

Psych 56L/ Ling 51:  
Acquisition of Language

Lecture 6  
Phonological Development I

Announcements

HW1 due at the end of class today

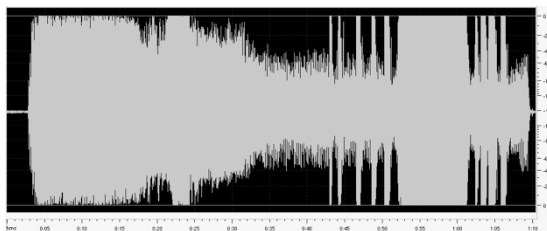
Review questions for phonological development available

HW2 available (not due till 2/17/11 – after midterm), but helpful for studying for the midterm

All kinds of useful sound charts available

The coursebook is available on reserve at Langson library.

Sounds of Language



Forget Spelling!

Sounds ≠ Spelling

Courtesy of <http://www.spellingsociety.org/news/media/poems.php>

Our Strange Lingo, by Lord Cromer (1902)

When the English tongue we speak.  
 Why is break not rhymed with freak?  
 Will you tell me why it's true  
 We say sew but likewise few?  
 And the maker of the verse,  
 Cannot rhyme his horse with worse?  
 Beard is not the same as heard  
 Cord is different from word.  
 Cow is cow but low is low  
 Shoe is never rhymed with foe.  
 Think of hose, dose, and lose  
 And think of goose and yet with choose  
 ...

Courtesy of <http://www.spellingsociety.org/news/media/poems.php>

...  
 Think of comb, tomb and bomb,  
 Doll and roll or home and some.  
 Since pay is rhymed with say  
 Why not paid with said I pray?  
 Think of blood, food and good.  
 Mould is not pronounced like could.  
 Wherefore done, but gone and lone -  
 Is there any reason known?  
 To sum up all, it seems to me  
 Sound and letters don't agree.

### One Sound - Many Characters

<u>h</u> e	e	<u>s</u> eas	ea
bel <u>i</u> eve	ie	am <u>o</u> e <u>b</u> a	oe
<u>C</u> aesar	ae	<u>k</u> ey	ey
<u>s</u> ee	ee	mach <u>i</u> ne	i
<u>p</u> eople	eo	<u>s</u> eize	ei

International Phonetic Alphabet: [i]

### One Sound - Many Characters

<u>t</u> oo	oo	thr <u>e</u> w	ew
<u>t</u> o	o	<u>l</u> ieu	ieu
<u>cl</u> ue	ue	sh <u>o</u> e	oe
thr <u>o</u> ugh	ough	<u>b</u> eautiful	eau

IPA: [u]

One Character - Many Sounds

d <u>a</u> me	e
d <u>a</u> d	æ
f <u>a</u> ther	ɑ
c <u>a</u> ll	ɔ , ɑ
vill <u>a</u> ge	ɪ , ə
man <u>y</u>	ɛ

One Sound - Multiple Letters

<u>sh</u> oot	ʃ
<u>ei</u> ther	ð
<u>ch</u> aracter	k
<u>de</u> al	i
<u>Th</u> omas	t
<u>ph</u> ysics	f
rou <u>gh</u>	f

One Letter - 0, 1, 2 Sounds

mnemonic	
psychology	
resign	
ghost	= no sound!
island	
whole	
debt	
cute	[kjʊt]
	= 2 sounds!

Differences across Languages

English: judge, juvenile, Jesus	[dʒ]
Spanish: jugar, Jesus	[h]
German: Jugend, jubeln, Jesus	[j]
French: Jean, j'accuse, jambon	[ʒ]

### THE INTERNATIONAL PHONETIC ALPHABET (revised to 1993)

CONSONANTS (SYMBOLS)

Place	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	p b		t d	ʈ ɖ	c ɟ	k ɡ	q ɢ				ʔ
Nasal		m ɱ	n ɳ	ɲ	ɳ̺	ɳ̺̻	ɲ̟	ŋ	ɴ		
Fricative		f v	s z	ʃ ʒ	ʂ ʐ	x ɣ	ç ʝ	ħ	ʕ		
Approximant				ɹ			ɻ				
Liquids			l ɭ								
Approximant				ɹ			ɻ				
Liquids			l ɭ								

CONSONANTS (IPA SYMBOLS)

Class	Symbol	IPA	Symbol	IPA
Labial	p	voiceless	b	voiced
Dental	t	voiceless	d	voiced
Alveolar	s	voiceless	z	voiced
Postalveolar	ʃ	voiceless	ʒ	voiced
Retroflex	ʂ	voiceless	ʐ	voiced
Palatal	ç	voiceless	ʝ	voiced
Velar	k	voiceless	ɡ	voiced
Uvular	q	voiceless	ɢ	voiced
Pharyngeal	ħ	voiceless	ʕ	voiced
Glottal	ʔ	voiceless		

VOWELS

Class	Symbol	IPA	Symbol	IPA
Close	i	close front	y	close front rounded
Open	e	open-mid front	ɛ	open-mid front
Open	æ	open front	ɶ	open front rounded
Open	ɶ	open front rounded	ɶ	open front rounded

OTHER SYMBOLS

ɸ = voiceless labial fricative  
β = voiced labial fricative  
ɸ̞ = voiceless labiodental fricative  
β̞ = voiced labiodental fricative  
ɸ̞̞ = voiceless bilabial fricative  
β̞̞ = voiced bilabial fricative  
ɸ̞̞̞ = voiceless labial-velar fricative  
β̞̞̞ = voiced labial-velar fricative  
ɸ̞̞̞̞ = voiceless labial-uvular fricative  
β̞̞̞̞ = voiced labial-uvular fricative  
ɸ̞̞̞̞̞ = voiceless labial-pharyngeal fricative  
β̞̞̞̞̞ = voiced labial-pharyngeal fricative  
ɸ̞̞̞̞̞̞ = voiceless labial-velar-pharyngeal fricative  
β̞̞̞̞̞̞ = voiced labial-velar-pharyngeal fricative  
ɸ̞̞̞̞̞̞̞ = voiceless labial-uvular-pharyngeal fricative  
β̞̞̞̞̞̞̞ = voiced labial-uvular-pharyngeal fricative  
ɸ̞̞̞̞̞̞̞̞ = voiceless labial-velar-pharyngeal-uvular fricative  
β̞̞̞̞̞̞̞̞ = voiced labial-velar-pharyngeal-uvular fricative  
ɸ̞̞̞̞̞̞̞̞̞ = voiceless labial-uvular-pharyngeal-uvular fricative  
β̞̞̞̞̞̞̞̞̞ = voiced labial-uvular-pharyngeal-uvular fricative  
ɸ̞̞̞̞̞̞̞̞̞̞ = voiceless labial-velar-pharyngeal-uvular-pharyngeal fricative  
β̞̞̞̞̞̞̞̞̞̞ = voiced labial-velar-pharyngeal-uvular-pharyngeal fricative

### Sounds: Speech Production

The image shows a violin on the left and a human head in profile on the right. The violin is labeled with parts: Chinrest, Body, Bridge, Tailpiece, F-hole, Neck, Tuning pegs, Scroll, Fingerboard, and Bow. The human head profile shows the vocal tract with labels for the Nasal Cavity and Oral Cavity.

