

LSci 51/Psych 56L: Acquisition of Language

Lecture 8 Phonological development I

Announcements

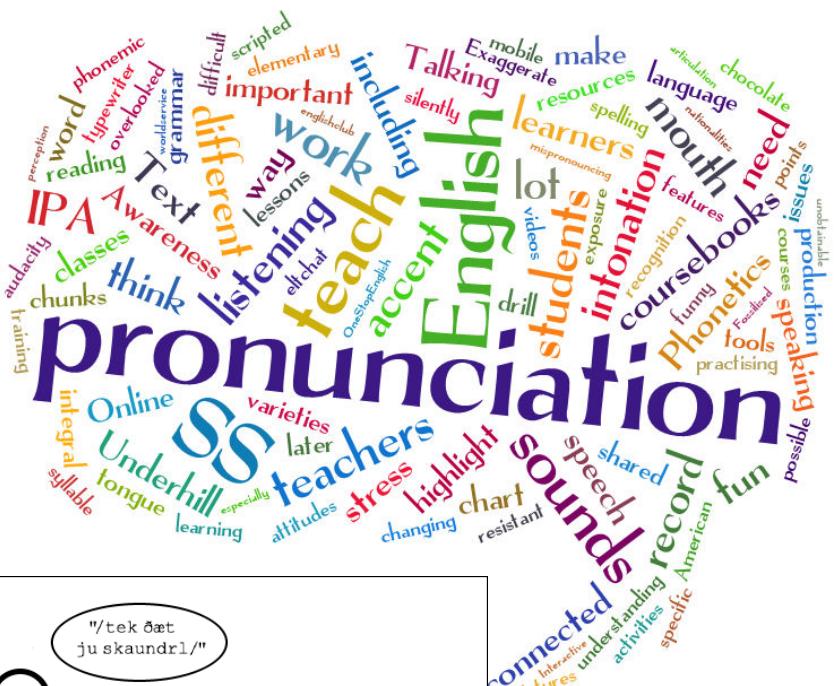
Review questions for phonological development available

HW3 available (due 10/25/21)

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

Many helpful lingspace video links included in the lecture notes as references.

Sounds of Language



www.tagxedo.com

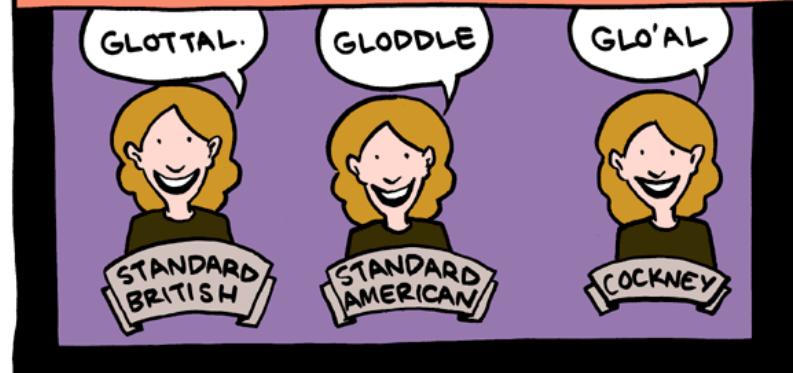
[http://specgram.com/
CLIII.1/09.parenchyma.cartoon.e.html](http://specgram.com/CLIII.1/09.parenchyma.cartoon.e.html)



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

<http://language.log.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.

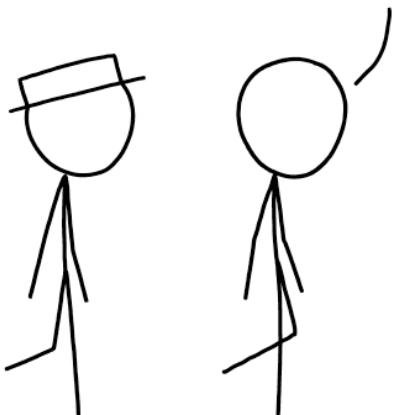


Spelling vs. Pronunciation

I SOMETIMES MISSPELL "MISSPELL"
AND "MISPRONUNCIATION," AND I
MISPRONOUNCE "MISPRONUNCIATION,"

1

BUT THE EPITOME OF
MISPRONUNCIATION IS
PROBABLY THE WAY I
PRONOUNCE "EPITOME."



<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



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

...

...

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.
Wherfore 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

he	e	seas	ea
believe	ie	amoeba	oe
Caesar	ae	key	ey
see	ee	machine	i
people	eo	seize	ei

International Phonetic Alphabet: [i]

One sound – Many letters

too

oo

threw

ew

to

o

ieu

ieu

clue

ue

shoe

oe

through

ough

beautiful

eau

IPA: [u]

One sound – Many letters

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

One letter – Many sounds

d <u>a</u> me	e
d <u>a</u> d	æ
f <u>a</u> ther	a
c <u>a</u> ll	ɔ, a
vill <u>a</u> ge	i, θ
m <u>a</u> ny	ɛ

One letter – Not one sound

mnemonic

psychology

res**i**gn

g**h**ost

= no sound!

island

whole

de**b**t

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)

© 2005 IPA

CONSONANTS (PULMONIC)

