

LSci 51/Psych 56L:  
Acquisition of Language

Lecture 8  
Phonological development I

# Announcements

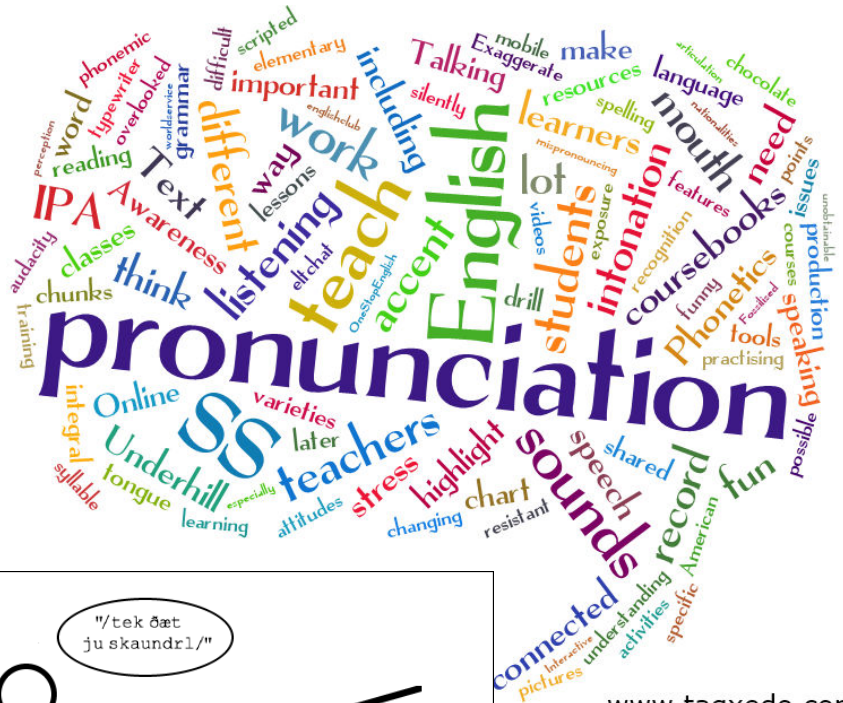
Make sure you understand any questions you didn't get correct on the first midterm.

Review questions for phonological development available

HW3 available (due 10/28/19)

All kinds of useful sound charts available (including interactive ones, in case you forget what sound corresponds to what symbol).

# Sounds of Language



www.tagxedo.com

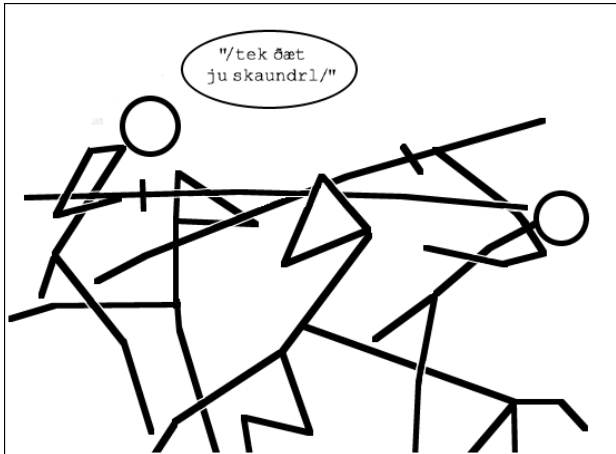


"Why do I have to keep writin' in these K's when they don't make any noise anyway?"

<http://languagelog ldc.upenn.edu/nll/?p=3946>

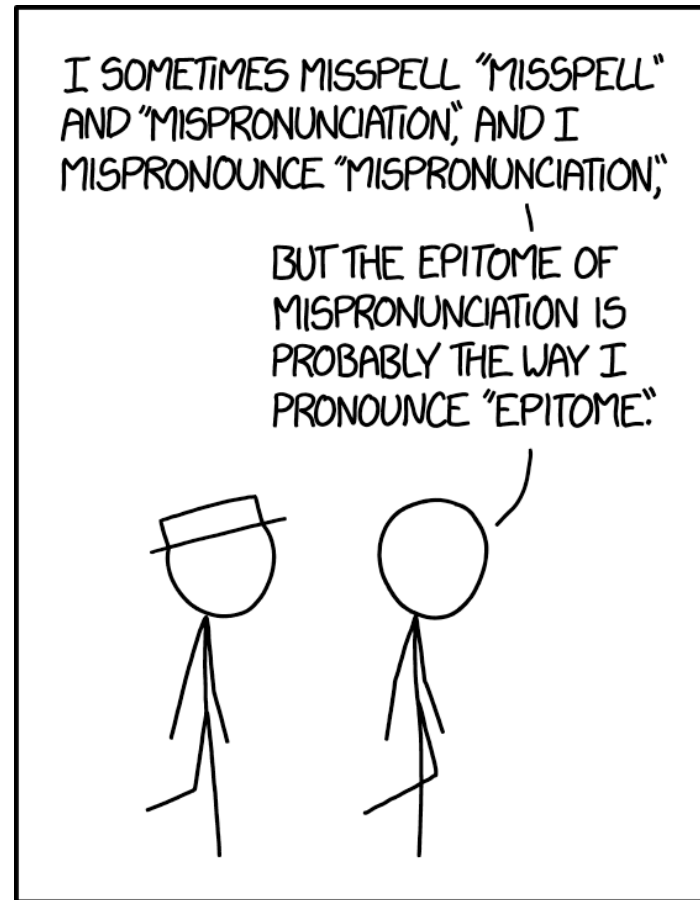
THERE IS A SOUND CALLED A "GLOTTAL STOP," WHICH IS MADE BY HALTING AIR FLOW WITH YOUR GLOTTIS. IN ENGLISH, WE OFTEN ASSOCIATE IT WITH THE COCKNEY ACCENT AND MID-WORD TS.

<p>GLOTTAL.</p> <p>STANDARD BRITISH</p>	<p>GLODDLE</p> <p>STANDARD AMERICAN</p>	<p>GLO'AL</p> <p>COCKNEY</p>
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<http://specgram.com/CLIII.1/09.parenchyma.cartoon.e.html>

# Spelling vs. Pronunciation



<https://xkcd.com/1816/>

Forget Spelling!

Sounds ≠ Spelling

[Extra]

# Forget spelling

<https://www.youtube.com/watch?v=XTzkT3j9pHI>

<http://www.thelingspace.com/episode-12>

beginning through 2:27



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 letters

h <u>e</u>	e	se <u>a</u> s	ea
bel <u>ie</u> ve	ie	am <u>oe</u> ba	oe
Ca <u>e</u> sar	ae	key	ey
se <u>e</u>	ee	mach <u>i</u> ne	i
pe <u>o</u> ple	eo	se <u>i</u> ze	ei

International **P**honic **A**lphabet: **[i]**

## One sound – Many letters

too

oo

threw

ew

to

o

lieu

ieu

clue

ue

shoe

oe

through

ough

beatiful

eau

**IPA:** [u]

## One sound – Many letters

<u>sh</u> oot	ʃ
ei <u>th</u> er	ð
<u>ch</u> aracter	k
de <u>a</u> l	i
<u>Th</u> omas	t
<u>ph</u> ysics	f
rou <u>gh</u>	f

## One letter – 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
m <u>a</u> ny	ɛ

# One letter – Not one sound

**m**nemonic

**p**psychology

res**ign**

g**h**ost

i**s**land

**w**hole

de**bt**

= **no sound!**

cute **kj**uwt

= **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

# [Extra] Why we need the IPA

<https://www.youtube.com/watch?v=XTzkT3j9pHI>

<http://www.thelingspace.com/episode-12>

2:27-5:27, 8:42-9:05



# International Phonetic Alphabet

## One symbol per sound



### THE INTERNATIONAL PHONETIC ALPHABET (revised to 2005)

#### CONSONANTS (PULMONIC)

© 2005 IPA

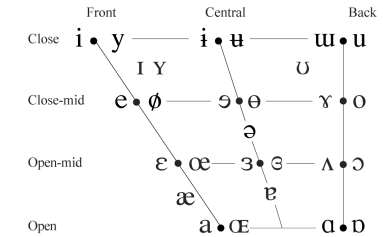
	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	p b			t d		ʈ ɖ	c ɟ	k ɡ	q ɢ		ʔ
Nasal	m	ɱ		n		ɳ	ɲ	ŋ	ɴ		
Trill				ʀ					ʀ		
Tap or Flap		ⱱ		ɾ		ɽ					
Fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç ʝ	x ɣ	χ ʁ	ħ ʕ	h ɦ
Lateral fricative				ɬ ɮ							
Approximant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

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

#### CONSONANTS (NON-PULMONIC)

Clicks	Voiced implosives	Ejectives
ʘ Bilabial	ɓ Bilabial	ʼ Examples:
ǀ Dental	ɗ Dental/alveolar	ɓ' Bilabial
ǃ (Post)alveolar	ɟ Palatal	ɗ' Dental/alveolar
ǁ Palatoalveolar	ɡ Velar	k' Velar
ǂ Alveolar lateral	ɠ Uvular	s' Alveolar fricative

#### VOWELS



#### OTHER SYMBOLS

ɱ Voiceless labial-velar fricative	ɕ ʑ Alveolo-palatal fricatives
ɰ Voiced labial-velar approximant	ɺ Voiced alveolar lateral flap
ɥ Voiced labial-palatal approximant	ɺ Simultaneous ʃ and x
ħ Voiceless epiglottal fricative	
ʕ Voiced epiglottal fricative	Affricates and double articulations can be represented by two symbols joined by a tie bar if necessary.
ʡ Epiglottal plosive	

kp ts

#### DIACRITICS

Diacritics may be placed above a symbol with a descender, e.g. ɲ̥

◌̥ Voiceless	◌̤ Breathy voiced	◌̦ Dental
◌̇ Voiced	◌̧ Creaky voiced	◌̨ Apical
◌̈ Aspirated	◌̩ Linguolabial	◌̪ Laminal
◌̊ More rounded	◌̫ Labialized	◌̬ Nasalized
◌̋ Less rounded	◌̭ Palatalized	◌̮ Nasal release
◌̌ Advanced	◌̯ Velarized	◌̰ Lateral release
◌̍ Retracted	◌̱ Pharyngealized	◌̲ No audible release
◌̎ Centralized	◌̳ Velarized or pharyngealized	
◌̏ Mid-centralized	◌̴ Raised	(ɹ̄ = voiced alveolar fricative)
◌̐ Syllabic	◌̵ Lowered	(β̵ = voiced bilabial approximant)
◌̑ Non-syllabic	◌̶ Advanced Tongue Root	
◌̒ Rhoticity	◌̷ Retracted Tongue Root	

#### SUPRASEGMENTALS

- ˈ Primary stress
- ˌ Secondary stress
- ː Long
- ˑ Half-long
- ˑ Extra-short
- ◌̥ 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             | ˥ or ˨ Falling        |
| ˥ Mid              | ˥ or ˨ High rising    |
| ˥ Low              | ˥ or ˨ Low rising     |
| ˥ Extra low        | ˥ or ˨ Rising-falling |
| ˥ Downstep         | ˥ or ˨ Global rise    |
| ˥ Upstep           | ˥ or ˨ Global fall    |



# Interactive chart of the International Phonetic Alphabet

<http://www.ipachart.com/>

Click on a symbol to hear the sound it represents.

## Pulmonic consonants

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

Where symbols appear in pairs, the one to the right represents a voiced consonant.  
Areas shaded grey indicate articulations judged impossible.

## Other symbols

ɱ	Voiceless labial-velar fricative
ɰ	Voiced labial-velar approximant
ɥ	Voiced labial-palatal approximant
ħ	Voiceless epiglottal fricative
ʕ	Voiced epiglottal fricative
ʡ	Epiglottal plosive
ɕ	Voiceless alveolo-palatal fricative
ʑ	Voiced alveolo-palatal fricative
ɻ	Alveolar lateral flap
ɣ̞	Simultaneous ʃ and x

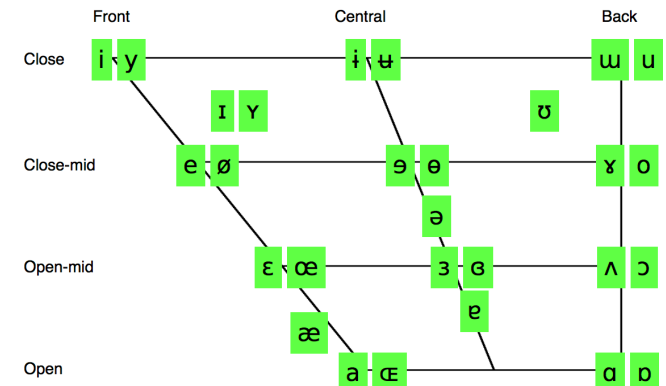
## Affricates

ɬɕ	Voiceless alveolar affricate
ɬʃ	Voiceless palato-alveolar affricate
ɬʈ	Voiceless alveolo-palatal affricate
ɬʂ	Voiceless retroflex affricate
ɖʒ	Voiced alveolar affricate
ɖʐ	Voiced post-alveolar affricate
ɖʑ	Voiced alveolo-palatal affricate
ɖʐ̠	Voiceless retroflex affricate

## Non-pulmonic consonants

Clicks	Voiced implosives	Ejectives
ɔ Bilabial	ɓ Bilabial	ɓ' Bilabial
ɔ̣ Dental	ɗ Dental/alveolar	ɗ' Dental/alveolar
ɔ̣! (Post)alveolar	ɟ Palatal	ɟ' Velar
ɔ̣ɰ Palatoalveolar	ɠ Velar	ɠ' Alveolar fricative
ɔ̣   Alveolar lateral	ɠ Uvular	' etc...

## Vowels

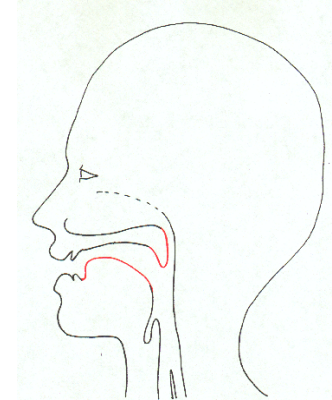


Where symbols appear in pairs, the one to the right represents a rounded vowel.

# Sounds: Speech production

**“Speech is a river of breath, bent into hisses and hums by the soft flesh of the mouth and throat.”**

- Pinker, *The Language Instinct*



**“Speech production is an invisible ballet that requires precise and rapid coordination of the many muscle groups that control the lips, tongue, jaw, larynx, and respiration.”**

- Myers 2017

## Wind Instruments



# Sounds: The vocal tract as an instrument

[Extra]

[https://www.ted.com/talks/tom\\_thum\\_the\\_orchestra\\_in\\_my\\_mouth?language=en](https://www.ted.com/talks/tom_thum_the_orchestra_in_my_mouth?language=en)

**0:45-2:14, 3:25-3:41, 4:43-6:20**



# Sounds: Vocal tract overview

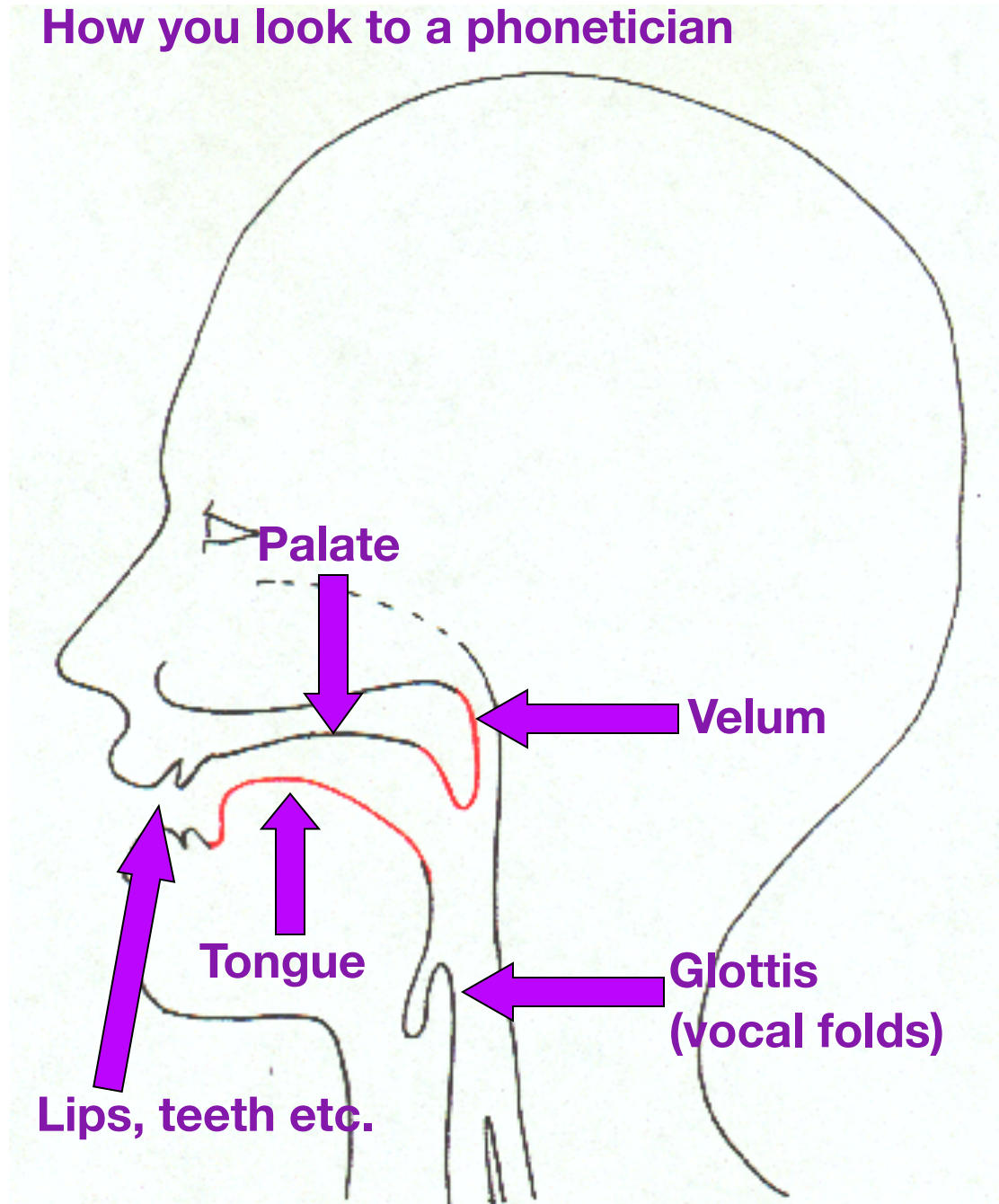
<https://www.youtube.com/watch?v=dtf8zGQj9GY>