### How you look to a phonetician

The diagram shows a human head in profile with a dashed box around the mouth and throat area. Labels with arrows point to the Palate, Velum, Tongue, Lips, teeth etc., and Glottis (vocal folds).

### How you look to a phonetician

The diagram shows a human head in profile with a dashed box around the mouth and throat area. Labels with arrows point to the Nasal Cavity and Oral Cavity.

### Major division: consonants vs vowels

Consonantal sounds: narrow or complete closure somewhere in the vocal tract.

Vowels: very little obstruction in the vocal tract. Can form the basis of syllables (also possible for some consonants).

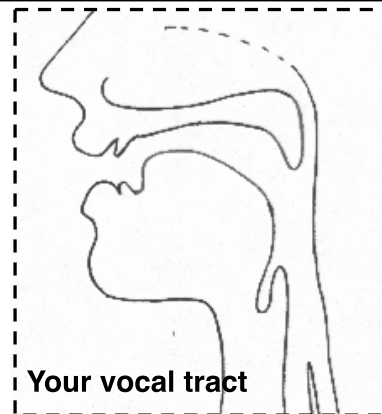
### Describing Speech Sounds

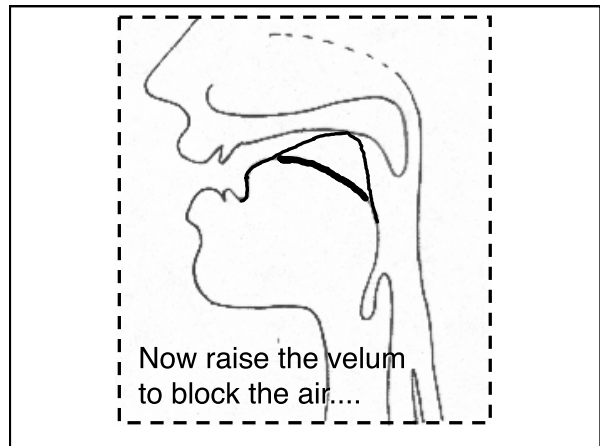
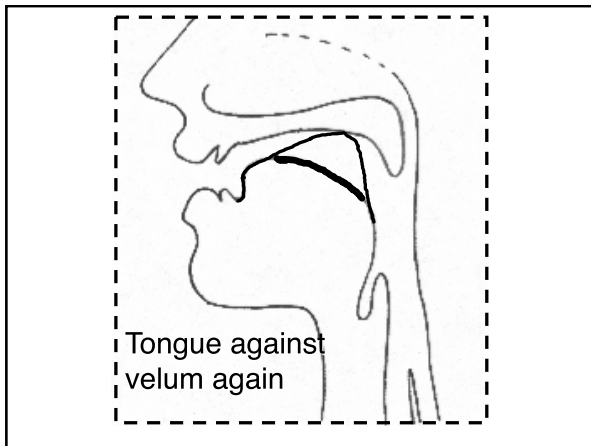
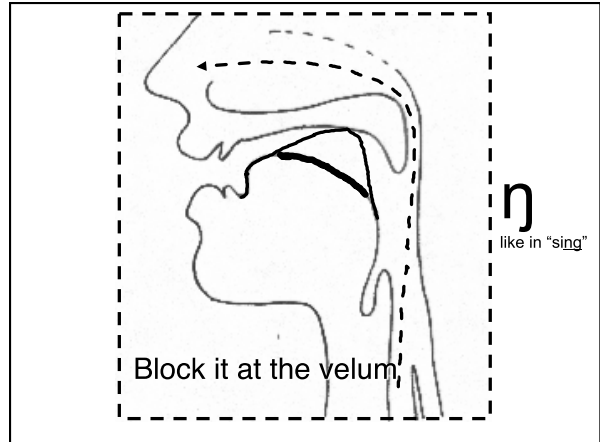
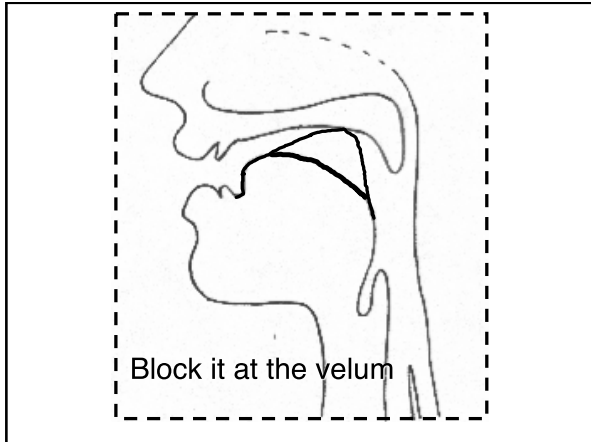
Where/how is the air flowing?  
*nasal/oral, stop, fricative, liquid, tap/flap etc.*

