

Psych 56L/ Ling 51:  
Acquisition of Language

Lecture 6  
Phonological Development I

Announcements

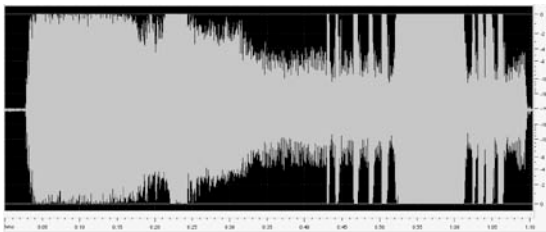
HW1 due at the end of class today

Review questions for phonological development available

HW2 available (not due till 2/18/10), but helpful for studying for the midterm

All kinds of useful sound charts available

Sounds of Language



Forget Spelling!

Sounds  $\neq$  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>ie</u> ve	ie	am <u>oe</u> ba	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	<u>th</u> rew	ew
<u>t</u> o	o	<u>l</u> ieu	ieu
<u>cl</u> ue	ue	<u>sh</u> oe	oe
<u>th</u> rough	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
ei <u>th</u> er	ð
<u>ch</u> aracter	k
de <u>a</u> l	i
<b>T</b> homas	t
<u>ph</u> ysics	f
rou <u>gh</u>	f

### One Letter - 0, 1, 2 Sounds

<b>m</b> nemonic	
<b>p</b> sychology	
re <u>s</u> ign	
g <u>h</u> ost	= no sound!
island	
<b>w</b> hole	
de <u>b</u> t	
cute	[kjuwt]
	= 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]

International Phonetic Alphabet

THE INTERNATIONAL PHONETIC ALPHABET (revised to 1993)

Place	Labial	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	p b		t d	ʈ ɖ	ʈ ɖ	ç ɟ	k ɡ	q ɢ		ʔ
Nasal	m	n̪	n	ɳ	ɳ̠	ɲ	ŋ	ɴ		
Fricative		f	s z	ʃ ʒ	ʃ̌ ǯ	ç ʝ	x ɣ	ħ		h
Approximant			l			ʎ	ʝ			ʕ
Liquids			l			ʎ	ʝ			ʕ
Approximant			l			ʎ	ʝ			ʕ
Liquids			l			ʎ	ʝ			ʕ