<http://www.thelingspace.com/episode-4>

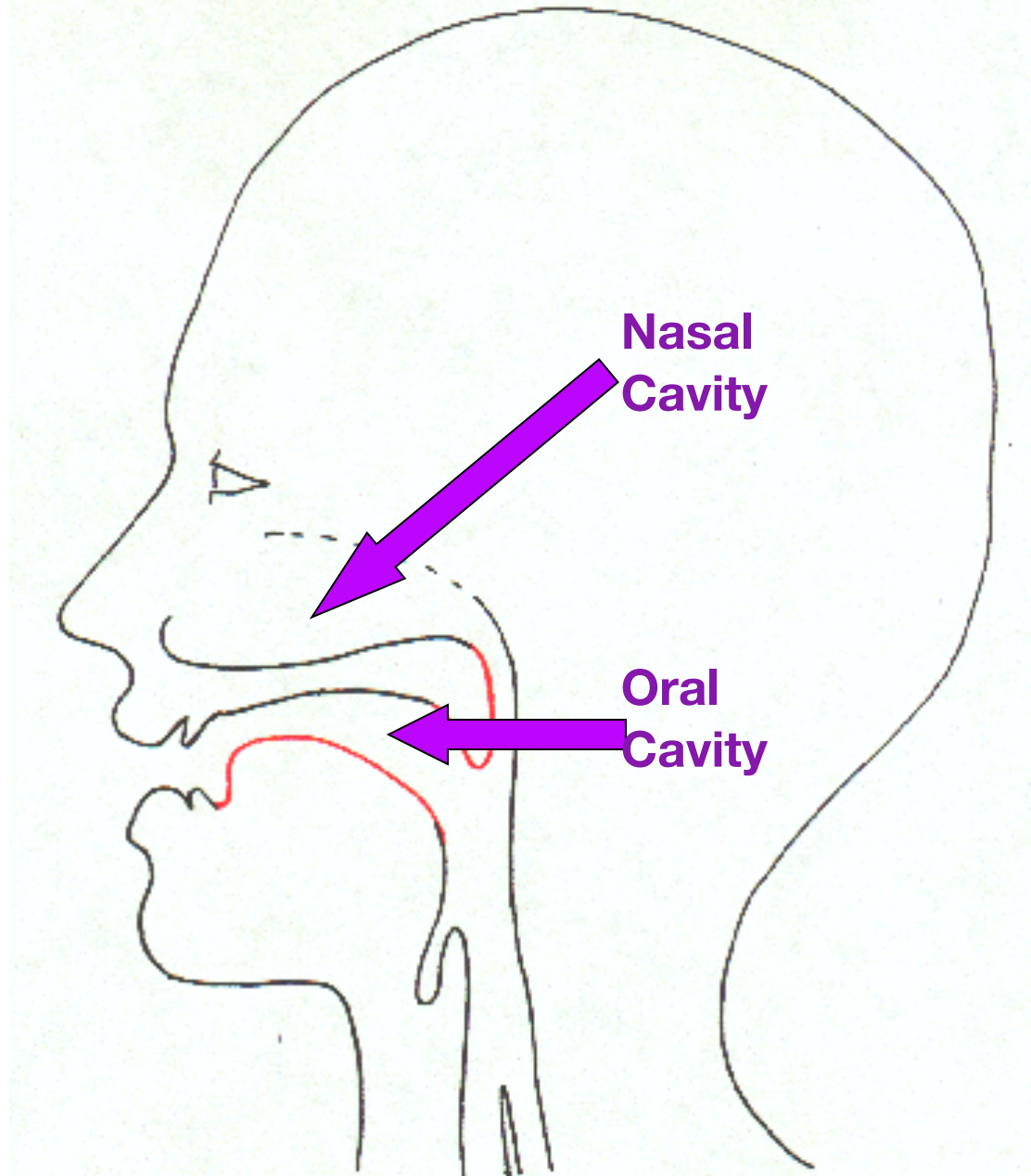
0:38 through 1:17



**[Extra] 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).

# Consonants

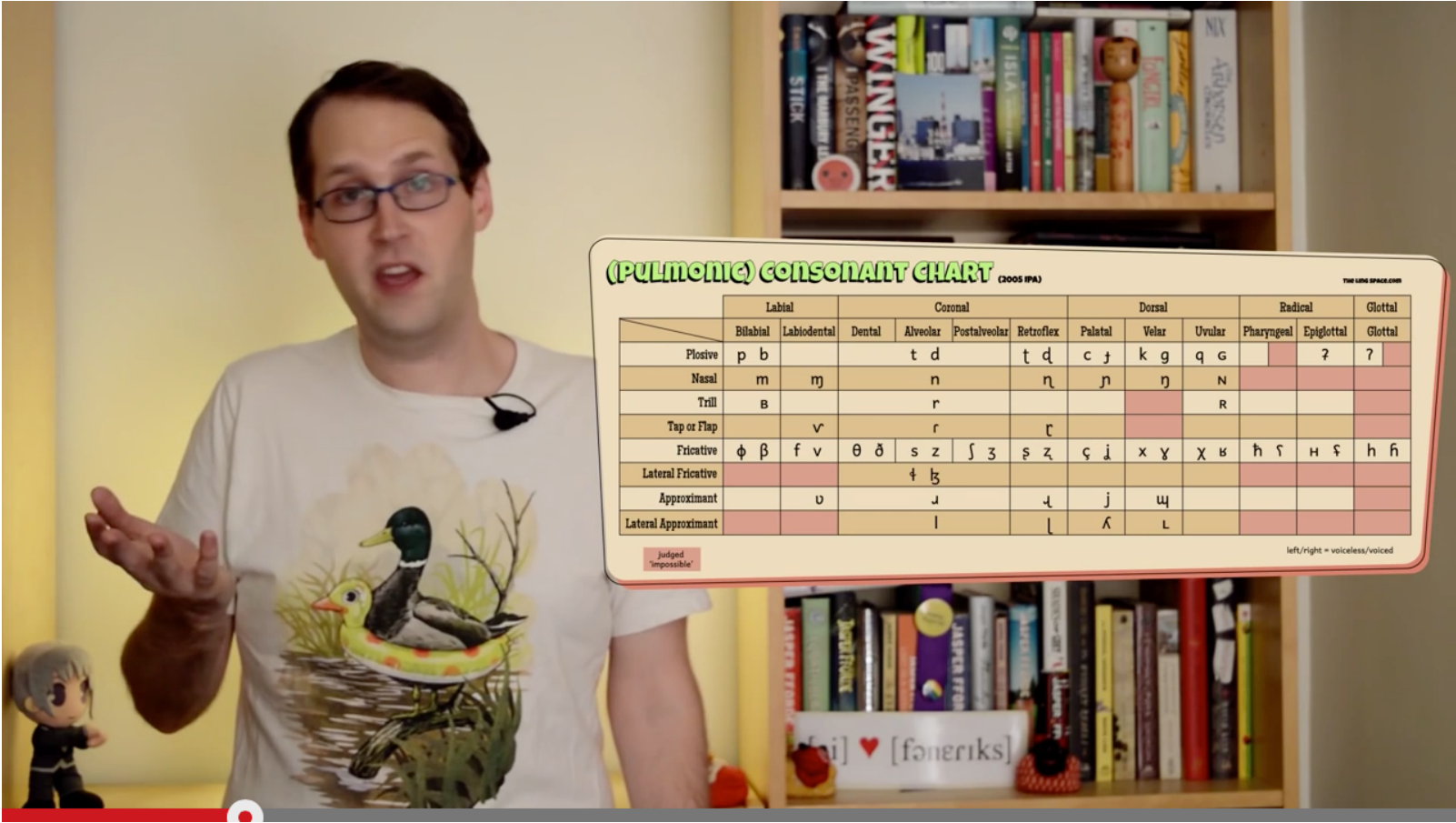


# Place of articulation: Where the airflow is blocked

<https://www.youtube.com/watch?v=zEaPQP3pXQc>

<http://www.thelingspace.com/episode-20>

beginning through 5:53



**(PULMONIC) CONSONANT CHART** (2005 IPA)

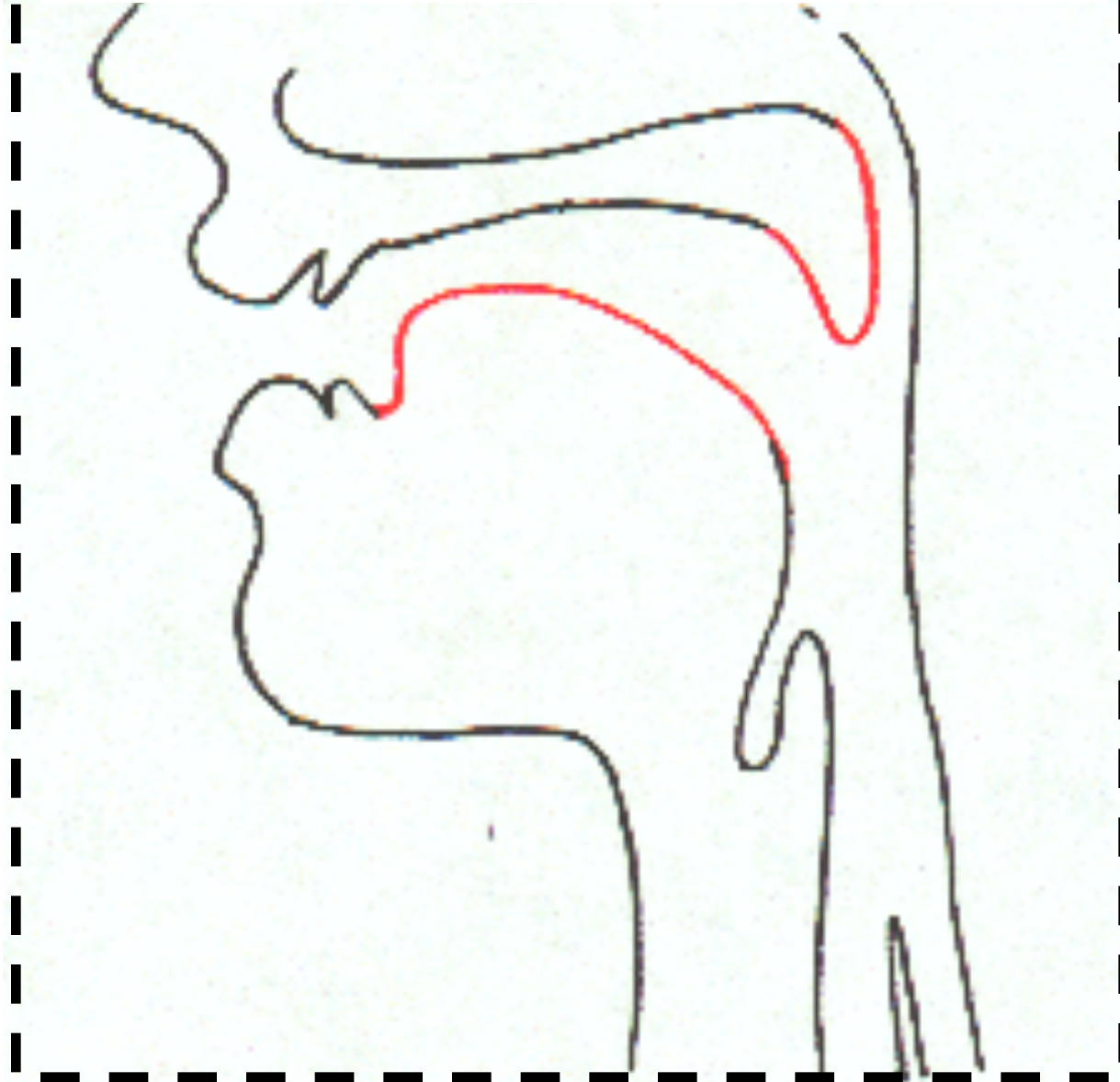
	Labial		Coronal					Dorsal			Radical		Glottal
	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Epiglottal	Glottal	
Plosive	p b			t d		ʈ ɖ	c ɟ	k ɡ	q ɢ		ʔ	ʔ	
Nasal	m	ɱ		n		ɳ	ɲ	ŋ	ɴ				
Trill	ʙ			ʀ					ʀ				
Tap or Flap		ⱱ		ɾ		ɽ							
Fricative	ɸ β	f v	θ ð	s z	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					

Judged "impossible"

left/right = voiceless/voiced

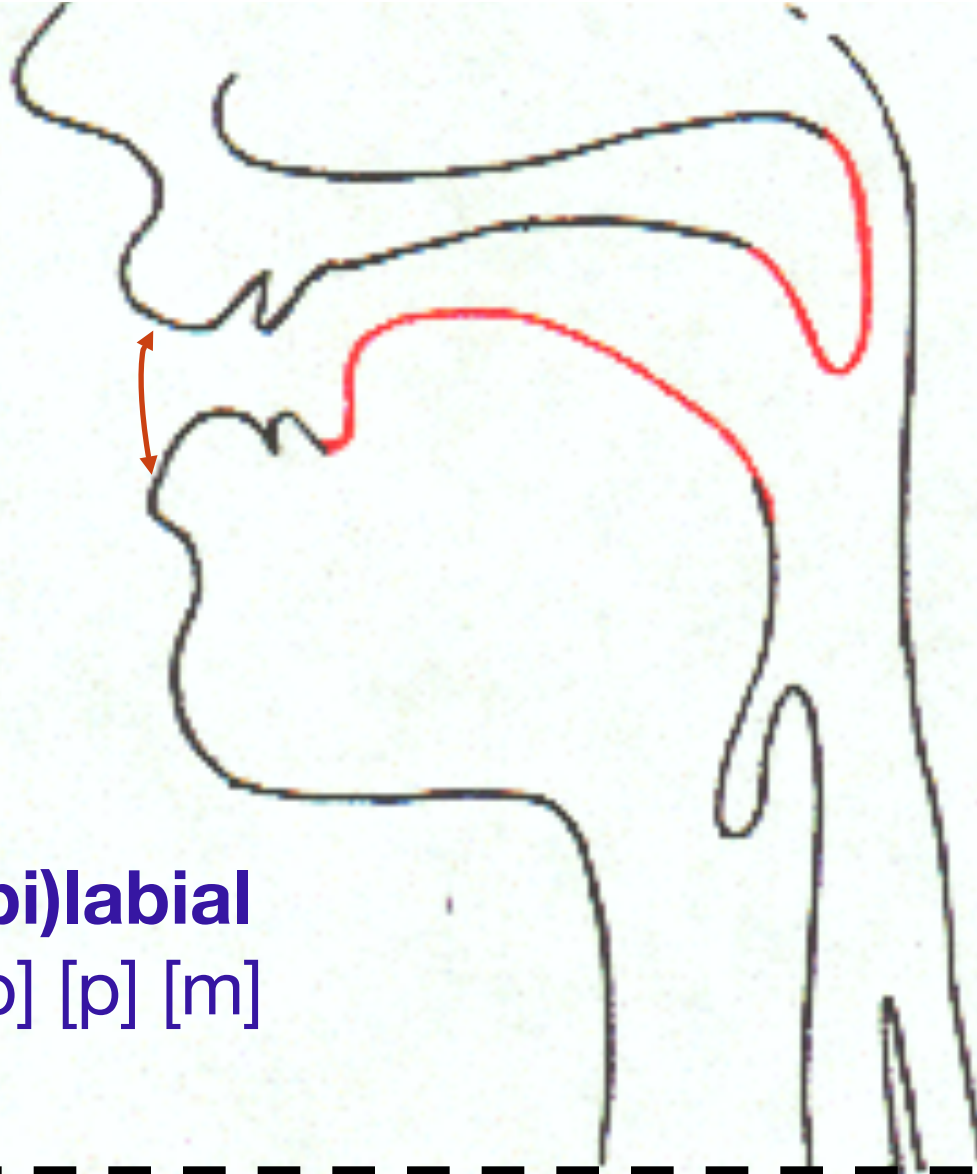
[Extra]

Where is the air flow blocked?



[Extra]

Where is the air flow blocked?

