

**Sophia Malamud**

**Intro to Linguistics**

### **Lectures on Phonetics**

Last time: differences between pidgins (like LSN) and creoles (like ISN), Broca's aphasia.

Basic similarity: lack of a rule system for putting together discrete units of speech into meaningful sentences.

Pidgin: "sentence structure" does not tell us who did what to whom:

LSN: "Mary pushed John" could also mean "John pushed Mary".

ISN: "Mary pushed John" differs from "John pushed Mary" in the way the verb "push" is signed.

Broca's aphasia patient recounting Cinderella:

keywords.

A few short two- and three-word "sentences" in the correct English order, but missing most of the "grammatical" words: articles (a, the), prepositions (at, of, on, in, etc.), subject pronouns (they in they married).

Language is a creative combinatorial system, combining discrete pieces into new combinations. The set of rules for combining these discrete pieces is called a grammar.

So, in a very important sense, a pidgin is not a language – since it lacks a grammar for putting together words into meaningful sentences.

### **Grammar units: how languages are put together**

**Sound structure** of human language - two fields that are dedicated to its study:

- **phonetics**: the **physical manifestation** of language in sound waves; how these sounds are articulated and perceived.  
**This subfield examines the pieces of speech sound.**
- **phonology**: the **mental representation** of sounds as part of a symbolic cognitive system; how abstract sound categories are manipulated in the processing of language  
**This subfield examines the rules for putting the pieces of sound together**

The sound structure of language encompasses quite a lot of **topics**, including

- the anatomy, physiology, and acoustics of the human vocal tract;
- the nomenclature for the vocal articulations and sounds used in speech, as represented by the International Phonetic Alphabet;

- hypotheses about the nature of phonological features and their organization into segments, syllables and words;
- the often-extreme changes in the sound of morphemes in different contexts;
- the way that knowledge of language sound structure unfolds as children learn to speak;
- the variation in sound structure across dialects and across time.

Goal 1: to **put language sound structure in context**.

Why do human languages have a sound structure about which we need to say anything more than that vocal communication is based on noises made with the eating and breathing apparatus?

What are the apparent "design requirements" for this system, and how are they fulfilled?

Goal 2: to give you a concrete sense of **what the sound systems of languages are like**.

## **Phonetics: the sounds of language**

### **Speech perception: units of sound and their coarticulation.**

Characteristics of speech perception:

- automatic, effortless, very effective in processing even noisy/variable input

Characteristics of speech:

- Perceived as a sequence of segments

Synthesizing speech: “rip, mix, and burn”?

1950s: Franklin Cooper, Alvin Liberman and colleagues at Haskins Laboratories:

Consonants and vowels cannot be “ripped” out of speech stream!

- Produced as continuous co-articulated stream

**Categorical perception** - “warping” of similarity space: differences are compressed within categories and expanded between categories.

### **Mechanics of talking:**

- lungs generate air stream
- air stream passes through vocal tract: throat, tongue, teeth, lips, nose
- vocal tract shapes the air stream, making it into different sounds
  - consonants: some constriction in the tract; with or without vibration of vocal cords
  - vowels: no air constriction, always use vocal cords, varying shape of vocal tract leads to different sounds
- coarticulation: “bee” vs “boo” – vocal tract anticipates the vowel (get ready to say “bee”, but don’t say it) (now do the same thing for “boo”)

### Why it makes sense to coarticulate:

English averages 5 phonemes per word, 150 words per minute – so, 12.5 sounds per second. But how do listeners keep up? - unconscious compensation for coarticulation?

Problems that coarticulation poses for perception:

Segmentation – no clear boundary, e.g. 1<sup>st</sup> portion of “shoe” carries info on both “sh” and “oo”

Invariance – no single acoustic property that corresponds to a single phonetic unit

### Vocal tract anatomy

**Vocal tract:** **oral cavity** (the mouth), the **nasal cavity** (inside the nose), and the **pharyngeal cavity** (in the throat, behind the tongue).

For most speech sounds, the airstream that passes through this tract is generated by the **lungs**.