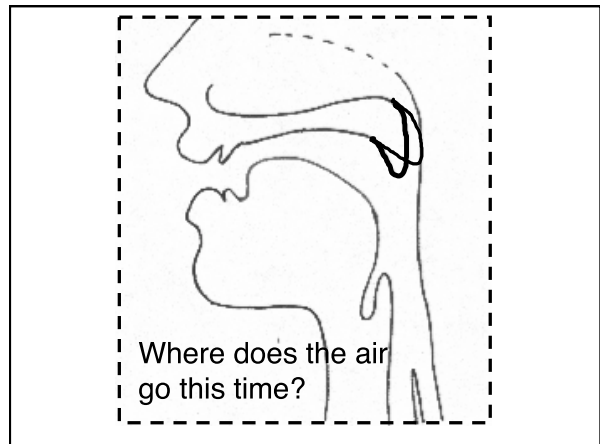
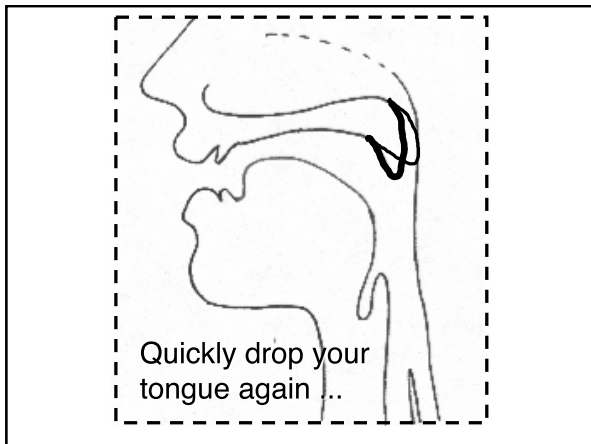
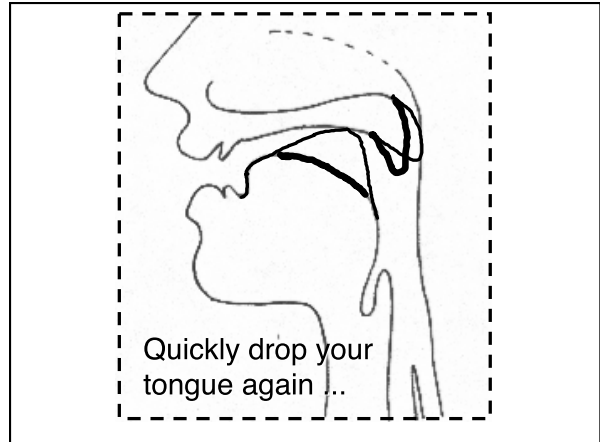
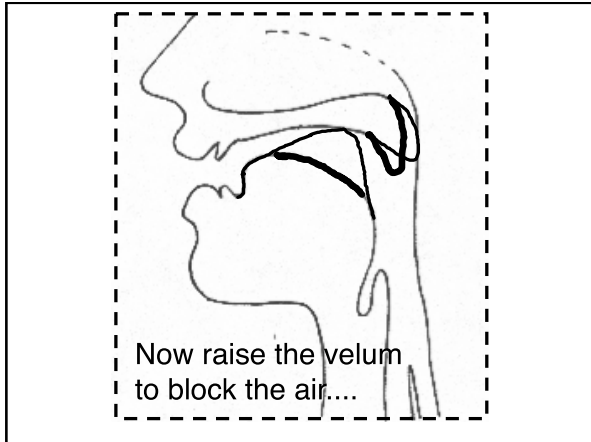
Where is the air-flow blocked?  
*labial, alveolar, palatal, velar etc.*

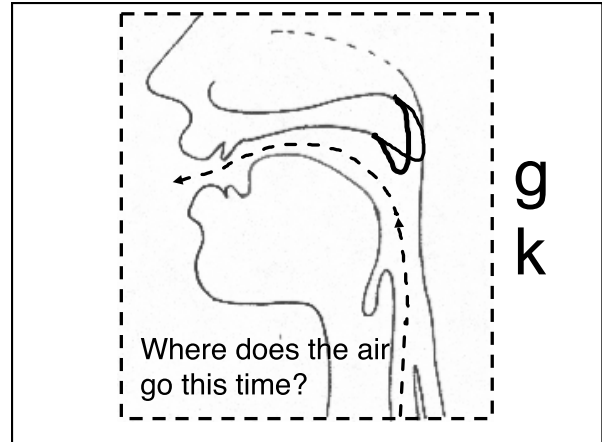
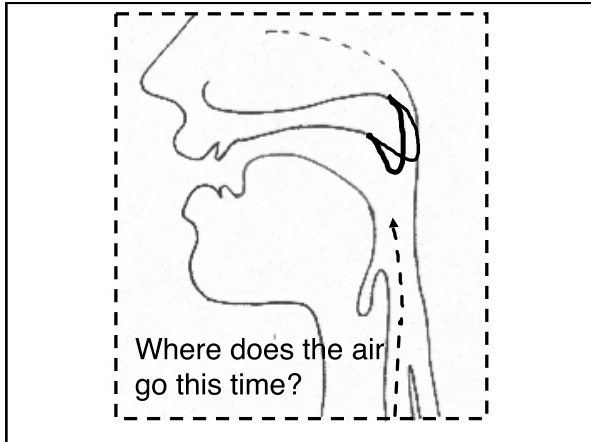
What are the vocal folds doing?  
*voiced vs. voiceless*

Where does the air flow?