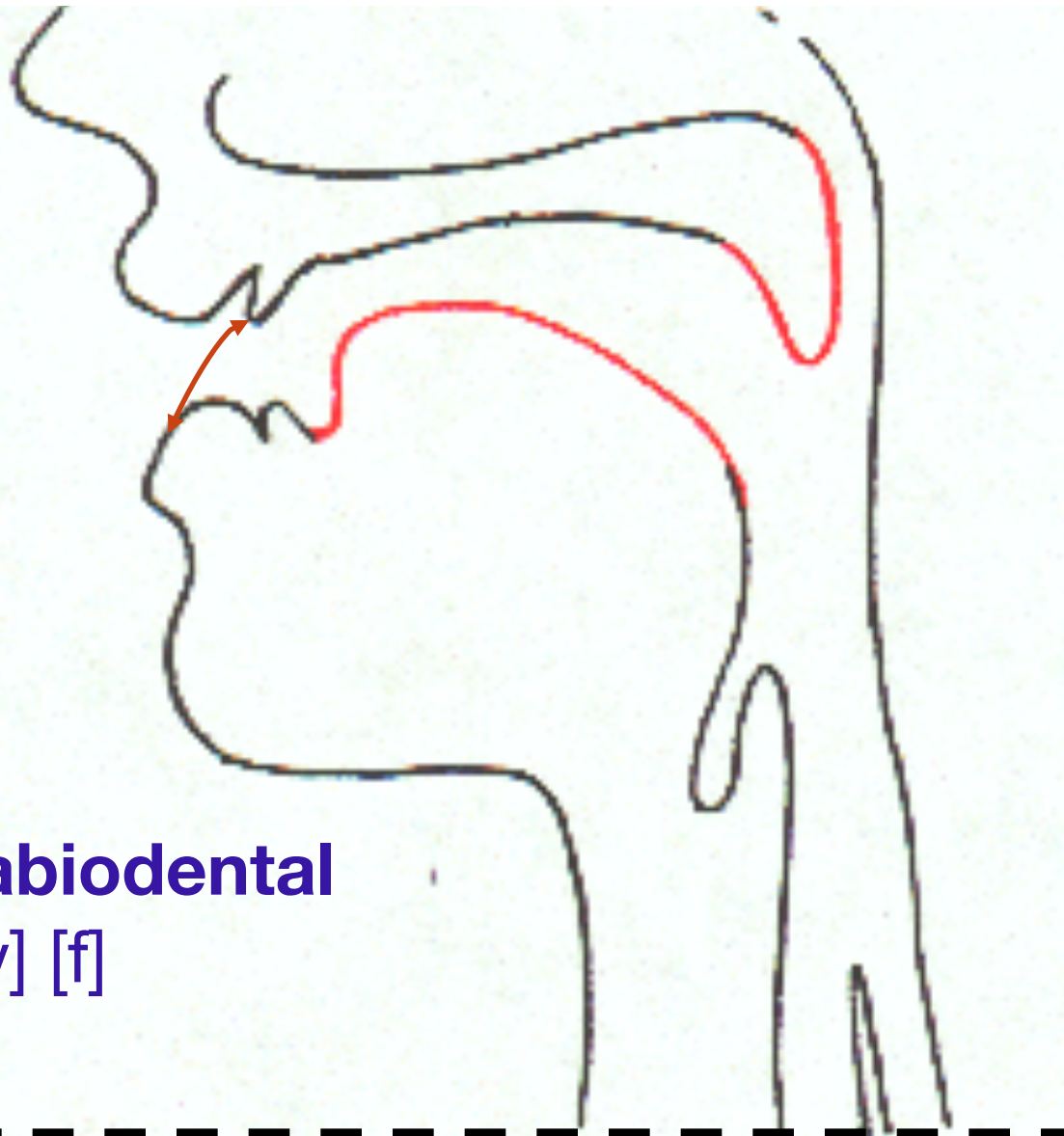


**(bi)labial**

[b] [p] [m]

[Extra]

Where is the air flow blocked?

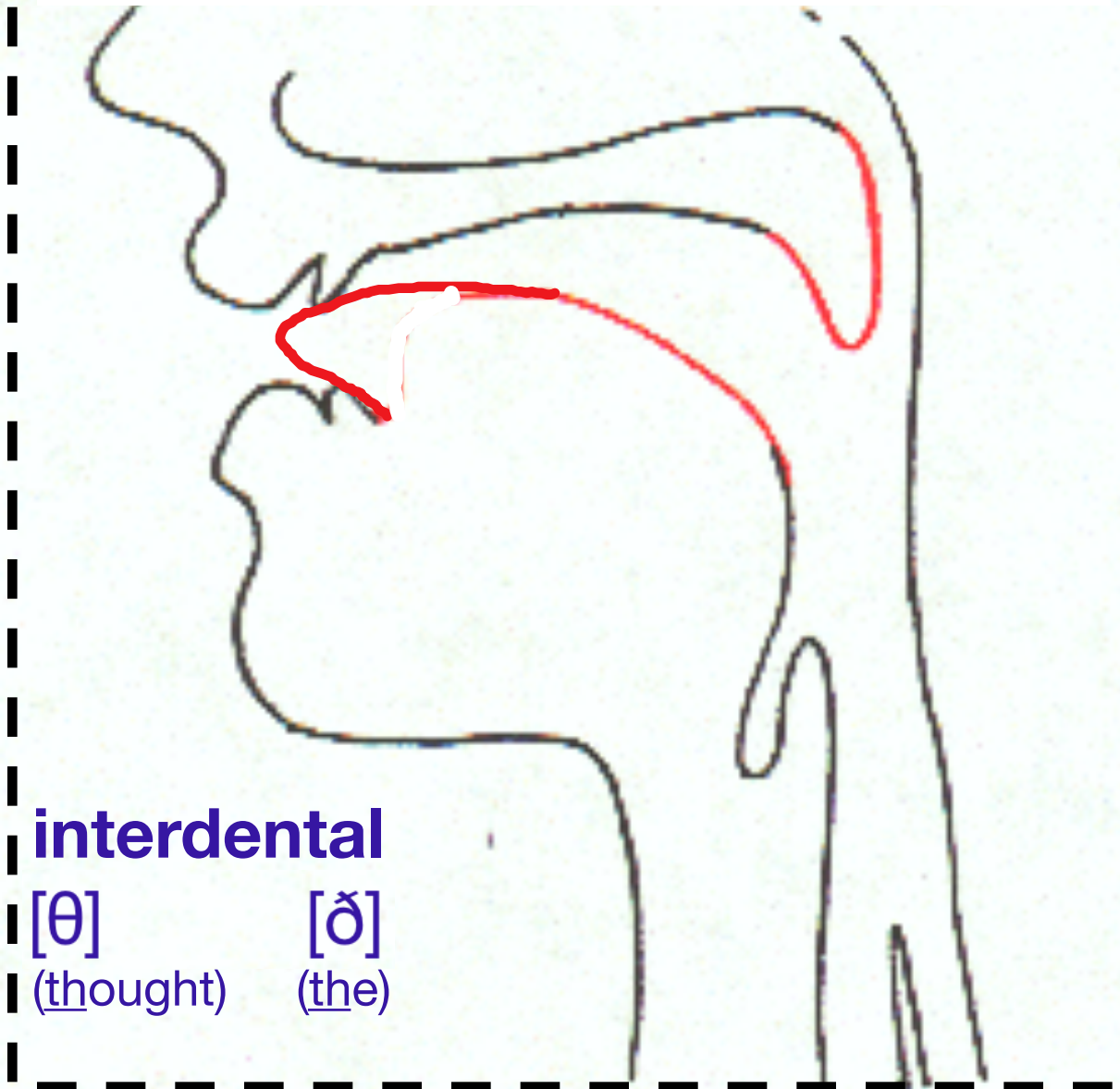


**labiodental**

[v] [f]

[Extra]

Where is the air flow blocked?



**interdental**

[θ]

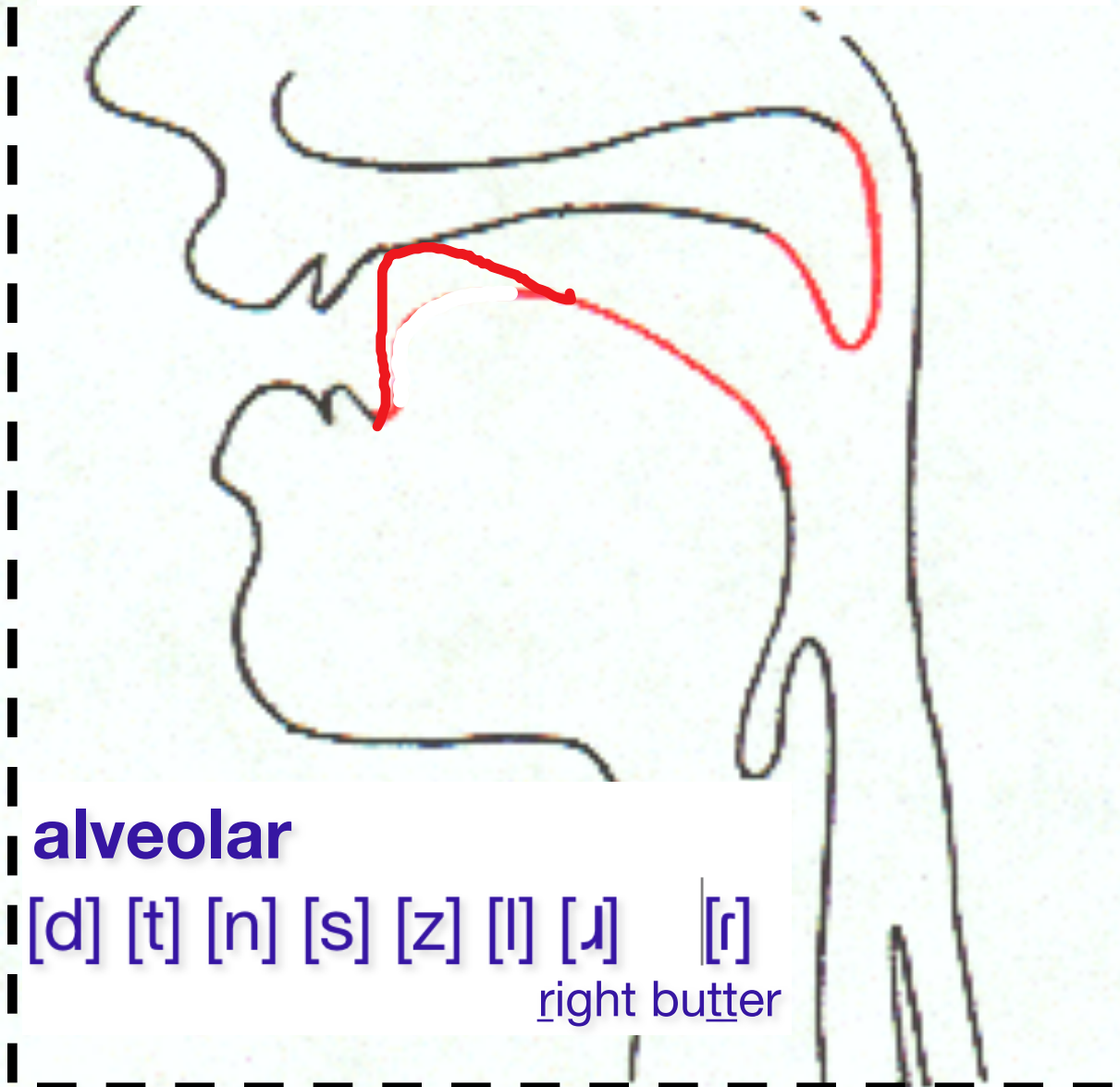
(thought)

[ð]

(the)

[Extra]

Where is the air flow blocked?



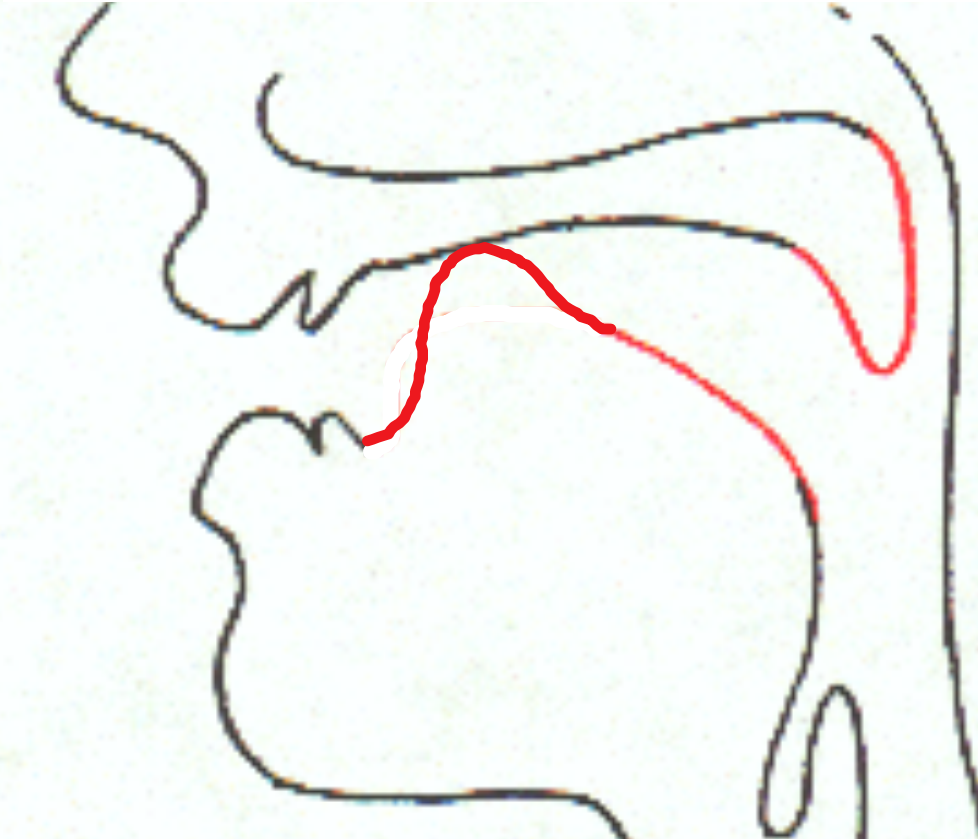
**alveolar**

[d] [t] [n] [s] [z] [l] [ʀ] [r]

right butter

[Extra]

Where is the air flow blocked?



postalveolar and palatal

[ʒ]

[ʃ]

[dʒ]

[tʃ]

[j]

azure sht

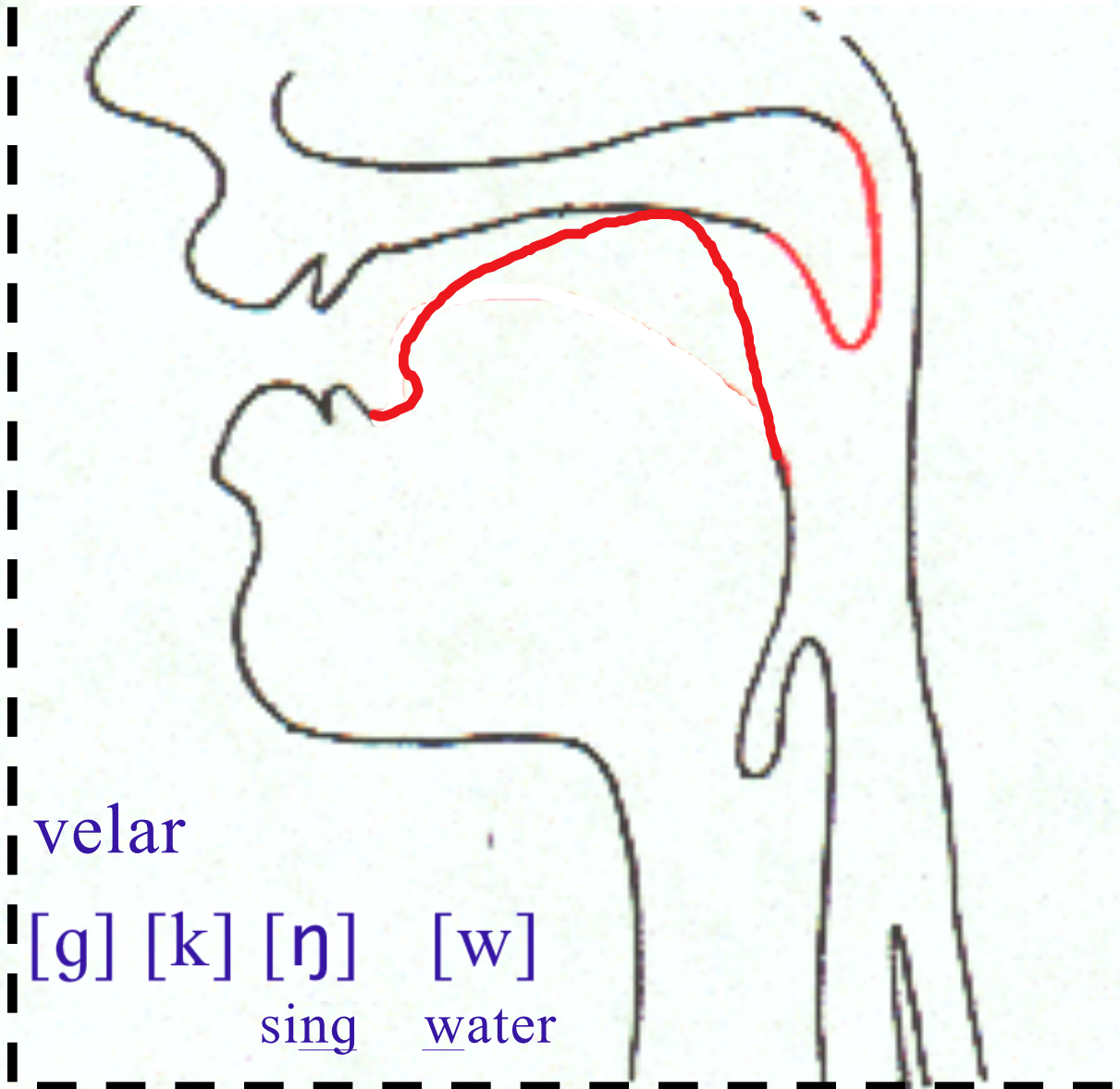
judge

church

yo

[Extra]