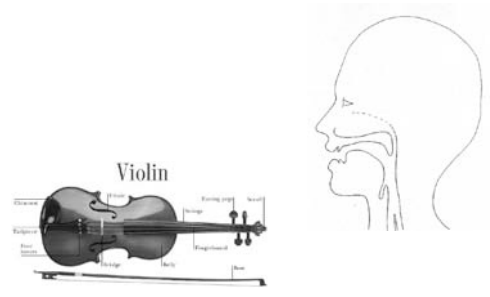
CONSONANTS BY PLACE

CONSONANTS BY MANNER

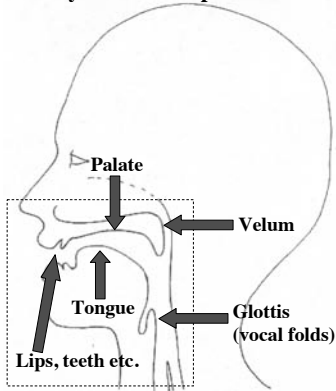
VOWELS

OTHER SYMBOLS

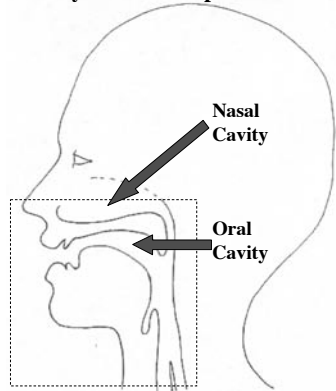
Sounds: Speech Production



How you look to a phonetician



How you look to a phonetician



### 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).

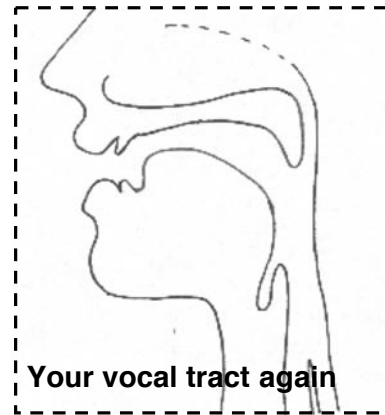
### Describing Speech Sounds

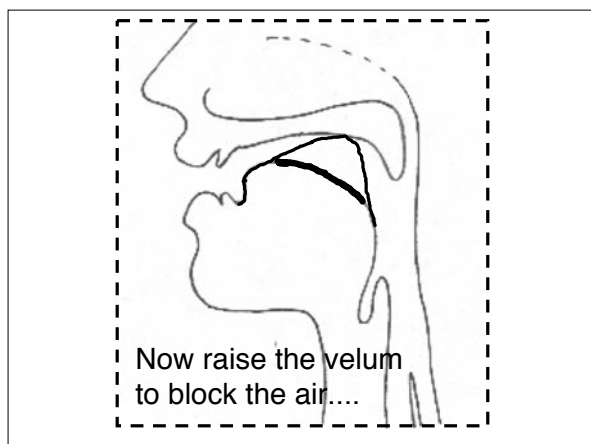
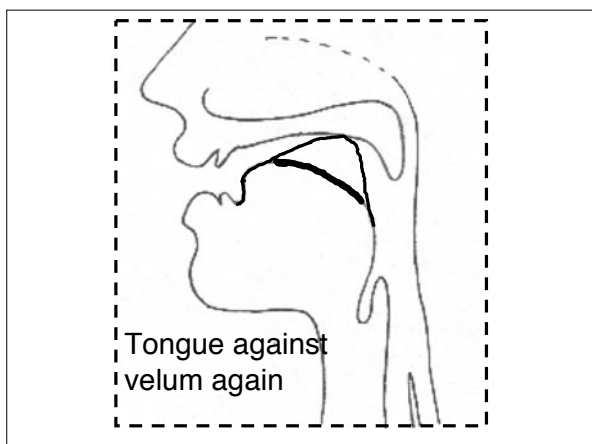
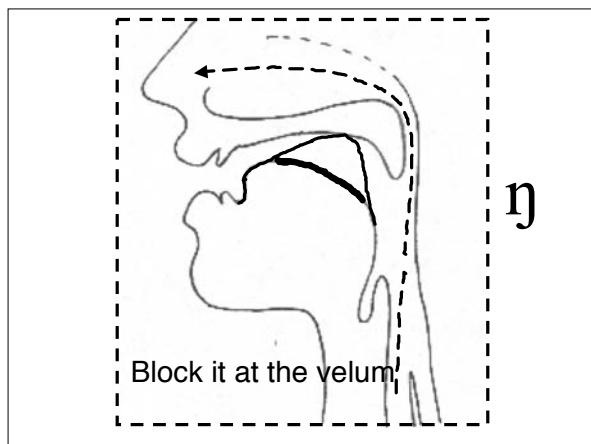
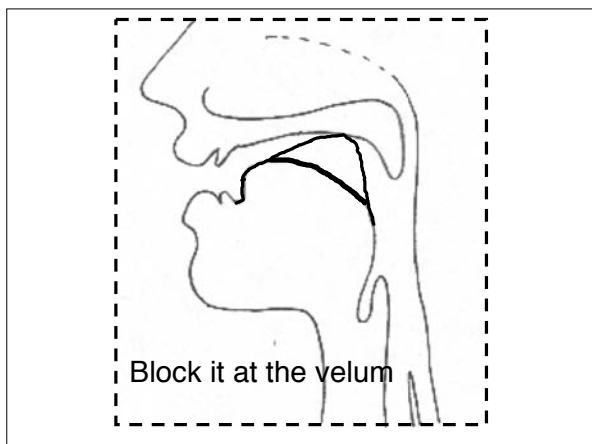
Where/how is the air flowing?  
*nasal/oral, stop, fricative, liquid, tap/flap etc.*

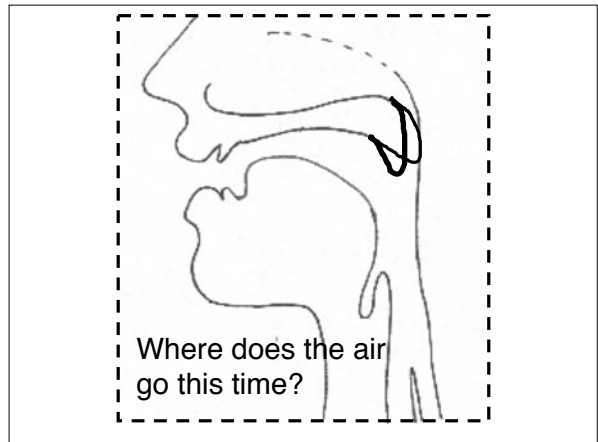
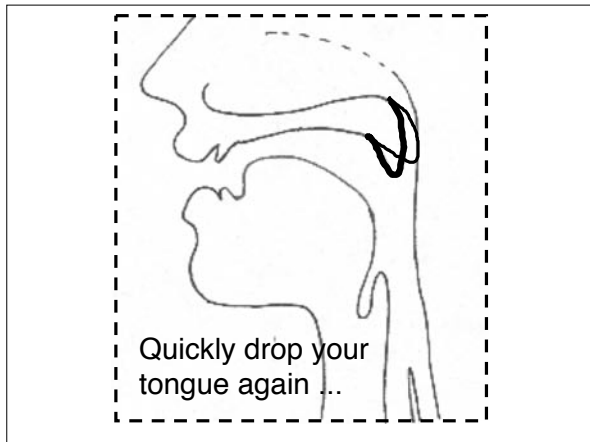
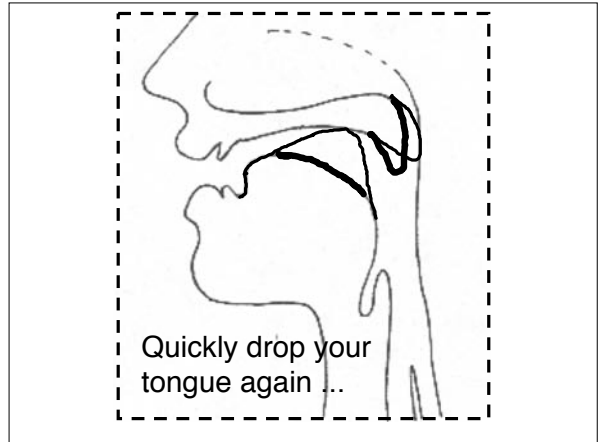
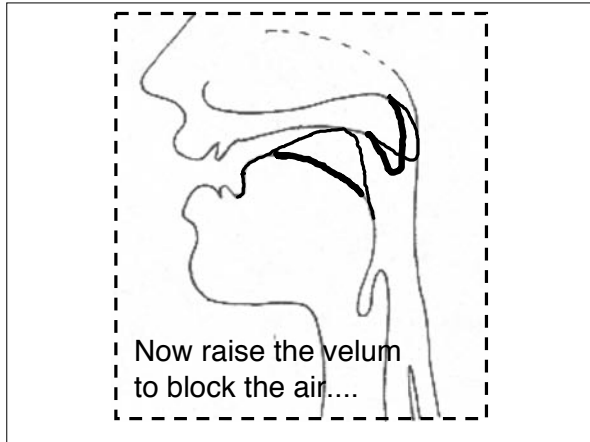
Where is the air-flow blocked?  
*labial, alveolar, palatal, velar etc.*