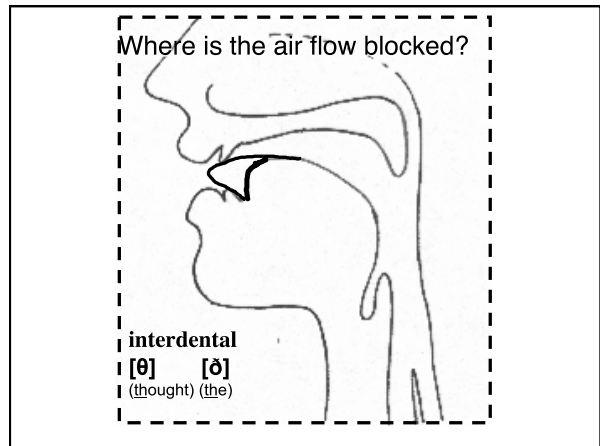
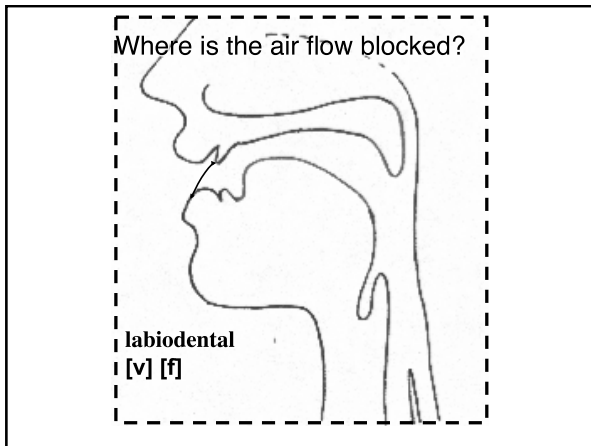
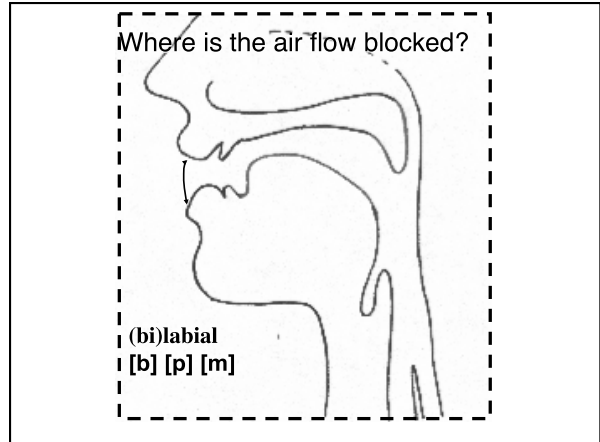
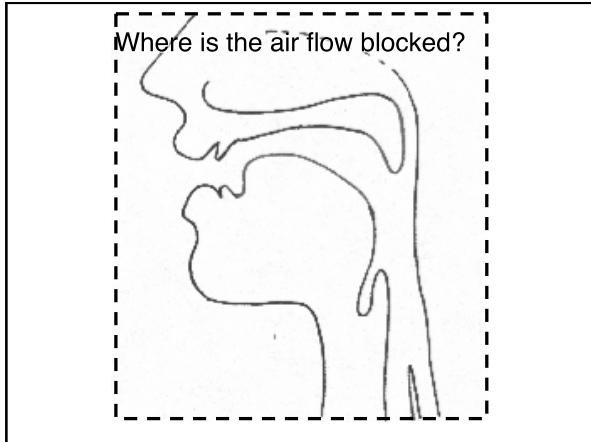
So far we have:

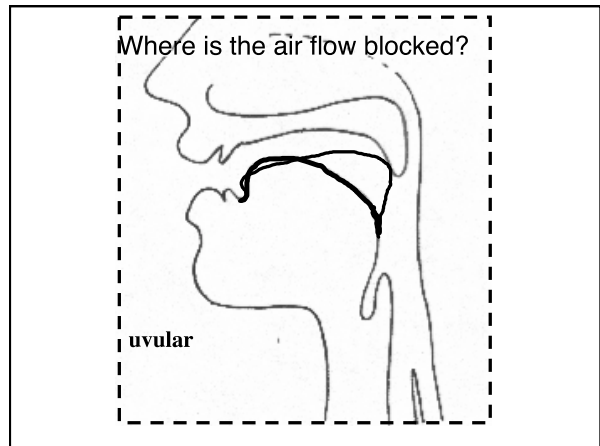
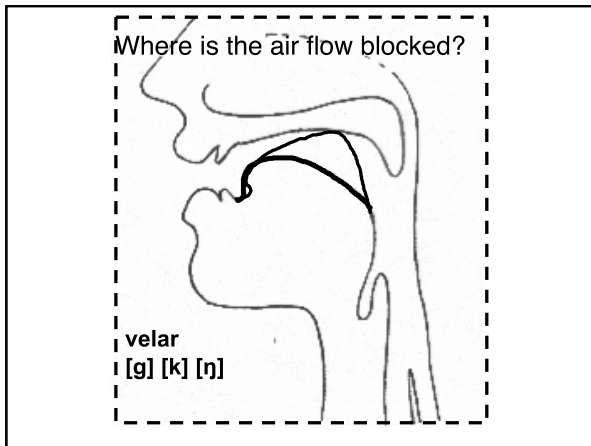
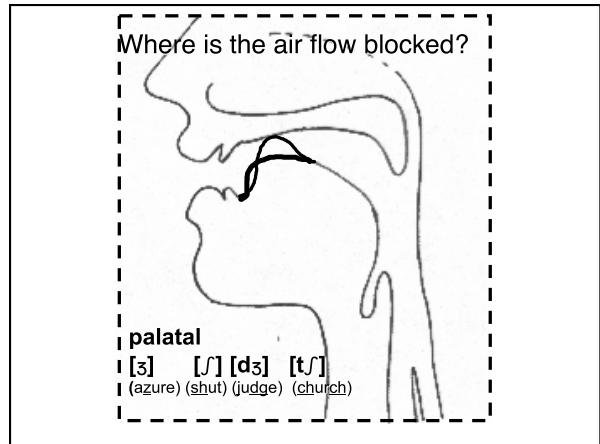
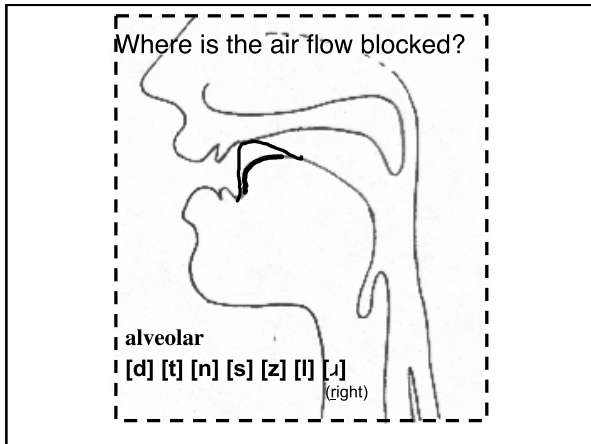
Nasal stop:  
[ŋ]

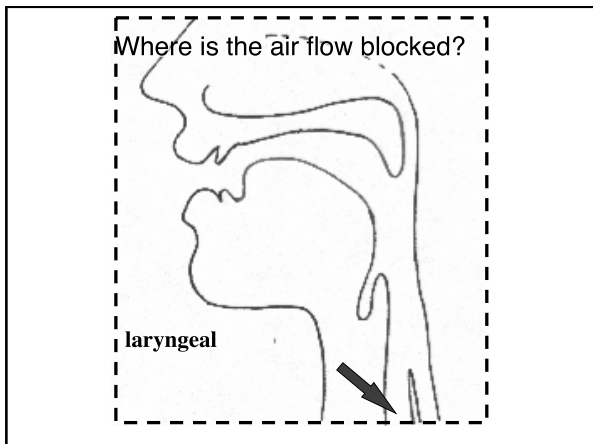
Non-nasal (oral) stops:  
[g] [k]

Where is the air flow blocked?