	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	p b		t d		t d	c j	k g	q G		?	
Nasal	m	n̪	n		n̪	n̪	n̪		N		
Trill	B		r						R		
Tap or Flap		v̄	f		t̄						
Fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç ɿ	x ɣ	χ ʁ	h f	h f̄
Lateral fricative			ɬ ɭ								
Approximant		v̄	ɹ		ɻ	ɺ	ɻ	ɻ	ɻ		
Lateral approximant			l̄		ɬ̄	ɭ̄	ɬ̄	ɭ̄	ɬ̄	ɭ̄	

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	,
Dental	ɗ Dental/alveolar	Examples: p' Bilabial
! (Post)alveolar	ʄ Palatal	t' Dental/alveolar
ǂ Palatoalveolar	ɠ Velar	k' Velar
ǁ Alveolar lateral	՜ Uvular	s' Alveolar fricative

OTHER SYMBOLS

ʍ	Voiceless labial-velar fricative	ç z	Alveolo-palatal fricatives
w	Voiced labial-velar approximant	j	Voiced alveolar lateral flap
ʗ	Voiced labial-palatal approximant	ʃ x	Simultaneous ʃ and x
হ	Voiceless epiglottal fricative		Affricates and double articulations can be represented by two symbols joined by a tie bar if necessary.
ʢ	Voiced epiglottal fricative		
ʡ	Epiglottal plosive		

DIAKRITICS Diaeretics may be placed above a symbol with a descender, e.g. ጀ

ጀ Voiceless	ጀጀ	ጀጀ	ጀጀ	ጀጀ
ጀ Voiced	ጀጀ	ጀጀ	ጀጀ	ጀጀ
ጀ Aspirated	ጀጀ	ጀጀ	ጀጀ	ጀጀ
ጀ More rounded	ጀጀ	ጀጀ	ጀጀ	ጀጀ
ጀ Less rounded	ጀጀ	ጀጀ	ጀጀ	ጀጀ
ጀ Advanced	ጀጀ	ጀጀ	ጀጀ	ጀጀ
ጀ Retracted	ጀጀ	ጀጀ	ጀጀ	ጀጀ
ጀ Centralized	ጀጀ	ጀጀ	ጀጀ	ጀጀ
ጀ Mid-centralized	ጀጀ	ጀጀ	ጀጀ	ጀጀ
ጀ Syllabic	ጀጀ	ጀጀ	ጀጀ	ጀጀ
ጀ Non-syllabic	ጀጀ	ጀጀ	ጀጀ	ጀጀ
ጀ Rhoticity	ጀጀ	ጀጀ	ጀጀ	ጀጀ

Breathy voiced

Creaky voiced

Linguolabial

Labialized

Palatalized

Velarized

Pharyngealized

Advanced Tongue Root

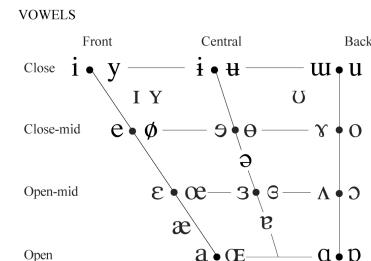
Advanced Tongue Root

Retracted Tongue Root

Retracted Tongue Root

Non-syllabic Tongue Root

Rhoticity Tongue Root



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

SUPRASEGMENTALS

'	Primary stress
՝	Secondary stress
,	founə'tuʃən
՝	Long
՝	Half-long
՝	Extra-short
՝	Minor (foot) group
՝	Major (intonation) group
՝	Syllable break ɹi.aɛkt
՝	Linking (absence of a break)

TONES AND WORD ACCENTS CONTOUR

é or ՚	Extra high	ě or ՚	Rising
é ՚	High	ê ՚	Falling
é ՚	Mid	é ՚	High rising
é ՚	Low	é ՚	Low rising
é ՚	Extra-low	é ՚	Rising-falling
↓	Downstep	↗	Global rise
↑	Upstep	↘	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

Where symbols appear in pairs, the one to the right represents a voiced consonant.

Areas shaded grey indicate articulations judged impossible.

Non-pulmonic consonants

Clicks	Voiced implosives	Ejectives
○ Bilabial	b Bilabial	p' Bilabial
Dental	d Dental/alveolar	t' Dental/alveolar
! (Post)alveoalar	f Palatal	k' Velar
‡ Palatoalveolar	g Velar	s' Alveolar fricative
Alveolar lateral	g' Uvular	' etc...

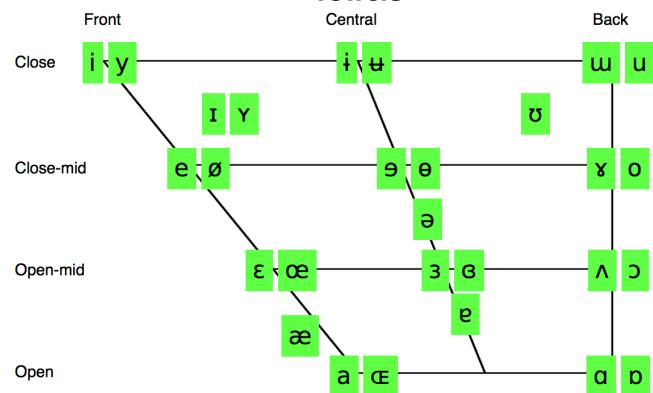
Other symbols

M	Voiceless labial-velar fricative
w	Voiced labial-velar approximant
ɥ	Voiced labial-palatal approximant
H	Voiceless epiglottal fricative
ɸ	Voiced epiglottal fricative
χ	Epiglottal plosive
ç	Voiceless alveolo-palatal fricative
ʐ	Voiced alveolo-palatal fricative
ɹ	Alveolar lateral flap
ħ	Simultaneous ʃ and X

