi]; this is a substitution and a deletion.

These changes are often called repairs; they fix a violation of the phonotactics of the native language.

3.1.2   Distributions

Two phones *contrast* if they change meaning. Minimal pairs/sets are groups of words having distinct meanings where only one phone differs. For example:

- *zip* [zɪp] vs. *sip* [xɪp] is a GAE minimal pair for the contrasting phones [z] and [s]
- *tome* [toʊm] vs. *tone* [toʊn] is a GAE minimal pair for the contrasting phones [m] and [n]

Phonemes are the smallest meaningful unit of sound. If two phones are found in minimal pairs or *overlapping distributions*, they are *allophones of different phonemes*.

Allophones are contextual variants of a phoneme. If two phones are found in *complementary distribution* (disjoint), they may be *allophones of the same phoneme*.

3.1.3   Greek

Let's look at some consonants from Greek as an example.

In Greek, [k] and [x] are found to contrast in (many) minimal pairs, and therefore [k] and [x] are allophones are different phonemes.

On the other hand, [k] and [c] are in complementary distribution; [k] appears before the phones [a], [o], [u], [r], while [k] appears before [i], [e]. The exact same occurs with [x] and [ç] with the same contexts, respectively.

3.1.4 Matsigenka

Another example is with Matsigenka.

The sibilants [s] and [ʃ] have no minimal pairs (in the bank given). Instead, let's look at the immediate environment around the phones.

With notation for environments, # stands in for a word boundary, and _ stands in for the target phone.

After we get these environments, we look at whether they're in complementary or overlapping distributions. In this case, we can propose that [ʃ] and [s] are in complementary distribution; [ʃ] always appears before an [i].

In doing so, we ask ourselves: does this phonological alternation "make sense" given what we know about phonetics?

Suppose the underlying representation ("default" allophone) is /s/. Could the presence of [i] influence the articulation of an [s]? Possibly, yes.

This is what we call *coarticulation*; when two phones next to each other can affect each other because of the need for the aritculators to move from one state to another state.

3.2 Natural Classes and Rules

3.2.1 Natural Classes

Last time, we found that [k] and [c] are in complementary distribution, along with [x] and [ç]. We want to ask ourselves: what do [i] and [e] have in common? What do [k]/[c] and [x]/[ç] have in common? This leads into natural classes.

A *natural class* is a complete set of phones in a given language that share at least one phonetic characteristic. This means that natural classes are language specific, and contains *only and all* the phones of a language that meet the criteria. Those criteria are *phonetic characteristics*—the criteria demarcating a natural class are articulary or auditory/perceptual.

A small note: GAE has a front low vowel [æ], and conventionally we transcribe the other low vowel in GAE as [ɑ]. Many languages have only one low vowel, usually central, yet we conventionally transcribe them as [a]. This means that depending on the language, [a] may not be a front vowel.

Back to the Greek example, we can finally ask ourselves: Is the set [i], [e] a natural class in Modern Greek?

They share the phonetic characteristics of being vowels, non-low, and front. Is this set complete for front non-low vowels? Yes! We can be broader and say that they're a natural class of front vowels in Modern Greek.

We can also ask: Is the set [k], [x] a natural class in Modern Greek? They're both consonants, velar, and voiceless. Is this set complete for voiceless velar consonants? Yes! We can then say that [k], [x] make up the natural class of voiceless velar consonants in Greek.

Piecing this together, we can say "In Greek, voiceless velar consonants surface as palatal allophones before front vowels."

Natural classes usually are named and determined based on the IPA: place (labial/bilabial/labiodental, coronal, dorsal), manner, voicing (voiced, voiceless), and airstream (pulmonic, ejective, click, etc.).

Some other terminology:

- Sonorants—phones with open passages for airflow

  These would be vowels, nasal stops, and approximants

- Obstruents—phones with obstructed airflow

  These would be oral stops, fricatives, and affricates

- Sibilants—fricatives with a particularly loud high-frequency noise

  In GAE, these are [s], [z], [ʃ], [ʒ], [tʃ], [dʒ]

3.2.2 Rules

We can think of rules as the machinery that convert phonological forms to phonetic forms.

Let's just dive into some examples. For example, in Setswana, let's look at [l] and [d].

There are no minimal pairs, and by looking at the environments, [l] and [d] are in complementary distribution. In particular, [l] only occurs before non-high vowels, and [d] only occurs before high vowels.

Additionally, the completeness is there (i.e. [i] and [u] are a natural class for high vowels in Setswana).

We can then write a rule:

$$/l/ \rightarrow [d] \:/\: \_ \text{ high vowels}$$
$$/l/ \rightarrow [l] \:/\: \text{ elsewhere}$$

The syntax here is "phoneme or underlying representation → allophone / conditioning environment"

An alternative notation is

$$/l/ \rightarrow \begin{cases} [d] \:/\: \_ \text{ high vowel} \\ [l] \:/\: \text{ elsewhere} \end{cases}$$

Positing an underlying representation is a *theoretical stance* stating that it is the default representation. This means that sometimes you might see the second line omitted, i.e. you might just see

$$/l/ \rightarrow [d] \:/\: \_ \text{ high vowels}$$

This means that every time you see /l/ *not* before a high vowel, it appears as itself, i.e. it is its own allophone under those circumstances.

Another question that may arise is how do you choose between which becomes the underlying representation? In the previous example, we could have chosen

$$/d/ \rightarrow [l] \:/\: \_ \text{ non-high vowels}$$
$$/d/ \rightarrow [d] \:/\: \text{ elsewhere}$$

In general, we want to choose the least-restrictive phoneme as the underlying representation, i.e. we want the "elsewhere" clause to cover more.

3.2.3 Rules: English

Let's look at [əʊ] and [ɑʊ] in (some varieties of) English.

Looking at the dataset, we can determine that [əʊ] only appears before voiceless consonants, and [ɑʊ] only appears before voiced consonants, or the end of a word.

This means that we can either choose the rule

$$/ɑʊ/ \rightarrow [əʊ] \:/\: \_ \text{ voiceless consonant}$$

or

$$/əʊ/ \rightarrow [ɑʊ] \:/\: \_ \text{ voiced consonants}$$
$$/əʊ/ \rightarrow [ɑʊ] \:/\: \_\#$$

Since the first has fewer conditions, it's a better choice for a rule.

3.3 Rules and their interactions

3.3.1 Types of Rules

First, let's talk about some common phonological processes:

- **Assimilation/dissimilation**: segments become more/less similar

  Assimilation is probably the most common phonological process; it captures how segments become more similar to neighboring segments. This could be

  – Place assimilation

    For example, in Greek, /k, x/ → [c, ç] / _ front vowels

  – Voicing assimilation

  – Manner assimilation

  This doesn't have to be for immediate neighbors, ex. vowel harmony

  Dissimilation is where segments become less similar to neighboring segments. For example, in Chukchi, [ŋ] becomes a velar fricative [ɣ] in the presence of a nasal consonant:

$$/\eta/ \to [\gamma] \text{ / } \_ \text{ nasal consonant}$$

Something that drives dissimilation could be the need to make two sounds distinct, and is one of many things that people cite as the phonetic rational for dissimilation. Sometimes it's easier to produce a sequence of articulations if they're different from each other too.

- Insertion/deletion: addition/deletion of segments

An example of insertion in English are emergent/excrescent stops. For instance, /hæmstɚ/ → [hæmpstɚ].

With this set of hypothetical data, we may observe that when a nasal is followed by a voiceless fricative, a voiceless stop of the same place of articulation as the nasal may be inserted. How would you write this as a rule? (only if you're dying to)

$$\emptyset \to \text{voiceless stop } [\alpha\text{-place] / nasal } [\alpha\text{-place]} \_ \text{ voiceless fricative}$$

- Metathesis: a change in the order of segments

For example, in Leti, if three consonants are consecutive, the first trades places with the preceding vowel. As a rule, this may be

$$/VC1C2C3/ \to [C1VC2C3]$$

Metathesis is uncommon in synchronic grammars (i.e. in current phonology), but are more common as diachronic explanations (i.e. in phonology in the past) for changes that have occurred in a language.

- Strengthening/weakening: segments becoming "stronger/weaker" in their sound or articulation

Strengthening is sometimes also called "fortition", or "hardening". For example,

    – Voiceless stop aspiration in English: /t/ → [tʰ] / #_

    – Hardening of sonorants (not stops, and not fricatives) in Luganda: sonorants surface as voiced germinate stops of the same place of articulation at the beginning of the word

        Some people think the Setswana example is also hardening: /l/ → [d] / _ high vowels

Weakening is sometimes also called "lenition". For example,

    – Vocalization of [l] in English

    – Spirantization of stops in Spanish

    – As touched on before, in Canadian English: /aʊ/ → [əʊ] / _ voiceless consonant

3.3.2   Rule Ordering

Let's look at the language of Bukusu Masaba (a variety of Masaba spoken by the Busuku tribe of Luhya in Kenya).

In this language, 3pl pres form is formed with the prefix /βa-/, and 1sg pres form is formed with the prefix /n-/. Some things to notice:

- Nasals assimilate place to following consonant
- Voiceless stops → voiced / nasal _

The question here is: do these rules interact?

Let's try this with the hypothetical Bukusu word /nkwa/:

- Rule 1 before rule 2: /nkwa/ → ŋkwa → [ŋgwa]
- Rule 2 before rule 1: /nkwa/ → ngwa → [ŋgwa]

The observation here is that no matter the order, the surface form is the same—this means that these rules do not interact.

Logically, these rules *shouldn't* interact because the first rule only affects place of articulation while rule 2 only affects voicing.

Here's another example, with pancakes in English.

Something we noticed in live lecture 2.2 is that /æ/ → [eɪ] / _ velar nasals.

We also learned in this section of nasal place assimilation: /n/ → nasal [α-place] / _ obstruent [α-place].

So we have these two phonological processes: æ-raising and nasal assimilation, respectively.

- Suppose æ-raising is applied before nasal assimilation:

  /pænkeɪks/ → pænkeɪks → [pæŋkeɪks]

- Suppose nasal assimilation comes before æ-raising:

  /pænkeɪks/ → pæŋkeɪks → [peɪŋkeɪks]

Since these surface forms are different, then the order does matter (as long as both rules exist in your variety of English).

3.4 Generalizations and Implications

3.4.1 GAE Velar Stops

To most native GAE speakers, if we remove the [s] from *skunk* results in something that sounds like *gunk*, rather than what we may expect as *kunk*. Similarly, if we add the [s] to *damp* results in something that sounds like *stamp*.

Slightly more accurate phonetic transcriptions may have *skunk* as [skʌŋk], *gunk* as [kʌŋk], and *cup* as [kʰʌp]. An even more accurate transcription of *gunk* would put [k] and [g] in free variation. For the sake of simplifying the data though, we will keep *gunk* as [gʌŋk]. (The same can be applied to [t].)

This divides these words into three groups: aspirated stops, unaspirated stops, and voiced stops. How do we talk about these alternations?

If we look at some more data/words, we'd notice that [kʰ] appears at the onset of syllables (ex. *acute* [əˈkʰjut]). We'd also notice that [k] appears after a word initial [s], and as a syllable final. Finally, we'd see that [g] can appear at the onset of tables, and as a syllable final.

As a table, this would be

	syllable onset	after word initial [s]	syllable final
kʰ	yes	no	no
k	no	yes	yes
g	yes	no	yes

Most phoneticians agree that [kʰ] and [k] are grouped together, rather than any other pairing. Let's try and come up with a rule for this.

For some unknown underlying representation, we have

$$/?/ → [kʰ] / \text{syllable initial}$$
$$/?/ → [k] / \#s\_$$
$$/?/ → [k] / \text{syllable final}$$

Since [k] is the least restrictive, it's likely the underlying representation, giving us the rule

$$/k/ → [kʰ] / \text{syllable initial}$$

But what do we do with the [g]? There just isn't a rule for it. Then why can't it be after a word initial [s]? Because there's a phonotactic constraint against */sg/ onset clusters.

What about labial and alveolar stops? Can we also say:

$$/p/ → [pʰ] / \text{syllable initial} \qquad \text{or} \qquad /t/ → [tʰ] / \text{syllable initial}$$

If so, then we can also say:

$$/\text{voiceless stop}/ → [\text{aspirated stop}] / \text{syllable initial}$$

3.4.2 Generalizations

Looking at the labial stops [p] and [pʰ], we can find similar environments as we did with [g]. This means that yeah—we can probably generalize it to labial stops.

What about alveolar stops? There's a lot of similarities, but there's a difference—the alveolar flap [ɾ]. This means that it can't just be /t/ → [tʰ] / syllable initial.

But what seems to be the case is that /t/ → [ɾ] / unstressed syllable initial. Additionally, we'd observe that /d/ → [ɾ] / unstressed syllable initial. In other words, [d] also undergoes flapping as well.

There's one more thing though—glottalization. This is when a stop is produced as a glottal stop, i.e. *cotton* as [ˈkʰɑˌʔn̩]. This only applies as /t/ → [ʔ] / ˈV_n, and not with [d] (i.e. *eden* as [ˈiˌdn̩]).

So, can we generalize? We *can* say that

- Voiceless stops are aspirated at the onsets of stressed syllables; but,
  - /t/ and /d/ participate in flapping
  - /t/-glottalization occurs in some contexts
- So, we can't generalize the "elsewhere" part.

We find many different combinations of voicing/aspiration across the world, ex. between [d], [t], [tʰ], [dʰ], etc.

But, languages tend to organize themselves in certain predictable ways. When we zoom out and look at all (or lots of) languages, we can find patterns.

This can tell us some types of phonological rules (lecture 3.3), i.e. some processes that are similar across languages, and can also tell us about implicational laws.

3.4.3　Implicational Laws

We can observe that some phones are more or less common than others. For example, [p,t,k,ʔ] are more common than [ʈ,c,q]. Similarly, we can observe that [i,e,u,o] (front unrounded and back rounded vowels) are much more common than [y,ø,ɯ,ɤ].

But what can we do about this information? Let's look at oral and nasal vowels.

All documented languages in the UPSID database have oral vowels. However, only 23% of languages have nasal vowels. This means that we can derive the implication that if a language has nasal vowels, then it has oral vowels.
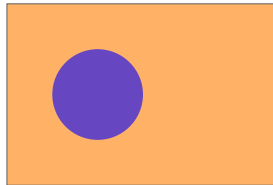
Let's look at voiceless and voiced stops. We'd find that 97% of languages have [k], and 63% of languages have [g], 2% of languages have [g] but not [k]. This means that we can represent this as the following picture:
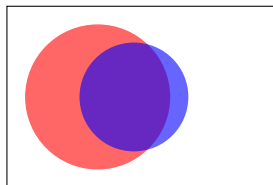
This means that a language with [g] is extremely likely to also have a [k].

Let's now look at voiced, voiceless, and aspirated stops. We'd end up with something like this:
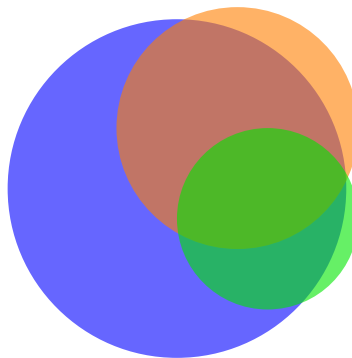
This means that almost all languages with a voiced stop also have voiceless stops. In other words, a voiced stop in the phonemic inventory of a language strongly implies the presence of voiceless stops. We can also learn that if a

language has aspirated stops, it almost always also has voiceless stops.

Additionally, no languages have only aspirated and voiced stops (and "skipping" voiceless stops).

Some other observations and implicational laws:

- Some common vowel systems:
    - 5-vowels: [i,e,a/ɑ/ɐ,o,u]
    - 3-vowels: [i,a/ɑ/ɐ,o,u]
- [s] is the most common fricative
- [d] is more common than [ð]
- A language with a [g] is very likely to have a [b]

3.5　Tone, Stress, and Intonation

"Tone is like segmental phonology in every way—only more so!"

- Quantitatively more so: tone does certain things more frequently, to a greater extent, or more obviously than segmental phonology.
- Qualitatively more so: tone can do everything segments and non-tonal prosodies can do, but segments and non-tonal prosodies cannot do everything tone can do.

Arguably the most popular example is with standard Mandarin Chinese—there are 5 pitches, each contrastive.

There's also various African languages with two, three, and four tonal levels.

What is a tone language? A language with tone is one in which pitch is an "exponent" in at least some morphemes.

Is English a tone language? Well not really. It doesn't affect the dictionary definition of the word, but it does convey meaning in the melody, i.e. to convey question, anger, etc.

4　Morphology

4.1　Words and Morphemes

4.1.1　Introduction to Morphology

Phonology deals with the organization and structure of sounds, and we were looking at phonemes and allophones.

Morphology deals with the organization and structure of words, and we are going to be looking at morphemes and allomorphs.