Manner - How the Air is Flowing

Stops  
 [p] [t] [k] [b] [d] [g] [m] [n] [ŋ]

Fricatives  
 [f] [v] [θ] [ð] [s] [z] [ʃ] [ʒ]

Approximants/Glides  
 [w] [j] (Like in "water" and "you")

Liquids  
 [l] [ɹ]

Tap/Flap  
 [ɾ] (Like in "water" and "butter")

Fricatives & Affricates

Palatal sounds [ç] [j] [dʒ] [tʃ]

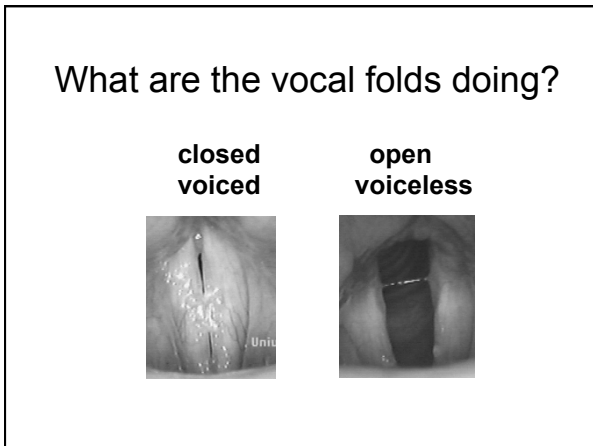
Palatal Fricatives – [ç] [j]  
 [note: according to IPA chart these are strictly 'post-alveolar']

Affricates - combination of stop + fricative - [dʒ] [tʃ], as in *judge*, *church*

(ex: affricate in fast speech: "What should...?", "What did you do? = Whad ja do)

[tʃ] [dʒ]

Said fast, this sounds like "Whachould..." or "Whajado?"



## Voiced & Voiceless Consonants

Consonants either voiced or voiceless.

English pairs:

<b>b p</b>	<b>v f</b>	<b>d t</b>	
<b>z s</b>	<b>ð θ</b>	<b>ʃ ʒ</b>	<b>tʃ dʒ</b>

## Describing Sounds

### Features

Ways of *describing* sounds

e.g., [t] = voiceless, alveolar, stop

Stronger claim: features are the *smallest building blocks of language*, used to store sounds in the mind

*Atoms of Speech*



Roman Jakobson, 1896-1982

### Features

Prediction: by combining a small number of atomic features, it should be possible to create a larger number of speech sounds

Goal: a set of universal features should make it possible to describe the speech sounds of all of the languages of the world

Different languages choose different feature combinations

	bi-labial	labio-dental	inter-dental	al-veolar	palatal	velar	glottal
oral stop	p b			t d		k g	<input type="checkbox"/>
nasal stop	m			n		ŋ	
fricative		f v	θ ð	s z	ʃ ʒ		h
affricate					tʃ dʒ		
liquid				l	ɹ		
glide					j	ɰ w	

	bi-labial	labio-dental	inter-dental	al-veolar	palatal	velar	glottal
oral stop	p b			t d		k g	<input type="checkbox"/>
nasal stop	m			n	ɲ		
fricative		ʃ ʒ	θ ð	s z	ʃ ʒ		h
affricate					tʃ dʒ		
liquid				l	ɹ		
glide					j	ɰ w	

	bi-labial	labio-dental	inter-dental	al-veolar	palatal	velar	glottal
oral stop	p b			t d		k g	<input type="checkbox"/>
nasal stop	m			n	ɲ		
fricative	ɸ β	f v	θ ð	s z	ʃ ʒ		h
affricate					tʃ dʒ		
liquid				l	ɹ		
glide					j	ɰ w	

“Fuji”  
“Cuba”

	bi-labial	labio-dental	inter-dental	al-veolar	palatal	velar	glottal
oral stop	p b			t d		k g	<input type="checkbox"/>
nasal stop	m			n	ɲ		
fricative	ɸ β	f v	θ ð	s z	ʃ ʒ		h
affricate					tʃ dʒ		
liquid				l	ɹ		
glide					j	ɰ w	

“año”

	bi-labial	labio-dental	inter-dental	al-veolar	palatal	velar	glottal
oral stop	p b			t d		k g	□
nasal stop	m			n	ɲ	ŋ	
fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ç ʁ	h
affricate					tʃ dʒ		
liquid				l	ʎ ʝ	ʟ	ʕ
glide				j		ʷ	w

“Bach”  
“agua”

?

	bi-labial	labio-dental	inter-dental	al-veolar	palatal	velar	glottal
oral stop	p b			t d		k g	□
nasal stop	m			n	ɲ	ŋ	
fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ç ʁ	h
affricate					tʃ dʒ		
liquid				l	ʎ ʝ	ʟ	ʕ
glide				j		ʷ	w

“caballo”

	bi-labial	labio-dental	inter-dental	al-veolar	palatal	velar	glottal
oral stop	p b			t d		k g	□
nasal stop	m			n	ɲ	ŋ	
fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ç ʁ	h
affricate					tʃ dʒ		
liquid				l	ʎ ʝ	ʟ	ʕ
glide				j		ʷ	w

**IPA full(er) chart**

THE INTERNATIONAL PHONETIC ALPHABET (revised to 1993)

CONSONANTS (PULMONIC)

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

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

The parts we care about for this class

THE INTERNATIONAL PHONETIC ALPHABET (revised to 1993)

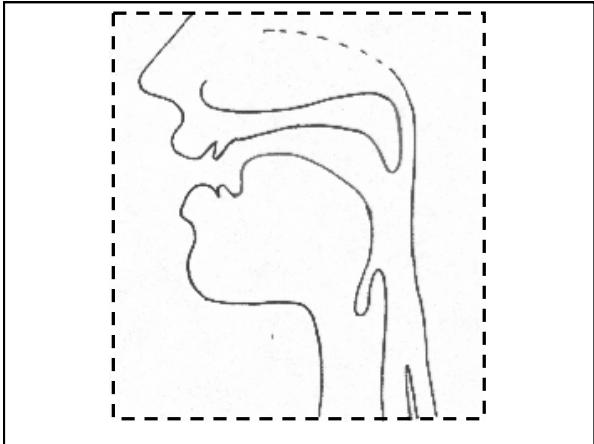
CONSONANTS (PULMONIC)