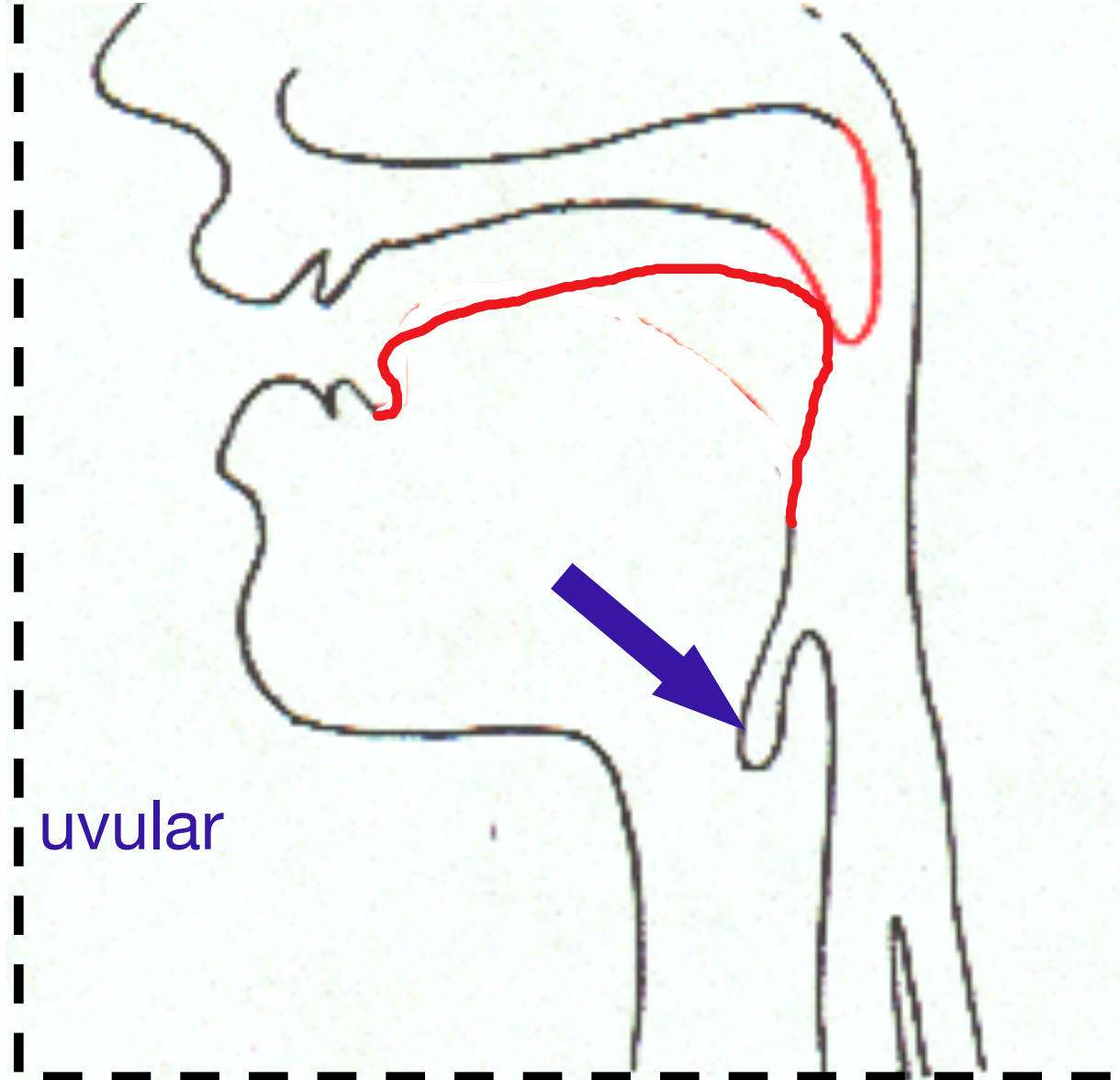
Where is the air flow blocked?





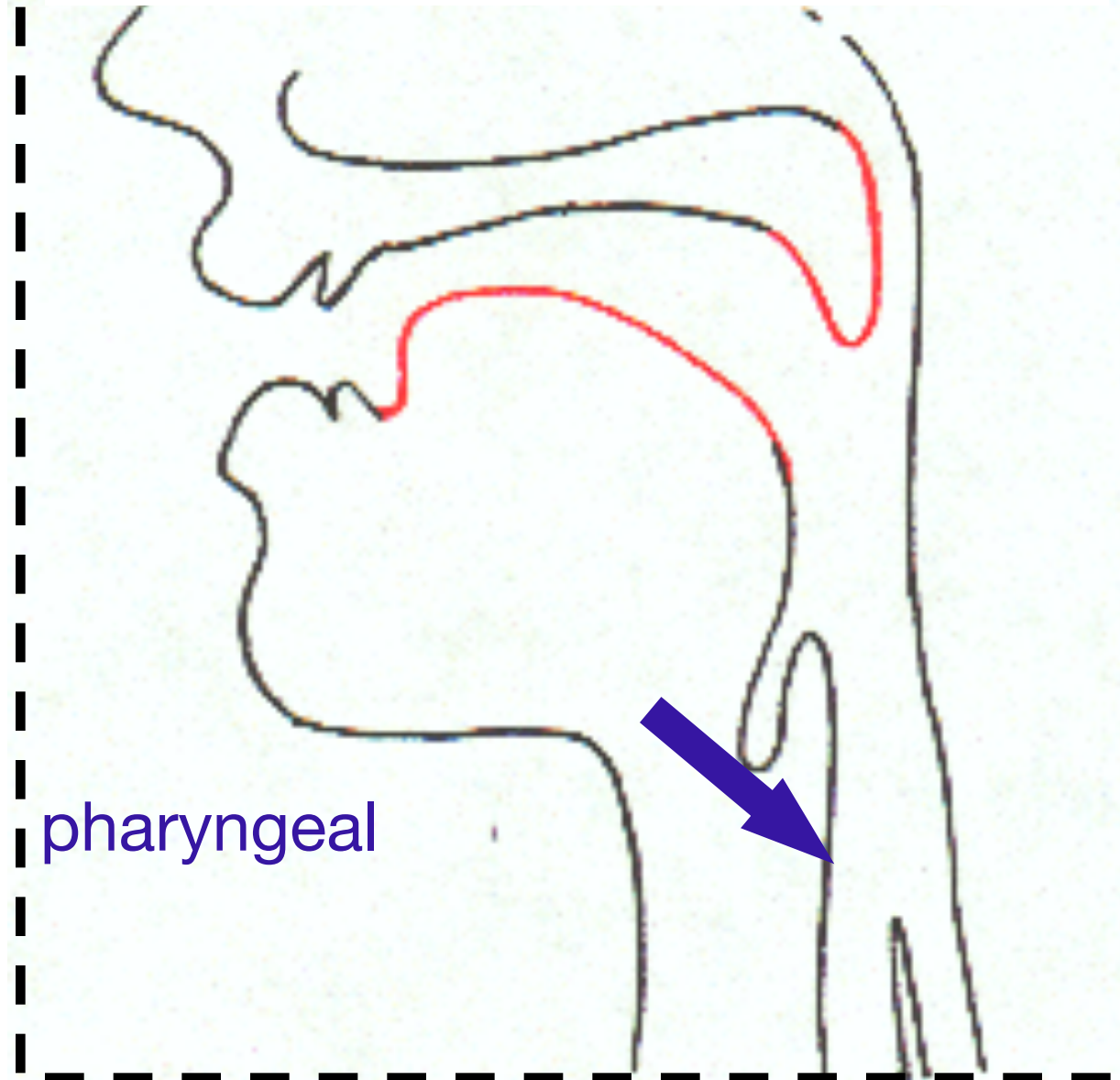
[Extra]

Where is the air flow blocked?



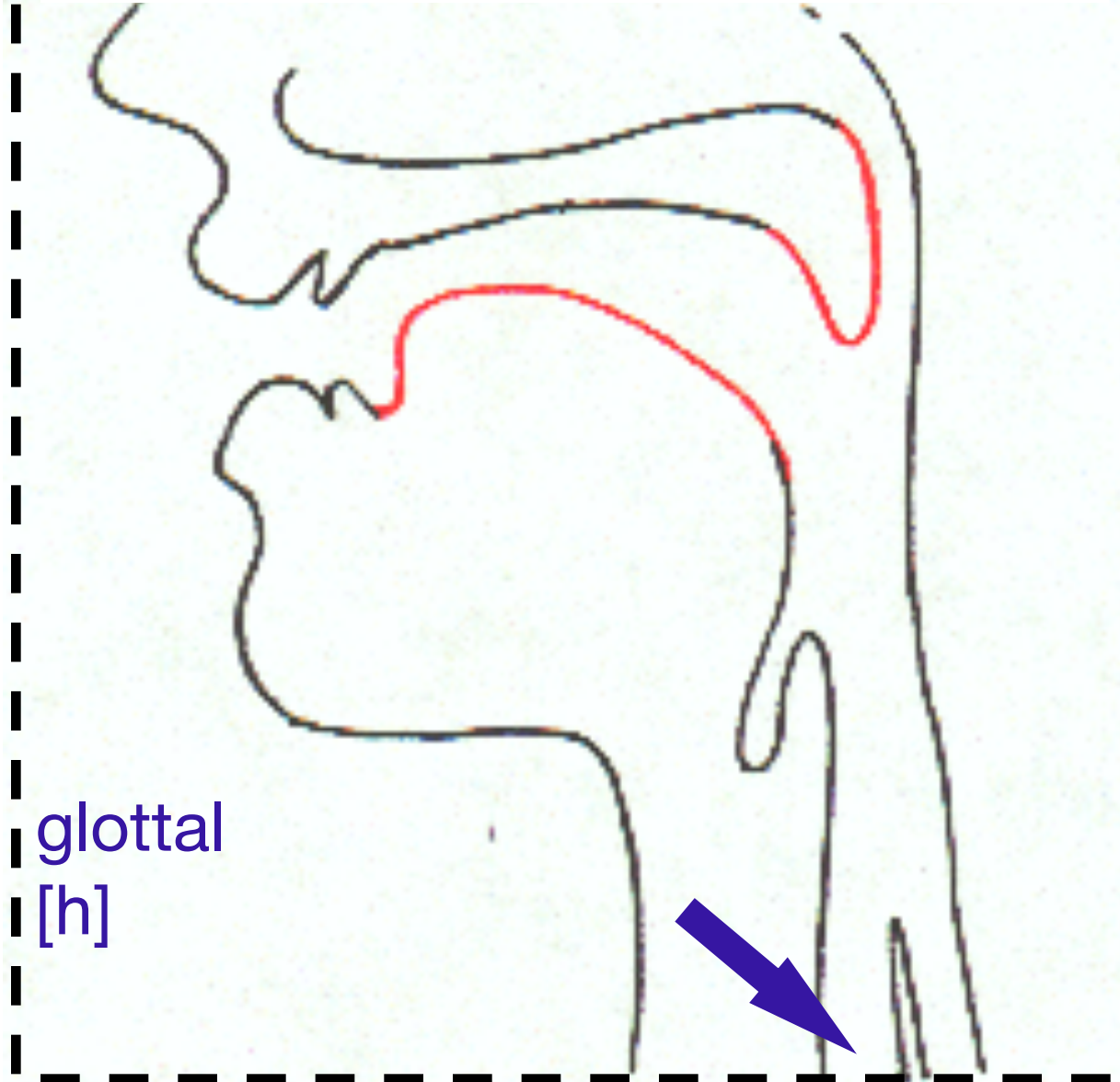
[Extra]

Where is the air flow blocked?



[Extra]

Where is the air flow blocked?



glottal  
[h]

# Manner of articulation: How the airflow is blocked

<https://www.youtube.com/watch?v=zEaPQP3pXQc>

<http://www.thelingspace.com/episode-20>

5:54 - 9:19

Nasals

Nasal	m	ŋ	n	ŋ	ɲ	ŋ	ŋ	N			
-------	---	---	---	---	---	---	---	---	--	--	--

[ni] ♥ [fəneɪks]

# Manner: How the air is flowing

**Stops** (sometimes called plosives)

[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**

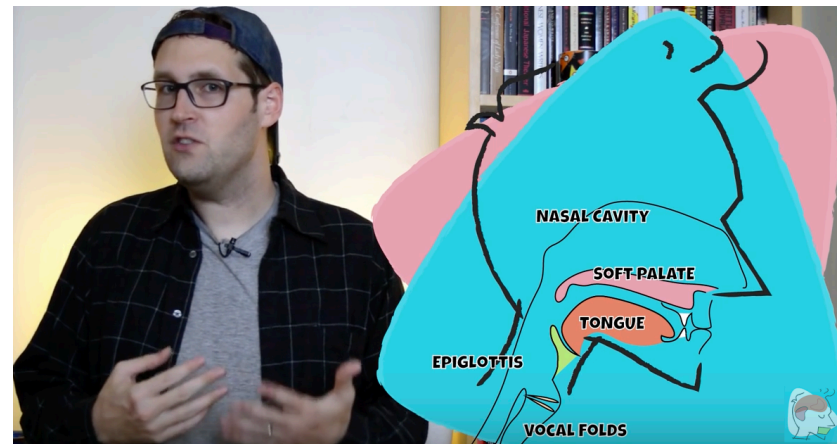
[ɾ] (Like in “water” and “butter”)

## [Extra] The acoustics of sonorants

<https://www.youtube.com/watch?v=g8BgfHEDbFY&feature=youtu.be>

especially 1:11 - 1:46 (intro to sonorants)

2:34 - 3:37 (producing nasals)



# Fricatives & Affricates

Postalveolar sounds [ʒ] [ʃ]  
(fricatives)

Palatal sounds [dʒ] [tʃ]  
(affricates)

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

Ex: affricates in fast speech:

“What should...?”  
[t ʃ]  
becomes  
“Whachould...?”

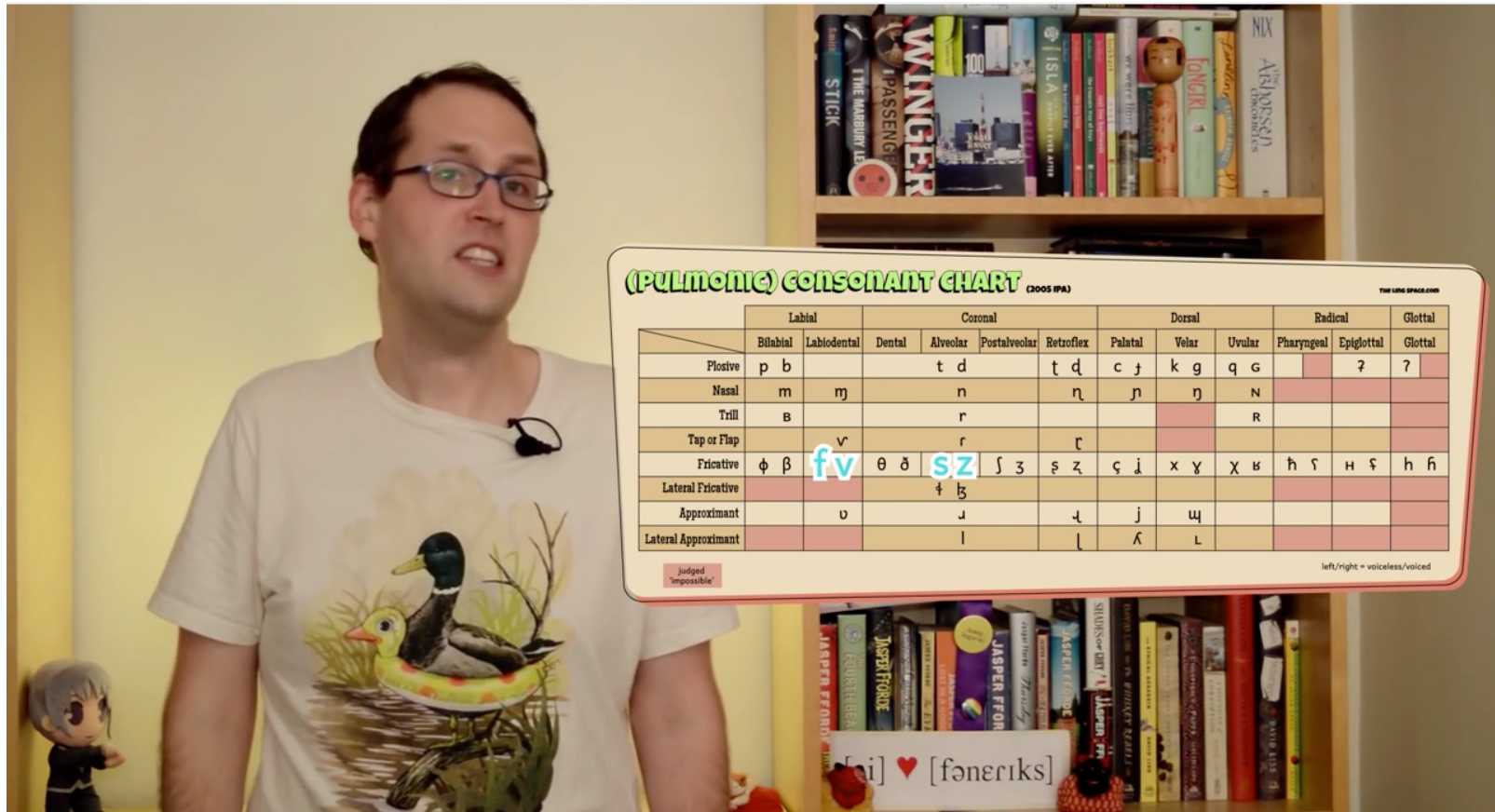
“What did you...?”  
[d j]  
becomes  
“What did zha...?”  
[d ʒ]  
becomes  
“Whaja...?”