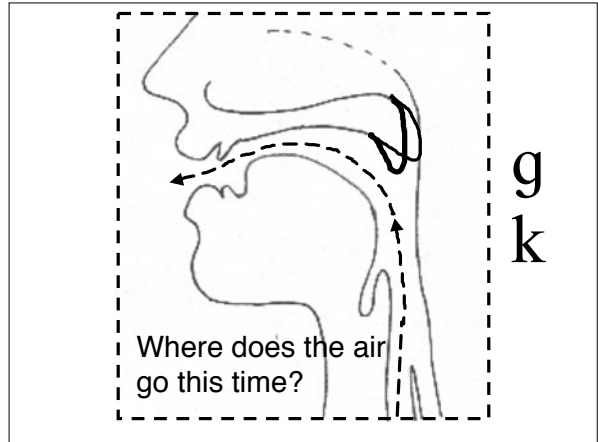
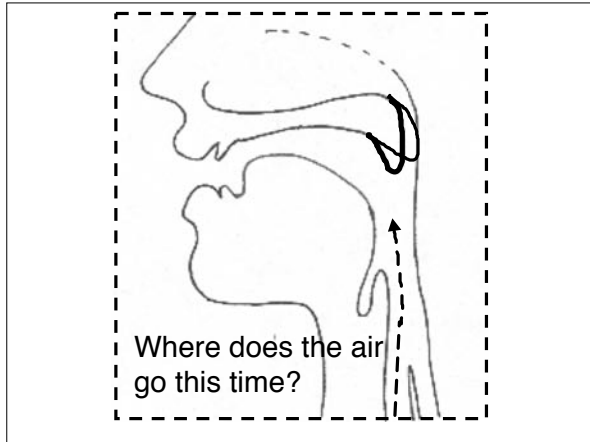
What are the vocal folds doing?  
*voiced vs. voiceless*

Where does the air flow?