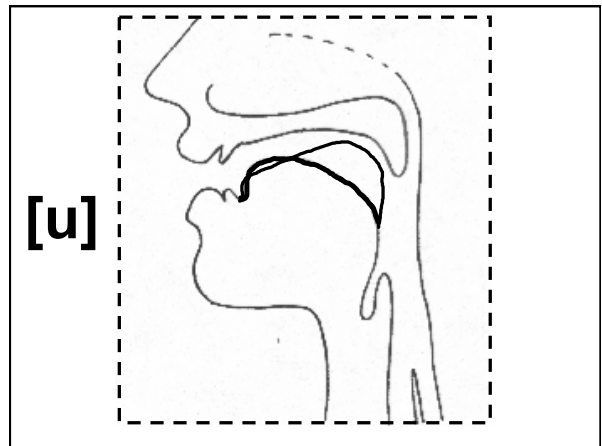
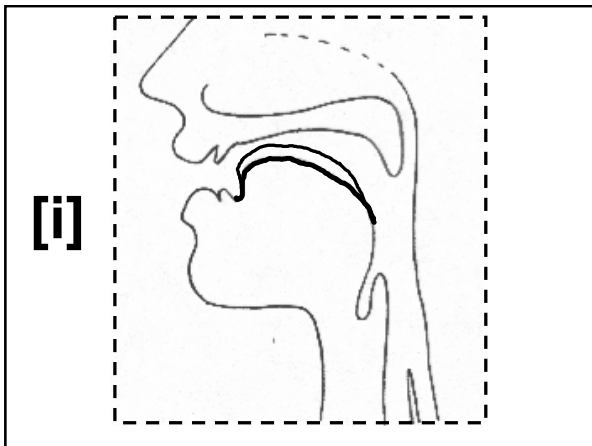
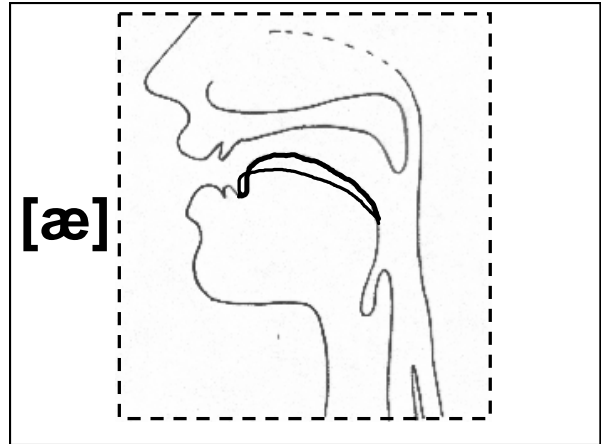
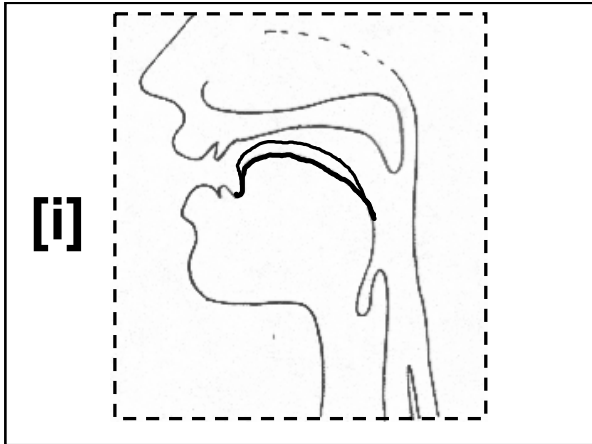
	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	p b			t d				k g			
Nasal	m			n			ɲ	ŋ			
Trill											
Tap or Flip				ɾ							
Fricative		f v	θ ð	s z	ʃ ʒ	ʂ ʐ					h
Lateral fricative											
Approximant				ɹ			j	w			
Lateral approximant				l							

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

# VOWELS

What can you do to alter the shape of your vocal tract?







You can....

- (1) Raise or lower your tongue
- (2) Advance or retract your tongue
- (3) Round or spread your lips
- (4) Tense or not tense your mouth

So what vowels do you have?

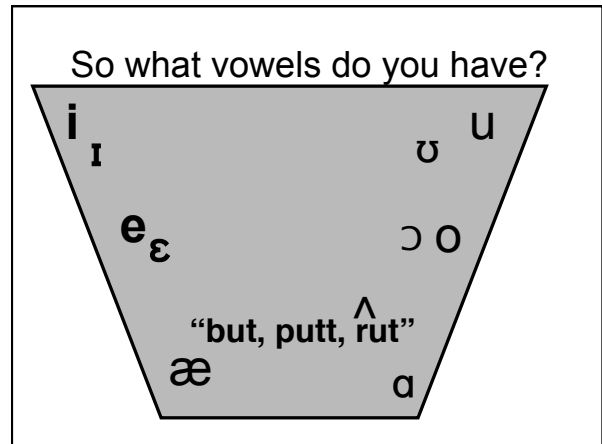
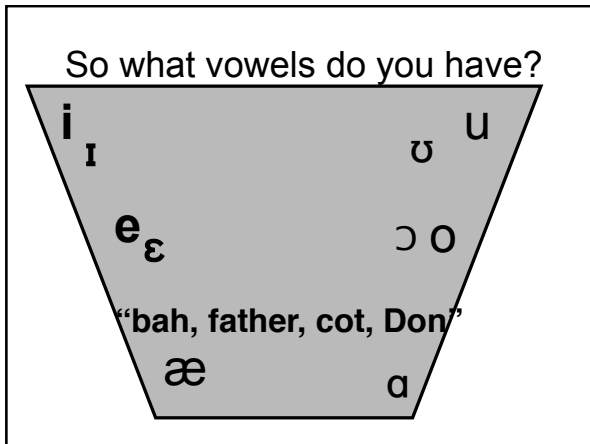
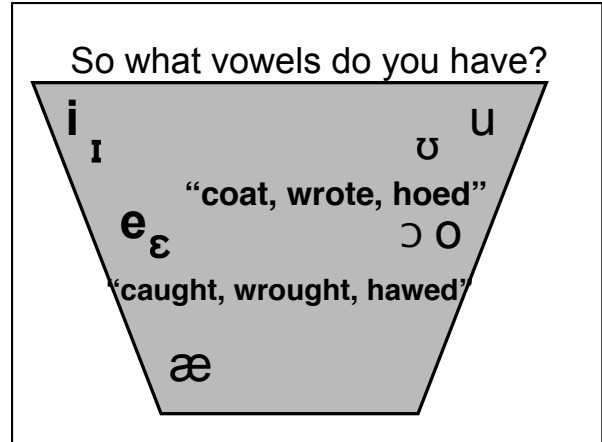
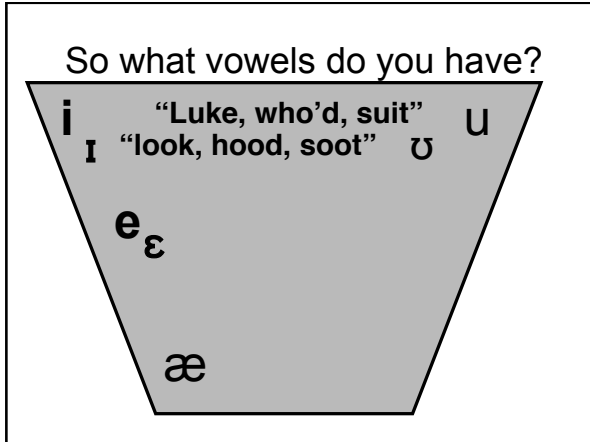
**i** "sheep, sleep"  
**ɪ** "ship, slip"