Affricates

ts	Voiceless alveolar affricate
tʃ	Voiceless palato-alveolar affricate
tʂ	Voiceless alveolo-palatal affricate
ʈʂ	Voiceless retroflex affricate
dʒ	Voiced alveolar affricate
dʒ	Voiced post-alveolar affricate
dʐ	Voiced alveolo-palatal affricate
ɖʐ	Voiceless retroflex affricate

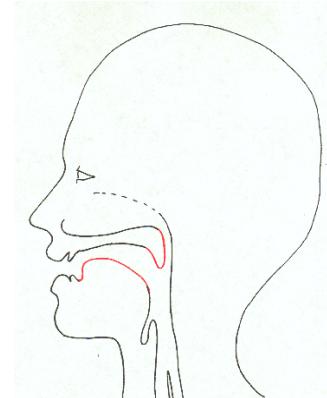
Vowels



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*



© 2009 Encyclopædia Britannica, Inc.

“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

Sounds: The vocal tract as an instrument

[Extra]

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

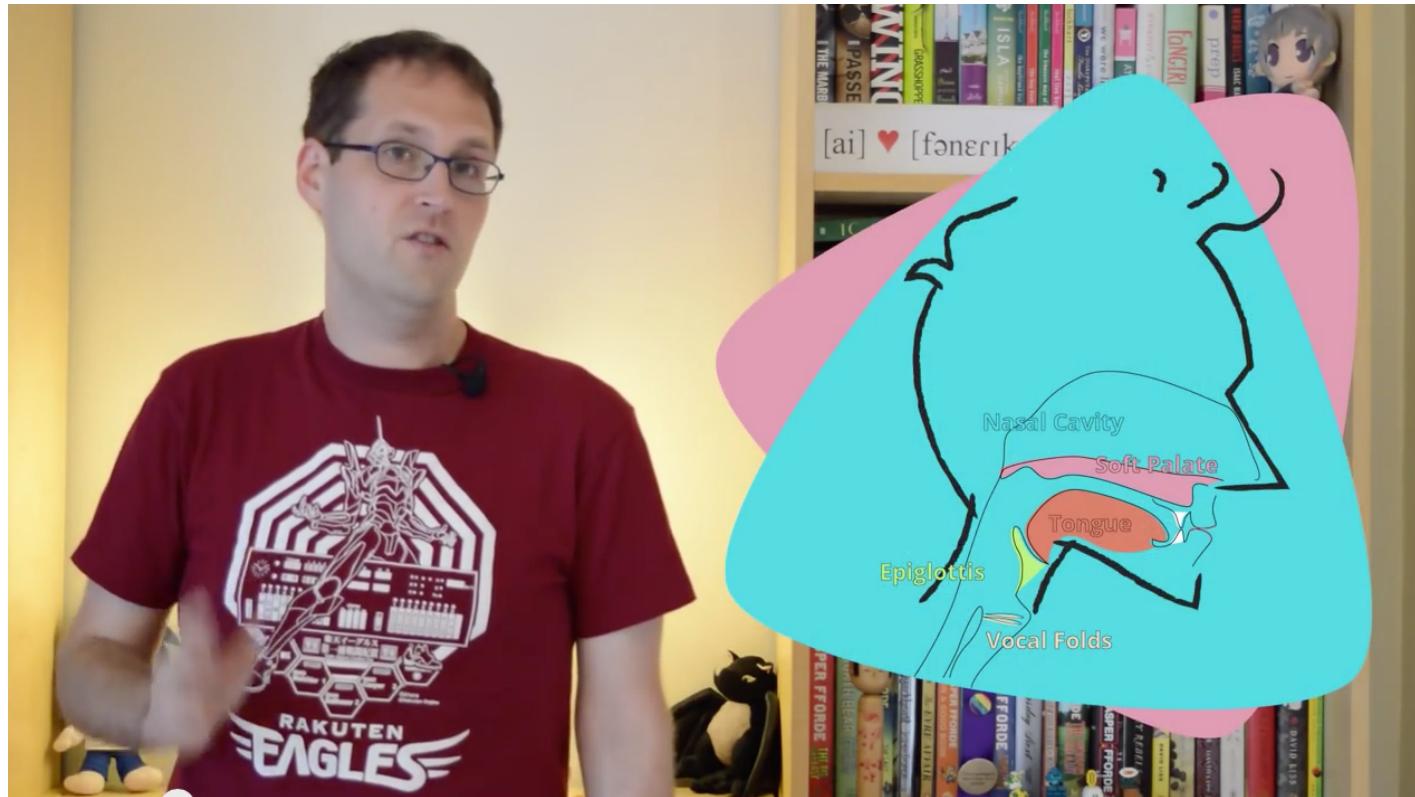


Sounds: Vocal tract overview

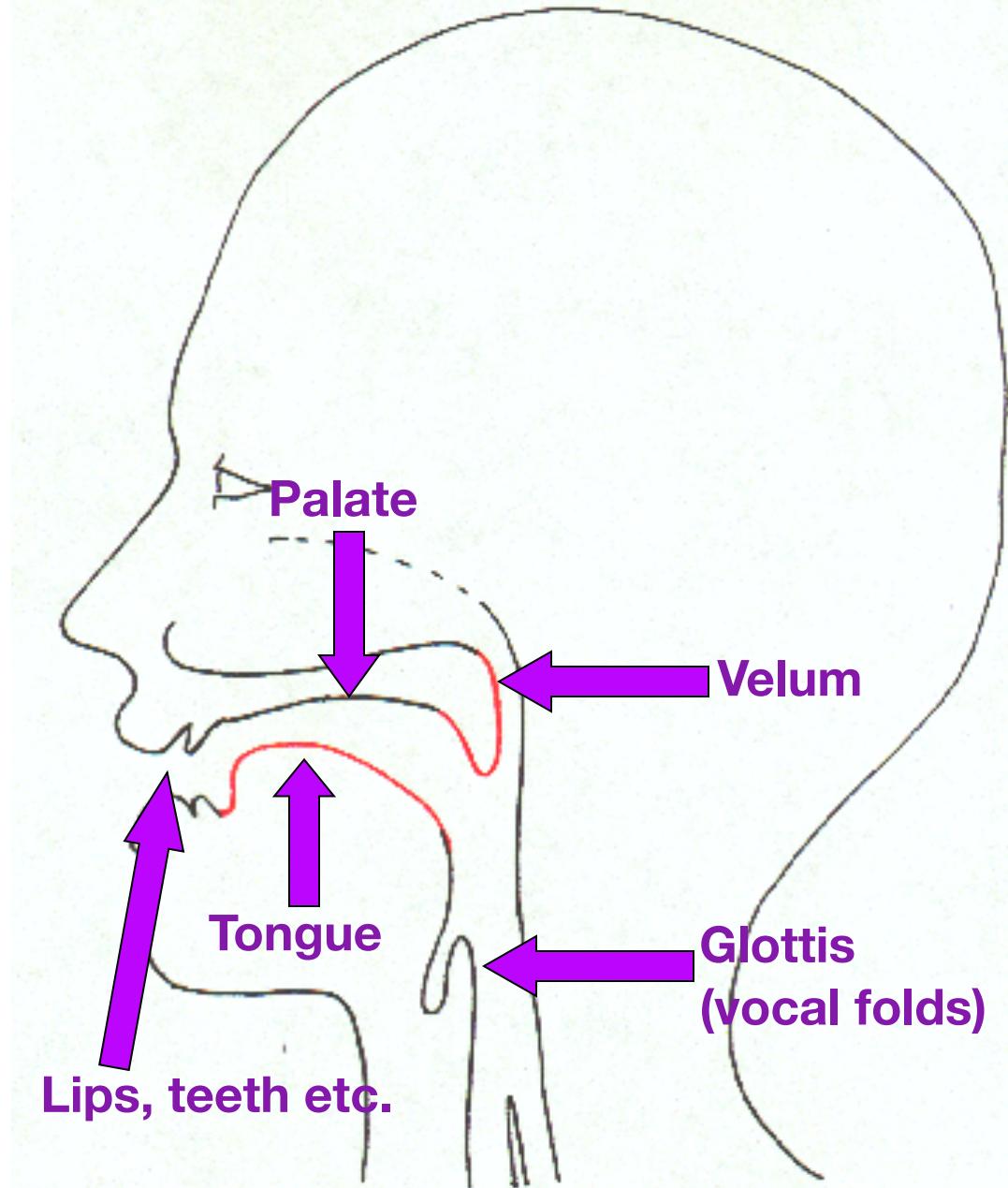
<https://www.youtube.com/watch?v=dtf8zGQj9GY>