In fact, we've already seen morphology in action—morphemes often gives insight into phonological alternations.

What are words and morphemes? They're a pairing between *form* and *meaning.*

For example, the pairing between *cat* and its meaning of the typical household pet is a word. Similarly, *feline* has the same meaning. These words have the same meaning, but have different phonological forms—and thus are distinct words.

Similarly, *mousse* and *moose* have the same phonological form, but different meanings, and as such are also different words.

Let's look at some English plurals.

The words *cat, book, roof, sixth* have plurals *cats, books, roofs, sixths*. This may lead us to believe that [s] is a morpheme—but it isn't. There are a lot of appearances of [s] in these words (ex. *sixths*), and not all of them are the same.

But, maybe [-s] is a morpheme—we added the [s] to the end of a word. But there are different ways to add the [s] to the end of a word, ex. *book* as a verb, to *books*. This is additional [s] has a different meaning in this context, and so [-s] is also not a morpheme.

So, maybe [-s] meaning "more than one X" is a morpheme? Almost. We'll circle back to this when we talk about allomorphs.

4.1.2   Word Formation

A few English examples (using affixes—morphemes that either go at the front or back of a stem) of word formation:

- *rewrite* — *re*-write: to do something again
- *writer* — *write*-er: a person or thing that does something
- *rewriter* — *re-write-er*
- *[re-] can't be used by itself—it means nothing by itself; it's a *bound* morpheme
- *write* can be used by itself; it's a *free* morpheme
- *er-write-re* is ungrammatical—there are rules that govern how and where morphemes can attach

Word formation is hierarchical:
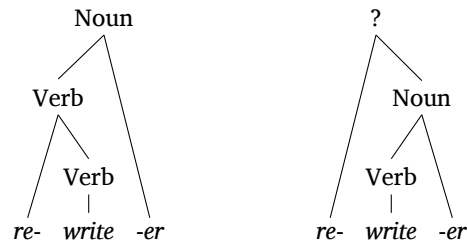
The left tree means "a person who writes again", a noun. The right tree is invalid—it doesn't make sense to add a *re-* to a noun (*re-* means to do something again, and we're working with a noun, so it doesn't make sense).

Before we move on, let's talk about lexical categories.

- **noun**: "a/some X" — *cat, writer, tree, machine*
- **verb**: "to X" — *write, walk, think, eat*
- **adjective**: "a X thing" — *happy, red, fast*
- **adverb**: "to do a thing X" — *quietly, frantically, fast*

Note that the two *fast* (adj.) and *fast* (adv.) are different words. This is because their meanings are different—they behave in different ways.

4.1.3   Hierarchical Structure of Words

Here are some more examples:
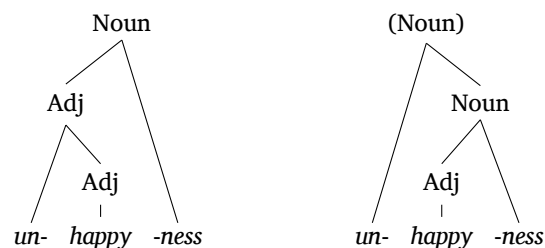
What we notice is that

- *un-*: *unhappy, unknown, unseen, *uncat, *untree*
  - Takes in an adj, and returns another adj
  - Can't take a noun
- *-ness*: *happiness, redness, speediness*
  - Takes an adj, returns a noun

The former is a valid word, the latter is invalid—*un-* can't take in a noun.

Another example is

```
            Adj                                      Adj
           /   \                                    /   \
        Verb    \                                  /    Adj
        /  \     \                                /    /   \
      /   Verb    \                             /   Verb    \
     |     |       |                           |     |       |
    un-   lock   -able                        un-   lock   -able

   able to be locked (adj)
```
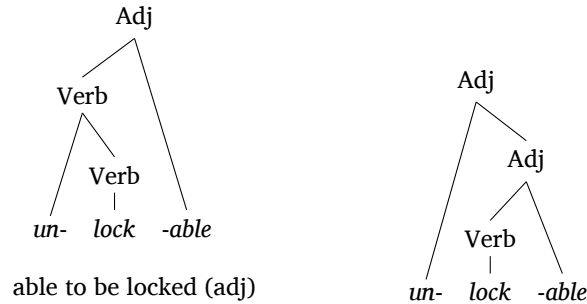
Both hierarchies are perfectly valid, but the left describes a word that means "able to be locked" (adj), and the right describes a word that means "not able to be locked" (adj).

This is called structural/hierarchical ambiguity.

The general approach to word structure problems are:

1. Identify the word category
2. Break the word into morphemes
3. Identify the root and its category
4. Determine how other morphemes attach to the root (making sure that morphemes attach grammatically)
5. Repeat until all morphemes are accounted for

But what do I do when I'm working with a word that I'm not familiar with? In all cases, you'll either be given this information, or you'll be able to derive this information.

4.2 Concatenative Morphology (Affixation and Compounding)

Types of morphemes:

- Function vs. Content
  - Content: more concrete meaning; usually "open", i.e. users can add new words/terms/morphemes
  - Function: mostly grammatically relevant; often "closed", i.e. users can't add new words/terms/morphemes
- Free vs. Bound
  - Free: can be used on its own
  - Bound: can't be used on its own
- Derivational vs. Inflectional
  - Derivational: bound non-root content morphemes
  - Inflectional: bound function morpheme

Inflectional morphemes of English are generally closed, so there's a quite small number of them; we can list them all out.

Derivational morphemes can do one (or both) of two things (for our purposes)

- Change the lexical category
  - *-y* (noun → adj): *dirt-y, glass-y, cheese-y, box-y*
  - *-able* (verb → adj): *count-able, lock-able, reach-able, reason-able*
  - *-ness* (adj → noun): *sad-ness, empty-ness, green-ness, box-y-ness*
- Substantially change the meaning
  - *re-* (verb → verb, to do again): *re-do, re-write, re-arrange*
  - *un-* (reverses the meaning): *un-do, un-lock, un-happy, un-reliable*
    - ∗ Note that this particular prefix can either do verb → verb or adj → adj

Combining derivational morphemes is a primary way in which new words are introduced into a language.

There are also other ways to introduce new words (not covered in this chapter, but we will cover toward the end of

the semester):
- Acronyms: abbreviations
  - *PPE* = **P**ersonal **P**rotective **E**quipment, *COVID* = **Co**rona**vi**rus **D**isease
- Eponyms: proper names that take on more general meaning
  - *xerox, kleenex, google, zoom*
- Clipping: shortening existing words
  - *blog* from *weblog*
- Blends/portmanteau: mashups
  - *friendsgiving* = friends + Thanksgiving
- Conversion/zero-derivation: a change in category without change to the form
  - *facetime* (v) meaning remote video call, from FaceTime (n) the software
  - This is a common English tactic for new word formation!

4.2.1 Concatenative Processes

Concatenative processes are grammatical processes that involve adding things together in a linear order.
- Affixation: combining a root with affixes
  - The most common affixes in English are **prefixes** and **suffixes**
  - **infix**: added inside of a word; there are very few in English.
  - **circumfixes**: added around a word; English has none of these
  - We commonly refer to morphemes by their form, but don't forget that we're always referring to a form and its meaning
- Compounding: combining two roots to form a new word
  - *greenhouse, afterthought, breakdance, jumpsuit*
  - One thing to note is that these compound words mean something different than just the two parts combined.

Concatenation in signed languages:
- Sequential affixation and compounding
  - The signer puts two parts together in sequence, i.e. *writer* is two parts put together: "to write" and the "-er" part.
- Simultaneous morphology (mostly inflectional)
  - Something unique in signed languages is that you can do multiple things at the same time, i.e. multiple parts can be combined at the same time
  - The change in motion occurs at the same time as the motion itself.

Glossing rules:
- Interlinearization
  1. Words are segmented into morphemes
  2. Morphemes are glossed
  3. Word is given a free translation

4.3 Allomorphy

While allomorphs are context dependent realizations of phonemes, allomorphs are context dependent realizations of morphemes. However, in allophones, rules always apply, whereas in allomorphs irregularities exists; rules may arbitrarily apply to only some forms. Additionally, allophones are always phonologically conditioned, while allomorphs may also be grammatically or lexically conditioned (it can also be phonologically conditioned too!).

4.3.1 Examples of Conditioning

The Spanish verb "sleep" /dorm-ir/ have two allomorphs: [duerm] and [dorm]. The alternation is that [dorm] appears in the 1pl and 2pl contexts, while [duerm] applies elsewhere.

Here, there is no phonological context involved in the rule; it's conditioned on the grammar of the word.

In Matsignka, the following morphemes exist:

morpheme	_ consonant	_ vowel except i	_ i
1sg	no-	n-	n-
2sg	pi-	p-	p-
3sg.fem	o-	∅-	∅-
3sg.masc	i-	j-	∅-

This is (complicated) phonological conditioning.

If we look at the future tense (technically a verbal inflection meaning the state is not a fact), we have

morpheme	p-initial root	t-initial root	k-initial root
1sg	m-...-e	n-...-e	ŋ-...-e
2sg	m-...-e	n-...-e	ŋ-...-e
3sg.fem	m-...-e	n-...-e	ŋ-...-e
3sg.masc	ri-...-e	ri-...-e	ri-...-e

The first three rows suggest that this is phonologically conditioned, but the last row suggests that there is some morphological conditioning as well—it doesn't behave the same way at all.

In English, the past tense *-ed* can appear in a few forms:

pushed	[pʰʊʃt]	*sinned*	[sɪnd]	*netted*	[nɛɾəd]
stopped	[stɑpt]	*lagged*	[lægd]	*sighted*	[saɪɾəd]
laughed	[læft]	*stayed*	[steɪd]	*noted*	[noʊɾəd]

There are two possible rules that could be proposed. One phonological rule with allophony (left) and a morphological rule with allomorphy (right)

$$/d/ \rightarrow [t] \text{ / voiceless consonant\_\#} \qquad /\text{-d}/ \rightarrow [\text{-t}] \text{ / voiceless\_}$$
$$\varnothing \rightarrow [\text{ə}] \text{ / ɾ\_d\#} \qquad\qquad\qquad \rightarrow [\text{-əd}] \text{ / ɾ\_}$$

4.4 Non-concatenative Morphology

Morphological processes involved in word formation include:

- **Concatenative processes**: adding specific phonological material in a specific linear order with respect to other morphemes in the word.

  Examples include **affixation** and **compounding**

- **Non-concatenative processes**:

  – Base modification: a change in the segmental or supersegmental characteristics of a word

  For example, in Ngiti, the singular [àbadu] 'my father' becomes [abádu] 'my fathers'; the singular [anadàdu] 'my uncle' becomes [andádu] 'my uncles'. This is a tone shift, and isn't really any affixation or other concatenative process.

  In English, we have a vowel change with tense: [siŋ] 'sing' becomes [sæŋ] 'sang', and [dɹɪŋk] 'drink' becomes [dɹæŋk] 'drank'.

  – Reduplication: involves the repetition of some phonologically definable subpart of the word

  For example, in Javanese, there is

  * Full reduplication:

    baita 'ship' becomes *baita-baita* 'various ships'; *omaha* 'house' becomes *omaha-omaha* 'various houses'

  * Partial reduplication:

    jawa 'rain' becomes *jəjawah* 'play in the rain'; *tamu* 'guest' becomes *tətamu* 'visit'

  – Subtractive morphology: involves the removal of phonological material

For example, in Murle pluralization, *oŋiit* 'rib' becomes *oŋii* 'ribs'

– Suppletion: involves replacing one morpheme with another

For example, in English, *go* and *went*, or *good* and *better*, etc.

Suppletion is most common with the highest frequency words in a language.

– Root-and-Pattern morphology (transfixation): segments of discontinuous affixes are interleaved with discontinuous roots.

In Hebrew, sequences of vowels are slotted in to the roots (consonants).

Present tense	Past tense	Gerund
[ʃomer] 'he guards'	[ʃamar] 'he guarded'	[ʃmira] 'guarding'
[ʃoméret] 'she guards'	[ʃamara] 'she guarded'	

The root of 'guard' is [ʃ-m-r]; it's just the consonants that make up the word. Differences between these morphemes are with the vowels and their alignments with respect to the base.

4.4.1 Multiple and Cumulative Exponence

A morpheme is a form-meaning pair; we can refer to the form as an *exponent*, or realization of a particular meaning.

With this concept, we can define different types of relationships between meanings and forms;

- **Single exponence**: One meaning (e.g. 'plural') is realized as one form (e.g. -s).
- **Multiple exponence**: One meaning (e.g. 'plural') is realized as multiple forms; includes *circumfixation*, and combinations of root alternations and affixation. [lif] 'leaf', [liv-z] 'leaves'
- **Cumulative exponence**: Many meanings (e.g. '3sg subject + present tense') realized as one form (-s)
- **Zero exponence**: One meaning (e.g. 'plural') realized as a null form: *sheep-∅*, *sheep-∅*

4.5 Morphological Typology

Both syntax and morphology involve structure (sentence structure vs. word structure).

An analytic language tends to use more syntax; words tend to be mono-morphemic, minimal use of morphological processes, low category-per-word (CPW) ratio, and few bound morphemes.

Synthetic languages tend to have multimorphemic words, an abundant use of morphological processes, a high CPW ratio, and a rich inventory of bound morphemes.

This all lies on a spectrum from analytic to synthetic; some languages fall in the middle, having some of each.

The distinction between analytic and synthetic languages relies crucially on the notion of 'word'.

A word is the smallest free form found in a language; words can bear emphatic stress, can appear in isolation, have no fixed position relative to other forms, and are less likely to undergo phonological change when combined with other linguistic elements (more phonologically independent).

We can measure CPW in individual expressions:

Analytic (CPW = 1)	Synthetic (CPW > 1)
more tall	*taller*
the car	Danish: *bil-en* (car-DEFINITE)
she will jump	Karuk: *uskák-eesh* (3SG-jump-FUTURE)
Thai *kʰǎo tī raō* ('s/he hits us')	Karuk: *kìn-iktir* (3SG.ACTS.ON-1PL.hit)

4.5.1 Types of synthetic languages

Analytic/Synthetic is not a binary distinction, but a scale. When you think of a language as a whole, the more analytic expressions a language has, the more "Analytic" it is. The more synthetic expressions a language has, the more "Synthetic" it is.

For example, in Mandarin, there is no subject agreement, no tense inflection, no inflectional plural, each character represents one individual meaning, etc.; it's an analytic language.

Do analytic languages 'lack morphology'? No! All languages make use of derivational morphology, and almost all languages make use of compounding and reduplication.

When we look at synthetic languages, we can see different types:

- **Agglutinating**: easy to determine morpheme boundaries, and most morphemes express one feature of meaning
- **Fusional**: difficult to determine morpheme boundaries, and many morphemes express multiple meanings
- **Polysynthetic**: almost all arguments can be inflected on the verb, and we can express the meaning of a sentence with morphology

Fusional vs. agglutinating is also really a scale; languages can be fusional for some suffixes (e.g. English *-s*), and agglutinating for others. Polysynthetic languages are just 'highly synthetic' languages.

Polysynthetic languages often have *noun incorporation*, where an object noun is 'included' in the verb:

For example, in the language Sora, [aninɲamjɔten] means 'he is catching fish':

anin	-ɲam	-jɔ	-te	-n
he	catch	fish	non-past	do

Here, the noun 'fish' is stuck in the middle of the word as [-jɔ].

Something like noun incorporation can be found in English compound nouns, like *can-opener* and *bus driver*.

5 Language Acquisition

5.1 Language Acquisition

5.1.1 Innateness Hypothesis

Human children are born with the ability to learn language. What is that ability?

Here are some ideas:

- Generic cognitive ability to learn and generalize; i.e. an ability to learn patterns around us
- Language-specific cognitive ability
- Universal grammar

These ideas are on a spectrum of "cognition general" to "specific to language" (top to bottom)

There are some limits to this ability to learn language. This is called the "critical period", starting from birth, and ending around the onset of puberty ($\approx$ 12 years).

After the critical period, if a child has not been exposed to language, they may become incapable of developing any capacity for language beyond simple memorized forms.

Some evidence of this (or something like it) comes from neglected children.

Isabelle was a child (born 1932) that was raised in isolation by a deaf mother. She was found at age 6, with limited gestural communication abilities. After being reintroduced to social life (i.e. placed in school, introduced to other children her age), she rapidly caught up with her peers by age 9.

On the other hand, Genie (born 1957, not the real name) was isolated and abused by her father. She was "found" at age 14, with no communication skills, and was unable to fully acquire language, despite the efforts of everybody around her.

Another piece of evidence of the critical period (or something like it) is that children born without hearing into hearing homes develop language-like communication.

5.1.2 Theories of Acquisition

There are some theories relating to "common knowledge":

- **Imitation Theory**—children learn by imitating adults
- **Reinforcement Theory**—children learn by being corrected by adults

But these theories have been debunked, and are only true to a very minimal extent. One thing to note here is that

these theories are very adult-centric, which simply isn't the case.