# Voicing: What the vocal folds are doing

<https://www.youtube.com/watch?v=zEaPQP3pXQc>

<http://www.thelingspace.com/episode-20>

9:20 - 9:52



(PULMONIC) CONSONANT CHART (2005 IPA)

THE LING SPACE.COM

	Labial		Coronal				Dorsal			Radical		Glottal
	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Epiglottal	Glottal
Plosive	p b			t d		ʈ ɖ	c ɟ	k ɡ	q ɢ		ʔ	ʔ
Nasal	m	ɱ		n		ɳ	ɲ	ŋ	ɴ			
Trill				r					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	h ɦ
Lateral Fricative				ɬ ɮ								
Approximant		ʋ		ɹ		ɻ	j	ɰ				
Lateral Approximant				l		ɭ	ʎ	ʟ				

Judged impossible

left/right = voiceless/voiced

[ni] ♥ [fɔneriks]

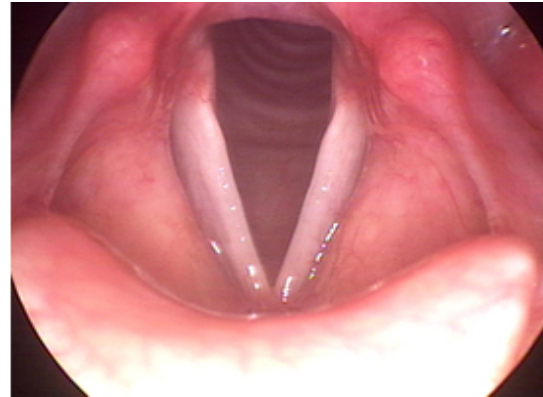


# What are the vocal folds doing?

**closed**  
**voiced**



**open**  
**voiceless**



“The air leaves the lungs through the trachea (windpipe), which opens into the larynx (the voice-box, visible on the outside as the Adam's apple). The larynx is a valve consisting of an opening (the glottis) covered by two flaps of retractable muscular tissue called the vocal folds...The vocal folds can also be partly stretched over the glottis to produce a buzz as the air rushes past.” - Pinker, *The Language Instinct*

# Voiced & Voiceless consonants

Consonants are either **voiced** or **voiceless**.

English pairs:

b p

v f

d t

z s

ð θ

ʃ ʒ

tʃ dʒ

# Other Glottal States (besides just +/-voiced)

[Extra]

<http://www.thelingspace.com/episode-53>

<https://www.youtube.com/watch?v=edYLoMRgaFw>

Discusses glottal states like breathy voice & creaky voice



# 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



# 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		r						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		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
<b>Stop</b>	p b		t d					k g			
Nasal	m		n					ŋ			
Trill											
Tap or Flap			ɾ								
Fricative		f v	θ ð	s z	ʃ ʒ		tʃ dʒ				h
Lateral fricative											
<b>Glide</b>							j	w			
<b>Liquid</b>			ɹ l								

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

# Describing speech sounds: Recap

Where is the air-flow blocked? (**place** of articulation)  
*labial, alveolar, palatal, velar* etc.

Where/how is the air flowing? (**manner** of articulation)  
*nasal/oral, stop, fricative, liquid, tap/flap* etc.

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



# Other ways of producing consonants

## [Extra]

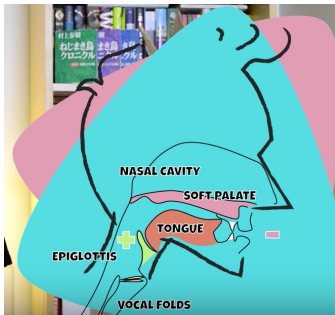
<https://www.youtube.com/watch?v=JKP10ARLnzM&feature=youtu.be>

Discusses clicks, implosives, and ejectives



**NON-PULMONIC CONSONANTS**

Clicks	Voiced Implosives	Ejectives
◉ Bilabial	ɓ Bilabial	p' Bilabial
Dental	ɗ Dental/Alveolar	t' Dental/Alveolar
! Post-Alveolar	ɸ Palatal	k' Velar
‡ Palatoalveolar	ɠ Velar	s' Alveolar Fricative
Alveolar Lateral	ɛ Uvular	' (Ejective Marker)



# Vowels

# Vowels

<https://www.youtube.com/watch?v=arMntA15A0s>

<http://www.thelingspace.com/episode-27>

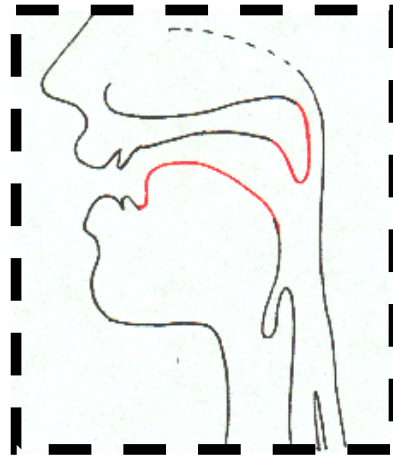
beginning through 4:10

**VOWEL CHART** (2005 IPA) THE LING SPACE.COM

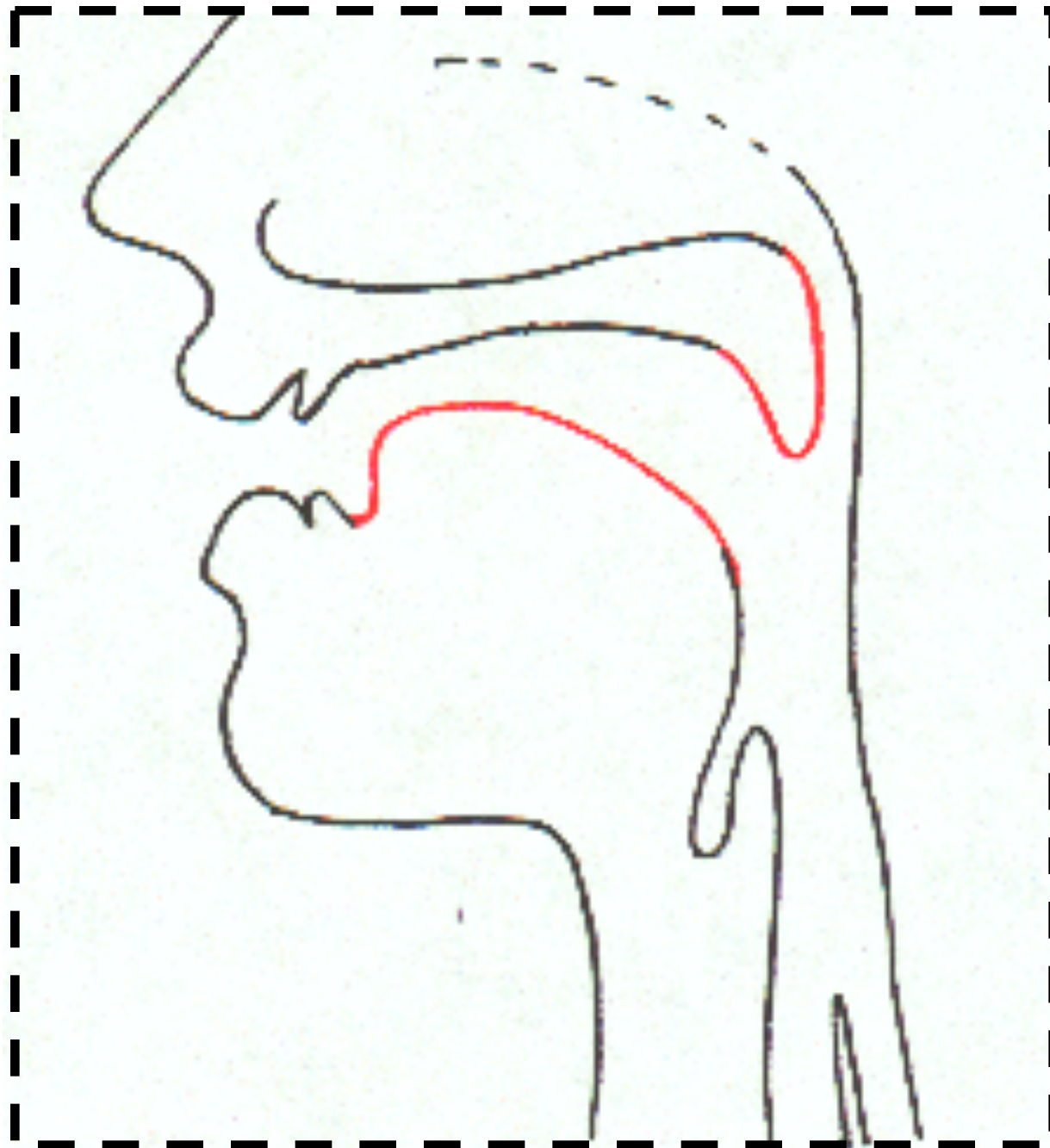
	Front	Near-Front	Central	Near-back	Back
Close	i • y		i • ʉ		ɯ • u
Near-Close		ɪ • ʏ			ʊ
Close-mid	e • ø		ɘ • ə		ɤ • o
Mid			ə		
Open-Mid		ɛ • œ		ɜ • ɞ	ʌ • ɔ
Near-Open		æ		e	
Open		a • œ			a • ɒ

left/right = unrounded/rounded

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

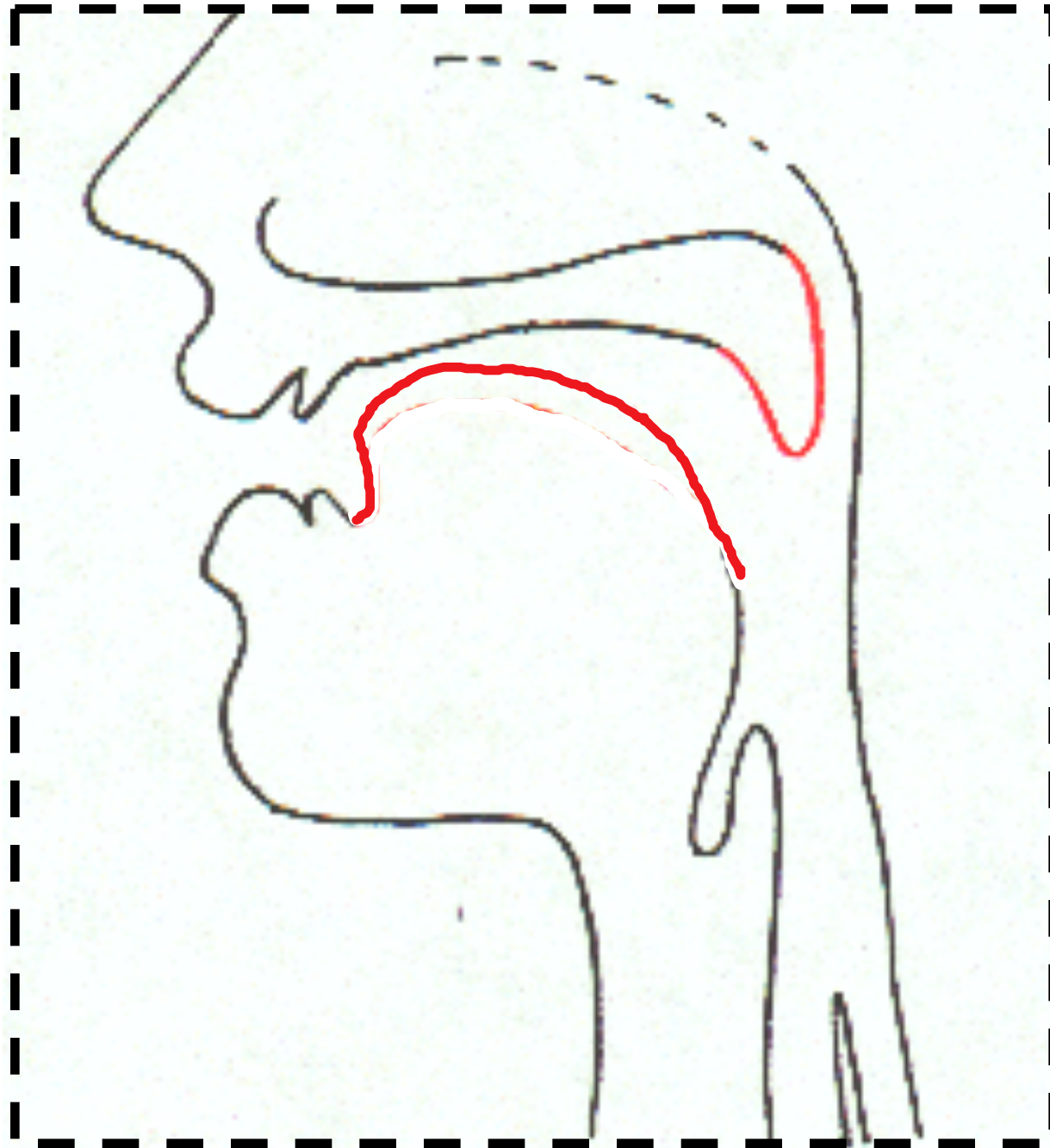


[Extra]



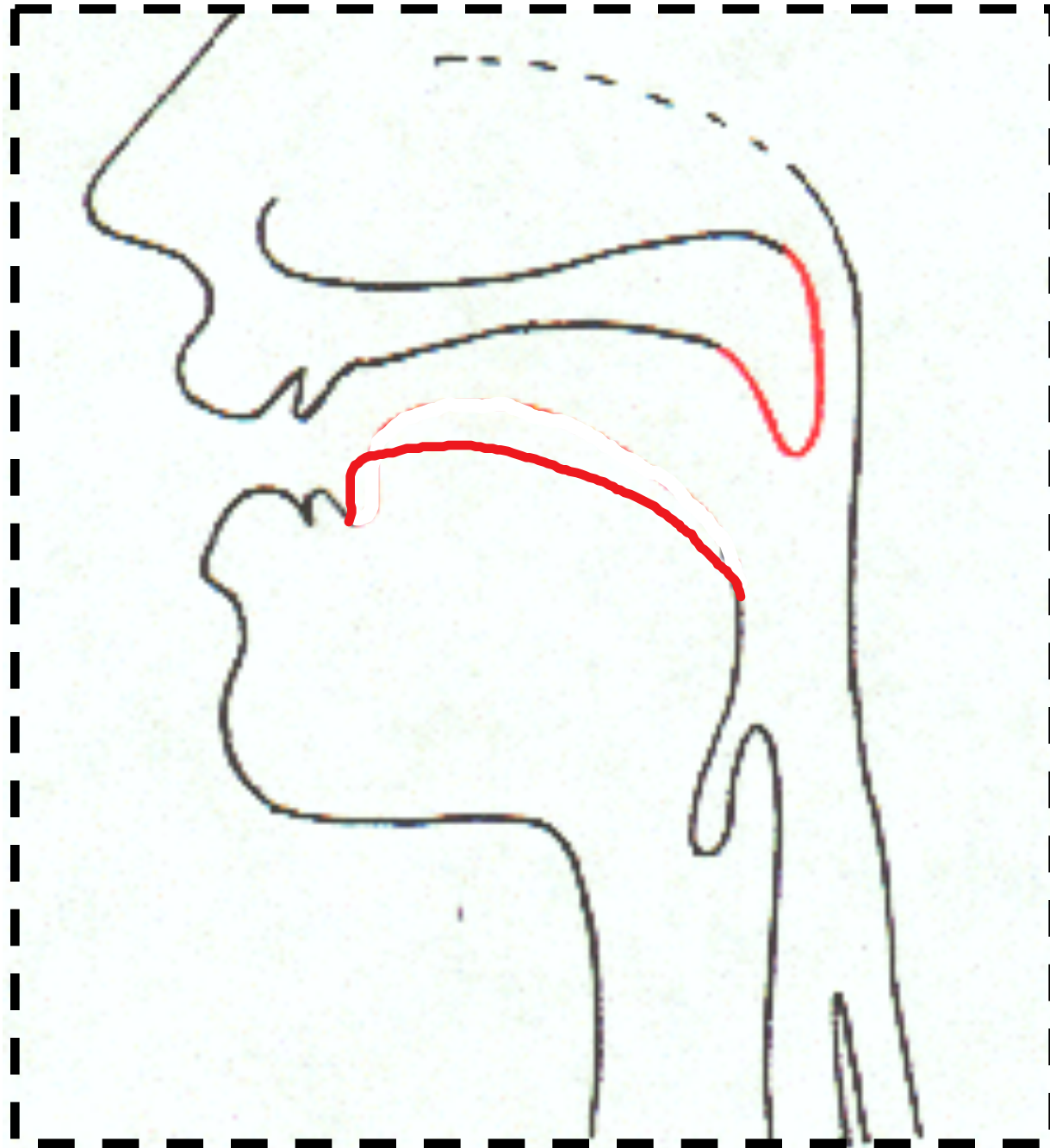
[Extra]