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

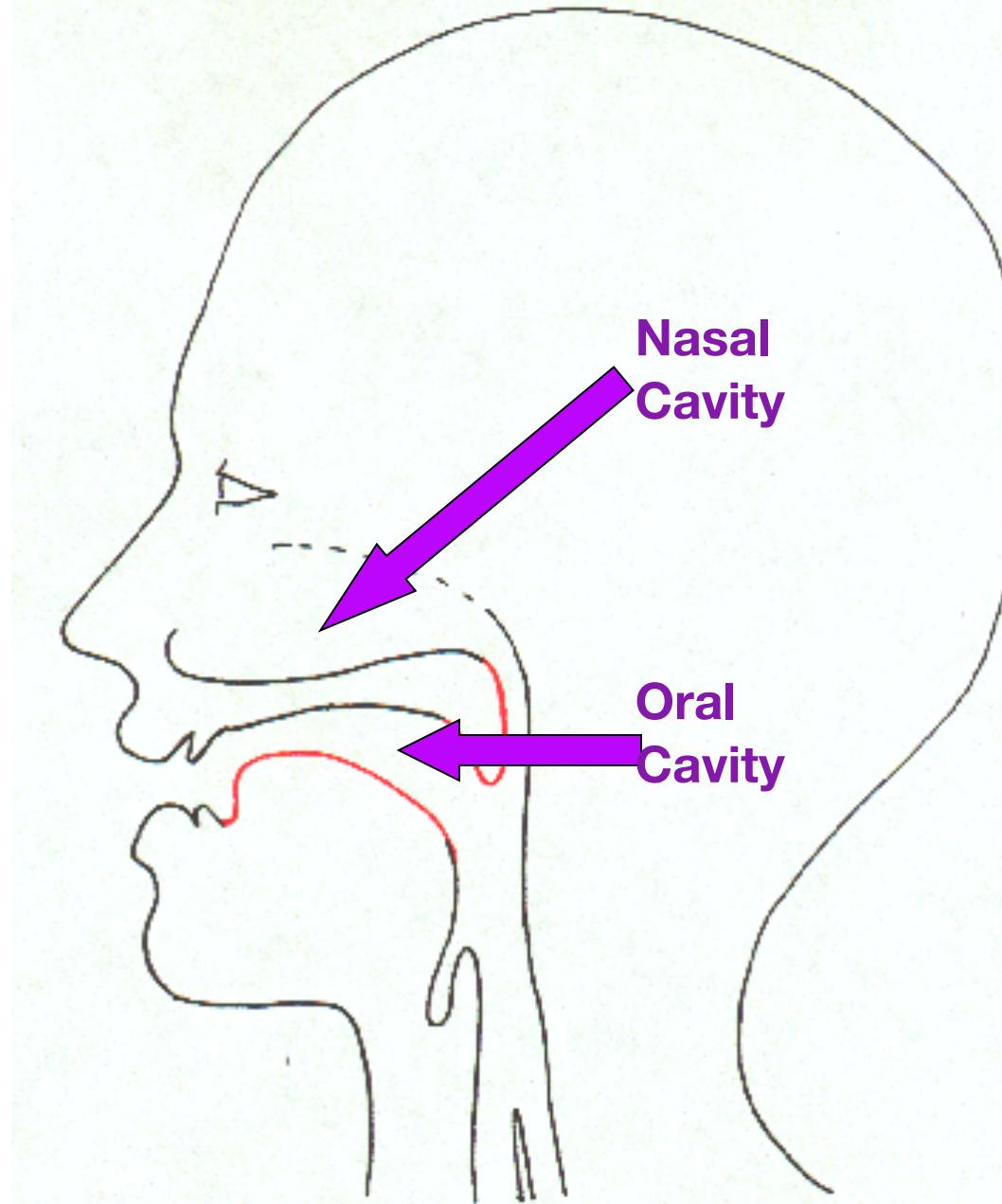
0:38 through 1:17



[Extra] How you look to a phonetician



How you look to a phonetician

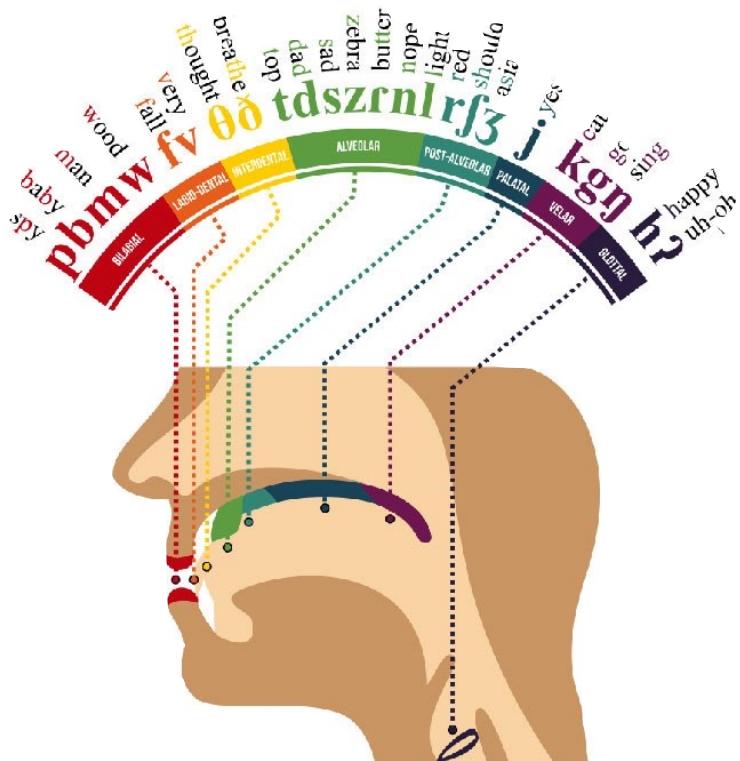


Major division: consonants vs vowels

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



On a handy chart

THE INTERNATIONAL PHONETIC ALPHABET (revised to 1993)

CONSONANTS (PULMONIC)

	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Stop	p b			t d				k g			
Nasal	m			n				ŋ			
Trill											
Tap or Flap				r							
Fricative		f v	θ ð	s z	ʃ ʒ		tʃ dʒ				h
Lateral fricative											
Glide							j	w			
Liquid				ɹ l							

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

Place of articulation:

Where the airflow is blocked

Front to back

CONSONANTS (PULMONIC)

	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Stop	p b		t d				k g				
Nasal	m	baby	n				ŋ	happy			
Trill											
Tap or Flap			r								
Fricative	f v	θ ð	s z	ʃ ʒ	tʃ dʒ						h
Lateral fricative											
Glide				j		w					
Liquid			l								

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

Place of articulation: Where the airflow is blocked

Front to back

CONSONANTS (PULMONIC)