The current (classes of) theories of acquisition are all centered around the idea that children are "tiny linguists".

- **Active Construction Theory**: children *construct rules* (and test them) constantly while they receive input
- **Connectionist Theories**: children learn by analyzing the *frequency and distribution* of patterns in their input

  This is distinct in active construction theory in that the strongest versions of active construction theory assume an innate mechanism for learning language, while the strongest versions of connectionist theories assume general innate mechanisms for learning are responsible for language learning.
- **Social Interaction Theory**: children learn language as part of their social environment

One thing to note here is that these classes/theories aren't mutually exclusive; there could be a mixture of these theories actually in play here.

5.1.3   Child-directed Language

Child-directed language is the language we use when talking to children. When we think of child-directed language, we normally think of slow, sing-song-y speech that we use when we talk to a child or infant. Here, we'll use child-directed language as any language directed at a child.

Many studies have found that children that receive more linguistic input do better in school. One study found that infants and toddlers in poorer households receive less speech directed toward them, and produce fewer unique words.

How can we fix this? This requires resources—whether it's time, or money, etc.

Perhaps one nuance to notice here is that we should make note of what metric we're looking at here (in the previous study, this metric was standardized assessments; this can vary between studies).

Do these interventions work? One research study told parents to just talk more to their children—a year later, children who received more child-directed language had a greater increase in number of utterances in a fixed period than children who received no more. But, still notice that children who didn't receive more child-directed language did still have an increase in utterances, but just had less of an increase.

However, this is very culture-specific. In cultures with minimal child-directed input, children still go through the same milestones as WEIRD (western, educated, industrialized, rich, and democratic) populations.

In any case, we still agree on several things. Children need regular and consistent exposure to language to become language users, the type and quantity of language directed to children varies by culture, and children in any cultural context are able to learn language as long as they are regularly and consistently exposed.

5.2   The First Few Years

5.2.1   Acquiring Sounds

Here's an average timeline of acquisition of sounds:

- In utero: able to identify language of gestational carrier

  That is, babies in utero are able to hear muffled language, and can start to hear and perceive those sounds. This is still enough for them to pick up on the language though.
- birth: cry, grunt
- 1-3 mo: first vowels
- 4-6 mo: first consonants
- 7 mo: canonical babbling e.g. [bababa], recognize small number of simple commands
- 10 mo: variegated babbling e.g. [bamigado]

  That is, babies are able to apply intonations to these strings of syllables.
- 10-12 mo: lose non-native phonemic contrasts

  That is, babies start to hone in on just the contrasts that are important to the language that they're learning, paying less attention to the contrasts that aren't present in their native language.
- beyond 12 mo: continued acquisition of consonants and vowels

How do we even study infants? One way is to study high amplitude sucking—that is, the baby uses a pacifier to tracks sucking speed; faster sucks occur when new sounds are heard or are excited. For in utero studies, we can look at heart rate variation.

For older infants, we use the conditioned head turn—that is, babies look to a toy (trained to be associated with newness) when they detect a change.

Babies are constantly learning and re-learning the motor commands that result in different sounds. Motor control over the tongue is "undifferentiated" early in life—babies lack independence between tip, front, and back of the tongue. Infants' and young children's oral cavities are also rapidly changing during the first 5-7 years.

As a result, babies' production of new sounds are also tiered. The earliest consonants produced are [m, b, n, d, w], and the last consonants produced are [s, tʃ/dʒ, l, ɹ]. This should make sense, because these are sounds that require really precise articular positioning, and require the coordination of multiple lingual articulators (i.e. different parts of the tongue do different things).

Children may substitute sounds that they are unable to articulate for other similar sounds they are able to; that is, [w] for /ɹ/, [j] for /l/, etc. Children may also use articulations that differ from adults' articulations (ex. children make passable sounding English /l/s even though they don't make them like adults do.

One thing to note here is that most of what we know about language development from the first 12 months of life is focused on sounds—babies don't actually utter what is obviously intended to be a word until more than 12 months.

5.2.2 Words, sentences, and meaning

After the first 12 months, here's more of an average timeline:

- 12 mo: first words
- 2 years: begin to use function words
- 3 years: several hundreds of words
- 4 years: speech is intelligible to strangers

Some children experience a word "explosion", or a vocabulary "spurt"; the number of words a child has in their vocabulary increases exponentially in a short time from about 1 year to 2 year old. Other children can experience gradual vocabulary growth, increasing approximately linearly across this time period.

What is interesting here is that kids with growth spurts had spurts in particular of nouns—this means that it's really just a *naming* explosion, rather than a word explosion.

If we go back and look at the morphology and syntax, we find

- 12 mo: one word phase

  That is, children *mean* to use more than one word, but are only *able* to use one word.

- 1.5 years: two word phase

  That is, children leave out pronouns or function words, etc.

- 2 years: say simple sentences, form questions

  Children tend to skip the three+ word phase, and skip to simple sentences.

- 3 years: start to use inflectional morphology
- 4 years: begin to apply irregular morphology

We also learn a lot about the "mistakes" that children make while learning language. The most common mistakes include

- **Omission**: leaving out words, especially function words (i.e. telegraphic speech); that is, they only include the most important words to convey the meaning they want.
- **Overgeneralization**: Using regular morphological rules on words adults would use an irregular form for
- **Overextension**: use a term for a larger category than adults do

  For example, calling anything that is round a moon, or extending *dog* to include things like cats or really anything that is small-ish, has four legs, and has fur.

6   Syntax

6.1   Syntactic categories and constituents

6.1.1   Syntactic categories

Phonology is the study of sound structure and the rules that act on sound units, or phonemes. Morphology is the study of word structure and the rules that act on word units, or morphemes. *Syntax* is the study of sentence structure and the rules that act on sentence units, or *constituents*.

Syntactic categories are words with the same syntactic (and morphological) distribution.

In other words, "parts of speech." These categories occur in a specific position in the sentence relative to other words, and have a distinct ability to take affixes.

We are still able to create grammatical but nonsensical sentences with these rules—most famously, "colorless green ideas sleep furiously." This sentence doesn't make any sense, but is still perfectly valid and grammatical.

Syntactic categories include *open lexical categories* (i.e. noun, verb, adjective, adverb), and also include *closed lexical categories*, also called *functional categories* (i.e. determiner, prepositions, conjunctions). We'll return to these later.

6.1.2   Syntactic constituents

In word order typology (when talking about the order of words), we refer to larger units like "subject" and "object" rather than specific lexical items.

These are the "arguments" of verbs:

- an intransitive verb takes just a subject: "the baby sleeps" (vs. *"the baby sleeps the toy")
- a transitive verb takes a subject and an object: "the baby pulls a toy" (vs. *"the baby pulls")

The arguments of verbs are not single words, but are groups of words.

Adjuncts are optional words (or phrases!). For example, "Sally saw (small fluffy brown) dogs."

Constituents are groups of words that can act syntactically as one unit. Constituents are also called phrases. All arguments of verbs, and all adjuncts are constituents.

There are four basic types of constituents:

- **Sentences (S)**: a verb with all of its arguments and adjuncts.

  For example, "[Our dog chased her cat]". Sentences can also be complements of verbs: that is, "We told [the mayor] that [Our dog chased her cat]".

- **Noun phrases (NP)**: Determiner + adjectives + noun

  NP can be arguments of verbs; for example, "[The big brown dog] slept" = NP slept, or "[the big brown dog] destroyed [its favorite toy]" = NP destroyed NP

- **Prepositional phrases (PP)**: preposition + noun phrase

  PPs are often adjuncts, so there can be several in a sentence. For example, "The dog slept [on the couch]", or "The dog slept [on the couch] [by the TV] [in the morning]".

- **Verb phrases**

Note that the last three are named after a part of speech, a "head" of the phrase.

6.1.3   Constituency tests

We know that constituents are groups of words that act as a unit in the syntax. Constituency tests are syntactic constructions/behaviors that provide evidence for the existence of constituents. These will help us develop an understanding of verb phrases.

- **Substitution test**: If a sequence of words can be replaced by a pro-form (like a pronoun) it is a constituent.
  - pro-NP: he/she/it/they
  - pro-PP: here/there
  - pro-VP: do so/ did so

– pro-S: so

For example, "Ten penguins chased a boat in the middle of the desert" = "They chased a boat in the middle of the desert", so "Ten penguins" is a NP.

Similarly, "Ten penguins did so in the middle of the desert", so "chased a boat" is a VP. But, we can also do "Ten penguins did so"—this means that "chased a boat in the middle of the desert" is also a VP.

- **Fragment answers**: Make a question so that the test sequence of words is the answer. If the words can be an answer, they are probably a constituent.

  For example, "Who chased a boat in the middle of the desert?" can be answered with "Ten penguins", and as such must be a constituent.

  Similarly, "What did ten penguins chase in the middle of the desert?" can be answered with "a boat".

  However, we can't make any question like *"What did ten penguins chase of the desert?" so "a boat in the middle" is not a constituent.

- **Clefting/Fronting**: Try to put a group of words at the beginning of the sentence. If the resulting sentence is grammatical, then the moved words are probably a constituent.

  For example, "I like this nice dog" can be modified to "This nice dog, I like", so "this nice dog" is a constituent.

- **Pseudoclefts**: take out a phrase, turn the rest of the sentence into a kind of relative clause and put the two pieces back together with the verb "be" in between.

  For example, "Sally bought a teapot" $\implies$ "[What Sally bought] was [a teapot]". This identifies "phrasal constituents" (NP, PP, VP, S).

  Similarly, "What ten penguins did in the middle of the desert was chase a boat."

6.2   Syntactic Properties

6.2.1   Constituent order

The constituents in English sentences must occur in a particular order. That is, "Sally walked" (Subject-Verb; SV) is grammatical, but *"Walked Sally" (Verb-Subject; VS) is not. That is, English has the word order Subject-Verb-Object (SVO).

The two most common word orders are SOV and SVO, and VSO/VOS are less common, and OSV/OVS are much much less common.

If we look at German, there's a difference between main/embedded clauses; there's a difference in word order based on syntactic position.

In English, there's fronting, which gives, a OSV word order (i.e. "Oh apples, I like.").

There are some languages which also have flexible constituent orders, though some orders have different rules than others.

There's also word order in nouns and determiners in different languages (ex. in English, "these books" but not *"books these").

Similarly, there's word order with adpositions (i.e. prepositions and postpositions) and noun phrases; that is, "Sally finally met with that person" is grammatical, but *"Sally finally met that person with" is not.

6.2.2   Syntactic Arguments

To think about arguments, it's helpful to think about co-occurrence requirements. That is, if X occurs in a sentence, Y is required to occur before/after X.

With arguments, if X necessitates the occurrence of Y, then Y is an *argument* of X.

For example, noun phrases can be arguments of verbs. That is, "[The dog] chased [the cat]". Omitting arguments from a sentence results in this sentence being ungrammatical.

There are two kinds of arguments of verbs:

- **Subjects**: in English, the argument to the left of the verb

- **Complements**: in English, the argument to the right of the verb

These positional definitions are very language-specific though.

Subjects are special; only one subject can occur per sentence, and every sentence must have a subject. Verbs in many languages agree with subjects but not objects, and object agreement is possible, but only in languages that also have subject agreement.

With languages with flexible word order, the same requirements are in place with arguments.

There are different types of syntactic complements; for example, in the sentence "Sally told [Polly] [she's leaving]," *Polly* and *she's leaving* are both complements of *told*.

Not only verbs take arguments; for example, *with* takes a NP complement (i.e. "Sally came to the party with [Bob]"). Arguments of conjunctions are called *conjuncts* (and both must be the same type of constituent)

6.2.3   Adjuncts

Adjuncts are constituents that are optional; the presence or absence of adjuncts do not affect the grammaticality of a sentence. For example, "Sally likes [small] [fluffy] [brown] dogs." Any of these constituents can be left out and it's still grammatical.

Semantically, adjuncts like adjectives are *modifiers*; they modify the meaning of the element they attach to.

Although adjuncts are optional, they do have rules about where they occur; for example, adjectives don't like to modify proper names, and can't modify verbs. Additionally, adjectives can't go after a noun, so the position of the adjective also matters.

The same expression can be an argument or adjunct:

- "Sally urged Bob to study French." vs "Sally went to France to study French."
- "Sally put the book on the desk." vs "Sally's cat was sleeping on the desk."
- "Sally's cat seemed cute." vs. "Sally has a cute cat."

Some differences between arguments and adjuncts include:

- Arguments are obligatory, and adjuncts are optional.
- Arguments cannot have more than one required, and adjuncts can have as many as you like.
- Arguments cannot be freely ordered with respect to one another, but adjuncts can be freely ordered with respect to one another.

6.3   Phrase structure rules

6.3.1   S rules

5 observations on syntax:

- Sentences have internal structure
- We can identify the structure using constituency tests
- Some constituents are arguments, others are adjuncts
- We can identify the category of words and constituents by examining their syntactic and morphological distributions
- We also need to account for the order of words/constituents

Generative grammar is an explicit procedure for constructing all grammatical sentences in a language—and no ungrammatical sentences. This means that speakers can generate new grammatical sentences, so this models mental grammar.

This is a theory of *competence*, i.e. human knowledge of language, not *performance*, i.e. what we are doing when we speak. This theory of grammar is due to Noam Chomsky.

Of course, it will be impossible to do this for all of English in this class, so we model a fragment of English grammar. What we won't model include auxiliary verbs, quantifiers, and negation.

Looking at sentence structure, we can note that sentences are made up of an NP and a VP. We notate this with

$$S \rightarrow NP \; VP$$

That is, a sentence consists of an NP and a VP, in that order. We can draw this as a tree with an example as

```
                    S
                  /   \
                NP     VP
               / \     / \
          The angry reporter  screamed.
```
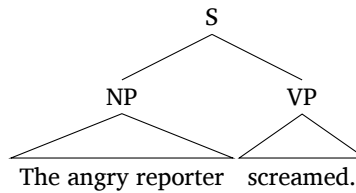
Here, we use a triangle to denote that we're ignoring internal structure.

6.3.2   NP rules

Some words have the distribution of an NP: pronouns and names. We can analyze these words as being of the category NP. We can then introduce a *phrase structure rule* for these words.

Phrase structure rules are instructions to draw trees; trees are models of syntactic structure.

There are three components of noun phrases:

- Noun: the *head* of the noun phrase, i.e. its presence is obligatory in a noun phrase
- Adjuncts: Adjectives that can precede the nouns
- Arguments: Singular count nouns require a determiner.

For NP, here are our rules (for English):

1. NP → Det N
2. N → Adj N
3. N → {dog, cat, book, park}
4. Adj → {fluffy, nice, dirty}
5. Det → {the, a, every}

The last three rules are lists of lexical items that can go under their respective nodes.

As a tree, we have

```
                    NP
                  /    \
                Det     N
                 |     / \
                the  Adj   N
                     |     |
                   fluffy  dog
```
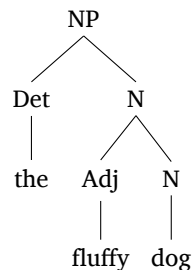
If we look at the rule for adjectives, N → Adj N is an adjunct rule for N. That is, we don't actually need to use this rule. In contrast, NP → Det N is an argument rule for NP.

Adjectives (like all adjuncts) are recursive; they can occur over and over again. Such rules are recursive rules.

6.3.3   VP rules

Each VP (minimally) consists of a verb and its complements.

Here are some of the subcategories of verbs:

- **Intransitive verb (VP)**: no complement

  For example, "[The dog] slept."
- **Transitive verb (TV)**: one NP complement

  For example, "[The dog] chased [the cat]."

- **Ditransitive verb (DTV)**: two NP complements

  For example, "[The dog] brought [the lady] [the cat]."

- **Sentential complement verb (SV)**: one S complement

  For example, "I think [the dog likes the cat]."