**i**



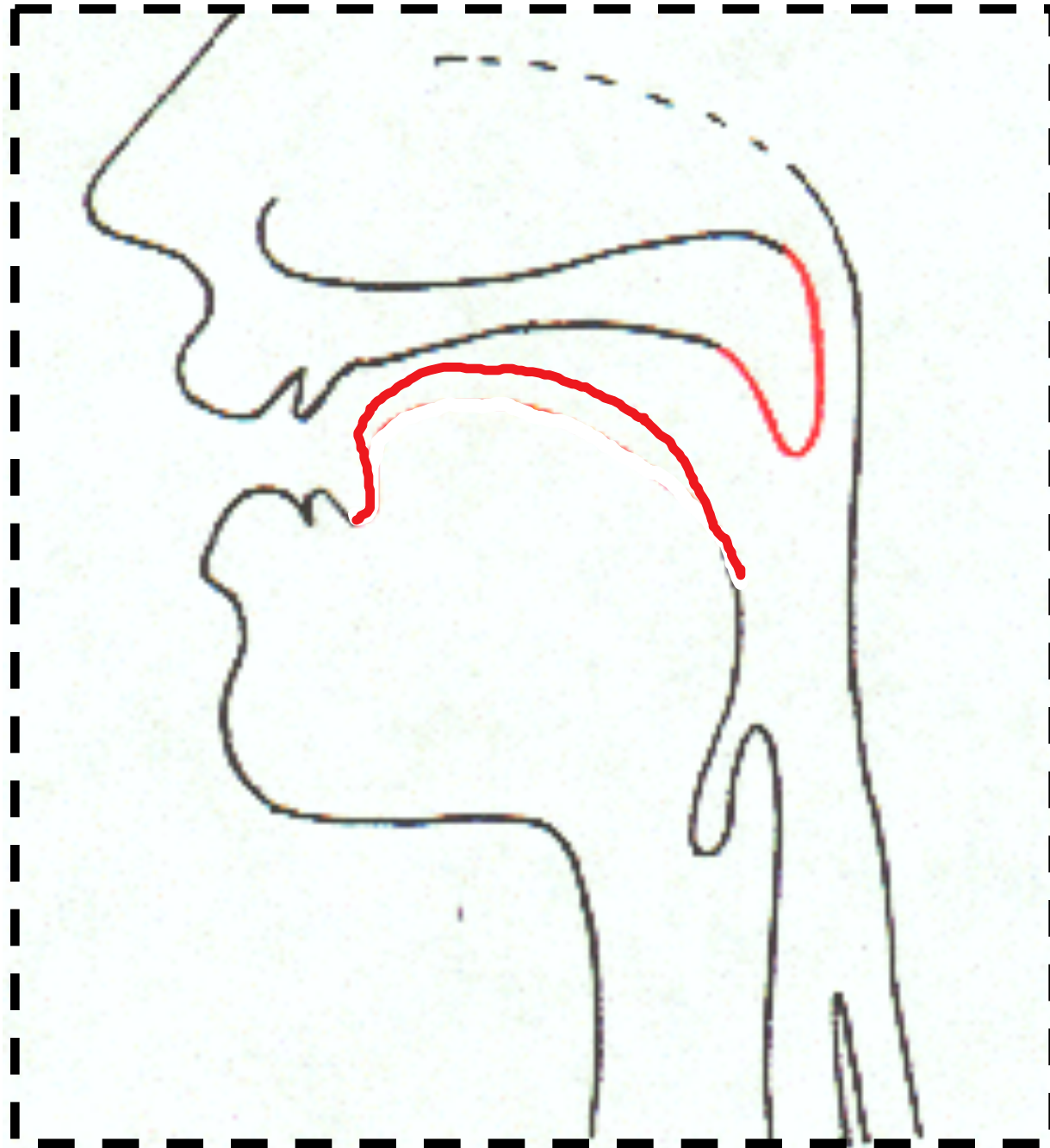
[Extra]

æ



[Extra]

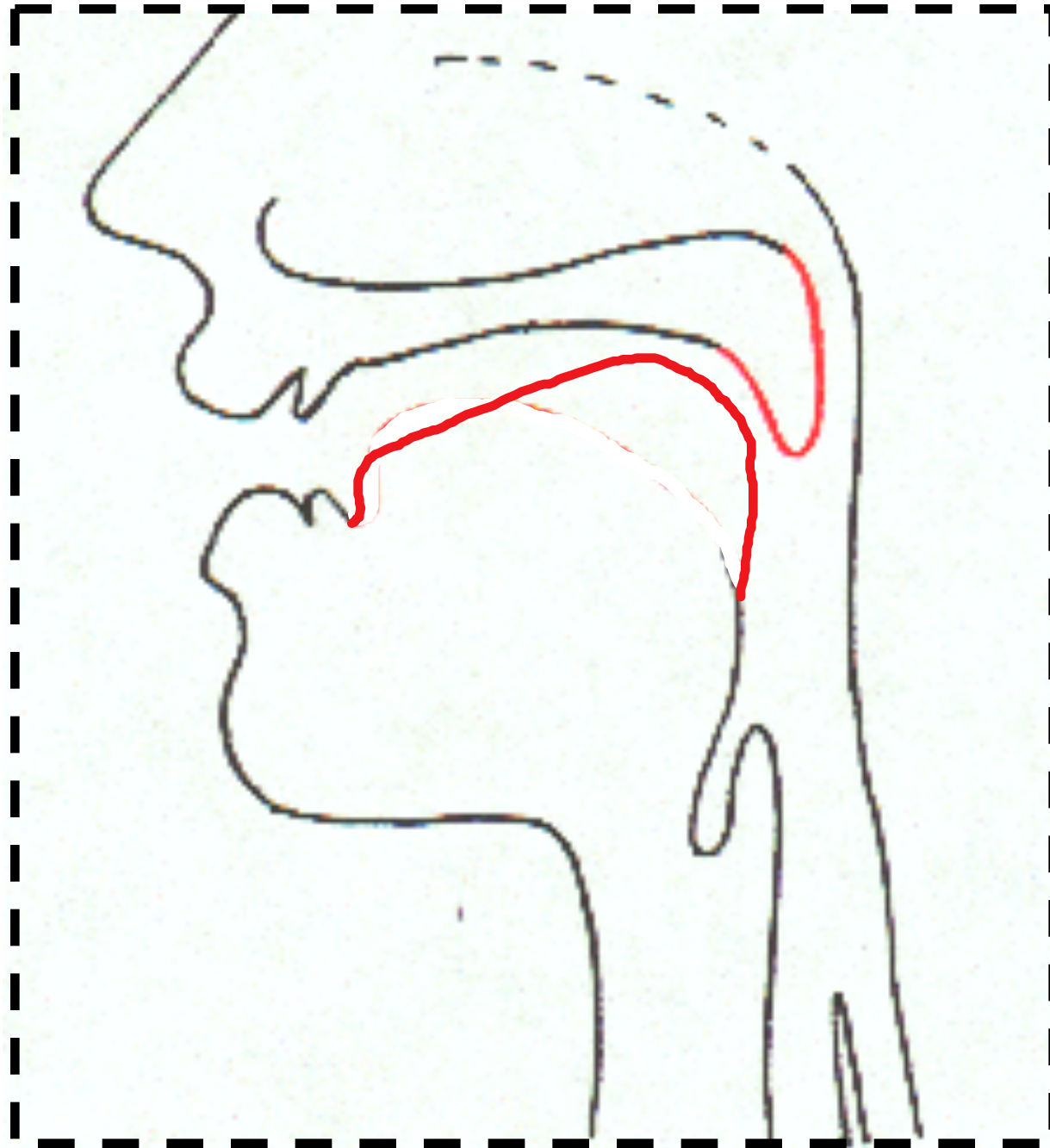
**i**





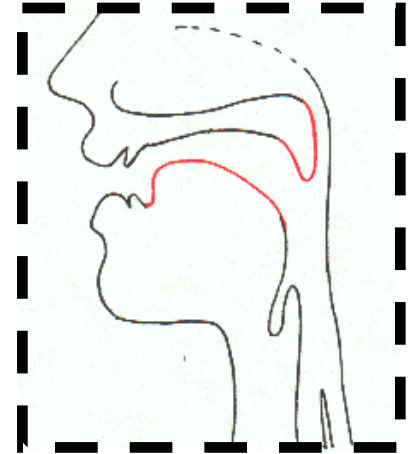
[Extra]

u



## You can....

- (1) Raise or lower your tongue  
(high, mid, low)
- (2) Advance or retract your tongue  
(front, central, back)
- (3) Round or spread your lips  
(round, spread)
- (4) Tense or not tense your mouth  
(tense, lax)



## A quick note about tense/lax

"...by advancing the tongue root....the tongue becomes tense and humped rather than lax and flat, and the hump narrows the air chamber in the mouth above it, changes the resonances."

- Pinker, *The Language Instinct*

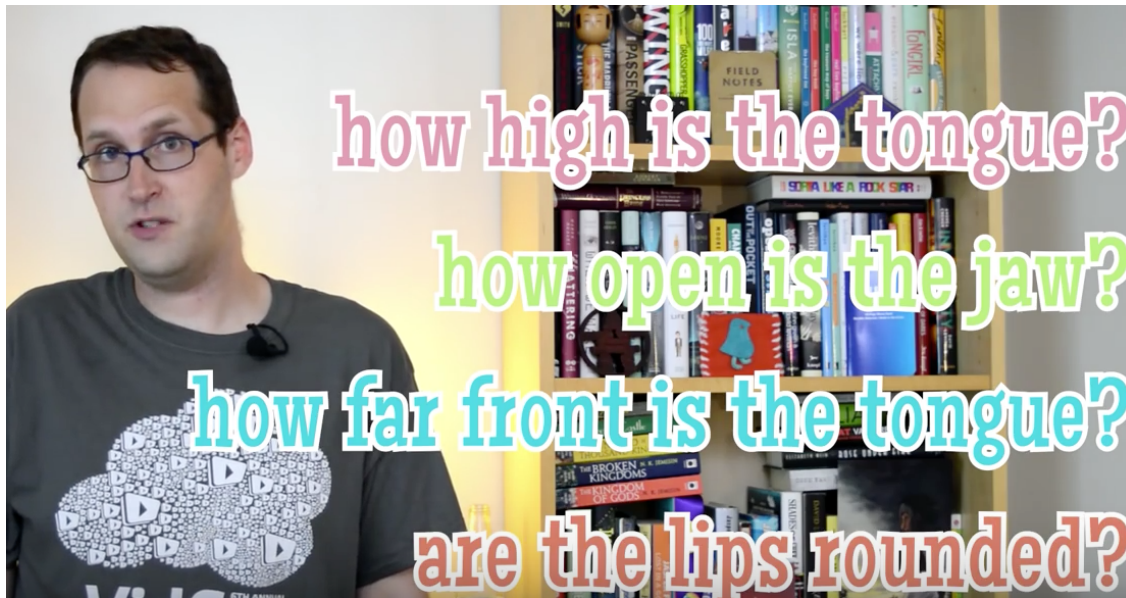
- (4) Tense or not tense your mouth  
(tense, lax)

# More precision when talking about vowels

[Extra]

<https://www.youtube.com/watch?v=jl4zGRSYqkE&feature=youtu.be>

Discusses frequency & formants relevant for describing vowels



[Extra]

So what vowels do you have?

**i**

“sheep, sleep”

**I**

“ship, slip”

[Extra]

So what vowels do you have?

i

I

e

“laid, spade, trade”

ɛ

“led, sped, tread”

[Extra]

So what vowels do you have?

i

I

e

ɛ

æ

“bat, lad”

[Extra]

So what vowels do you have?

i

I

e

ɛ

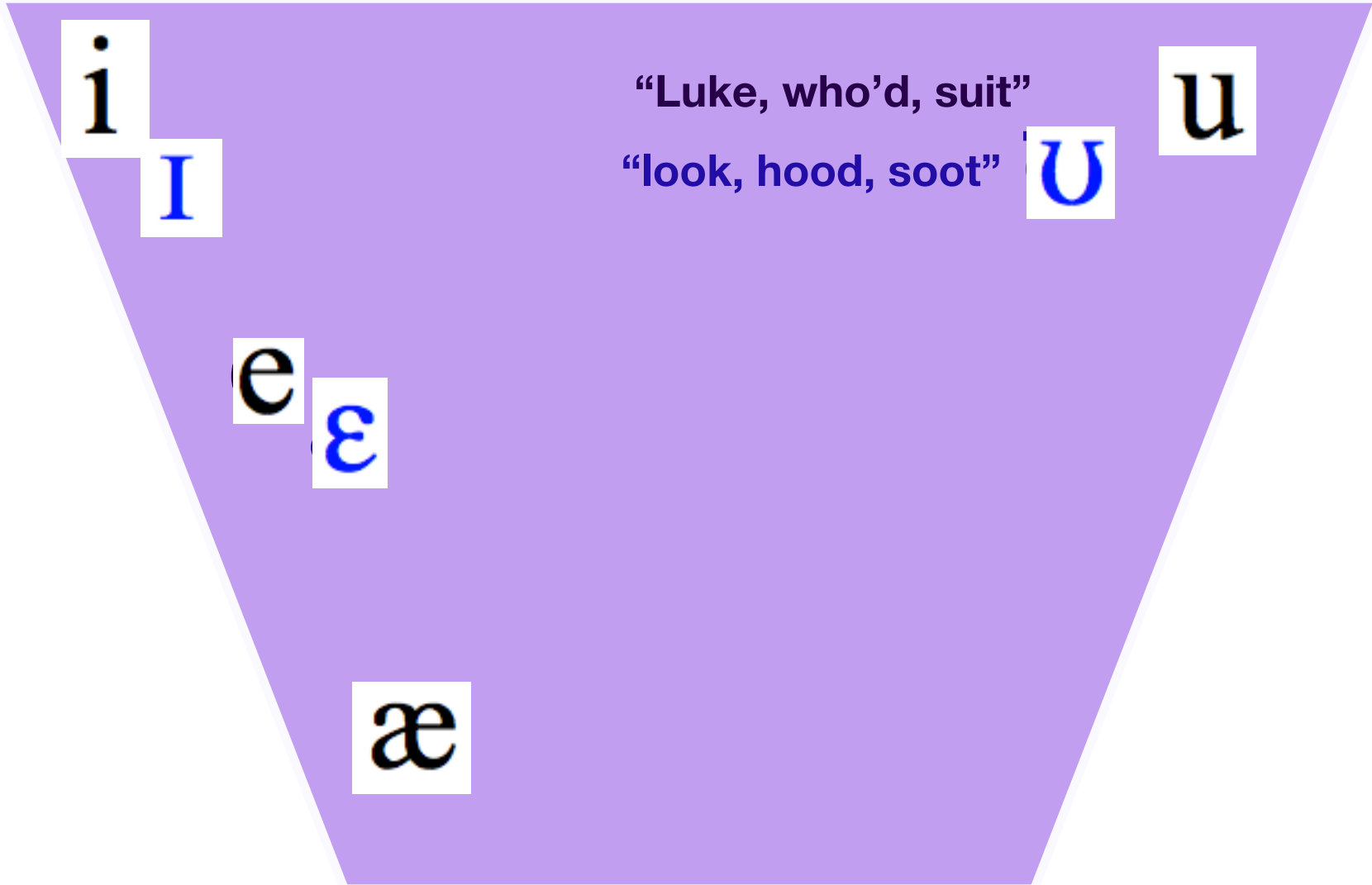
æ

“Luke, who’d, suit”

“look, hood, soot”