	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Stop	p b			t d				k g			
Nasal	m			n				ŋ			
Trill											
Tap or Flap				r							
Fricative		f v	θ ð	s z	ʃ ʒ		tʃ dʒ				h
Lateral fricative											
Glide							j w				
Liquid				ɹ l							

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

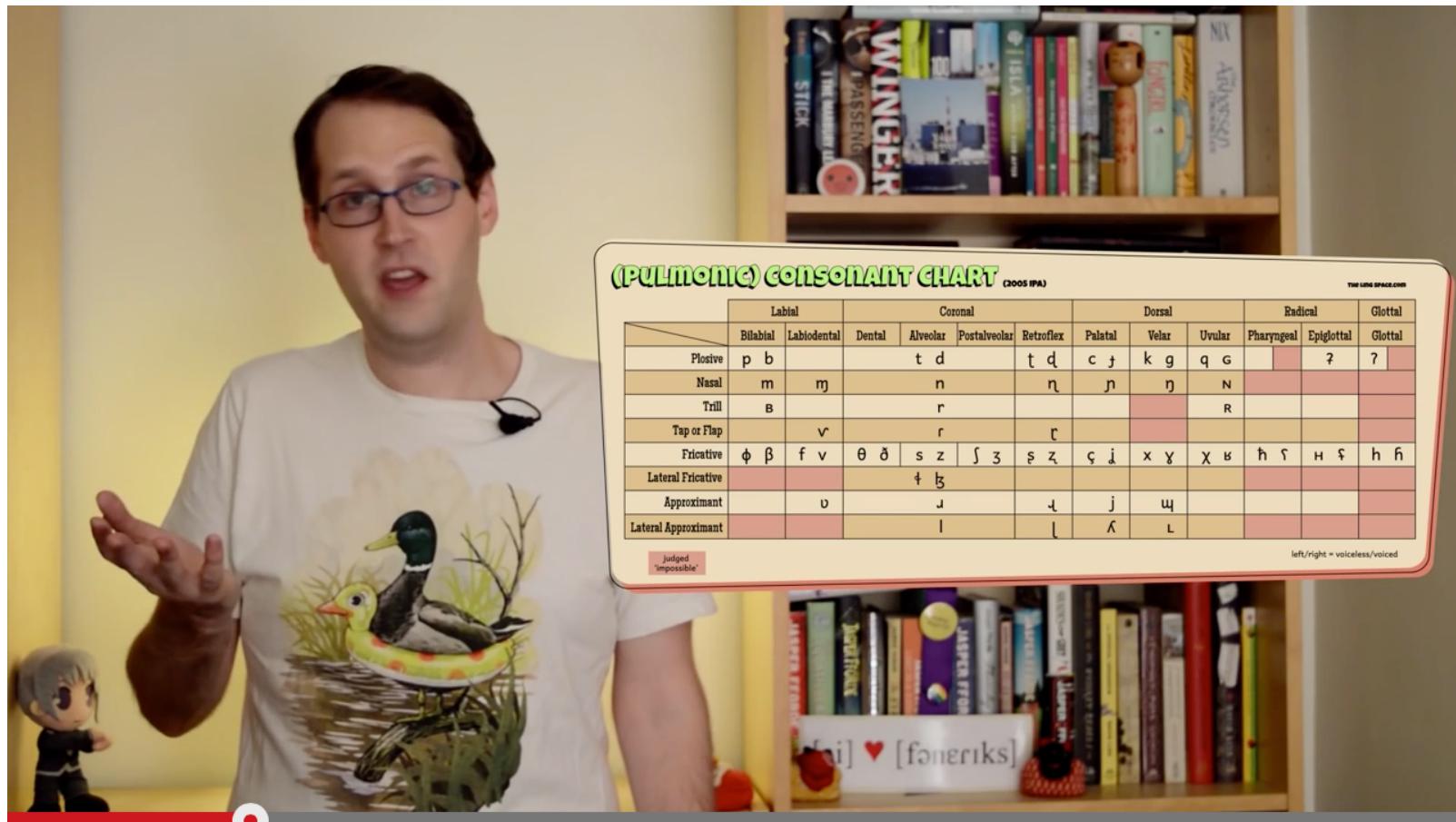
Place of articulation: Where the airflow is blocked

[Extra]