For each of these subcategories, we need a different VP rule:

1. VP → V
2. VP → TV NP
3. VP → DTV NP NP
4. VP → SV S

We can make this a little easier by using subscripts:

1. VP → V_0
2. VP → V_1 NP
3. VP → V_2 NP NP
4. VP → V_S S

Here are examples of each type of VP:

VP | VP | VP | VP
V_0 | V_1 NP | V_2 NP NP | V_S S
slept | bit the angry reporter | showed the angry reporter my wombat | said the hedgehog disappeared
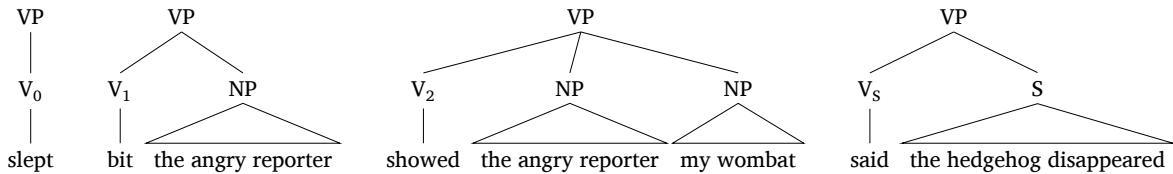
We can now make a complete sentence:

```
                              S
                    ┌─────────┴─────────┐
                   NP                   VP
               ┌────┴────┐          ┌───┴────┐
              Det        N         V_S        S
               │      ┌───┴───┐     │     ┌───┴───┐
              The    Adj      N    said   NP      VP
                      │       │        ┌──┴──┐  ┌──┴──┐
                    angry  reporter   Det    N  V_1   NP
                                       │     │   │   ┌─┴─┐
                                      the  lady ate Det  N
                                                    │    │
                                                    a   bug
```
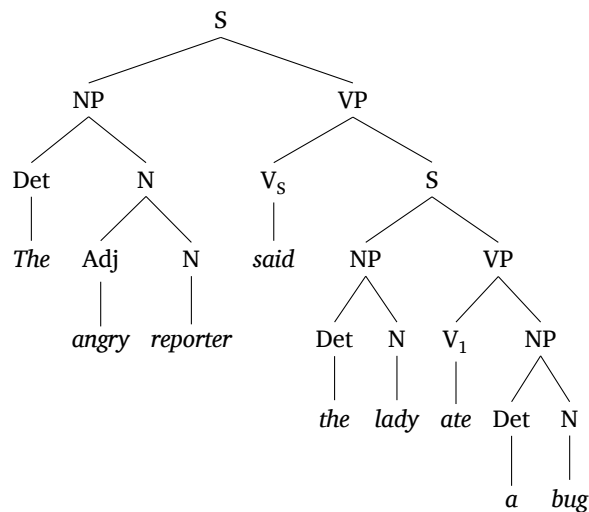
With adverbs, we have the adjunct rules (as they're optional)

1. VP → Adv VP
2. VP → VP Adv

In a tree, this looks like
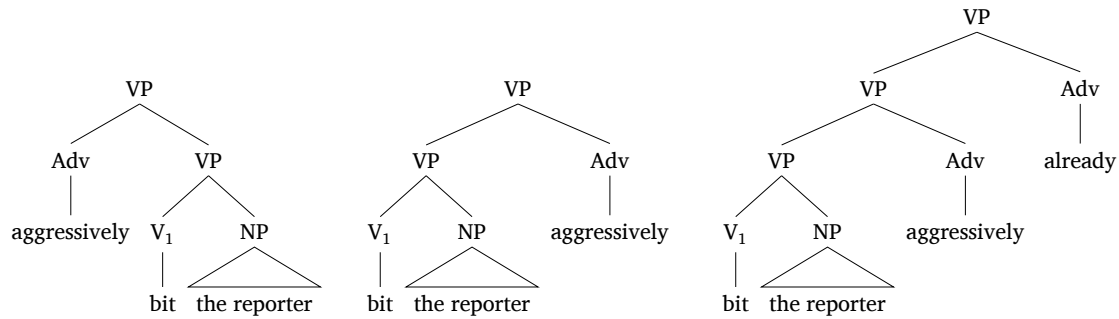
6.4 Ambiguity and Intermediate Constituents

6.4.1 PP Adjunction in NP

Prepositions are words like *on, above, under,* and *of*. They take a *noun phrase complement*.

For example, "I put the mail **on/under/above** the table." or "I put the mail **on/under/above** tables around the house."

of has a completely different distribution, but we won't be going over them.

PPs are adjuncts occurring after NPs and VPs, and are impossible before NPs and VPs.

Our PP rules are:

1. PP → P NP

2. P → {on, under, above, …}

We also need the PP adjunction to N:

3. N → N PP

Note here that we can apply N → N PP in a few orders:
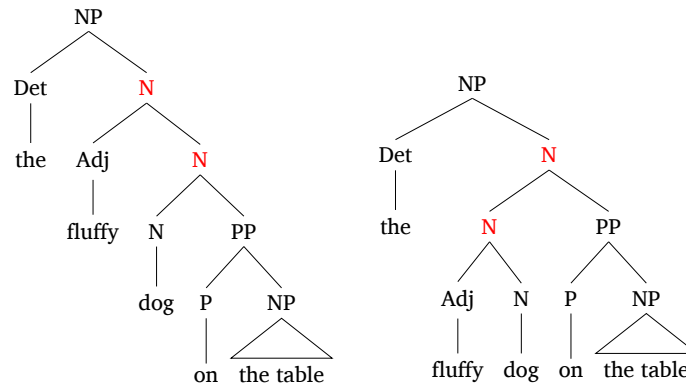
This brings up the topic of intermediate constituents.

The *one*-substitution test gives evidence for intermediate constituents. We take the N node and target it in a question. For example, with "The fluffy dog under the table", we have

1. "Which [**dog**] do you like?"

   "The fluffy [**one**] under the table."

2. "Which [**fluffy dog**] do you like?"

   "The [**one**] under the table."

3. "Which [**dog under the table**] do you like?"

   "The fluffy [**one**]."

That is, we can always apply N → {*one*}, and the phrase we replace is a possible N phrase.

6.4.2 PP Adjunction in VP

With VPs, we have the additional rule

1. VP → VP PP

In other words, any VP can be modified with a PP. For example,
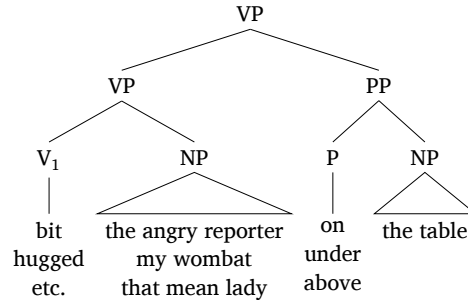
Here, it seems like we have multiple "levels" of nested VPs, and it turns out that all these nested VPs are valid, according to any of the aforementioned VP tests.

6.4.3 Ambiguity

There are two kinds of ambiguity that we talk about with language.

The first is *lexical ambiguity*, where two words have the same pronunciation but two different meanings or categories. This is also called *homophony*. For example,

- Sally is going to have the **mole** on her back surgically removed.
- Sally hates the pesky **mole** in her backyard.

These are different words which happen to be pronounced the same.

Ambiguous words can also differ in their lexical category, for example

- Sally has a **fast** car.
- Sally walks **fast**.

In the first sentence, *fast* is an adjective, and in the second sentence, *fast* is an adverb.

The second is *syntactic ambiguity*. Here, sentences have multiple meanings, but not due to any ambiguous words:

- The cop watched the man with the binoculars.

  This could be interpreted as "The cop watched [the man with the binoculars]." or "The cop watched the man [with the binoculars]."

- Sandy said Tom would be here yesterday.

  This could be interpreted as "Sandy said [Tom would be here yesterday]." or "[Sandy said Tom would be here] yesterday."

We can make ambiguity disappear with constituency tests.

In the first sentence, we can use substitution for NP:

- The cop watched [him]$_{NP}$.
- The cop watched [him]$_{NP}$ with the binoculars.

As trees, this is represented as follows:

This ambiguity comes from the two rules VP → VP PP and N → N PP.

As a reminder for pronouns, we have

1. NP → Pron
2. Pron → {I, me, he, she, her, him, they, …}

Syntactic ambiguity shows that *word order ≠ syntactic structure*. Linear order can be predicted from a single syntactic structure, but the syntactic structure can't be predicted from a string of words.
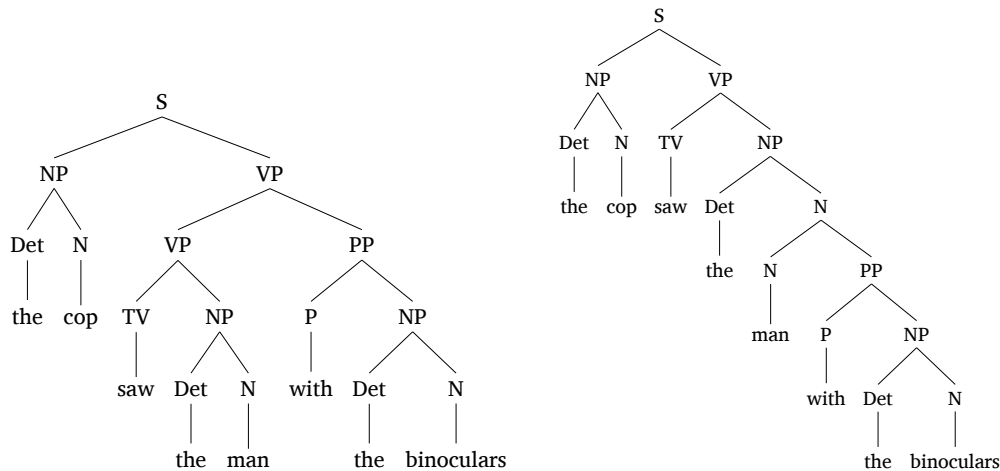
It also shows that *sentence meaning* depends on *syntactic structure*. Sentence meaning can be predicted from a syntactic structure, but syntactic structure can't be predicted from meaning. That is, syntax always comes before semantics.

6.5 Crosslinguistic syntax

6.5.1 Japanese and Headedness

In Japanese, the basic word order is S-O-V, has postpositions, embedded clauses precede verbs, and adverbs also precede verbs.

The English syntax rule PP → P NP would be changed to become PP → NP P to account for postposition. Also, the English syntax rule VP → VP PP would be changed to become VP → PP VP to account this as well.

With embedded clauses, the English syntax rule VP → V_S S would be changed to become VP → S V_S.

Lastly, the fact that adverbs precede verbs would be accounted by changing the English syntax rule VP → VP Adv to become VP → Adv VP.

In summary, here are the basic Japanese syntax rules we just went over, with some large simplifications. Most of the changes here are just the flipping of the rule order.

1. S → NP VP
2. NP → N
3. PP → NP P
4. VP → NP V_1
5. VP → S V_S
6. VP → Adv VP
7. VP → PP VP

From the analysis we've done, it seems like there are no major obstacles to extending our syntactic analysis of English to Japanese. Deeper analysis of Japanese syntax confirms that the analysis just described for Japanese is essentially correct. Despite the fundamental differences in word order, Japanese and English have essentially the same syntactic structure.

This brings us to the notion of a *head*. The category that labels a phrase is its head. For example, N is the head of NP, P is the head of PP, V is the head of VP. As far as we've seen, S has no head.

Comparing Japanese and English, we have

Japanese rules	English rules
1. PP → NP P	1. PP → P NP
2. VP → NP V_1	2. VP → V_1 NP
3. VP → S V_S	3. VP → V_S S

We can observe that the heads are on the right in Japanese, and heads are on the left in English.

Looking past just English and Japanese, postpositional languages are almost all SOV, and languages where embedded S precedes the verb are also pretty much all SOV. In essence, languages tend to be left-headed or right-headed as a property of the entire language.

Suppose that English and Japanese have the same phrase structure rules, in an abstract sense, with one difference; heads go on the right in Japanese, and heads go on the left in English. We say Japanese is a *head-final* language, with postpositions and object-verb order. We say English is a *head-initial* language, with prepositions and verb-object order.

Additionally, adjuncts tend to precede the head in Japanese, and at least can follow the head in English. This leads to the observation that head-adjunct order (weakly) correlates with head-complement order across languages.

6.5.2   Malagasy and Verb-initiality

Malagasy is a Malayo-Polynesian language with 25 million speakers, spoken in Madagascar. It's famous among syntacticians for its strict VOS word order.

Verb-initial languages like Malagasy are strongly head-initial. All arguments follow the head, and all adjuncts follow the head as well.

The verb-initiality means we need to change the sentence rule to become S → VP NP. Adjectives notably appear after nouns rather than before them in English. Otherwise, the other rules are pretty similar:

1. S → VP NP

2. NP → Det N

3. N → N Adj

4. VP → VP Adv

5. VP → VP PP

6. VP → V_0

7. VP → V_1 NP

8. VP → V_2 NP NP

To step back here, English (SVO), Japanese (SOV), and Malagasy (VOS) have radically different word orders. Nevertheless, via syntactic analysis we can analyze them all as having essentially identical *structures*.

Variation between languages is reduced to the way structure is mapped to linear order, i.e. do heads tend to precede or follow their complement? The shared structure among languages was anticipated by Noam Chomsky's idea of 'Universal Grammar', essentially the idea that the structure of natural languages is largely similar.

6.5.3   Case and Agreement

Case is the process of 'flagging' or marking particular arguments of the verb based on their grammatical status as subject or object, i.e. "They (=nominative) saw them (=accusative)."

Agreement is where languages 'index' arguments on the verb, indicating their special grammatical status:

- I am (=1sg) happy.

- You are (=2sg/pl) happy.

- She is (=3sg) happy.

Not all languages have case or agreement. The function of case and agreement is essentially to indicate which arguments are subjects and which are objects; this can be done in other ways as well (for example, with word order).

There are some substantial differences on how case and agreement vary between languages.

It's helpful to break down grammatical relations into three categories:

- S: intransitive subject
- A: transitive subject
- O: transitive object

Here, the intransitive subject refers to the NP associated with an intransitive verb (a verb that has no complements), and the transitive subject/object refers to the NPs associated with a transitive verb (a verb that has complements).

In English, we tend to think of S and A to be the same, but they pattern differently in different languages.

There are two different alignments in different languages.

- Nominative/Accusative: S and A are treated the same, and O are treated as special
- Ergative/Absolutive: S and O are treated the same, and A are treated as special

An example of nominative/accusative is in German:

- <u>Der</u>   Vogel   sieht   <u>den</u>   Hund.
  the.M.SG.NOM   bird   sees   the.M.SG.ACC   dog

- <u>Der</u>   Hund   sieht   <u>den</u>   Hund.
  the.M.SG.NOM   dog   sees   the.M.SG.ACC   bird

- <u>Der</u>   Vogel   singt.
  the.M.SG.NOM   bird   sings

Here, S and A are treated the same (nominative), and O is treated differently (accusative). This can be analyzed just like English and Japanese.

An example of ergative/absolutive alignment is in Chukchi:

- **ɣəm**   tə-kətɣəntat-ɣʔak.
  1SG.ABS   1SG.SUB-run-1SG.SUB

  'I ran.'

- **ɣəm-nan**   ɣət   tə-lʔu-ɣət.
  1SG-ERG   2SG.ABS   1SG.SUB-see-2SG.OBJ

  'I see you.'

- ərɣə-nan   **ɣəm**   ne-lʔu-ɣəm
  3PL-ERG   1SG.ABS   3.SUB-see-1SG.OBJ

  'They saw me.'

Here, S and O are treated the same (absolutive), and A are treated different (ergative)

In many languages, subject agreement describes agreement with the intransitive subject and the transitive subject:

- He smile-s.
- They smile-∅.
- He like-s them.

In English, verbs only agree with the subject, and not with the object, but some languages can agree with both.

Some languages also show ergative-absolutive alignment in their agreement patterns.

6.6 Movement

6.6.1 Case and Agreement Rules

The function of case and agreement is to indicate the grammatical role (subject vs object) of NP arguments. Subjects and objects boil down to specific syntactic positions; subjects are the NP daughter of S, and objects are the NP complement of V.

Case and agreement can be analyzed as rules or constraints which make reference to these syntactic positions.

In Japanese, the sentence "Mary-ga John-o mita" is glossed as "Mary-NOM John-ACC see-PAST", i.e. "Mary saw John". Here, *-ga* represents the nominative case, and *-o* represents the accusative case. This can be represented as the tree

```
              S
           /     \
         NP       VP
         /\      /  \
    Mary-ga    NP    V₁
              /\     |
          John-o   mita
```
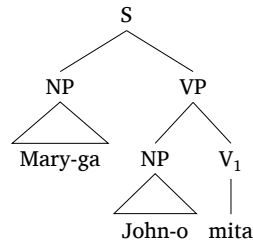
This leads us to observe that the NOM case occurs on the NP immediately below S, and that ACC case occurs on the NP complement of V.

These rules are identical in English; we always assign nominative and accusative cases, but sometimes don't pronounce them (ex. in "the dog").

With agreement in English, we copy the person and number features from the subject to the verb (the subject here is the NP below the S). This creates a morphological dependency of the verb on the subject.

But, when we look at ergative/absolutive languages, this breaks down.

Here's a different system for case rules, called "dependent" case.

With nominative/accusative languages,

1. Assign the NOM case to the NP in the highest position (closest to S)
2. Assign the ACC case to the remaining NPs

With ergative/absolutive languages,

1. Assign the ABS case to the NP in the lowest position (farthest from S)
2. Assign the ERG case to the next highest NP

As long as the first part applies first, ACC/ERG will only ever appear once NOM/ABS have appeared.