U

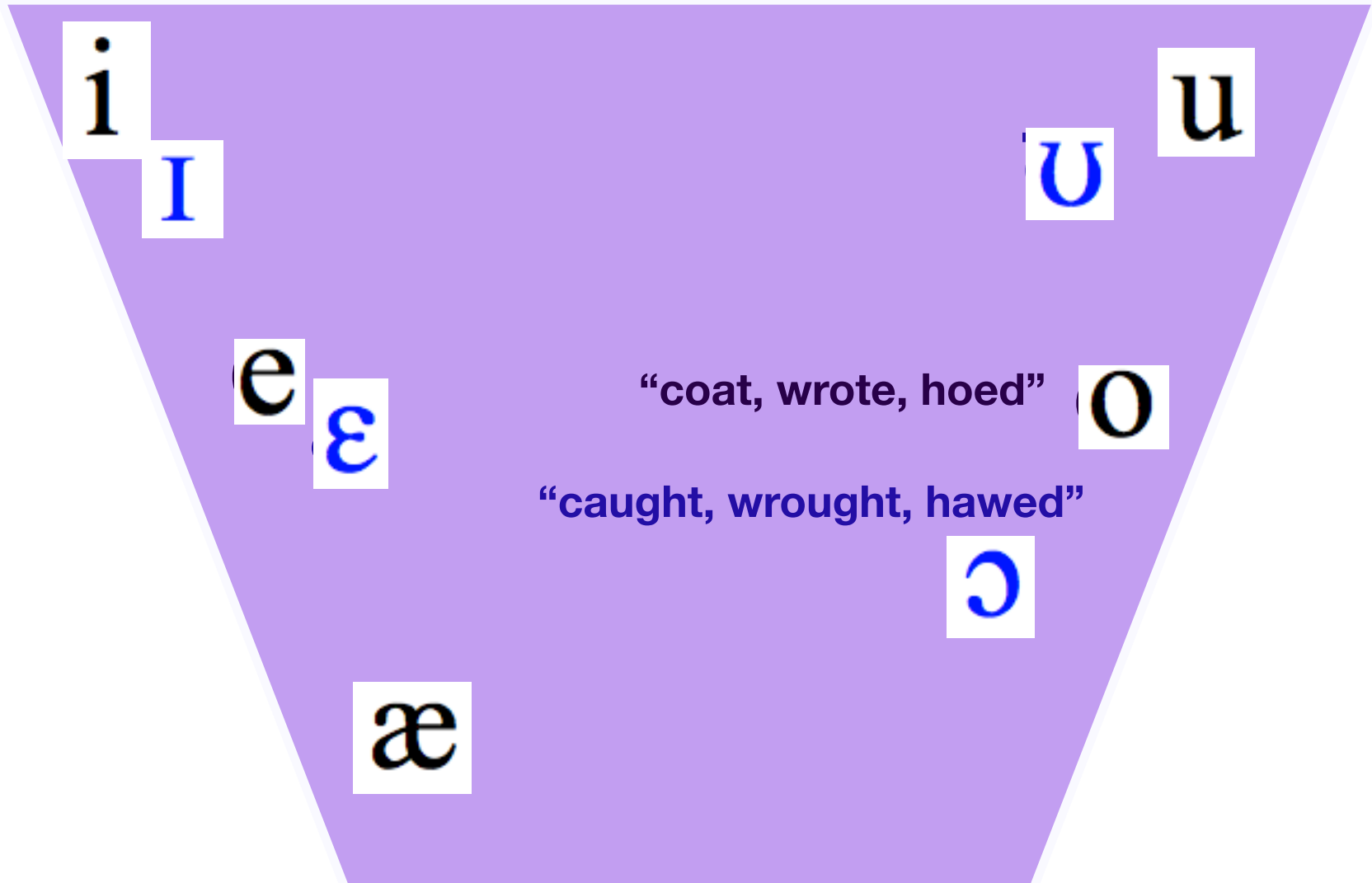
u





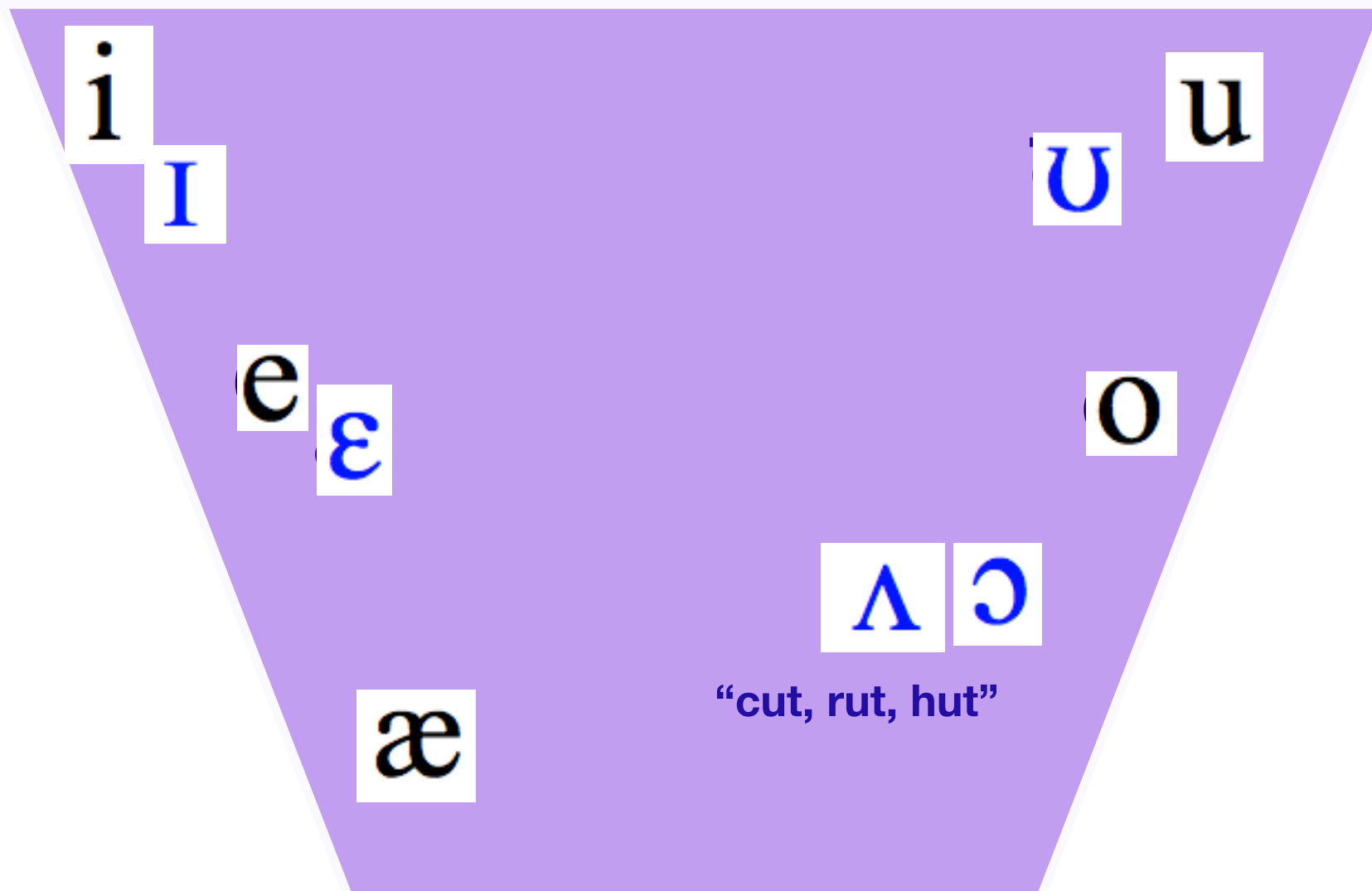
[Extra]

So what vowels do you have?



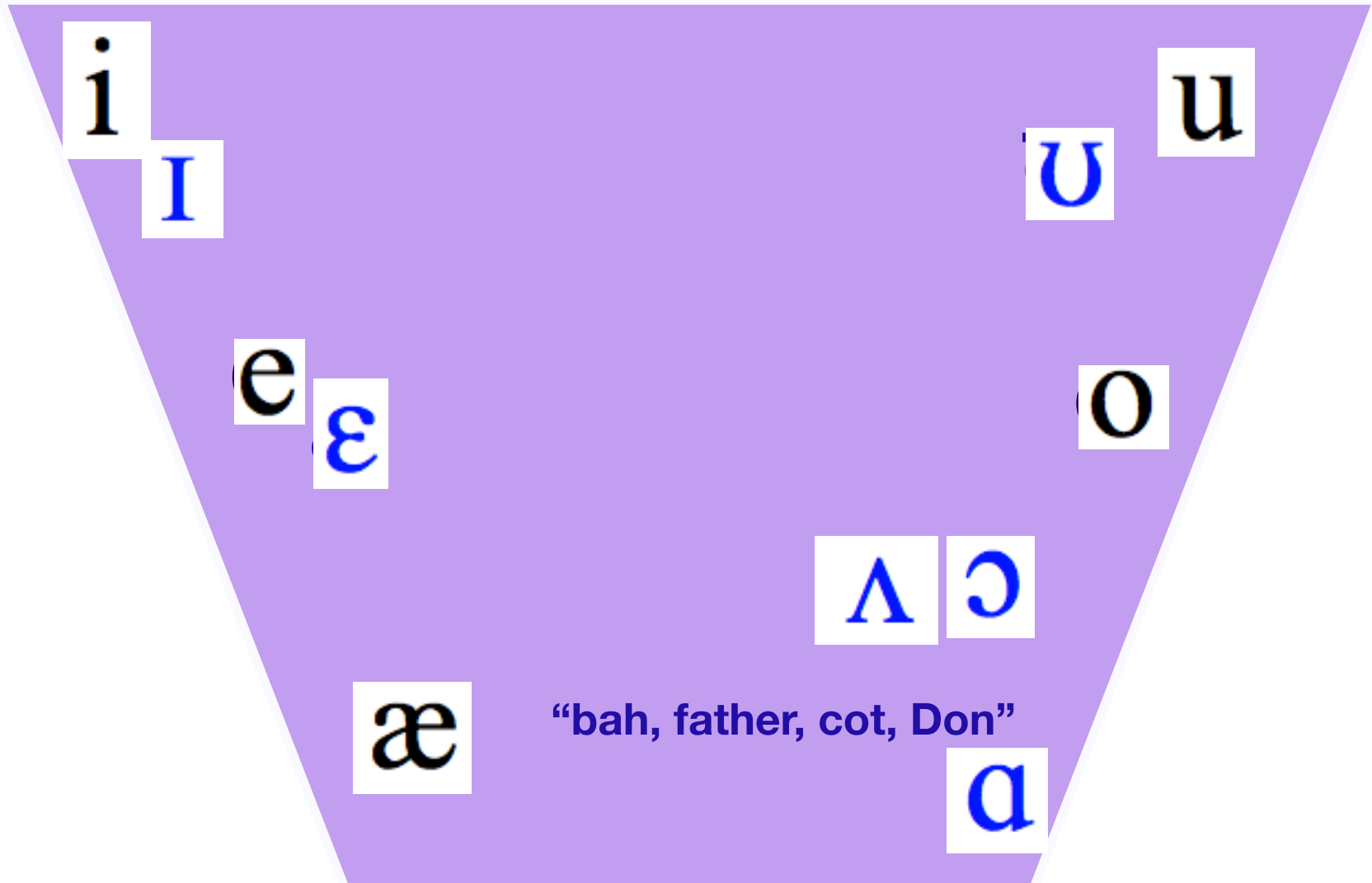
[Extra]

So what vowels do you have?

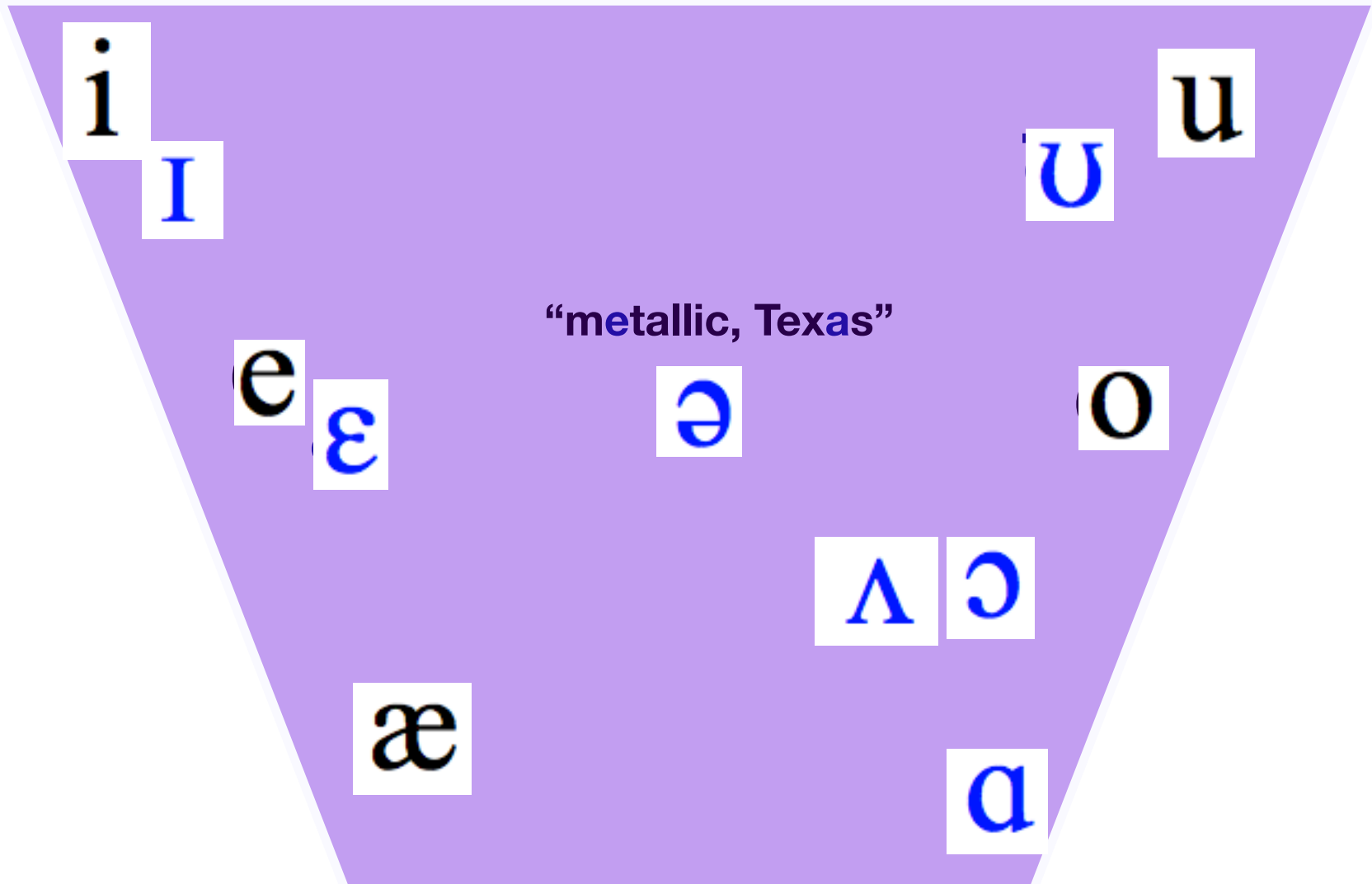


[Extra]

So what vowels do you have?

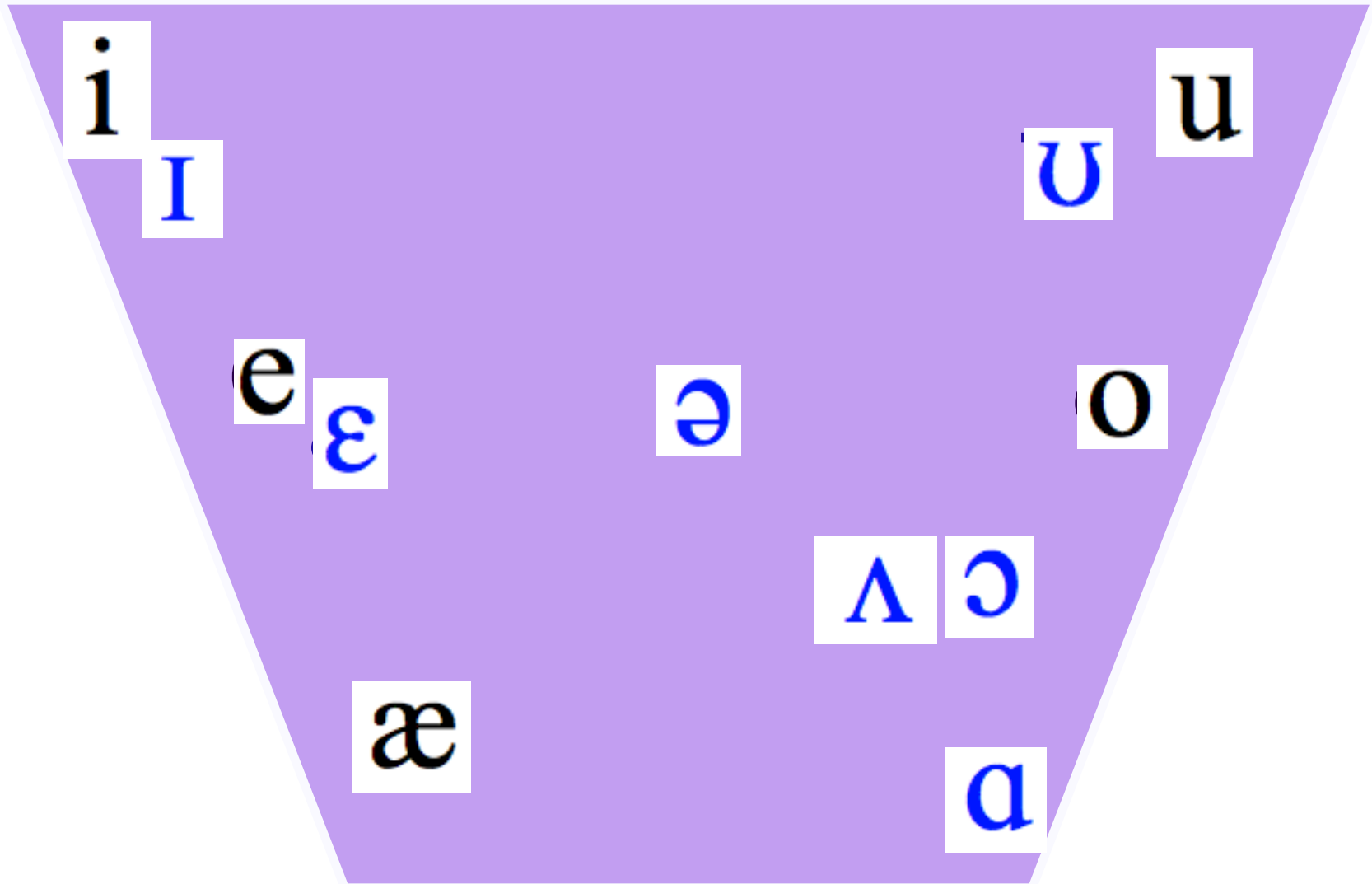


So what vowels do you have?



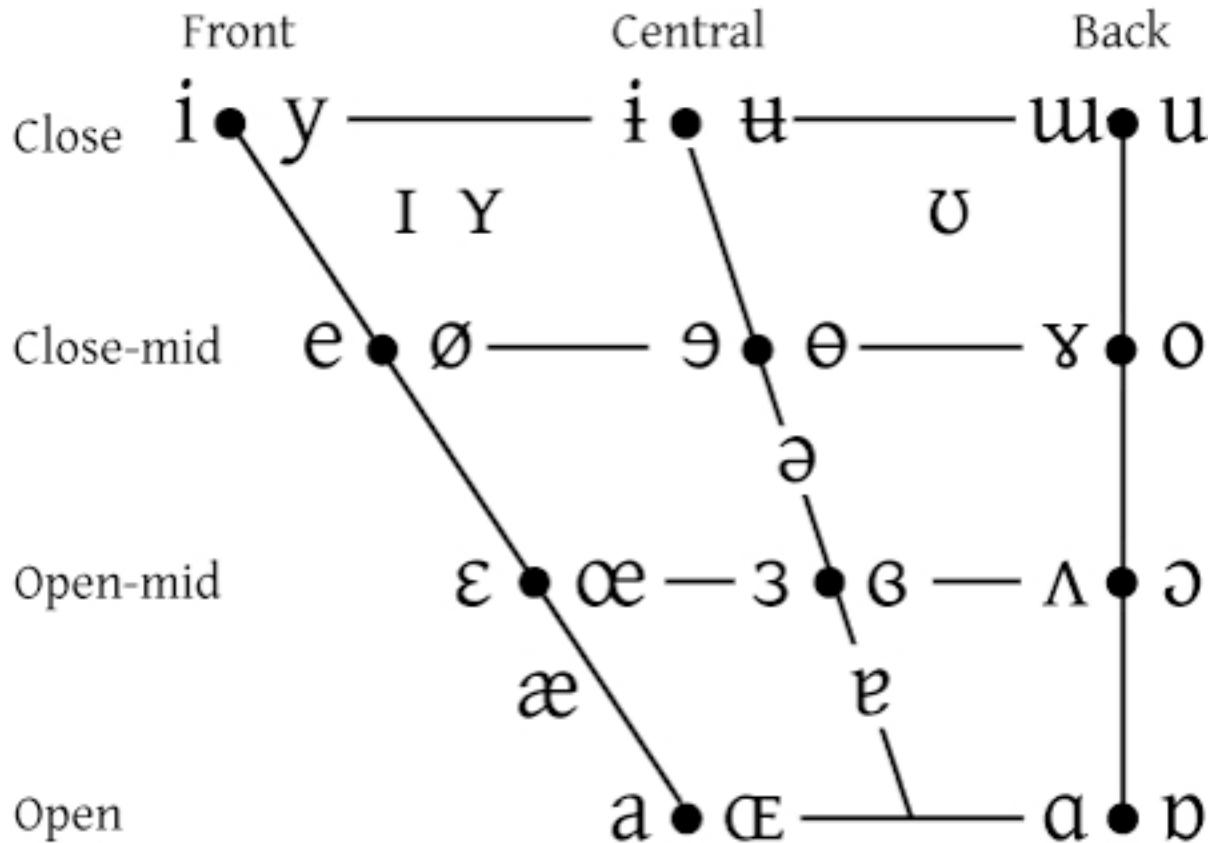
[Extra]

So here they are!