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

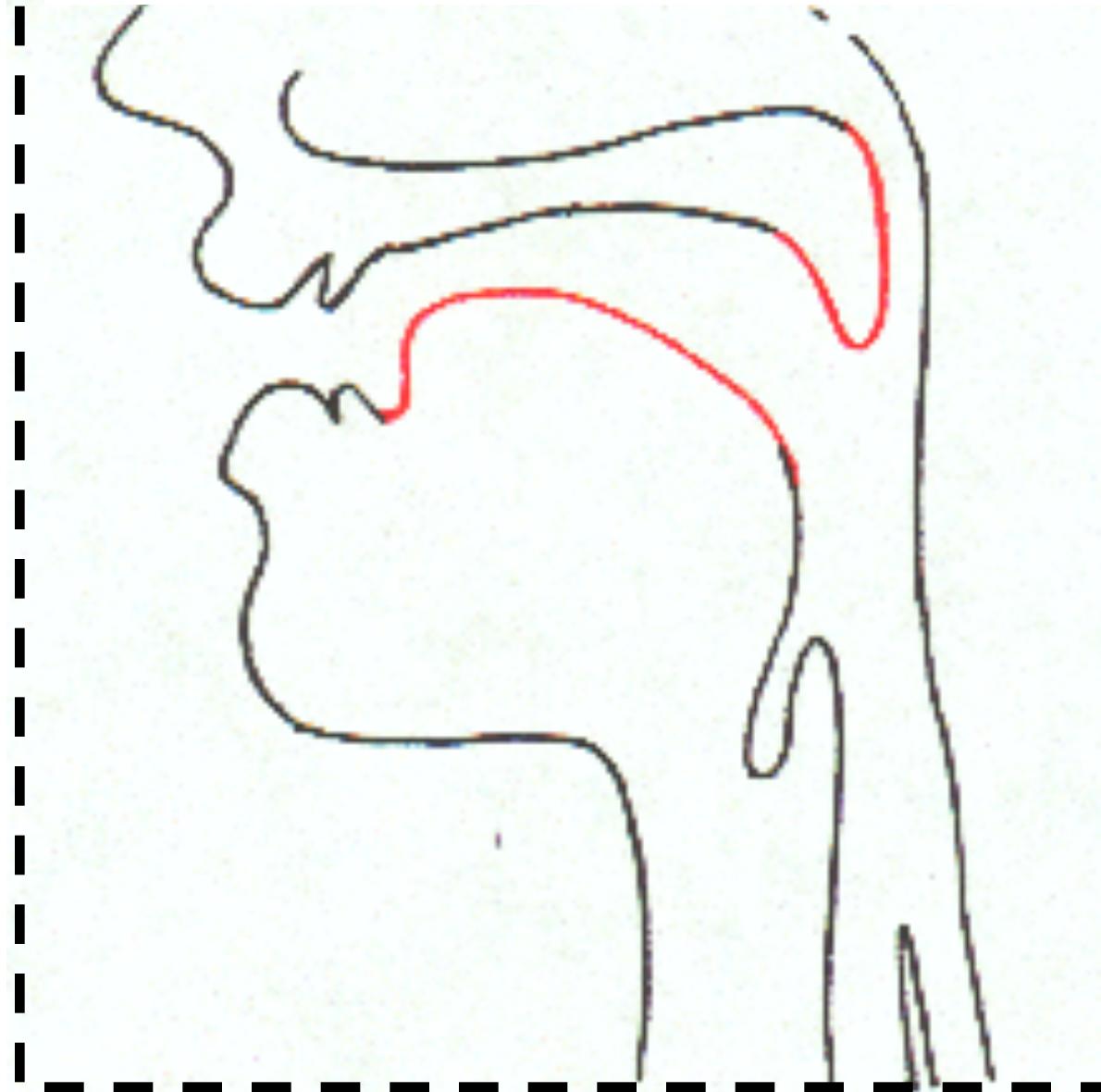
<http://www.thelingspace.com/episode-20>

beginning through 5:53



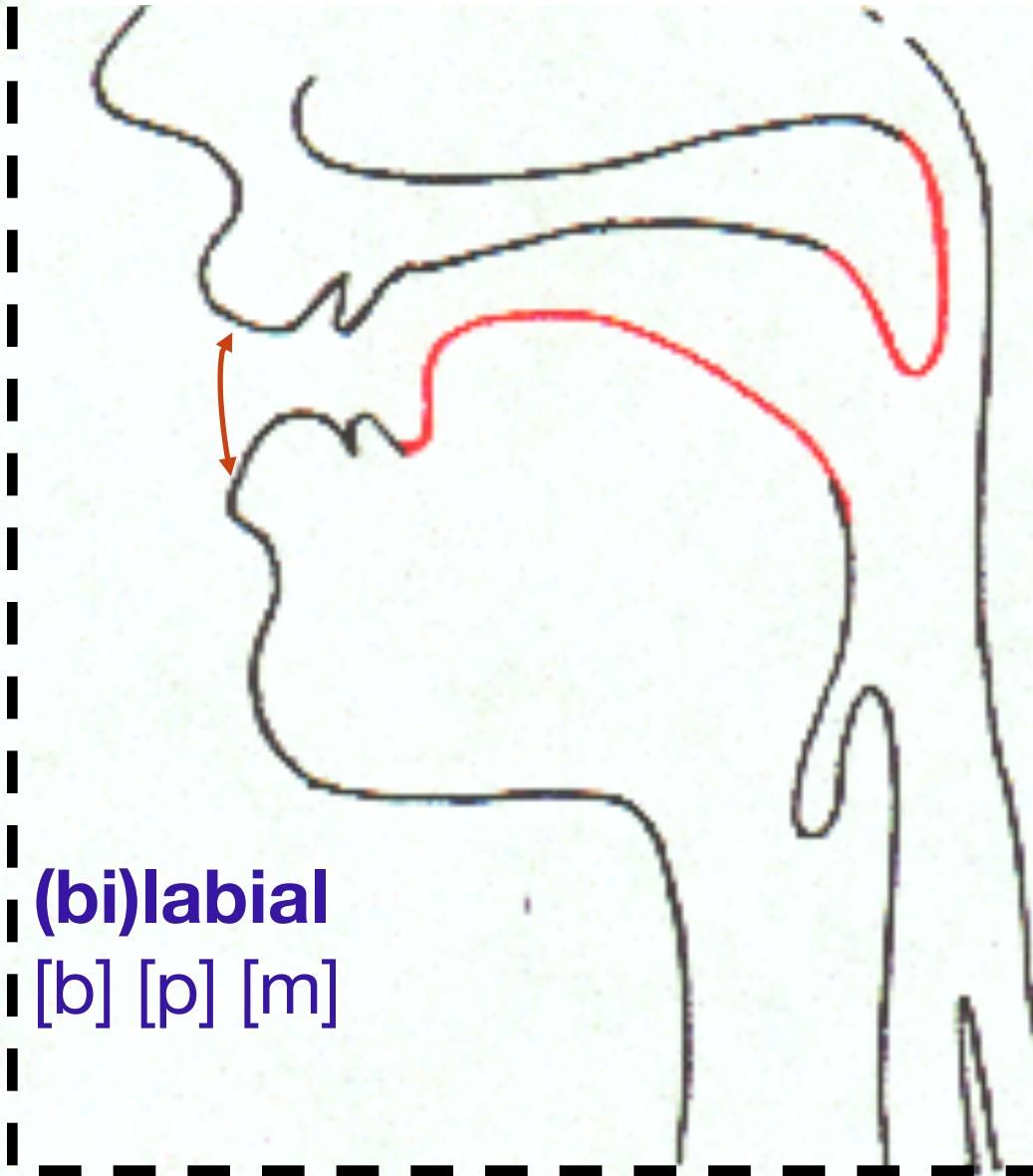
[Extra]