We can use the same principles with agreement for erg/abs languages:

1. Copy the person features from NP in the lowest position to the verbal suffix
2. Copy the person and number features from the remaining NP to the verbal prefix

In summary, nominative-accusative alignment can be analyzed by reference to absolute position (subject vs object) or as "highest first" dependent case/agreement.

However, it's hard to analyze ergative-absolutive alignment in terms of absolute position. But, it is possible to analyze erg-abs alignment as "lowest first" case assignment. However, structural analyses of ergative languages have been proposed for some languages, in the context of more detailed structural analysis.

6.6.2   Movement Rules

So far, we have a theory of categories (N, Adj, V, etc.), a theory of structure (phrase structure rules), and we've just developed a theory of case/agreement rules. Now, we'll talk about movement and movement rules.

Let's go back to "fronting", i.e. *topicalization*. This is the appearance of an element high in the tree when it's supposed to appear lower in the tree.

That is, the NP/PP at the beginning of the sentence belongs in the VP, as shown below in bold:

- (My cat doesn't usually eat mice but) **this mouse**, it [enjoyed __]$_{VP}$.
- (I don't like most books but) **this novel**, I [finished __ quickly]$_{VP}$.
- (I eat different food with different utensils…) **With a spoon**, I [eat soup __]$_{VP}$, (but with a fork, I eat spaghetti).

Wh-questions behave similarly:

- **What** did the cat [eat __]$_{VP}$?
- **Which book** did you [finish __ quickly]$_{VP}$?
- **How** does Mary [eat soup __]$_{VP}$?

Here, the wh-word at the beginning of the sentence belongs in the VP.

How do we think about and study these phenomena?

Chomsky proposed that syntactic structure is generated in two stages. There is some *deep structure* (i.e. phrase structure rules), but they undergo "transformations" (e.g. movement) and become a *surface structure*.

We can characterize these transformations as rules.

With topicalization, after completing the phrase structure rules, move any NP, PP, or VP to the front of a sentence as a topic. For example,

1. (Deep structure) The cat ate **the rat**.
2. (Surface structure) **The rat,** the cat ate __.

This rule also explains why topicalization was such an excellent test for constituency!

For wh-movement, after completing the phrase structure rules, move any *wh*-phrase to form a question.

Looking across languages, we'd find that not all languages have the same movement rules. For example, languages like Mandarin and Thai lacks *wh*-movement. Because of this, these languages would use the deep structures.

Are there any alternatives to this view? The idea of "movements" entail that the generation of a syntactic structure involves different stages in a "derivation". This has been one of the more controversial aspects of Chomsky's theory, as it seems too complicated. Yet, there are very few good alternatives.

Now, let's go back to Japanese. We can observe that there are SOV and OSV sentences in Japanese; looking at the distributions, we can determine that one of the two can be categorized as a basic word order.

More specifically, when we're trying to emphasize a certain part of the sentence, it can be placed rather freely to the left of the sentence.

The rule relevant in Japanese is called *scrambling*; after completing the phrase structure rules, move any NP or PP to the front of a sentence to emphasize it.

1. (Deep structure) John-ga Mary-o mi-ta
2. (Surface structure) Mary-o John-ga mi-ta

Japanese scrambling obeys similar constraints as operations like *wh*-movement and topicalization in English. We can also preserve the nominative/accusative case rules on deep structure. That is, we assign case to the deep structure, and move the words afterward.

Some languages also allow *verbs* to move, for example, in questions. In Spanish,

1. Gabriela compró la computadora.

   'Gabriela bought the computer.'
2. Compró Gabriela __ la computadora?

   'Did Gabriela buy the computer?'

Here, we move the verb to the front of the sentence to mark a question.

This also allows us to understand the structure of VSO languages (ex. Scottish Gaelic), where it seems there is no VP. Such languages can be analyzed as involving SVO order where the verb moves to a position before the subject.

Movement can also help us understand languages with apparently free word order; we'd just

1. Identify a "basic" word order
2. Identify specific movement rules (e.g. topicalization, scrambling, verb movement) which generate different word orders

this approach captures the fact that not all of the orders seem identical; some are used in particular contexts, etc.

7   Semantics

7.1   Lexical Semantics and Theta Roles

7.1.1   Meaning

Semantics is the study of linguistic meaning. There are three ways to think about linguistic meaning.

- *Lexical semantics*: What is the meaning of a word?
- *Compositional semantics*: How do words combine to form the meaning of a sentence?
- *Pragmatics*: How does the context contribute to the meaning of a sentence?

We will start with lexical semantics, and in particular, the lexical semantics of verbs.

When we are thinking about the meaning of a word, we must think about what it makes the sentences it occurs in mean.

This means that we have to think about sentence meaning; we can think about the meaning of a sentence as its *entailments*.

We can think about entailment as follows: Sentence X entails a sentence Y if whenever X is true, Y **must** be true as well.

Our language ability includes knowledge of entailment relations—entailment is at the core of human meaning and reasoning.

Here's an example of entailment:

1. All dogs bark.
2. Sally's dog barks.

We have that (1) entails (2) because if it is true that all dogs bark, it must be true that Sally's dog barks. However, (2) does not entail (1) because it could be true that Sally's dog barks without it being true that all dogs bark.

7.1.2   Argument Theta Roles

We can distinguish between two kinds of entailments that verbs have:

- *Event entailments*: entailments about the kind of event a verb describes
- *Argument entailments*: entailments about the arguments/participants in that event

Take the sentence "Ethel found some rocks."

The event entailment is that Ethel "happened upon rocks whose location was unknown." The argument entailment is that Ethel is a sentient being. Furthermore, there is no entailment about the object (the rocks).

On the other hand, consider the sentence "The rocks found Ethel."

The event entailment is that the rocks "happened upon Ethel, whose location was unknown." The argument entailment is that the rocks are sentient beings.

This sentence is *semantically anomalous* because one of its entailments ('the rocks are sentient') is at odds with our normal understanding of the world.

Suppose we look at the sentence "Francesca kicked the wall."

The propositions entailed by this sentence include: Francesca's foot made forceful contact with the wall, and Francesca moved her foot on purpose (or at least has the capacity to). It does not entail that Francesca doesn't like the wall, and also does not entail that the wall was injured.

Generalizing here, we can say that the entailments of X kicked Y to be:

- X's foot made forceful contact with Y.
- X caused the event to occur.
- X is sentient.

Here, (i) is an event entailment, and (ii) and (ii) are argument entailments.

Certain verbal entailments about arguments, particularly entailments about causation and sentience, occur across many different verbs and allow us to classify verbs. These are called theta θ- roles.

We say that a verb assigns theta roles to their arguments. The number of theta roles a verb assigns corresponds to its number of arguments.

Here, kick assigns two theta roles because it has two arguments:

- **agent** to the NP *Francesca*: "agents" cause events and are sentient
- **patient** to the NP *the wall*: "patients" don't cause events and don't have to be sentient.

Every NP must receive a theta role, and verbs must assign their theta roles to only one argument. NPs which are not arguments of verbs get assigned a theta role by their preposition:

- Francesca cooked the popcorn *in the kitchen*.
- Francesca cooked the popcorn *with the microwave*.

There are a total of seven theta roles:

1. **Agent**

   Agents are in control of an event, i.e. they are volitional. Agents apply force, and cause the action, and often (but not always) show an *animacy restriction* (i.e. being sentient).

   (a) Francesca jumped.   (c) Francesca ran.

   (b) *The table jumped.   (d) *The table ran.

   Note here that all of these verbs are intransitive, but still entail something about Francesca: she's applying force somehow, she's in control of the event, etc.

2. **Patient**

   Patients are not in control of the action, i.e. they are non-volitional. Patients don't apply force, didn't cause the event, and are affected by the event, either in change of state or location.

   (a) The table broke.   (c) The ice melted.

   (b) The package disappeared.

   Note here that all of these are inanimate objects, i.e. there is no entailment of sentience here.

   When agents and patients are in the same sentence with transitive verbs, the agent is always the subject. This gives us a notion of a 'possible verb meaning': there are no patient-agent verbs.

   (a) Francesca kicked the wall.   (c) My hand melted the ice.

   (b) Ahmed kissed Bernard.   (d) The elephant crushed the tent.

3. **Experiencer**

   Experiencers must have a mental state. The verb describes the metal state of this argument, and could be positive or negative. The experiencers always show an animacy restriction (i.e. are sentient).

   (a) Fatima worried.   (c) Fatima admired Francesca.

   (b) *The table worried.   (d) *The table admired Francesca.

   Experiencers and agents can be subjects of intransitive or transitive verbs. However, patients can only be subjects if the verb is intransitive. Experiencer objects typically require agent subjects, and experiencer agents typically take patient subjects.

   (a) Fatima worried.   (c) Fatima admired the rocks.

   (b) The storm worried Fatima.   (d) Francesca annoyed Fatima.

   Note that in the last two, the experiencer is the subject and object, respectively.

The question that we could ask is: why do certain theta roles get linked with certain positions? We have that

- Subjects of intransitive verbs (V_0): Agents, patients, or experiencers
- Subjects of transitive verbs (V_1: Agents or experiencers

The answer is that there is a *Theta Hierarchy*: Agent > Experiencer > Patient.

The linking rules is that if a verb has more than one argument:

- Assign the highest-ranked argument to *subject*.
- Assign the second-highest-ranked argument to *direct object*.

Looking at the earlier two sentences, we have

- Francesca annoyed Fatima. (Agent > Experiencer)
- Fatima admired the rocks. (Experiencer > Patient)

7.1.3 Adjunct Theta Rules

Let's look at the last four theta roles.

4. **Instrument**

   Instruments describe the means by which an agent does an event. This is usually an adjunct, introduced by *with* or *by*.

   (a) Fatima jumped with the trampoline.   (b) Francesca ate the sushi with a fork.

   Instruments can also be arguments; in certain verbs, instruments can be subjects (in the absence of an agent, as in (a) and (b) below.). The number of verbs that take instruments as objects is limited, but they exist (as in (c) below).

   (a) The key unlocked the door.   (c) The lady used the knife.
   (b) The knife cut the bread.

5. **Source**

6. **Goal**

   Sources describe the origin of motion or force, and goals describe the destination of motion or transfer. Both are introduced by prepositions: sources are introduced with *from* or *out of*, and goals are introduced with *to, into, at, onto*, etc.

   (a) Fatima ran from the woods.   (b) Francesca jumped into the pool.

   Verbs with two NP complements (V_2) always assign a goal and a patient; the goal always comes first:

   (a) Fatima threw the dog a bone.   (c) *Fatima threw a bone the dog.
   (b) Francesca gave me a sticker.   (d) *Francesca gave a sticker me.

   Because goals and sources are often adjuncts, they can occur together:

   (a) A bug crawled out of the hole.   (c) A bug crawled out of the hole towards the chef.
   (b) A bug crawled towards the chef.

7. **Location**

   Locations describe where the event takes place. Motion events must be contained within the location, and are always introduced by prepositions, usually adjuncts.

   (a) Fatima ran in the woods.   (c) Fred ate his dinner beneath the ocean.
   (b) Francesca jumped on the moon.

We can look at the anomalous sentences we looked at before and explain why they're anomalous:

- *The wall **kicked** Francesca.

  With *kicked*, "the wall" is the agent, and is required to be sentient (which it isn't).
- *Colorless green ideas **sleep** furiously.

  With *sleep*, "colorless green ideas" is the agent, and is required to be sentient (which it isn't).
- *The wall **surprised** some driftwood.

  With *surprised*, "the wall" is the agent, and "some driftwood" is the experiencer. Neither is valid, as neither are sentient.

As a brief summary:

- Subjects of intransitive verbs (V_0) can be agents, patients, or experiencers
- Subjects of transitive verbs (V_1) are agents, experiencers, or instruments.
- Subjects of ditransitive verbs (V_2) are always agents.
- Complements are patients, experiencers, or goals.

In the hierarchy, we have

<center>Agent > Experiencer > Instrument > Patient > Goal > Source > Location</center>

If a verb has more than one argument:

- Assign the highest-ranked argument to *subject*.
- Assign the second-highest argument to *direct object*.
- Assign the third-highest argument to *indirect object*.

In summary, the meaning of a sentence is its entailments. Verbs have entailments about the event they describe and entailments about their arguments. Entailments about their arguments fall into systematic classes called theta roles. Theta roles and the theta hierarchy help us understand what verbs are possible in natural language, and why subjects or objects occur where they do in sentences.

7.2   Types of meaning

7.2.1   What is meaning?

Last section, we talked about semantics and its relation to syntax; now, we'll venture into pure semantics.

Last time syntactic ungrammaticality is different from semantic anomaly, and sentence meaning is dependent on syntactic structure (semantic ambiguity is evidence for this). A grammar for well-formed syntactic representations can be stated without reference to meaning.

There are three uses of the word 'mean':

- Smoke means fire.

  This is more about implication; if there's smoke, there's a fire.
- Doris means to be nice.

  This is more about intention.
- *Corazón* means heart.

  This is more of what we're interested in—what does this word tell us in relation to the world?

Ferdinand de Saussure introduced the idea of signs (Saussurian signs). A sign is a mapping between a signifier (the word) and the signified (the physical object or representation in the world). Hence, each word is a sign.

What makes a sign?

- Linguistic signs are *arbitrary*.
- Linguistic signs are *conventionalized*.
- Linguistic signs have *capacity to be combined*.

7.2.2   Sense and Reference

Two components to linguistic meaning are **Sinn** (sense) and **Bedeutung** (reference). The *reference* of an NP is the person, object, or entity that it indicates. The *sense* of an NP is the "mode of presentation" the NP provides for that reference.

The following NPs have different senses, but the same reference:

- I visited China.
- I visited that country. [pointing to China on a map]
- I visited the most populous country in the world.
- I visited the host country of the 2008 summer Olympic Games.

Why distinguish sense and reference? Sense and reference capture distinct but equally important aspects of linguistic meaning.

If we disregarded reference, we wouldn't be able to explain:

- how we can use language to talk about the world around us.
- the fact that the four sentences earlier are true in exactly the same situations.
- the difference in meaning between 'that horse' and 'that unicorn'.

In other words, reference allows us to understand the connections between presentation and physical objects.

If we disregarded sense, we would be unable to distinguish the following sentences:

- The morning star is the evening star.
- The morning star is the morning star.

The context to this is that the morning star and evening star are both the planet Venus, but were thought to be different stars in the past. Here, "morning star" and "evening star" refer to the same object, but with different modes of presentation.

We also can't explain why the previous sentences about China could have different meanings if we use "want to visit". For example, "I want to visit the most populous country in the world" is just referring to the country with the most population, whichever one that is.

7.2.3   Types of meaning

Sentences express propositions. A *proposition* is a claim that a sentence makes about the world.

Propositions have the capacity to be either true or false—this is a semantic notion.

The following sentences both express the proposition that Sally visited Molly:

- Sally visited Molly
- Molly was visited by Sally

There are three kinds of word meanings (though there are actually more):

- Reference

  Referential expressions *pick out individuals in the world*. Only NPs refer; referring expressions are *names* and *pronouns*.

  Names also refer independent of context, but pronouns are context dependent:

    - I: whoever is talking at the time of the utterance
    - you: whoever I'm talking to at the time of the utterance
    - they: whoever I'm talking about at the time of the utterance

- Properties

  Properties describe traits or attributes that hold of individuals. All open lexical categories (nouns, verbs, adjectives) can describe properties.

  Noun properties include: dog, unicorn, universe, etc. These are all properties of some particular individuals.

  Verb properties include: smile, sleep, run, etc. These are intransitive verbs that are true of individuals at a certain point in time.

  Adjective properties include: tall, disgusting, blue, etc. All adjectives are properties, by definition.

- Relations

  Relations describe kinds of relationships that hold between two individuals. Again, all open lexical categories (nouns, verbs, and adjectives) can describe relations.

  Noun relations include: mother, enemy, mayor, etc.

  Verb relations include: hug, drink, admire, etc. These are all transitive verbs, describing the action between two objects/individuals, etc.

  Adjective relations include: taller, grosser, better, etc. These comparative adjectives describe the relationship between two objects/individuals, etc.

7.3   Compositional Semantics

7.3.1   Properties

The *sense* of a property is some kind of abstract concept, but this is surprisingly difficult to characterize. There are three ideas:

1. Property senses correspond to definitions

   For example, suppose we say that *glass* means 'a receptacle for drinking made of glass'.

   The problem here is that this is dependent on language, and it's inherently circular. It can also often be imprecise or insufficient.

2. Property senses correspond to mental representations

   For example, suppose we say that *bird* means what is in your brain when you hear 'bird'.

   The problem here is that what we think of is not sufficient to include marginal cases (ex. we'd think of sparrows or robins, but not penguins or ostriches).

   Another problem is that many words lack mental images (e.g. *universe*, *impossible*, *lie*)

3. Property senses correspond to uses

   For example, suppose we say that *bird* are things that you use the word *bird* to talk about.

   The problem here is that meanings cannot exist independent of their uses. Furthermore, using *bird* to talk about a dog doesn't make it a bird.