# The full(er) vowel chart

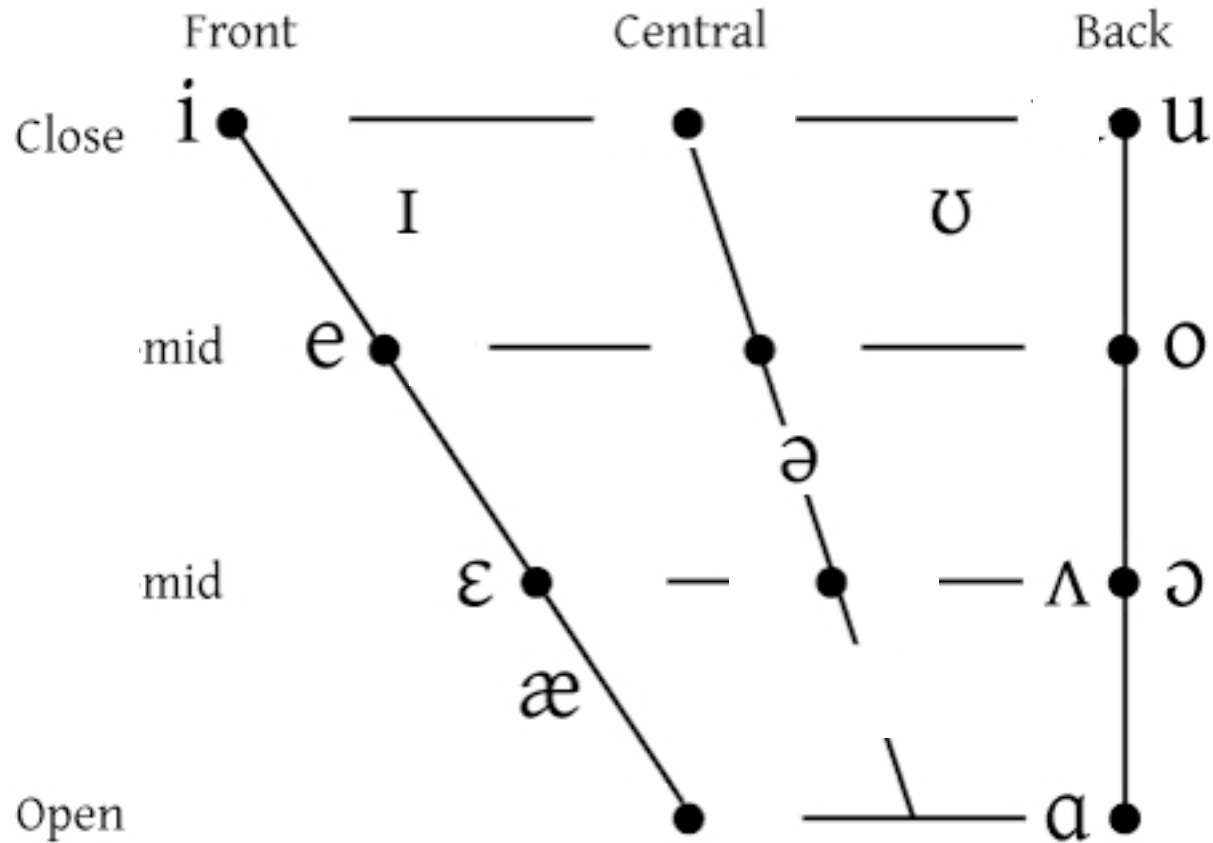
## VOWELS



Where symbols appear in pairs, the one to the right represents a rounded vowel

# The parts we care about for this class

## VOWELS




Where symbols appear in pairs, the one to the right represents a rounded vowel

# Diphthongs

<https://www.youtube.com/watch?v=arMntA15A0s>

<http://www.thelingspace.com/episode-27>

7:02 through 7:38



**Diphthong**

**VOWEL CHART (2005 IPA)** THE LING SPACE.COM

	Front	Near-Front	Central	Near-back	Back
Close	i • y		i • ɨ		ɯ • u
Near-Close		ɪ • ʏ			ʊ
Close-mid	e • ø		ɘ • ɵ		ɤ • o
Mid			ə		
Open-Mid		ɛ • œ		ɜ • ɞ	ʌ • ɔ
Near-Open		æ		a	
Open		a • ɶ			ɑ • ɒ

left/right = unrounded/rounded

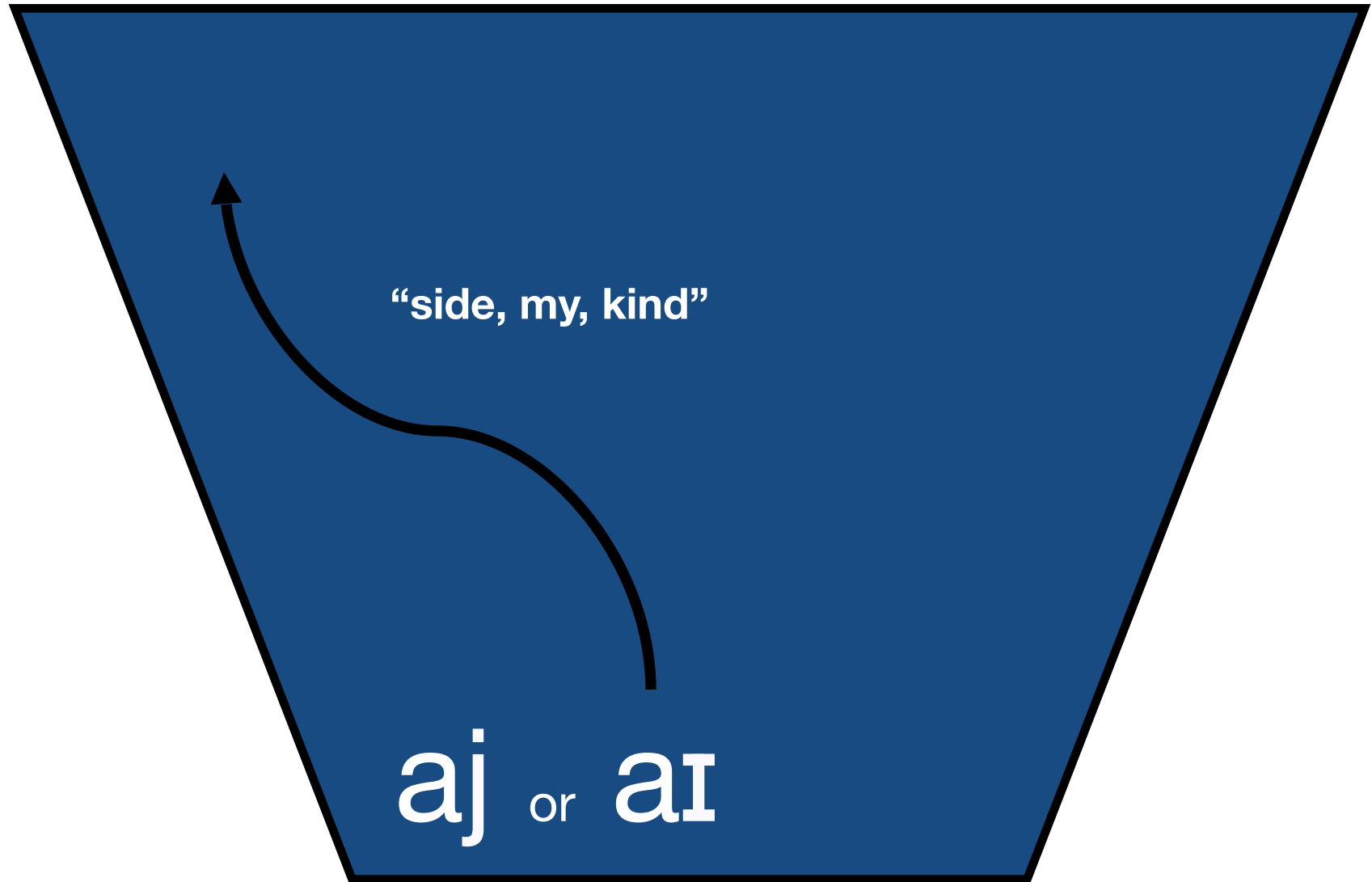


Diphthongs: Two vowel-ish sounds together



a

# Diphthongs: Two vowel-ish sounds together

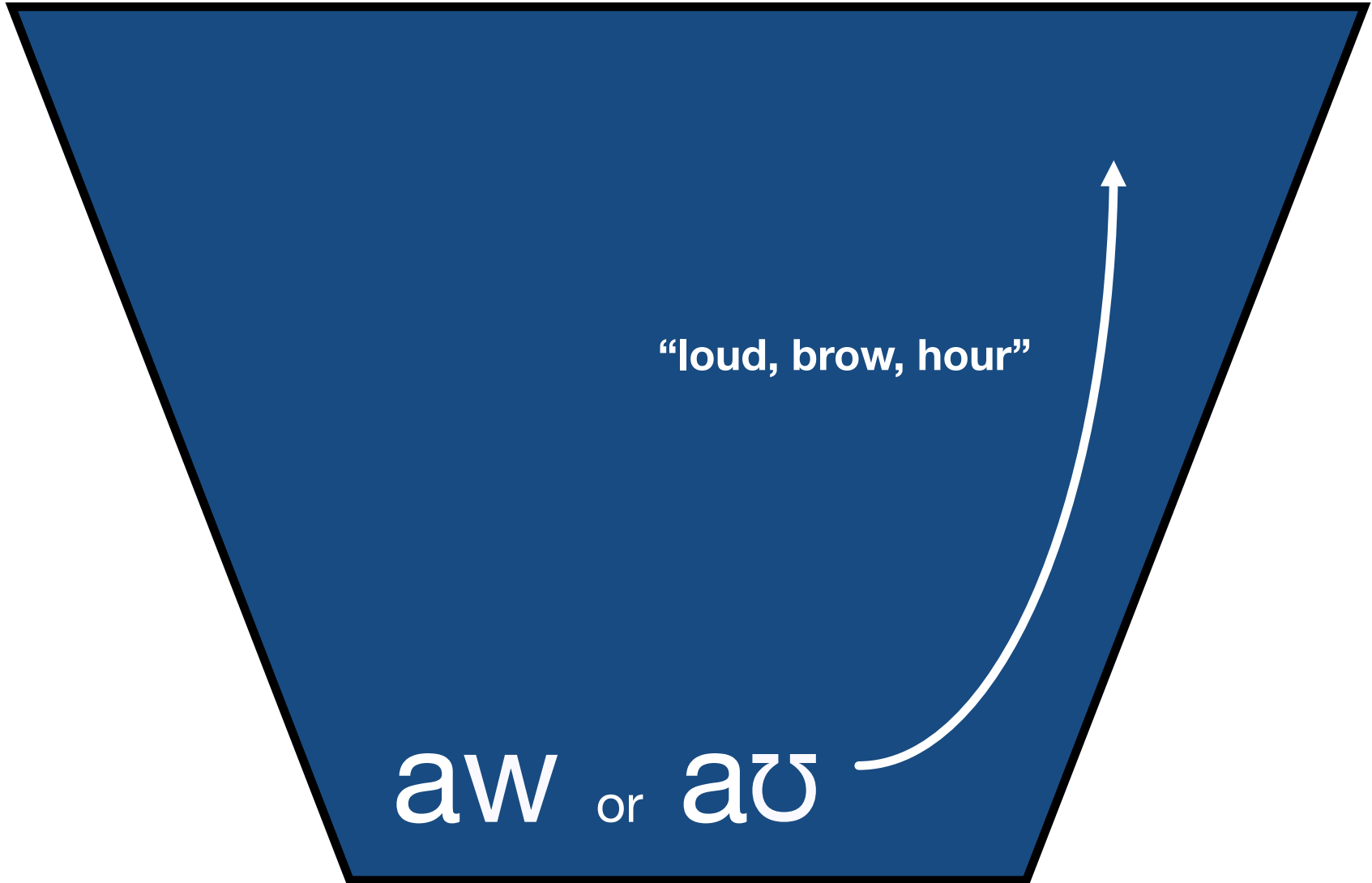


Diphthongs: Two vowel-ish sounds together

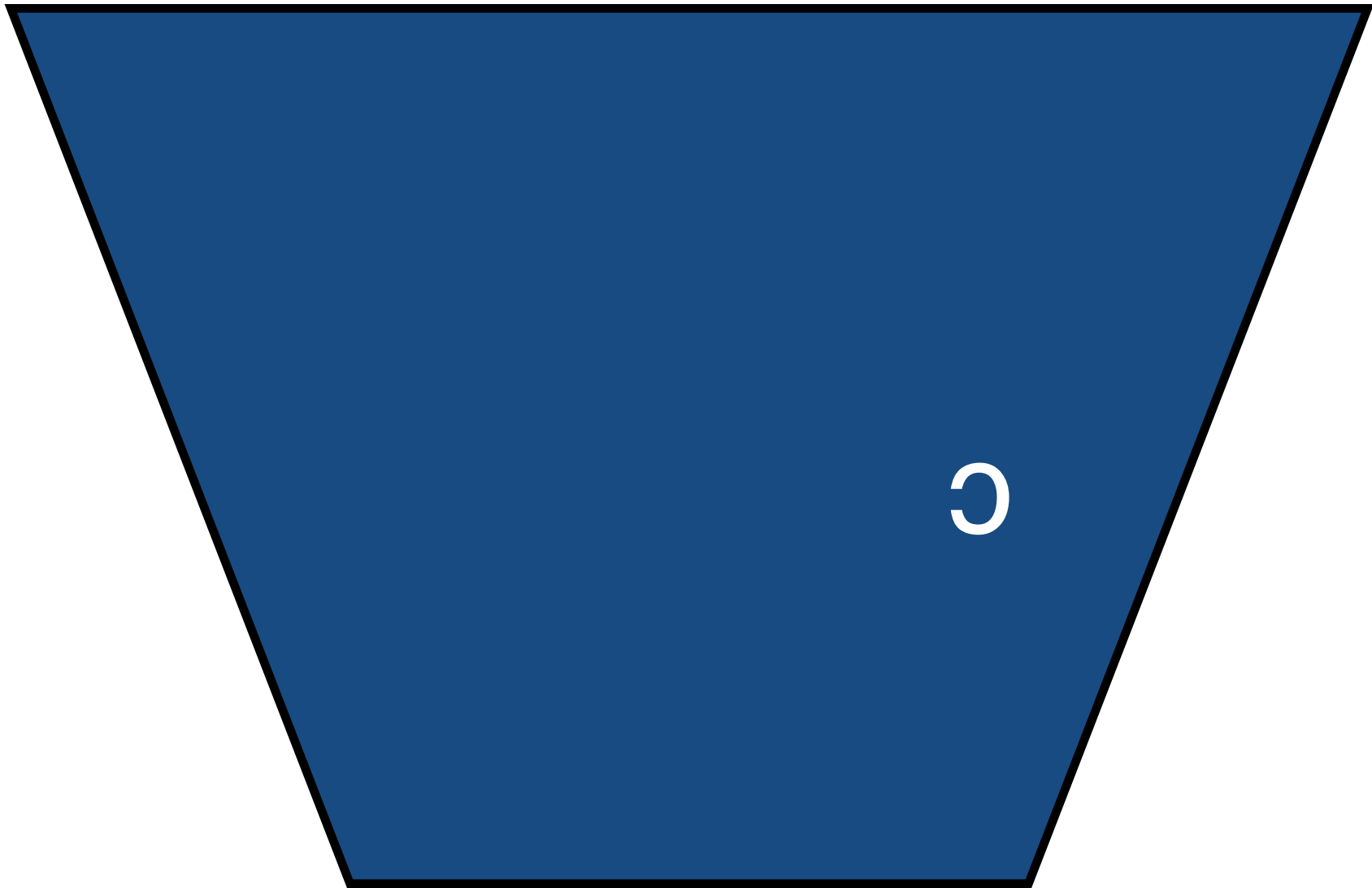


a

# Diphthongs: Two vowel-ish sounds together



Diphthongs: Two vowel-ish sounds together



# Diphthongs: Two vowel-ish sounds together



“boy, annoy, toil”

oj or oI

# Speech production summary

Airflow set in vibration by vocal folds and 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 3 on HW3, and up through question 2 on the phonological review questions.