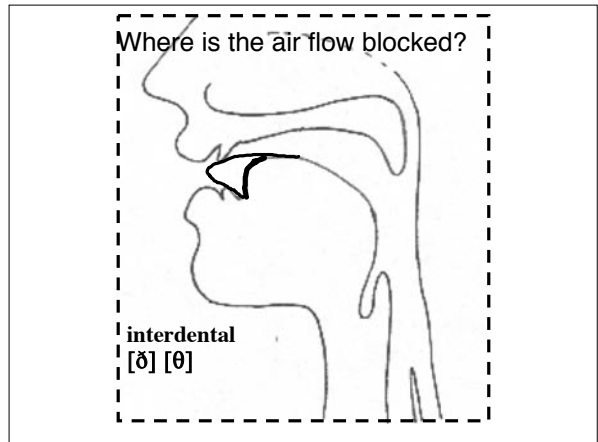
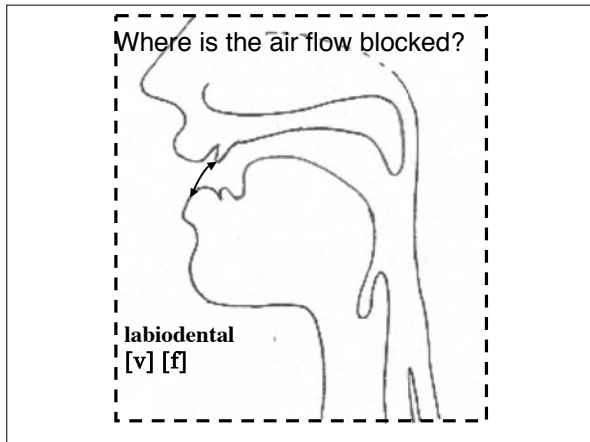
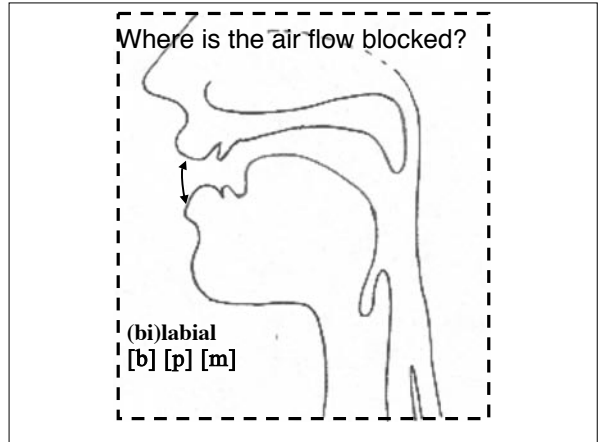
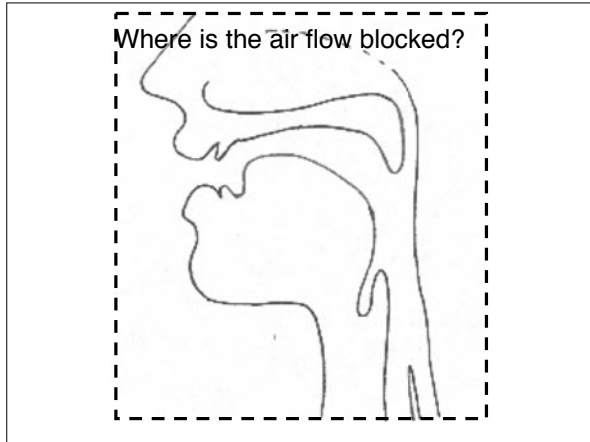
So far we have:

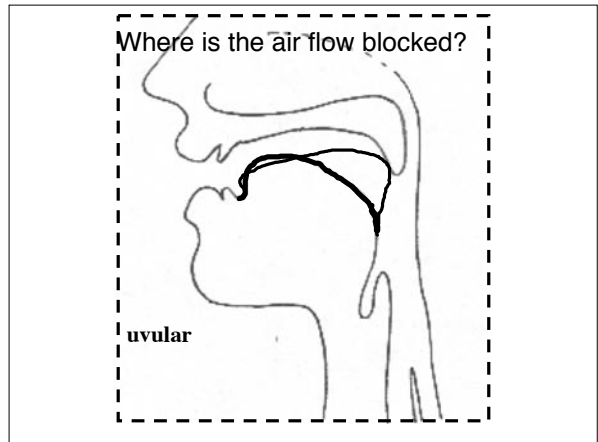
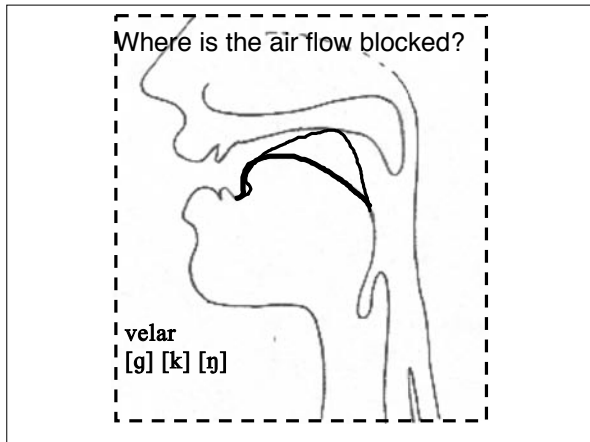
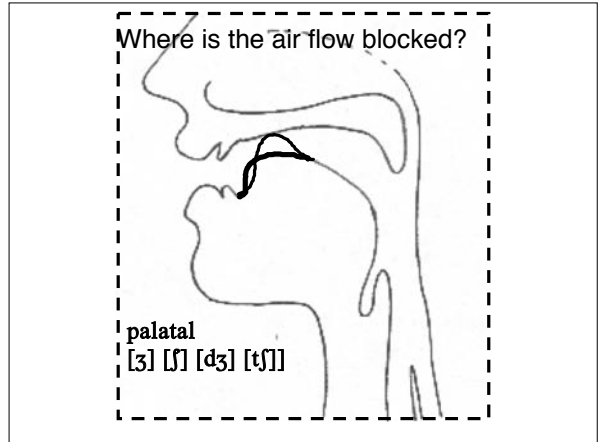
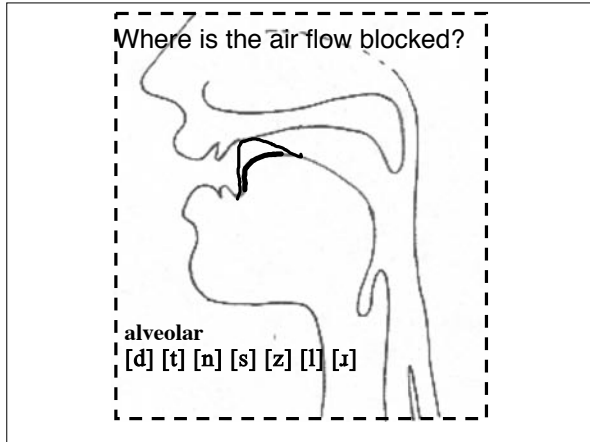
Nasal stop:  
[ŋ]