Yet we'll think of properties as 'referring' to sets of individuals. That is, if we were to refer to a *woman*, we'd be referring to the set of all women in the world.

There are still problems; there are nouns like *unicorn* which are ambiguous. Another problem is that we don't need to know every possible individual to use the word.

Nevertheless, the set-based meaning of properties is the most widely assumed. It easily accounts for sentences like *Mary is a woman*. It can also easily be expanded to include rational meanings, which are just sets of pairs/tuples.

$$\textit{mother} = \{(\text{Michelle, Sasha}), (\text{Michelle, Malia}), \ldots\}$$

It is also compatible with *externalism*, the philosophical stance that the notion of truth is determined by the facts which hold in the world.

7.3.2 Propositions, Truth, and Entailment

Sentences express propositions, or claims about the world. Propositions have *truth values*, either true or false. To know the *truth value* of a sentence, you must know its *truth conditions*. If the truth conditions hold of the world, the sentence is true; otherwise, if they do not hold, the sentence is false.

The sense of a sentence is its truth conditions, i.e. the conditions in which it is true. The reference of a sentence is its truth value: *true* or *false*.

As a recap, sentence X entails a sentence Y if whenever X is true, Y must be true as well. Our language ability includes knowledge of entailment relations, and entailment is at the core of the human meaning and reasoning.

If we look at the familiar example of

1. *All dogs bark.*
2. *Sally's dog barks.*

We have that (1) entails (2), but (2) does not entail (1). In other words, the truth conditions of (1) include the truth conditions of (2).

One caveat: entailment is a very strong relation: if X is true, Y **must** be true. For example, (1) does not entail (2) here:

1. *Sally's dog barks.*
2. *Sally's neighbors are annoyed.*

We can think of entailment in terms of truth conditions, but we cannot know if X entails Y just by knowing truth values; only truth conditions. For example,

1. *Barack Obama was the 44th President of the United States.*
2. *China is the most populous country in the world.*

Here, (1) does not entail (2) although both are true; (2) was true before (1) was.

The reference of proper names is assumed to be part of one's knowledge of language, so (1) entails (2) in the following

pair:

1. *Ian has visited Spain.*
2. *Ian has visited Europe.*

7.3.3 Compositionality

What determines truth conditions? Take the following sentence; these sentences have exactly the same three words, but their truth conditions are independent:

1. *The dog likes Sally.*
2. *Sally likes the dog.*

There are two factors in determining sentence meaning:

1. The words in the sentence (lexical semantics)
2. The way the words are put together (the syntax)

   That is, the syntax builds the sentence in a certain way, and depending on that syntactic structure, the meaning is assembled in a way that determines the final truth conditions.

This ties into an axiom for meaning; **The Principle of Compositionality**. The meaning of a sentence (or any other multi-word expression) is a function of the meanings of the words it contains and the way in which these words are syntactically combined.

In other words, a sentence's meaning is composed of its parts and the way they're put together.

Our syntactic knowledge allows us to build an infinite number of sentences. We have a corresponding semantic system which allows us to understand an infinite number of sentences, including those never heard before.

One caveat to the principle of compositionality is with idioms. Some kinds of words and sentences have *non-compositional* meanings. For example,

1. *Polly kicked the bucket.* $\implies$ *Polly died.*
2. *Polly gave Tim a hard time.* $\implies$ *Polly teased Tim.*

Setting the side the case of idioms, we'll now see how we interpret a sentence like *Sandy runs.*

We know that *Sandy* is a reference; it picks out a specific individual. *Runs* is a property; it describes traits which hold of a particular set of individuals. For *Sandy runs* to be true, it must be the case that Sandy is a member of the set of individuals that run.

Formally, we have

$$
\begin{array}{c}
[\![\mathbf{S}]\!] \\
\diagup \diagdown \\
\text{NP} \quad\quad \text{VP} \\
| \quad\quad\quad | \\
[\![\text{Sandy}]\!] \quad [\![\text{runs}]\!] \\
\mathbf{s} \quad\quad \lambda x[x \text{ runs}]
\end{array}
$$
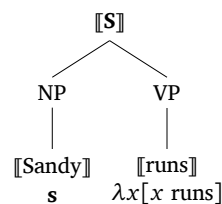
Here, **s** represents the subject *Sandy*, and *runs* is a function that takes in an argument; the lambda is true if and only if x runs.

This can be interpreted as $[\![\mathbf{S}]\!] = \lambda x[x \text{ runs}](\mathbf{s})$, or **s** runs.

To evaluate these truth conditions, we have two scenarios:

Sandy runs is false   *Sandy runs* is true
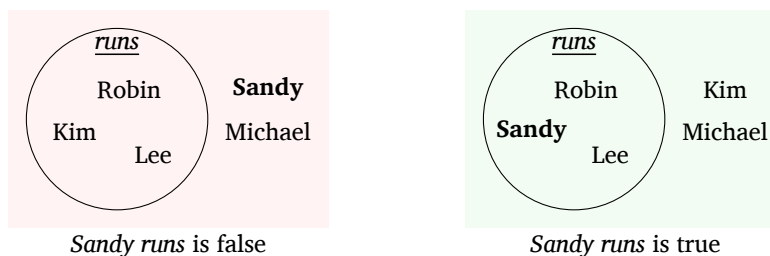
Another kind of compositions we can talk about is when we modify a noun, ex. *green sweaters*:
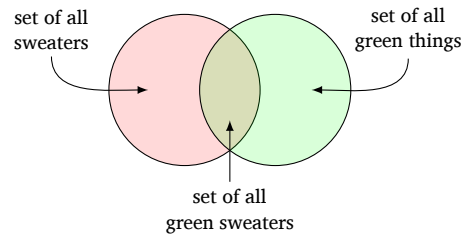
This also captures the entailment relationship correctly:

1. *Green things are dangerous.*
2. *Sweaters are dangerous.*
3. *Green sweaters are dangerous.*

(1) entails (3), and (2) also entails (3).

8   Language Contact

8.1   Language Contact

8.1.1   Contact

In these last few modules, we'll be tackling the notion that language is a social construct that is constantly changing. Here, we'll focus on language contact.

What is language contact? "In language contact situations, two or more distinct languages or dialects come into contact with each other either directly through social interaction of the speakers or indirectly through education or literature." This can also be thought of as studying the language resulting from the social interaction of users of two or more distinct languages or dialects.

Language contact can occur in many different forms based on the social situation. We think of language contact as varying on multiple dimensions, but there are two primary dimensions:

- The intensity of contact between groups

  We can think of this on a continuous scale from low to high intensity.

 Lower intensity contact would be some bi-/multilingualism, and some borrowing of lexical items. For example, Spanish and English at the San Diego-Tijuana border.

  Next, we may have full bi-/multilingualism from all groups, and more extensive lexical borrowing. For example, French and English during the Norman occupation of England in the 11th century.

  The most intense contact situations would be the merger of two or more languages into a single *mixed* language. For example, Michif (endangered now; originated in the 19th century), spoken in the Métis community in Canada, developed through interaction between Cree and French fur trappers.

- Power/prestige asymmetries between groups

  This refers to the extent to which users of one language do or do not need to command the other language.

  Adstratal contact is when there is a roughly equal transfer between the languages. For example, English and Norse speakers in early England.

  Asymmetrical contact involves a *superstratum* language (language of the more dominant group) and a *substratum* language (language of the less dominant group). Typically, the lower power/prestige individuals are forced to learn to use the higher power/prestige language.

  Most of the recent (during the 18-19th centuries) examples of asymmetrical contact involve war, terrorism, enslavement, and genocide. Asymmetrical contact often results in a *forced language shift* and the emergence of *pidgins* and *creole languages* (covered in the next subsection).

  The logical endpoint of forced language shift is *language endangerment* and *dormancy* (sometimes also called death/extinction); (covered in the third subsection).

8.1.2   Borrowing

Borrowing is kind of a silly term if you think about it too hard (try not to think about it too hard).

The extent and direction of borrowing depends on contact intensity and power asymmetry. Users of substratum languages tend to borrow *from* the language they are forced to learn.

Borrowing also occurs at all levels of language structure, from phonemes to syntactic structure—though we'll mostly be talking about phonology, morphology, and syntax (i.e. the structure of the language).

When we think of borrowing, we most often think of *loanwords*—where new works are taken from one language into another. For example, in English, *piazza*, *sushi*, and *kayak*.

Usually, some classes of words are more likely to be borrowed than others. They're unlikely to be "basic vocabulary" (e.g. closed lexical categories like pronouns), and more likely to be groups of words like technical terminology, food and crops, animal names, etc.

One of the neat but also annoying things about English is the extensive effects of contact. Over many centuries of contact, speakers of the English language have experienced many shifts, and waves of loanwords. This extensive borrowing is a major challenge for historical linguists as well. More about this subject will be in the next module with language change.

There are also instances of phonological borrowing as well. For example, /ʒ/ was introduced into English from French through loanwords. There are also instances of adoptions of stress patterns in language, including with English.

The words *azure* /ˈæ.ʒjɚ/ and *vision* /ˈvɪ.ʒən/ were borrowed in the 13-15th century, and the words *croissant* /kɹə.ˈsɑnt/ and *chateau* /ʃæ.ˈtʰoɯ/ were borrowed in the 18-19th century.

Here, notice that the first two words have stresses on the penultimate syllable, while the latter two have stresses on the last syllable. This suggests that time may play a role in how these borrowings occur.

Morphological borrowing also occurs in languages—New morphemes and morphological patterns have been borrowed into English, ex. *alumnus/alumni* and *cactus/cacti*.

Syntactic borrowing (i.e. new syntactic patterns) is less attested to than other forms of borrowing, and sometimes leads to syntactic change.

8.1.3   Societal Multilingualism

Societal multilingualism is when communities share multiple languages or dialects in use in everyday life. Oftentimes, when we talk about multilingualism, we refer to single persons that speak multiple languages or dialects; here, we're talking about whole societies or communities of people who share multiple different languages or dialects—this kind of multilingualism in communities is often structured and expected in some way.

In these scenarios, we usually can observe two things: code-switching and diglossia. Code-switching is when one uses multiple languages or dialects in a single conversational context sometimes within a single sentence. Diglossia is when one uses different languages or dialects for different functions.

Recently, "code switching" has gained a colloquial use to mean the same thing as "diglossia".

In popular opinion, code-switching is often considered to be unintentional, lazy/easy, or random. It is not any of these three things.

There have been lots of studies on code-switching costs, and it's been shown that when multilingual speakers switches between languages, it costs them something cognitively; it requires an additional amount of brainpower and takes more work to do. Hence, it's not lazy or easy.

It's also not random either; what can be code-switched and when code-switching occurs is highly constrained by the syntax of one or both of the languages involved in the switch.

One question that one might have is whether single-word code-switching is the same as a loanword. It's a little complicated, but generally no. Loan words typically lose the linguistic features of the source language, while code-switch words don't; they retain those features of the other language. Code-switching also shows anticipatory phonetic cues—the closer you get to a code-switch in the speech, more phonetic features of the switched language appears.

8.2 Pidgins and Creoles

8.2.1 Pidgins

Pidgins are languages with no native speakers—"contact languages". Pidgins tend to have small vocabularies, and highly analytic (i.e. amount of meaning contained in each word is on the smaller side). Pidgins also tend to have little inflectional morphology.

How do Pidgins and Creoles develop? Oftentimes Pidgins develop as trade languages, where two groups come in close contact through trading, and they have no common language or bilingualism. Creoles are often developed as a result of a forced language shift—when a group of language users is removed from contact with other users of their language, or is otherwise prohibited from using their language.

What are some stages of Pidgin development?

1. **Jargon (prepidgin)**

   Created when two groups are in need of communication between one another. At this stage, there's a lack of consistency, and extensive variation.

2. **Prototypical Pidgins**

   If the language users continue to be in contact with each other, crystallization occurs (the establishment of consistency, i.e. grammar), and becomes a prototypical Pidgin. There is still limited settings for use, with a reduced grammar and vocabulary (compared to non-Pidgin languages), but they do start to have a more consistent grammar.

3. **Extended Pidgins**

   An extended Pidgin is not limited to certain settings, and has a larger vocabulary, and has a larger set of grammatical rules.

   Sometimes crystallization is used a process by which Jargon turns into a prototypical Pidgin, and prototypical Pidgins turn into extended Pidgins. However, it's not clear whether or not extended Pidgins are further crystallized prototypical Pidgins.

Pidgins also have some common features.

In terms of phonology, Pidgins often have reduced consonant clusters. With morphology, there is usually very little inflectional morphology, and no affixes. With syntax, Pidgins tend to be head initial, SVO, with prepositions. In terms of semantics, words in the Pidgin language are often borrowed from the superstratum language, though the lexical items' use and meaning are expanded.

One thing to note is that these are general tendencies and not absolutes; there are many Pidgins that don't have these features as well.

8.2.2 Creoles

Creoles are "full" languages that have developed through *nativization*. Nativization is the adoption of a language or a combination of languages by children as a (new) native language. The distinction here is that Creoles are considered to have native speakers, while Pidgins do not have any native speakers.

Most known creoles were developed in the context of enslavement (ex. Haitian Creole) or language loss (ex. Hawaiian Creole).

Looking at nativization in New World plantations—during slavery, adult speakers of African languages were separated from each other. Children born into slavery often learned the Pidgins in their communities (and possibly also their parents' languages). Children's innate ability to learn language kicks in, and a new native language is formed.

Creoles also tend to have some shared features. If we compare Hawaiian Creole, Haitian Creole, and Srananan, we'd find that tense, mood, and aspect are extremely similar (as in Language Files), despite their different parent languages.

From the DeGraff (2020) article, there's an idea of Creole Exceptionalism. That is, there are two common views of Creole languages; that they are "lesser" or "simplistic" languages, and another view that they are a remarkable "triumph" of humanity.

The problem with exceptionalism in general is that it places a lot of emphasis on the conditions under which Creoles develop Coupled with insidious bias implicitly accepted by an application of "family-tree' model of Darwinian

evolution to language change, it is very easy to think of this as a process of evolution, which then implies that languages that are further from the leaves and closer to the roots, the more simple or basic a language is. This is something that is warned and cautioned against by this reading.

8.3 Language Endangerment and Revitalization

8.3.1 Language Endangerment

There are just over 7000 languages in the world; of these languages about 42% of them are considered endangered based on certain measurement tools. What's even more devastating is that the rate of language extinction appears to be accelerating.

Note that everything we'll be talking about here can also apply to dialects, even though we're talking about languages.

What is a minority language? Some regions have a *hegemonic*[1] dominant language which is necessary to participate socially and economically. A minority language is any other language spoken in such a region.

Because the size of pre-industrialized communities is small and languages are constantly changing, languages tend to continue to diversify. Coupled with smaller communities, this results in less stability.

Some minority languages continue to thrive though. This could be because of a cultural and economic autonomy of language user population, or because of the existence of bilingual education and/or native language education. In some cases, there could be a robust language user population with stable diglossia with the majority language.

Social, political, and economic pressures from confrontation with dominant languages and culture can force speakers to give up their native language.

Access to mainstream economic opportunities can be restricted because of this. There is also commonly ridicule, overt discrimination, and prejudice for being different (e.g. being forbidden by law or regulation to speak one's own language). There's also a lack of instruction in their native language (with the schools forcing the majority language on minority language using children).

All of this leads to a limited "scope" for using the language (what can be referred to as its "domains of usage").

An interesting study finds that immigrants prefer their native language throughout their lifetime, and first generation children are bilingual in their dominant language. The second generation immigrants have limited vocabulary and context of use, and third generation immigrants are monolingual in the dominant language.

What this means is that language maintenance relies on full transmission to children in order to keep the language from becoming extinct or dying out.

What is language death? The death of a language is taken to occur when it no longer has any speakers actively using it.

What is lost when a language is extinct? We lose the unique combination of linguistic structures of the language. We also lose a central component of a unique human culture/ethnicity—for many of us, our language is part of who we are, losing this language is essentially a loss of a heritage of ethnic identity. Because of this, we're not only losing a language; we're also losing a record of a unique path of linguistic and cultural innovation for thousands of years.

How are languages lost?

- **Ethnocide through assimilation**: Australian "Stolen Generation" (1900s–1960s)

  Aboriginal Protection Act (1869) authorized the forcible removal of children from Aboriginal parents for neglect. The rationale here was that Aboriginal parents often weren't able to provide the same level of care as white parents could (which is inherently racist).

  In 1915, an amendment was made (Aborigines Protection Amending Act) authorized the removal *without proof of neglect*.

  Children taken in this context were "resocialized", typically including forced name changes. The children also lose the opportunity to learn the Aboriginal language of the parents. Records of the child's parentage were typically not kept either. What this means is that the vast majority of members of this "stolen generation" has effectively no ability to recover their heritage.

- **Ethnocide through education** (19th century USA)

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[1] (adj.) ruling or dominant in a political or social context.