Organs with other functions, “recruited” for speech:

Organ	Survival function	Speech function – <b>FILL IN</b>
<b>Lungs</b>	exchange oxygen and carbon dioxide	
<b>Vocal cords</b>	prevent food and liquids from entering the lungs	
<b>Tongue</b>	move food within the mouth	
<b>Teeth</b>	break up food	
<b>Lips</b>	seal oral cavity	

Organs that evolved specifically to serve language independent (and even contrary to) the original function:

- The **vocal cords** in humans are **more muscular and less fatty** than in other primates => greater control over their precise configuration.
- The **lowering of the larynx** => permits a greater variety of articulations with the tongue, BUT  
The resulting **longer vocal tract** (seen behind the tongue in the human) separates the soft palate and epiglottis, so that **airflow between the larynx and the nose cannot avoid passing through the oral cavity**. This is why humans choke more easily than other primates. **Selective advantage** of increased articulatory ability wins despite the increase in the likelihood of choking.

We'll be referring to the places in the vocal tract when **describing the way various sounds are produced**.

# Basic sounds: buzz, hiss, and pop

## Laryngeal buzz

The **larynx** (behind “adam’s apple”): little structure sitting on top of the trachea (windpipe).  
The original role of the larynx is to seal off the airway.

Part of the airway-sealing system in larynx: a pair of muscular flaps, the **vocal folds** (cords) - can be brought together to **form a seal**, or moved apart to permit free motion of air.

Aerodynamics: when any elastic seal is not strong enough to resist the pressurized air, the result is an **erratic release of the pressure through the seal**, creating a sound.

Examples: the *raspberry* (leaky seal at the lips); the *burp* (opening of the esophagus is the seal).

The mechanism of this sound production is very simple and general:

1. the **air pressure forces an opening**, through which air begins to flow;
2. the **flow of air generates a so-called Bernoulli force** at right angles to the flow (which in other circumstances helps airplanes to fly);
3. this force combines with the elasticity of the tissue to **close the opening again**;
4. and then the cycle repeats, as air pressure **again forces an opening**.

When a **regular oscillation** can be set up, we get a **periodic sound that we perceive as having a pitch**. Many animals can do that with their larynxes.

When **vocal cords are vibrating**, the sound is **voiced**. Without vibration, it’s **voiceless** (unvoiced):

<u>Voiceless</u>	<u>Voiced</u>
<b>s</b>	<b>z</b>
<b>f</b>	<b>v</b>
<b>p</b>	<b>b</b>

## The hiss of turbulent flow

The hiss is generated when a **volume of air is forced through a passage that is too small to permit it to flow smoothly**. The result is turbulence. We hear this turbulent flow as a hiss.

In the vocal tract, **turbulent flow** can be created at many points of constrictions: e.g., the upper teeth can be pressed against the lower lip -- sound [f].

In speech, the term for hiss is **frication**; sounds that involve frication are called **fricatives**. Some English examples are the sounds written "f, v, s, z, sh, th."

## The pop of closure and release

When a constriction somewhere in the vocal tract is **complete**, air pressure is built up behind the constriction.

If the constriction is abruptly released, the sudden release of pressure creates a sort of a pop. In speech, phoneticians call this a *stop* (focusing on closure) or a *plosive* (focusing on release).

As with friction, **a plosive constriction can be made anywhere along the vocal tract**, from the lips to the larynx. Three common examples: labial p/b, dental t/d, velar k/g

## The phonetic alphabet

A **way to write these sounds down**: phonetic alphabets.

### Historical background

In the mid-19th century, Melville Bell invented the first writing system that he called "Visible Speech" for writing down any language sound independent of dialect or language. In the 1860's, Melville, Edward and Alexander Bell demonstrated the *Visible Speech* in Scotland.

One of the three performers, [Alexander Graham Bell](#), who began following in his father's footsteps as a teacher of the deaf, went on to invent the telephone.

### The IPA

The [International Phonetic Association](#) (IPA) was founded in 1886 in Paris: the official International Phonetic Alphabet (also IPA).

While other phonetic alphabetic notations are in use, the IPA alphabet is the most widely used by linguists.

Look at the charts given here: <http://www.paulmeier.com/ipa/charts.html>

For this course, we'll be mostly using portions of the IPA that describe the sounds of English.

### Consonants

#### Don't confuse spelling with pronunciation.

Pronunciation is in [\[square brackets\]](#) - interpret the symbols in the phonetic alphabet.

Notice that the English chart from *Linguistics for Everyone* (like the main IPA chart) is organized along **two main dimensions**. Only terms needed for English are listed here.