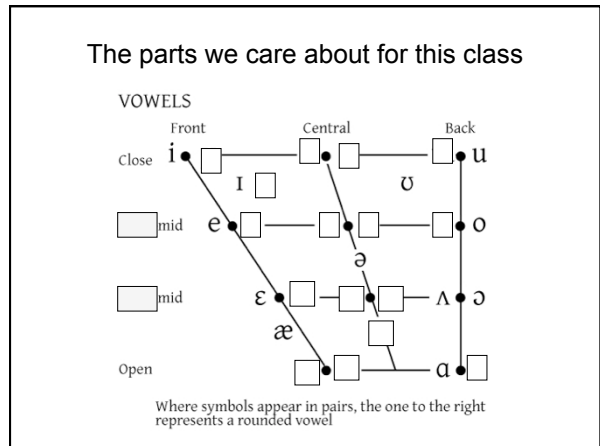
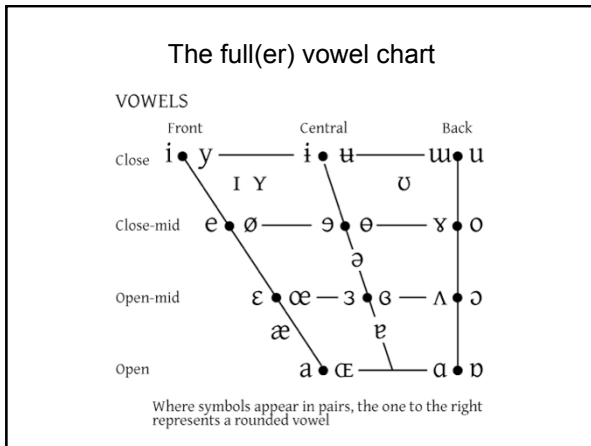
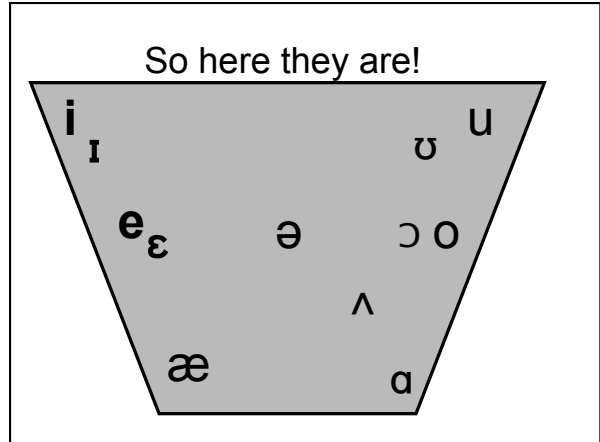
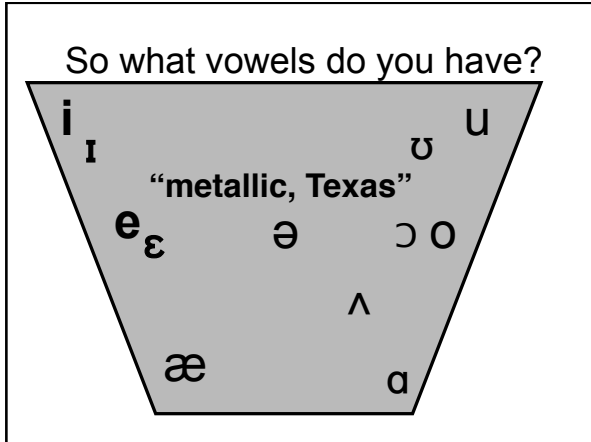
So what vowels do you have?

**i**  
**ɪ**  
**e** "laid, spade, trade"  
**ɛ** "led, sped, tread"

So what vowels do you have?

**i**  
**ɪ**  
**e**  
**ɛ**  
**æ** "bat, lad"





### Cross-language Differences

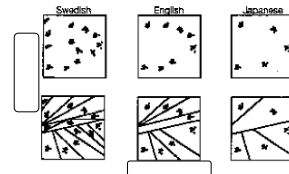
#### Feature Combinations

English: back vowels are rounded, others are not  
 German/French has high, front, rounded vowel [y]  
 Russian has high back unrounded vowel [ɯ]

Many languages don't make the tense/lax distinction found in English (ex: Spanish [i], rather than [i] and [ɪ])

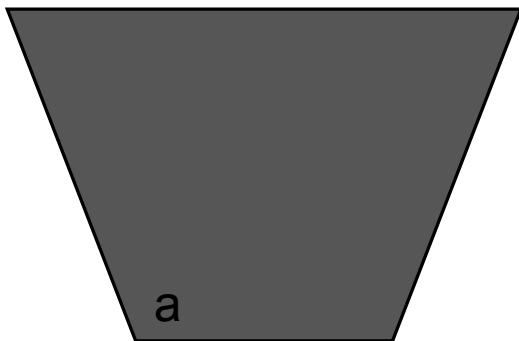
Many languages distinguish short and long vowels (unlike English), ex: Japanese [i] vs. [i:]