Captain Richard H. Pratt on the Education of Native Americans: "Kill the Indian in him, and save the man."

This is effectively saying that Indians have no humanity in them, so they should remove the Indian within them. This kind of thinking resulted in the establishment of Californian Missions and forced education. In these missions, there was forced labor and torture as punishments for speaking their native language.

The idea was to teach these natives the western languages and European customs—to assimilate them into European colonial society, by changing their appearance, giving them new names, and were shamed and ridiculed for speaking their native language.

There's a remarkable diversity of languages in California's history (more than 80 languages in 20 distinct families). Today, all of these languages are dormant or extinct or have small numbers of elderly speakers. This was the consequence of missions, schools, genocide/ethnic cleansing.

If we look at the Bay Area in particular, Chochenyo was the language spoken on the grounds UC Berkeley was built on, and there is currently ongoing revitalization work of this language.

8.3.2 Documentation and Revitalization

By documenting and describing languages, linguists can create a record of a language that can be studied by future generations. In order for such a record to be valuable for revitalization efforts, we need a systemic record of language being used in all possible contexts, all given equal weight. As linguists, we'd also like to record and analyze all levels of linguistic structure that we can identify. There also needs to be sufficient volume and quality for somebody to turn to and study.

Revitalization is about re-energizing and language. This involves providing educational opportunities and social incentives to slow and prevent language loss, and maintaining native speaker children.

Reclamation or revival involves the learning of a dormant or extinct language by adult speakers who then transmit to a new generation. Modern Hebrew is an example of a successful reclamation.

How might we revitalize a language?

- **Education**:

  Often a curriculum is developed for students in elementary school or later to begin learning the language. This could be in the form of a full immersion school, where students only speak the native language. There are also summer programs where fluent older and younger speakers are able to interact. This provides social opportunities to use the language.

- **Language 'nests'**:

  Elders will expose babies and toddlers to the native language by being part of their social community and family. This has to take place in a monolingual early childhood environment, where the children haven't fully established another language.

Let's look at an example. Hawaiian is an Austronesian language native to Hawai'i.

In 1778, James Cook arrived, which led to the arrival of American immigrants, and workers from China, Japan, Phillippines. Because of all of this contact, there were displacement and disease which led to the rapid reduction in the native Hawaiian population.

By the end of the 19th century, English became the legal language of Hawai'i; students were banned from speaking Hawaiian in school. By the mid 20th century, only 2000 Hawaiian speakers were remaining.

Right around the same time, the Hawaiian dictionary was commissioned in recognition of the importance of the language. Because of this, in the 1970s revitalization efforts increased, including recording and broadcasting interviews with elder Hawaiian speakers. In the 1980s, there was the establishment of the first Hawaiian immersion classes, and today there are many language nests and immersion K-12 schools, and the number of speakers is growing.

Let's look at another example, of Chochenyo, an Ohlone language native to the Bay Area. The language was dormant in the early 20th century, and Ohlone activist Vincent Medina used field notes on the language from Harrington to teach himself Chochenyo, and spearheaded ongoing revitalization efforts. Because of his efforts, in 2009 the Ethnologue reclassified Northern Ohlone from Dormant to Reawakening.

9 Language Change

9.1 Historical Linguistics

9.1.1 Historical Linguistics

One of the key facts about languages that we introduced at the beginning of the course is that all languages change. But what does it really mean for a language to change? We can think of a language as a whole to gradually change from one state to another. Another way to think about it is in terms of the language speakers, where each generation has its own variation, but there's a general shift toward a certain direction.

However, we're going to represent language change in terms of discrete chunks of time, where there is a distinct change from one version to another of the language.

The Language Files textbook gives an example of the transition of English from Old English (ca. 1100) to Middle English (ca. 1400) to Early Modern English (ca. 1611) to Contemporary English (ca. 1994). Analyzing the text, we can see that there is language change on all levels that we've studied so far; lexically, phonologically, morphologically, semantically, etc.

Synchronic and diachronic linguistics   *Synchronic* Linguistics is the study of the structure and use of a language at a given time (usually, the present). (This is everything we've been doing until now in the course!)

Diachronic Linguistics is the study of the structure and use of a language across time.

What do historical linguists do? They ask how a given language or group of languages has changed—some historical linguists specialize in particular language or language families. Some reconstruct ancient languages (we'll try some of this). Some also ask what kinds of changes occur, or what factors precipitate change.

Factors of language change   Why do languages change at all? Because of variation; every individual's language is distinct. With enough variation, some of these variants can spread across a population. How do we get these variations? Through innovation—with new words, new phonemes, new syntactic structures, etc.

Language *diversification* occurs when languages change after geographical (or social) separation. Because of this separation, the variation and innovation happens separately in these groups. We can't predict with high certainty how these languages will change, but these two groups will continue to develop and change their versions of the language.

Language contact (which we talked about in the previous module) can result in mixed languages, Pidgins, and Creoles, and can also lead to language loss.

Language similarities   Why might two languages share similarities? This could be due to similarities between humans with respect to anatomy and cognition, and could also be due to iconicity of certain sounds or words or language features. Languages may also share similarities because of language contact. Sometimes, it's just pure coincidence.

If its none of these, the two languages might actually be related; that is, at some point, these two languages were the same language.

Models of relation   The first model that we introduced was a family-tree style model. This model captures "genetic" relationships very well; we use "mother/parent", "daughter", and "sister" to describe these kinds of relations.

However, this kind of model fails to capture the fact that sometimes language split off but still have contact with each other. The wave diagram captures relationships that are not strictly "genetic".

Neither of these models really capture what is really going on with the different languages in the world, but we have to start somewhere.

9.1.2 Sound Change

One of the major tools we have in historical linguistics is reconstruction. That is, positing what a parent language looked like. One of the main ways we reconstruct languages is to look at the different patterns or sounds of a language.

There are a few things to notice here with sound change.

Phonetic changes only affect the pronunciation, i.e. the underlying representation. For example, the English /ɹ/ was once /r/ (it's part of the reason why we use the latter character in English). Another example is in many varieties of English, /u/ is in the process of *fronting* (pronounced closer to [ʉ] or even [y]). If this were to continue, we may eventually consider this sound change as complete.

In additional to phonetic changes, there are phonological changes—sound changes that affect the structure of the phonology. This could be the addition or removal or a phoneme; for example, through borrowings English gained the phoneme /ʒ/. Another phonological change is a change in allophone distribution; for example, the distribution of voiced/voiceless/aspirated stops in English.

It's important to note that phonetic variation is not the same as sound change. Synchronic phonetic and phonological variation exists and is a normal part of language use; this can lead to sound change though when a variant is adopted more widely—a process called *spreading*.

Spreading is a gradual process, and typically spreads from one social group to a wider audience. Sound change is also regular—it typically spreads throughout the entire lexicon in all contexts (i.e. there are few exceptions).

The /u/-fronting we mentioned before is synchronic phonetic variation, but is not a sound change because we don't believe that it is spreading. If it was though, we may classify this as "a sound change in progress".

One thing that is nice is that sound change notation is extremely similar to phonological rule notation:

$$\text{*A} > \text{B} \text{ / conditioning environment}$$

The conditioning environment is only present if it describes a phonological change though—in other circumstances, it does not appear. The asterisk tells us that A is a reconstructed proto-sound (i.e. a proposed sound in the reconstructed language). Another change is that there are no // or [] to indicate phonemes or phones—this is because we don't want to commit to saying that certain sounds are phonemes or phones, and also because we're typically talking about phonemes.

When we do reconstruction, there are two major assumptions that we make, often in order to decide between two options.

- Sound change is regular.

  If proposing a change from a protosound $*\alpha$ to sound β in a given daughter language, all or nearly all $*\alpha$ must be expected to change to β.

  That is, there should be as few exceptions as possible.

- Natural sound changes are most common.

  All else being equal, reconstruct the protosound that results in the more natural change. Here, we're talking about "naturalness" with respect to phonetics and phonology.

9.2   The Comparative Method

9.2.1   Reconstruction

There are two kinds of reconstruction, though we'll mainly focus on the second.

- *Internal reconstruction* uses evidence from a simple language to make inferences about that language's history.

  For example, the ⟨g⟩ in English words *sign* and *deign* are not pronounced, but the alternations *sign* ∼ *signal* and *deign* ∼ *dignity* demonstrate that in some previous English, they probably were!

- *Comparative reconstruction* uses evidence from multiple languages to make inferences about those languages' common ancestor language (protolanguage).

The comparative method consists of a few steps:

1. Assemble a set of *cognates* from sister languages, eliminating borrowings.

   Cognates are words with similar forms and meanings.

2. Identify *correspondence sets*.

   These are sets of sounds across the sister languages that appear to correspond with one another.

3. Reconstruct the *proto-sound* in each correspondence set.

A proto-sound is a proposed sound in the common ancestor language that the sounds in correspondence set "descended" from.

4. Reconstruct the *protoform* of each cognate (when asked)

The protoform is a proposed phonological form of the word in the protolanguage that each cognate "descended" from.

9.2.2 Naturalness

Let's look at an example of reconstruction.

We'll be looking at the Zaparoan family of languages: Andoa, Arabela, Iquito, Záparo. The set of cognates is shown below:

meaning	Andoa	Arabela	Iquito	Zápro
EAT	at<u>s</u>a	<u>s</u>a	a<u>s</u>a	at<u>s</u>a
TRUMPETER	mat<u>s</u>a	ma<u>s</u>a	maa<u>s</u>a	mat<u>s</u>a
GRANDFATHER	iyat<u>s</u>ao	hiya<u>s</u>o	iya<u>s</u>úuha	yat<u>s</u>awha

Here, we have three cognates; one meaning EAT, one meaning TRUMPETER, and one meaning GRANDFATHER.

In this example, the correspondence set that we want to look at is

<p align="center">ts:s:s:ts</p>

We write this in the order of languages, separating the sounds with colons. This is a correspondence set, because in each of the cognates, the same language has the same form (i.e. along columns). Ideally, correspondence sets should have many examples in the data and be regular.

Now, we'll reconstruct the proto-sound (or protoform) in each correspondence set. We often start with two proposals, saying that one of the forms that exist synchronically in the daughter languages:

*ts > s in Arabela and Iquito   *s > ts in Anoda and Záparo

The former is a deletion process, and the latter is a t-insertion process.

To determine which is correct, we turn to the notion of naturalness. Lenition/"weakening" is more common/natural than fortition/"strengthening". That is, it takes more work to add a letter than to remove a letter. There is also no articulatory process that we can see here that could lead to the insertion of a t.

Some examples of natural sound changes are:

- *Voiceless sounds become voiced between vowels and before voiced consonants.
- **Stops become fricatives between vowels.
- *Consonants become palatalized before non-low front vowels.
- Consonants become voiceless at the ends of words.
- **Difficult consonant clusters are simplified.
- Difficult consonants are made easier (for example, voiced aspirated stops might become plain voiced stops).
- *Oral vowels become nasalized before nasals.
- Fricatives other than [h] become [h], and (voiceless) stops other than [ʔ] become [ʔ].
- **[h] deletes between vowels.
- Clusters of vowels are broken up by consonants.

Notice that the examples marked with (*) are examples of assimilation/coarticulation; that is, when we produce speech, the movements bleed into one another. Similarly, the examples marked with (**) are examples of weakening or lenition.

These are really similar to the types of phonological processes in module 3.3.

9.2.3 Protoforms, Ordering, and Subgrouping

Sometimes though, we don't even need to involve naturalness.

Common sounds If all of the daughter languages share a common sound, there's no need to propose a distinct proto-sound.

If we look at Proto-Peninsular Spanish, we have

Castillian	Andalusian	Gloss	Protoform
[majo]	[majo]	'May'	*majo
[kaʎe]	[kaje]	'street'	*ka_e
[poʎo]	[pojo]	'chicken'	*po_o
[pojo]	[pojo]	'stone bench'	*pojo
[dos]	[dos]	'two'	*dos
[dieθ]	[dies]	'ten'	*die_
[θiŋko]	[siŋko]	'five'	*_iŋko
[si]	[si]	'yes'	*si
[kasa]	[kasa]	'house'	*kasa
[kaθa]	[kasa]	'a hunt'	*ka_a
[θiβiliθaθion]	[siβilisasion]	'civilization'	*_iβili_a_ion

In the first four rows, we have two correspondence sets; j:j and ʎ:j. In the remaining rows, we have two correspondence sets; s:s and θ:s.

The first in each group trivially gives us *j as the protosound, and the second has a conflict.

It is far more likely that two protosounds *j and *ʎ *merged* to j in Andalusian than a single protosound *j split, apparently arbitrarily in some words in Castilian. The same scenario appears for θ:s.

Hence, we propose that *ʎ > j and *θ > s in Andalusian.

Rule Ordering Suppose we're given the following cognates:

meaning	Andoa	Arabela	Iquito	Záparo
HOUSE	itʲa	tʲa	ita	itʲa
PLANT (v.)	nata	nata	nata	nata
TOOTH	ikʲa	kʲa	ika	ikʲa
SLEEP (v.)	makɨ	makɨ	makɨ	
FOOT	inʲawaka	nʲoaka	inuwa	inʲawkʷa
SNAKE	atsakono	sokonu	kuni	kawnu
BRUGMANSIA SP.	iʃawna	ʃona	isúuna	iʃawna
CHEW	sakɨ	sakɨ	sakɨ	sakɨ

Also suppose we've found the following four rules:

- Palatalization: *C > Cʲ / i_ in all but Iquito
- Coalescence: *V + G > V: in Arabela and Iquito
- Loss of vowel length: V: > V in all but Iquito
- Apharesis: V > ∅ / #_ in Arabela

Note here that palatalization and apharesis are conditioned changes.

Let's take these four rules and see what happens with *iswana when we apply the rules in the order we gave them:

*iswana	Andoa	Arabela	Iquito	Zaparo
palatalization	iʃawna	iʃawna	isawna	iʃawna
coalescence	iʃawna	iʃoona	isuuna	iʃawna
shortening	iʃawna	iʃona	isuuna	iʃawna
apharesis	iʃawna	ʃona	isuuna	iʃawna

This gives the forms that appeared in the earlier cognate table, so this is a plausible ordering of the rules. What would happen if we put palatalization last?
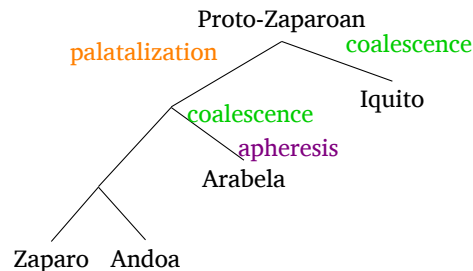
*iswana	Andoa	Arabela	Iquito	Zaparo
coalescence	isawna	isoona	isuuna	isawna
shortening	isawna	isona	isuuna	isawna
apharesis	isawna	sona	isuuna	isawna
palatalization	iʃawna	sona	isuuna	iʃawna

Arabela does not have sona, so this is not a valid ordering of the rules; the [i] necessary for palatalization in Arabela got deleted in the previous step of apharesis, which is why the final form is incorrect.

This is very similar to rule ordering in phonology, but instead of thinking about these rules synchronically, we're thinking about them diachronically, over time.

With this, we can think about two types of changes. A *shared innovation* is a change that occurred once (presumably before the languages split off and diversified). A *parallel development* is a change that developed independently in multiple branches or daughters.

One proposed subgrouping is

```
                       Proto-Zaparoan
        palatalization                coalescence
                                            Iquito
                  coalescence
                      apheresis
                  Arabela

        Zaparo    Andoa
```

With this subgrouping, palatalization would be a shared innovation (as all Zaparo, Andoa, and Arabela has it), and coalescence would be a parallel development (as Iquito and Arabela must have independently developed coalescence).

9.3 Morphological, Syntactic, and Semantic Changes

9.3.1 Morphological Changes

Like sound change, synchronic morphological variation is the seed of morphological change. However, unlike sound change, morphological change often isn't fully regular. That is, sometimes certain groups of words will be affected, but not others.

Morphological changes can occur as changes to the structure of a word, or as neologisms—the addition of new words.

One of the ways that morphological change happens is through *analogic changes*. An *analogy* is the influence of one form or group of forms over another.

Of these analogic changes, we'll split them into two groups.

Regularizing changes   The most prototypical kind of analogy is a proportional analogy, i.e. A:B :: C:X, for example, *kick:kicked :: light:lighted*.

Another kind of regularizing analogic change is *paradigm leveling*. A *paradigm* is a set of inflectionally related words. This "levels out" irregularities within a paradigm. For example, in early Latin:

Case	Original	Conditioned sound change	Paradigm leveling
Nominative	*honos*	*honos*	*honor*
Genitive	*honos-is*	*honor-is*	*honor-is*
Accusative	*honos-em*	*honor-em*	*honor-em*

Here, the paradigm leveling removed the irregularity in the nominative case. We know this isn't a sound change because it only happened to the one word.