- **Place of articulation: where** the sound is made
  - **Bilabial** = with the two lips
  - **Labiodental** = with the lower lip and upper teeth
  - **Interdental** = with the tongue between the teeth, or just behind the upper teeth (also called "dental")
  - **Alveolar** = with the tongue tip at the alveolar ridge, behind the teeth
  - **Palatal** = with the front or body of the tongue raised to the palatal region
  - **Velar** = with the back of the tongue raised to the soft palate ("velum")
  - **Glottal** = at the larynx (the *glottis* is the space between the vocal cords)
- **Manner of articulation: how** the tongue, lips, etc. are configured to produce the sound
  - **Stop / Plosive** = complete closure, resulting in stoppage of the airflow
  - **Affricate** = closure followed by frication (= stop + fricative)
  - **Fricative** = narrow opening, air forced through
  - **Nasal** = air allowed to pass through the nose (generally while blocked in mouth)
  - **Liquid** = minimal constriction allowing air to pass freely
    - through center of mouth, as in [r], called a **rhotic**
    - around side of tongue, as in [l], called a **lateral**
  - **Glide** = minimal constriction corresponding to a vowel (thus also called "semi-vowel")
    - [j] corresponds to [i]
    - [w] corresponds to [u]
    - in some dialects, there is also the voiceless [ʍ]
  - **Flap** = the tongue briefly taps the ridge behind the teeth, as in the standard American pronunciation of "tt" in *butter*

In addition, the **obstruent** sounds (stops, affricates, fricatives) come in **voiced and voiceless** varieties. The **sonorant** sounds (nasals, liquids, glides) are normally voiced.

The **glottal stop**, written ʔ, has a limited role in English: between the two vowels in *uh-oh*.

## Natural Classes

"Natural classes" of sounds are defined by these labels:

E.g. the **plural suffix** spelled "**(e)s**" is realized in three different ways, depending on the preceding sound.

voiceless fricative [s] following another **voiceless** sound

**p, t, k, f, θ**

*caps, hats, rocks, reefs, births*

voiced fricative [z] following another **voiced** sound (including vowels)

**b, d, g, v, ð, m, n, ŋ, l, ɹ, w, j**

*tabs, rods, dogs, caves, lathes, drums, pins, songs, pills, cars, cows, eyes*

voiced, but with a **vowel** inserted before it when it follows a "sibilant", i.e. an alveolar or palatal fricative or affricate.

s, z, tʃ, dʒ, ʃ, ʒ

*kisses, gazes, churches, judges, wishes, rouges*

The rule makes reference to the classes **voiced, voiceless & sibilant**, not to specific sounds.

Based on examples below, give the similar rule for **past-tense suffix** spelled "ed" :

p, k, f, θ, s, tʃ, ʃ

*hopped, kicked, ruffed, frothed, kissed, reached, wished*

b, g, v, ð, z, dʒ, ʒ, m, n, ŋ, l, r, w, j

*robbed, rigged, raved, bathed, razed, raged, rouged, hummed, sinned, longed, filled, marred, plowed, eyed*

**t, d**

*hated, rented, belted, loaded, grounded, welded*

The rules can **extend to new sounds**. E.g., German voiceless velar fricative:

*He out-Bachs Bach* with voiceless [s]

*She out-Bached Bach* with voiceless [t]

## Vowels

For **vowels**, a different set of terms is used.

- **high-mid-low**: height of the tongue in the mouth
- **front-central-back**: frontness or backness of the tongue in the mouth
- **rounded-unrounded**: the state of the lips
  - in English, as in many languages this is predictable: rounded for high back and mid back vowels, unrounded for other vowels.
- **tense-lax** : roughly, the degree of tension in the tongue

The terms refer, loosely speaking, to the location of the **main tongue constriction** within the mouth.

Here are English **words containing the vowel sounds** for these symbols.