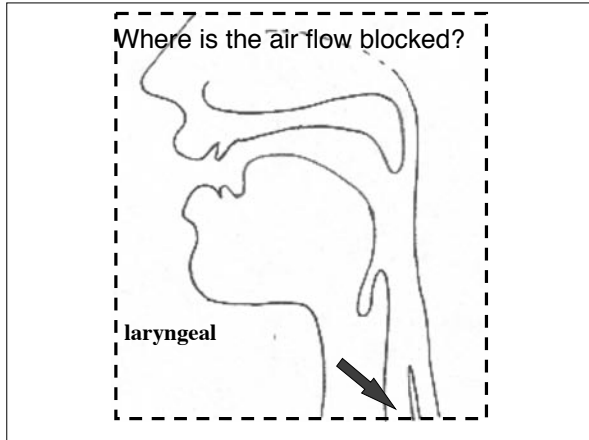
Non-nasal (oral) stops:  
[g] [k]

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] [ʃ] [dʒ] [tʃ]

Palatal Fricatives - [ç] [ʃ]  
 [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 shoes?")  
 [tʃ]

Said fast, this sounds like "Whachoos?"

What are the vocal folds doing?

## 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

	ll-lllll	llll-lllll	lllll-lllll	ll-lllll	llllll	llllll	llllll
llllll	■			■		■	■
llllll	■			■		■	
llllllll		■	■	■	■		■
llllllll		■	■	■	■		
llllll				■	■	■	
llllll				■	■	■	
llllll				■	■	■	

	ll-lllll	llll-lllll	lllll-lllll	ll-lllll	llllll	llllll	llllll
llllll	■			■		■	■
llllll	■			■		■	
llllllll		■	■	■	■		■
llllllll		■	■	■	■		
llllll				■	■	■	
llllll				■	■	■	
llllll				■	■	■	

“Fuji”  
“Cuba”

	ll-lllll	llll-lllll	lllll-lllll	ll-lllll	llllll	llllll	llllll
llllll	■			■		■	■
llllll	■			■		■	
llllllll		■	■	■	■		■
llllllll		■	■	■	■		
llllll				■	■	■	
llllll				■	■	■	
llllll				■	■	■	

“año”

	ll-lllll	llll-lllll	lllll-lllll	ll-lllll	llllll	llllll	llllll
llllll	■			■		■	■
llllll	■			■		■	
llllllll		■	■	■	■		■
llllllll		■	■	■	■		
llllll				■	■	■	
llllll				■	■	■	
llllll				■	■	■	

“Bach”  
“agua”

	bilabial	labiodental	labial-velar	labial-uvular	labial-uvular	labial-uvular	labial-uvular	labial-uvular	labial-uvular
voiced stop	■			■		■		■	■
voiceless stop	■			■		■		■	■
nasal	■	■	■	■	■	■	■	■	■
lateral fricative					■				
lateral approximant					■				
lateral approximant					■				
lateral approximant					■				
lateral approximant					■				
lateral approximant					■				
lateral approximant					■				

**“caballo”**

	bilabial	labiodental	labial-velar	labial-uvular	labial-uvular	labial-uvular	labial-uvular	labial-uvular	labial-uvular
voiced stop	■			■		■		■	■
voiceless stop	■			■		■		■	■
nasal	■	■	■	■	■	■	■	■	■
lateral fricative					■				
lateral approximant					■				
lateral approximant					■				
lateral approximant					■				
lateral approximant					■				
lateral approximant					■				
lateral approximant					■				

### 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	ʙ			ʀ					ʀ		
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				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)