Reanalyzing changes   *Backformation* is an analogy that results in the creation of a new *root* or *stem*. For example, the word *commentate* (∼1800) from *commentator* (1300s), and *escalate* from *escalator* (in the 1900s).

Folk-etymology is where obscure morphemes are reanalyzed as more common morphemes. For example, *crayfish* from *creveis* (originated in Anglo-French). Here, the "*veis*" sounds kind of like "*fish*", which is where the change comes from. Similarly, *muskrat* from *musquash* (originated in Massachusett).

9.3.2   Syntactic and semantic changes

Like morphological change, syntactic change is also more likely to retain exceptions than sound change. Some examples of syntactic change include changes in word order (ex. SVO, pre- vs. postpositions), or changes in co-occurrence requirements (ex. case, agreement).

Semantic changes perhaps has the most exceptions of them all—its scope, in general, is very small. Semantic changes usually fall into one of four groups.

Extensions and reductions are an increase or decrease in the set of referents of a word. Metaphorical extensions is where metaphoric relationships lead to non-literal extensions. One example of a metaphorical extension is the use of *ship* to be used in the context of space exploration, as the ocean and the space are similar metaphorically, with exploration.

Elevations and degradations are where words take on loftier (elevation) or baser (degradation) meanings. An example of this is the Middle English word *wenche* changed meaning from "female child" → "female servant" → "lewd woman"

One of the interesting things about semantic changes is the interactions that occur—semantic changes in one word often accompany changes in another word. A classic example of this is where the Old English *hund* "dog (in general)" became the Modern English *hound* "a particular kind of dog" (i.e. a reduction). In parallel, the Old English *docga* "a particular kind of dog" became the Modern English *dog* "dog (in general)" (i.e. an extension).

10   Sociolinguistics

10.1   Language Variation

10.1.1   Language Variation

There's a lot of new terminology we need to establish first. Individual speakers/signers have *idiolects*. Groups of features that individuals share are *language varieties*. (Here, "variety" is deliberately vague.)

Dialects are systematic lexical, morphological, and syntactic differences between varieties. *Accents* are systematic phonological and phonetic differences between varieties. One thing to note is that lexical/morphological/syntactic differences are often accompanied by phonological/phonetic differences, so dialects and accents often come together.

Languages vs. Dialects   It's quite tricky sometimes to distinguish between languages and dialects. One criterion is that dialects of a single language are *mutually intelligible*. That is, two monolingual speakers of different dialects can communicate easily with each other. For instance, Appalachian English and GAE are different dialects of English; they're mutually intelligible for the most part.

However, it's not always this simple—for example, with dialect continuums. It could be the case that the pairs $A \leftrightarrow B \leftrightarrow C \leftrightarrow D$ are mutually intelligible, but A and D are not. As per our earlier definition, A, B, C, D are all dialects of a language, but A and D aren't.

This is further complicated by heritage and culture. Mandarin and Cantonese are considered dialects, even though the two are very distinct in phonology, morphology, syntax, etc.; they share the same orthography and the people in power want them to be considered dialects. On the other hand, Bosnian, Croatian, Montenegrin, and Serbian are considered distinct languages, because of politics, culture, and history.

This is one of the important reasons why "variety" is left quite vague.

Style shifting   A *speech* or *language style* is a systematic variation dependent on topic, setting, etc. This is more narrow than a *dialect*. Styles that differ in terms of "formality" are often called *registers*.

Style shifting is an automatic ability of individuals to change their style as needed.

Standard and Prestige   *Standard variety* is a variety commonly used by people with power or authority (GAE, General American English, could be considered a standard variety of English spoken in the USA). Once again, it's important to recognize that no variety is linguistically "better" or "more logical" than another.

Prestige is the degree of power held by speakers of a variety. In general, we can divide prestige into *overt prestige* (standard) and *covert prestige* (where users of "non-standard" varieties have higher standing than those who use the wider "standard" variety)

10.1.2   Linguistic Variation

In what ways do language varieties vary?

The first thing that comes to mind is perhaps lexical variation—variation in the vocabulary of a variety. For example, "What is the bubbly carbonated drink called?" This could be *soda, pop, coke, ...*

We can use these kind of questions to draw a dialect map—in fact, Vaux and Golder conducted a dialect survey in the USA with similar kinds of questions.

Phonetic variation involves differences in the realization of a given phoneme. For example, many Scottish English speakers use [r] instead of [ɹ].

Phonological variation involves differences in the phonological structure or rules. For example, many English speakers in New England do not produce the [ɹ] in V_# or V_C positions. Also, many English speakers do not distinguish the vowels in *caught* and *cot* (the *caught-cot* merger).

In general, phonetic variation is unconditioned, while phonological variation is conditioned.

Morphological variation involves differences in morphemes, their application, and their regularity. For example, the differences in pronouns in standard and nonstandard varieties of English (ex. "He likes himself" vs "He likes hisself").

Syntactic variation involves differences in categories of words, syntactic properties of words and structures, or phase structure rules.

10.1.3   Apparent Time

The idea of apparent time is used to try to understand the connections between variation and change—changes are often seeded by some variation in language varieties.

How do we study this connection? One way is to use synchronic age-graded data to study a suspected *change in progress*. For example, one study gathered age-graded data from a bunch of speakers, and found that older central Canadians are more likely to produce different sounds for *which* [ʍ] and *witch* [w], while younger central Canadians are more likely to produce both with [w]. The different ages effectively represents time, and the conclusion is that English speakers in central Canada recently lost the [w]~[ʍ] distinction.

One critical assumption here is that people don't change their language use over time (or at least, not very much)—this assumption allows us to extrapolate to find conclusions about how a language is currently changing.

10.2   Sociolinguistic Factors

So far in this module, we've been talking about sociolinguistic variables, which are linguistic features that may be different; they distinguish a language from other varieties. Now, we'll be talking about sociolinguistic factors, which are the social categories and factors along which the variables may differ.

10.2.1   Regional Variation

In this section, we'll walk through regional variation in different parts of the United States, just to give you a taste of how different varieties of English may be, purely based on where you live.

Figure 10.1: Approximate major dialect regions of the United States (from Language Files)

Dialectologists examine *isogloss bundles* to help define the boundaries between regional variants, through surveys, etc. Also note that there are many different ways to draw these lines and define dialect regions; we'll be using the one above.

Further, keep in mind that there are many other notable features of the specified regions not mentioned here!

- **The North**:

  Perhaps the most salient feature of the North is the Northern Cities Vowel Shift[2]. Most notable is the raising of /æ/, and a lot of other shifts follow along with it.

- **New England**:

  In New England, most speakers exhibit the *caught-cot* merger: /ɑ/ and /ɔ/ are pronounced the same (like in many other regions). There's a ton of variations of English in New England as well.

  Additionally, many speakers have a non-rhotic accent: /ɹ/ → ∅ / V_C, V_#

- **The South**:

  Many speakers exhibit the *pin-pen* merger: /ɪ/ and /ɛ/ are pronounced the same before /n/. Another (syntactic) feature is the dative presentative: phrases like "Here's you" are present in the south.

- **Appalachia**:

  The Appalachia is a very small area, presumably due to the geographical isolation (i.e. the mountains).

  Speakers exhibit *a*-prefixing, ex. "I know he was *a-tellin*' the truth, but I was *a-comin*' home." Additionally, *for to* infinitives are also grammatical.

- **The Midland**:

  Speakers in the midland have l-vocalization: /l/ → [ɔ,ʊ,ʌ] / V_C, V_#. For example, the word *milk* turns from [mɪlk] to something like [mɪʌk].

- **The West**:

  The west is a very wide area, possibly due to the fact that it was settled by English speakers later than other regions.

  There are various different vowel shifts that occur in the west, ex. /u/-fronting, Pacific Northwest æ-raising, and the California Vowel Shift.

10.2.2 Social Variation

We'll now talk about some other sources of variation that are not necessarily regional.

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[2]For more information: `https://www.youtube.com/watch?v=7Xppob-ilgA`

One such example is socioeconomic variation. In 1972, Labov did a study on the NYC social stratification of rhoticity. In the study, he showed that speakers of lower social status produce less [ɹ] and those of higher social status produce more [ɹ]. In addition to the factor of socioeconomic status, the results showed that those in the middle and lower socioeconomic groups shift into a "careful" speech style that produces significantly more [ɹ] than in a casual setting.

Stuart-Smith et al. did a similar study in 2014 on Scottish English. They found that working class speakers also tended to have less [r], and middle class speakers had more [r]. However, note that there's nothing really inherent about [r] and prestige (in RP English, the opposite happens).

Researchers often find differences in the language use of (self-reported) female and male language users. There is no inherent reason why this occurs; it's culture specific. In Western societies, young women are found to be "innovators" of these changes that are then adopted by the rest of society. However, young women are also found to be more likely to use a prestige variety compared to young men.

Our contemporary understanding of gender is that of a performative act; we make choices in "doing gender", choosing how to present ourselves.

Research on trans speech is historically focused on traditionally masculine vs. feminine characteristics, effects of HRT, presuming a goal of vocal modification. With this perspective, there are changes to the range of pitch that is possible, and the acoustics of vocal tract size and shape due to hormone changes.

However, more contemporary research focuses on all linguistic characteristics various queer communities use to build *communities of practice*. That is, these studies are about the parts of the vocal range that people *choose* to use.

There are many regional variations, occurring as a result of contact; other variation is due to a shared "engagement" or identity. A *community of practice* is the latter; it's an aggregate of people who come together around mutual engagement in an endeavor. Individuals can belong to many and overlapping communities of practice.

Ethnic variation often involves both. For example, with Chicano English, there are syntactic and phonological features resulting from close contact and bilingualism with Mexican Spanish. At the same time though, there are plenty of monolingual English speakers who command a variety of Chicano English too.

10.3 Language, Identity, and Discrimination

We talked a little bit previously about how language is a part of our identity—how language can influence and shape our identity. A critical piece to this is that language isn't inherent to your identity, nor is it the only thing that can signal your identity to others. However, it is certainly *part* of what we use to identify ourselves and other people.

One example of this is that in some varieties of AAVE, /aɪ/ monophthongizes to /aː/, and speakers that have command over AAVE and another variety of English are able to style-shift between the two versions. A famous study used data from Oprah and her talk show, and they found that if Oprah's guest was African American, she used the monophthong more frequently.

John Baugh did a study on household appointments, using AAVE and ChE (Chicano English) varieties of English, and found that he got much fewer callbacks in areas with smaller representation of the respective race. Further, if he used GAE, the callback percentage stayed approximately constant, even in areas that are predominantly white. This is an example of linguistic profiling—landlords are (illegally) screening people based on the way they "sound".

Who is at risk of being misunderstood? Primarily, second language learners and "non-standard" variety speakers, especially in official settings. For second language learners, one of the solutions that is employed is to hire interpreters. For "non-standard" variety speakers, one solution is to assume that everybody commands a standard variety.

10.3.1 Language in the Courtroom

We'll be looking at some examples of previously discussed topics in the courtroom. Why? This is the place where misunderstandings can potentially have the most impact.

We talked a little bit before on some findings from Rickford and King (2016), where the phrase "mi drap a groun" (I fell to the ground) got mistranslated to "I drop the gun".

Another example is with Aboriginal English and its lexical differences. Specifically, the word *half* in Aboriginal English means "small part", and when speaking of a "half moon", they were specifically referring to a crescent moon, but got misunderstood, and distorted the court's understanding of the timeline. Another example of this an individual

says "properly my father" and got misunderstood as "probably my father"; in the former, "properly" is needed to disambiguate due to potential ambiguity because of Aboriginal English familial terms.

In the US Judicial Policy, "A judge must appoint interpreters in judicial proceedings in the United States, if the judge determines that a party or witness speaks only or primarily **a language other then English**...". This last phrase allows for misunderstandings like previously mentioned to occur.

More recently, in the Chauvin trial for the Floyd murder, there was a question about whether Floyd said "I ate too many drugs" vs "I ain't do any drugs". Analyzing the phonetics, we can compare *ain't* /eɪnt/ to *ate* /eɪt/; in fast speech, these could surface as [ẽʔ] and [eʔ], which sound similar—which makes this misunderstanding plausible.

What can we take away from all of this? The importance and value of having people present who understand and can correctly interpret what speakers are saying, whether the speakers are speaking a standard or non-standard variety of a language.

Jones and Kalbfield in 2017 presented pilot data, and found that AAVE speakers were 100% accurate in interpreting 32 AAVE sentences, whereas non-AAVE speakers were only 45% accurate. This goes to show that an individual's experience with a particular variety is really important in their ability to understand what people are saying.

10.3.2   Rachel Jeantel

On February 26, 2012, Trayvon Martin was shot and killed by George Zimmerman. Trayvon Martin was walking home, unarmed, and George Zimmerman followed him (with a gun). Ultimately, Zimmerman was acquitted due to lack of evidence; Zimmerman claimed self-defense, there was no eye-witnesses, and one "ear-witness" who was on the phone with Martin—Rachel Jeantel. The bulk of the Rickford and King (2016) paper was about Rachel Jeantel's testimony.

Part of the picture here is Rachel Jeantel's AAVE variables; syntactic, morphosyntactic, phonetic, phonological variables, and her lexical choices. We'll go through some of these here (not all of them, as there are tons).

Some notable syntactic variables include the stressed *bin* as a remote phase marker, and the invariant habitual *be*:

- "I **bin** knew I was the last person to talk to Trayvon." ('had known for a long time')
- "That's where his headset **be** at" ('where his headset was always at')

Some morphological and phonological variables include the absence of the third singular present *-s* ('It make him hungry.'), possessive *-s* ('His daddy fiancée house'), and the plural *-s* ('A couple second later').

As a result of this, Rachel Jeantel was treated as if she did not natively speak English, and the lawyers talked down on her, asking her to slow down, talking slower to her, etc.

There's a long history of non-standard dialects being associated with "unsavory" characteristics, and a sense of "low intelligibility, low credibility"—people tend to believe and take the side of those who sound like them, and those that they can understand well.

What can we do about this? We can continue to work on documenting and describing non-prestigious varieties, and we can continue to educate the public. We can also advocate for the presence of interpreters and language experts in the courtroom.

An important thing for all of us to do is just to listen, and respond with empathy.

11 Appendix: IPA

CONSONANTS (PULMONIC)

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

Symbols to the right in a cell are voiced, to the left are voiceless. Shaded areas denote articulations judged impossible.

CONSONANTS (NON-PULMONIC)

Clicks		Voiced implosives		Ejectives	
ʘ	Bilabial	ɓ	Bilabial	ʼ	Examples:
ǀ	Dental	ɗ	Dental/alveolar	pʼ	Bilabial
ǃ	(Post)alveolar	ʄ	Palatal	tʼ	Dental alveolar
ǂ	Palatoalveolar	ɠ	Velar	kʼ	Velar
ǁ	Alveolar lateral	ʛ	Uvular	sʼ	Alveolar fricative

OTHER SYMBOLS

ʍ	Voiceless labial-velar fricative
w	Voiced labial-velar approximant
ɥ	Voiced labial-palatal approximant
ʜ	Voiceless epiglottal fricative
ʢ	Voiced epiglottal fricative
ʡ	Epiglottal plosive

ɕ ʑ	Alveolo-palatal fricatives
ɺ	Voiced alveolar lateral flap
ɧ	Simultaneous ʃ and x

Affricates and double articulations can be represented by two symbols joined by a tie bar if necessary.

$$\widehat{ts} \quad \widehat{kp}$$

DIACRITICS Some diacritics may be placed above a symbol with a descender, e.g. ŋ̊

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

SUPRASEGMENTALS

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

TONES AND WORD ACCENTS

LEVEL			CONTOUR		
◌̋ or ˥	Extra high		◌̌ or ˩˥	Rising	
◌́	˦	High	◌̂	˥˩	Falling
◌̄	˧	Mid	◌᷄	˧˥	High rising
◌̀	˨	Low	◌᷅	˩˧	Low rising
◌̏	˩	Extra low	◌᷈	˧˩˧	Rising falling
↓	Downstep		↗	Global rise	
↑	Upstep		↘	Global fall	

VOWELS (IPA)
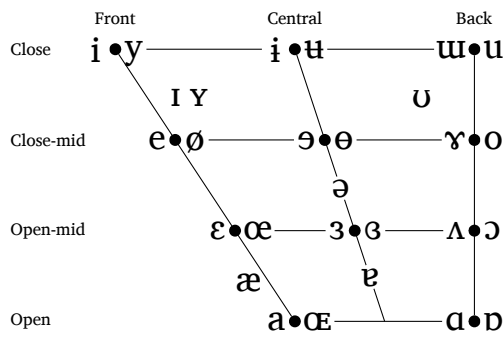
Where symbols appear in pairs, the one
to the right represents a rounded vowel.

GAE VOWELS

GAE DIPHTHONGS