**i**

*see*

**[si]**

	<i>seat</i>	[sit]
	<i>diva</i>	[divə]
<b>i</b>	<i>sit</i>	[sit]
	<i>pin</i>	[pɪn]
<b>ɛ</b>	<i>let</i>	[lɛt]
	<i>ten</i>	[tɛn]
<b>æ</b>	<i>hat</i>	[hæt]
	<i>plaid</i>	[plæd]
	<i>laugh</i>	[læf]
<b>a</b>	<i>hot</i>	[hat]
	<i>papa</i>	[papə]
<b>ɔ</b>	<i>saw</i>	[sɔ]
	<i>caught</i>	[kɔt]
<b>u</b>	<i>put</i>	[put]
	<i>took</i>	[tuk]
<b>u</b>	<i>ooze</i>	[uz]
	<i>use</i>	[juz]
	<i>bloom</i>	[blum]
	<i>fume</i>	[fjum]

ʌ, while slightly lower, is extremely similar to ə. ʌ is the stressed vowel in "cup", while ə is the unstressed (second) vowel in "papa".

<b>ʌ ə</b>	<i>up</i>	[ʌp]
	<i>sofa</i>	[sofə]
	<i>attack</i>	[ətæk]

Many Americans do not distinguish the vowels [a] and [ɔ], pronouncing *cot* and *caught* the same way. That's just one of many **variations in pronunciation** for different regional dialects.

English has several **diphthongs** (i.e. vowels that combine a vowel with a glide/semi-vowel in a single unit).

These are written with two phonetic symbols, even if they can (e.g. "long i") be written with one symbol in English spelling.

<b>eɪ</b>	<i>say</i>	[seɪ]
	<i>plain</i>	[pleɪn]
	<i>take</i>	[teɪk]
<b>aɪ</b>	<i>tie</i>	[taɪ]
	<i>sigh</i>	[saɪ]

	<i>my</i>	[maɪ]
	<i>mine</i>	[maɪn]
<b>au</b>	<i>cow</i>	[kaʊ]
	<i>bough</i>	[baʊ]
	<i>cloud</i>	[klaʊd]
<b>oi</b>	<i>boy</i>	[bɔɪ]
	<i>coin</i>	[kɔɪn]
<b>ou</b>	<i>sew</i>	[səʊ]
	<i>roam</i>	[rəʊm]
	<i>home</i>	[həʊm]

In most dialects of English, all of the tense vowels are **diphthongs**.

Some linguists analyze the combinations of vowel+"r"-like sound in Standard American English as diphthongs and even triphthongs. We will transcribe these combinations as just the vowel sound, followed by an [r]. In British English (Received Pronunciation), these vowels do not contain the "r"-like sound, and are best analyzed as diphthongs and triphthongs (see this chart for more information: <http://www.paulmeier.com/ipa/diphthongs.html>)

## Transcribing English

Most important is to **pay attention to the sounds**, and don't be distracted by the spelling.

For example, a single letter (or combination of letters) "ng" in English spelling can represent **two different pronunciations**.

- Just a velar nasal [ŋ]
  - *singer, hangar*
  - Here "ng" is a digraph, like "ch"
- A velar nasal [ŋ] followed by [g]
  - *finger, anger*
  - Here the two letters represent two sounds, like "nk" in *thinker*

These have to be **distinguished in a correct transcription**, even though the spellings are the same:

"finger" = [fɪŋɡr]      "singer" = [sɪŋɡr]      "think" = [θɪŋk] (cf. *thin, thing* as first part)

Similarly, "th" is ambiguous.

- Voiceless fricative [θ] in *thing, ether, thigh*
- Voiced fricative [ð] in *this, either, thy*

And **vowels** especially are spelled chaotically. Some examples:

- sound [i]
  - spelling fee, tea, be, key, thief, Leigh
- diphthong [eɪ]
  - spelling say, great, made, prey, Mae
- sound [u]
  - spelling do, food, new, sue, soup, rude
- diphthong [aɪ]
  - spelling sigh, I, eye, my, hide, lie
- sequence of sounds [si]
  - beginning of word: see, sea, senile, seize, scenic, siege, ceiling, cedar, cease
  - end of word: juicy, glossy, sexy

The **influence of orthography** is powerful!

**Note for homework:** **Your pronunciation will differ** in some ways from that of your friends or the instructor. This is generally due to difference in regional dialect or sometimes a matter of age: e.g. witch vs which

In homeworks and exams, either we'll give you a recording of pronunciation, or else you should give an **accurate transcription** of how you pronounce something. If you think we've taken off credit unfairly for something like this, tell us! We'll ask you to pronounce a word for us, and decide on that basis whether your transcription is in fact true to the way you speak.