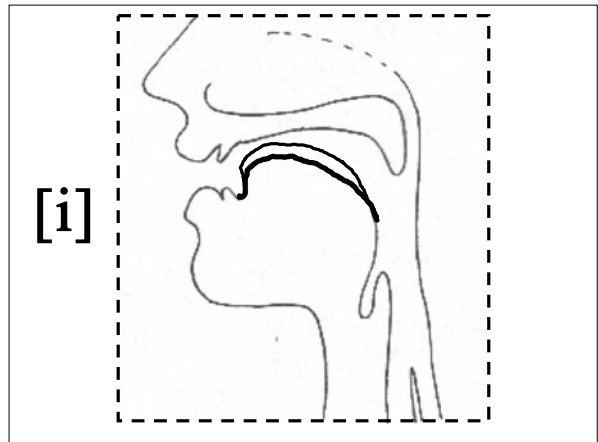
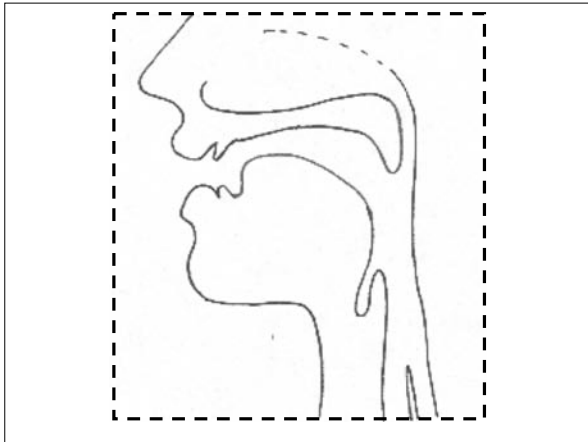
CONSONANTS (PULMONIC)

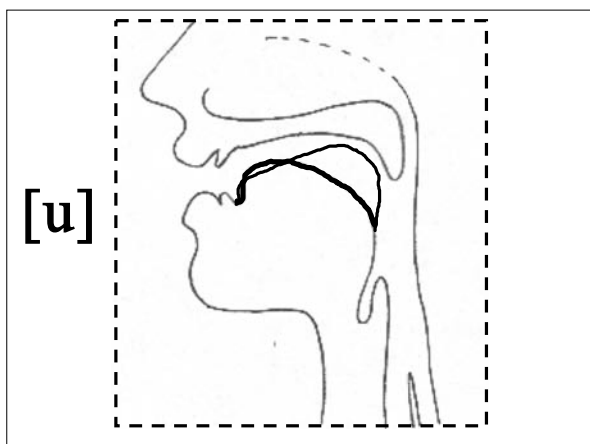
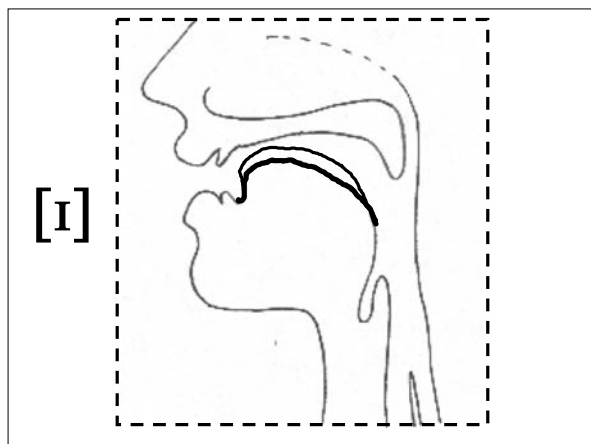
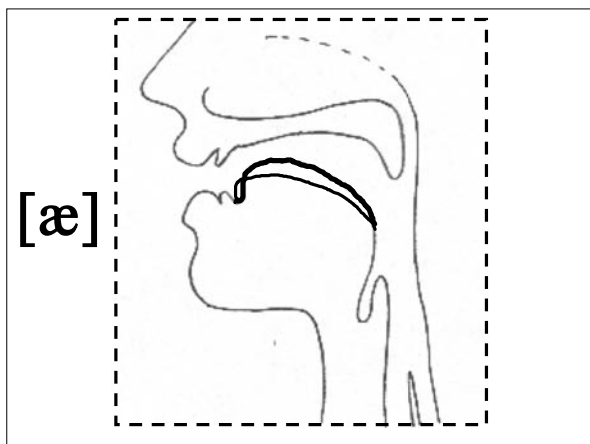
	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	p b			t d				k ɡ			ʔ
Nasal	m			n			ɲ	ŋ			
Trill											
Tap or Flap				ɾ							
Fricative		f v	θ ð	s z	ʃ ʒ		ç ʝ	x ɣ	χ ʁ	ħ ʕ	h ɦ
Lateral fricative											
Approximant				ɹ			j	ɰ			
Lateral 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"  
**I** "ship, slip"

So what vowels do you have?

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

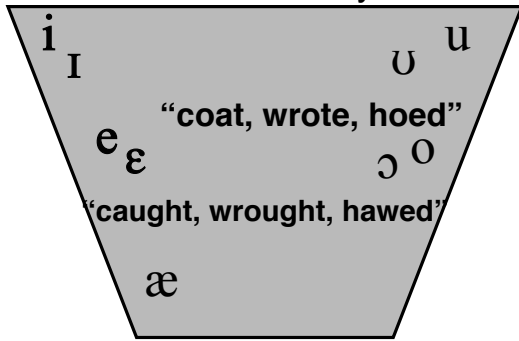
So what vowels do you have?