### Cross-language Differences

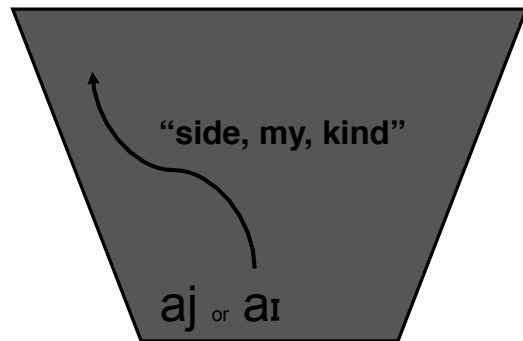


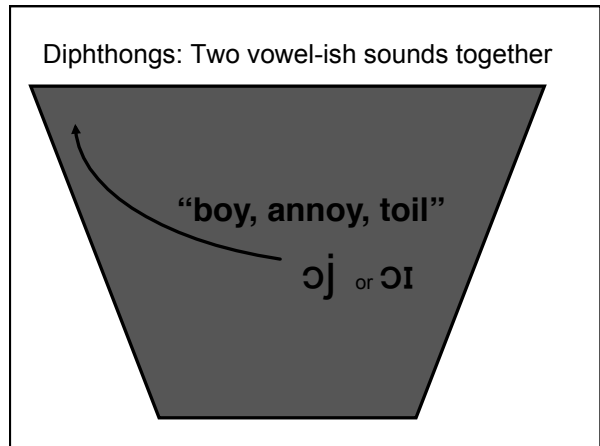
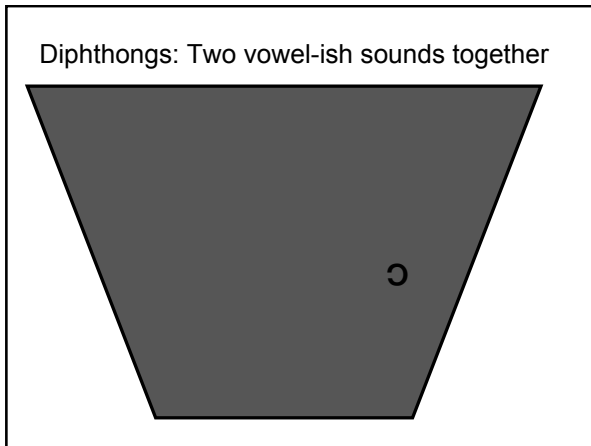
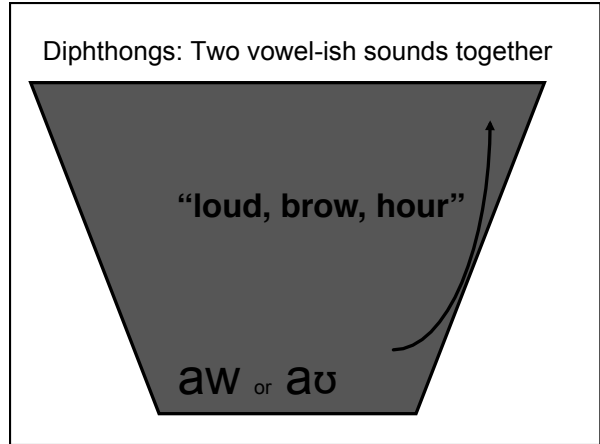
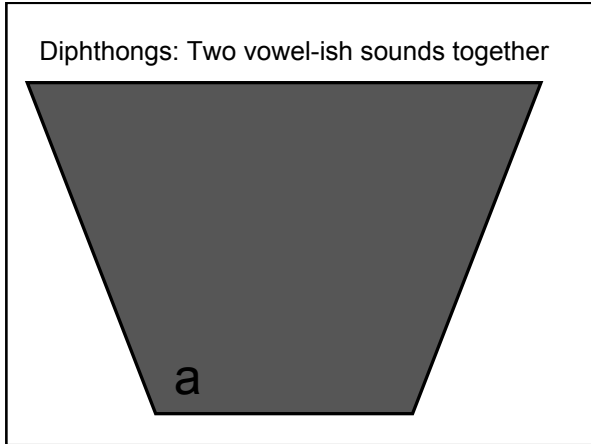
Languages carve up the acoustic space in different ways. Children find these categories, based on the distributions of sounds they hear in their linguistic environment (using statistical learning).

Diphthongs: Two vowel-ish sounds together



Diphthongs: Two vowel-ish sounds together





### More details of American English pronunciation

[http://en.wikipedia.org/wiki/General\\_American](http://en.wikipedia.org/wiki/General_American)

Monophthongs	Front		Central		Back
	plain	rhoticized			
Close	i				u
Near-close	ɪ				ʊ
Close-mid	e <sup>[ɪ]</sup>				ɔ <sup>[ɪ]</sup>
Mid		ɪ	ə		
Open-mid	ɛ		ɜ	ɹ	ɔ
Near Open	æ				ɑ

Depending on one's analysis, people who merge the vowels of *cot* and *caught* to /ɔ/ either have /noʊ/ and /hoʊ/, but since all accents with *cot* and *caught* merged to /oʊ/ have also undergone in these cases, the [ɔ] before /r/ can be analyzed as an allophone of /ɔ/, [ɜ] and [ɹ] are often unstressed syllables. Since the occurrence of [ɹ] is mostly predictable, it need not be considered.

Among speakers who distinguish between /ɔ/ and /ɜ/, the vowel of *cot* (usually transcribed as closer to [ɔ])<sup>[1]</sup> Among *cot-caught* merged speakers, /ɔ/ usually remains a back vowel, [ɔ], or /ɜ/, their retracted allophones /ɜ/ may be identical to the lowered allophones of /ɜ/ among

The diphthongs of General American are shown in the next table:

Diphthongs	Offglide is a front vowel	Offglide is a back vowel
Opener component is unrounded	aɪ <sup>[1]</sup>	aʊ
Opener component is rounded	ɔɪ	oʊ <sup>[1]</sup>

### Speech Production - Summary

Airflow set in vibration by vocal folds  
 Airflow modified by vocal tract

Consonants: narrowing or blocking of oral/nasal cavity

Vowels: shaping of oral cavity

Different languages choose different selections of these

### Speech Perception

Speech production processes must be *undone* by the ear

Motions of articulators must be *reconstructed* from patterns of air vibration

Requires extremely precise hearing, possibly a system specialized for hearing speech

Substantially developed at birth



### Questions?



You should be able to do question 1 on HW2, and up through question 2 on the phonological review questions.