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

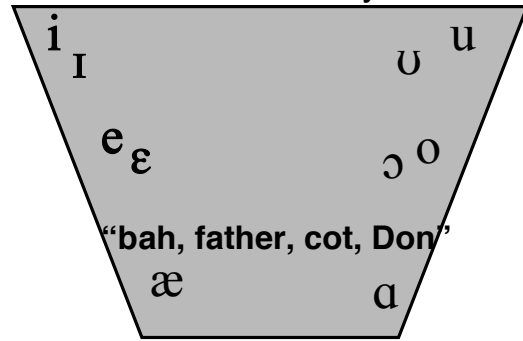
So what vowels do you have?

**i** "Luke, who'd, suit" **u**  
**I** "look, hood, soot" **U**  
**e**  
**ɛ**  
**æ**

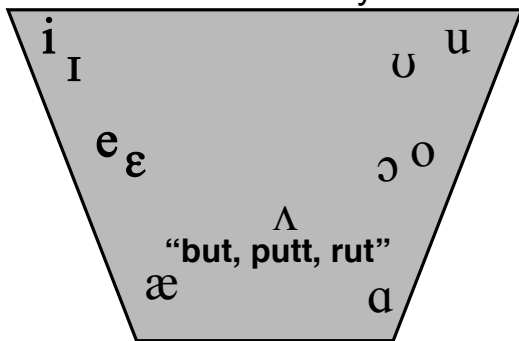
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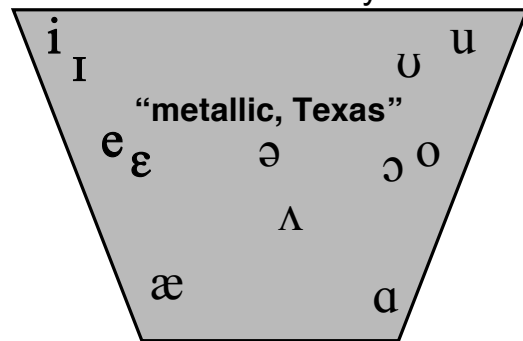
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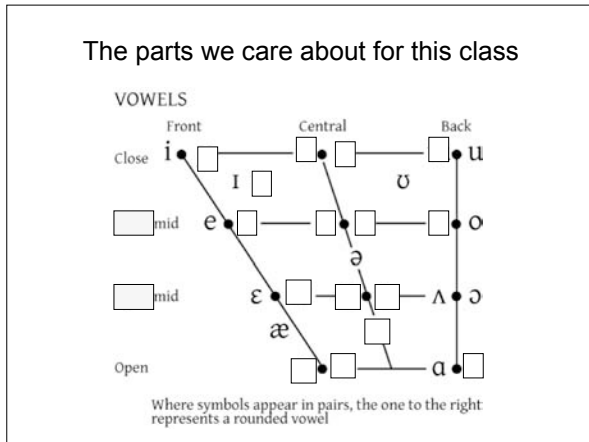
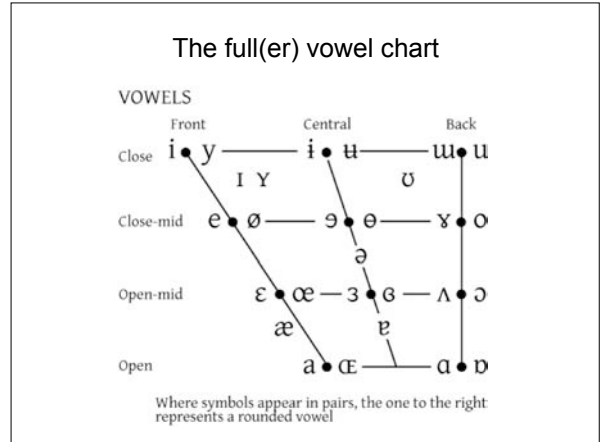
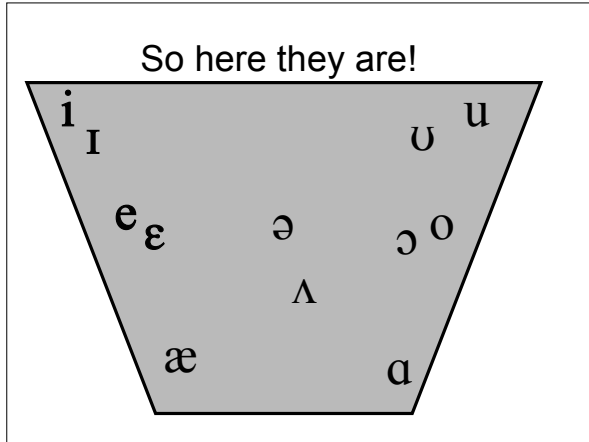


So what vowels do you have?



So what vowels do you have?





Cross-language Differences

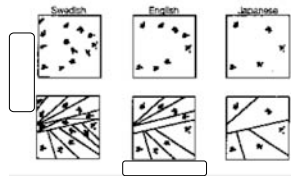
**Feature Combinations**

- 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])

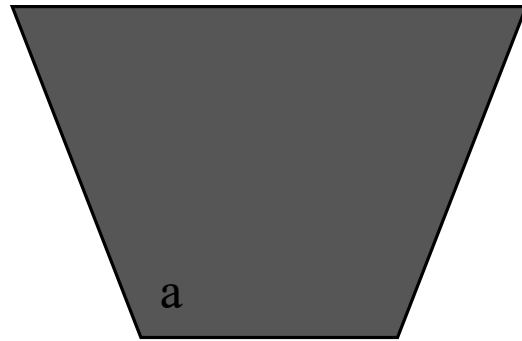
Many languages distinguish short and long vowels (unlike English), ex: Japanese [i] vs. [i:]

### Cross-language Differences

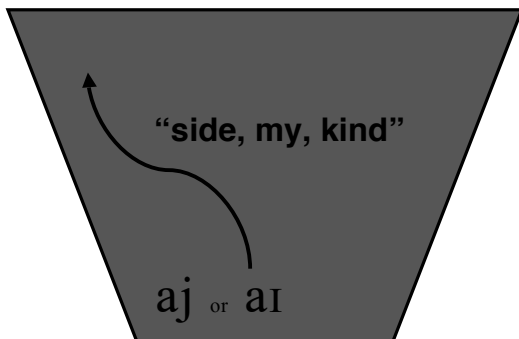


Languages carve up the acoustic space in different ways. Children find these categories, based on the distributions of sounds they hear in their linguistic environment (statistical learning).

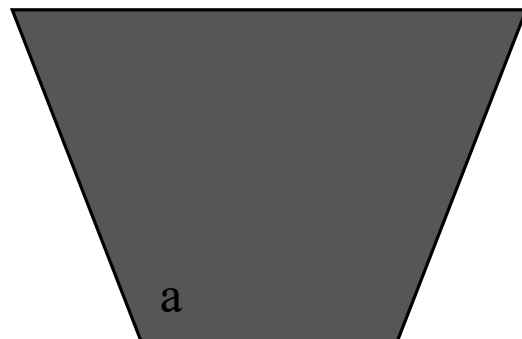
### Diphthongs: Two vowel-ish sounds together



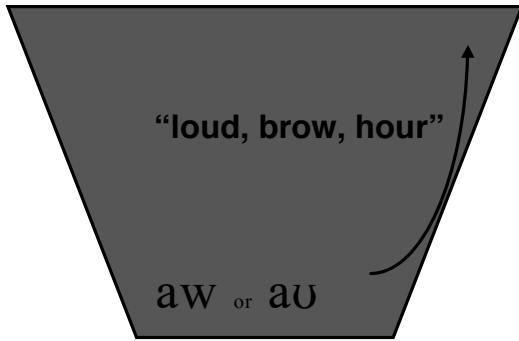
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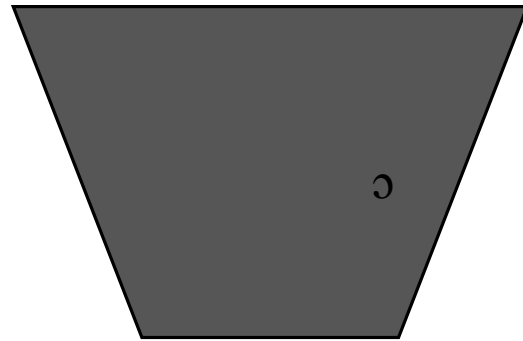
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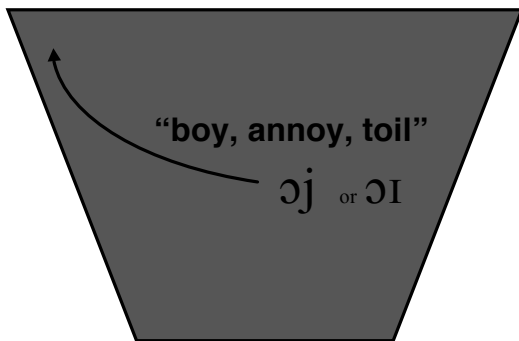
Diphthongs: Two vowel-ish sounds together



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
Close	i	ɪ	u
Near-close	e		ɔ
Close-mid	e <sup>h</sup>		ɔ <sup>h</sup>
Mid	ɛ	ɪ	
Open-mid	ɛ	ɪ	ɔ
Near Open	ɛ		ɔ

Depending on one's analysis, people who merge the vowels of *cot* and *caught* to /ɔ/ either in /ɔʊ/ and /ɔɪ/, but since all accents with *cot* and *caught* merged to /ɔ/ have also merged in these cases, the /ɔ/ before /r/ can be analyzed as an allophone of /ɔ/. /ɪ/ and /e/ are often unstressed syllables. Since the occurrence of /ɛ/ is mostly predictable, it need not be coded. Among speakers who distinguish between /ɔ/ and /ɔɪ/, the vowel of *cot* (usually transcribed as closer to [ɔ])<sup>11</sup>. Among *cot-caught* merged speakers, /ɔ/ usually remains a back vowel, [ɔ], as /ɔ/, their retracted allophones for /ɔ/ may be identical to the lowered allophones of /ɔ/ 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	ɪ e <sup>h</sup>	ɔ
Opener component is rounded	ɔ	ɔ <sup>h</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?