Where is the air flow blocked?



[Extra]

Where is the air flow blocked?

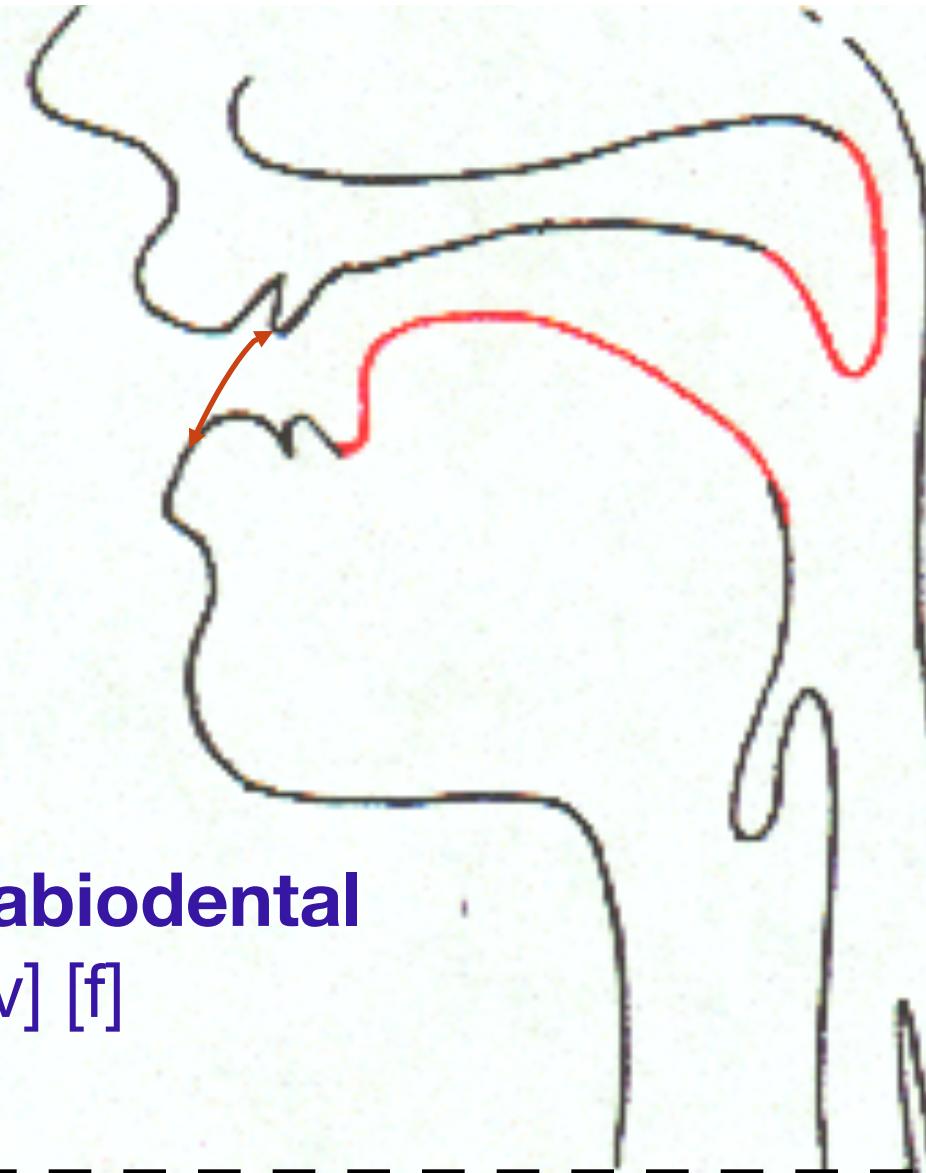


(bi)labial

[b] [p] [m]

[Extra]

Where is the air flow blocked?

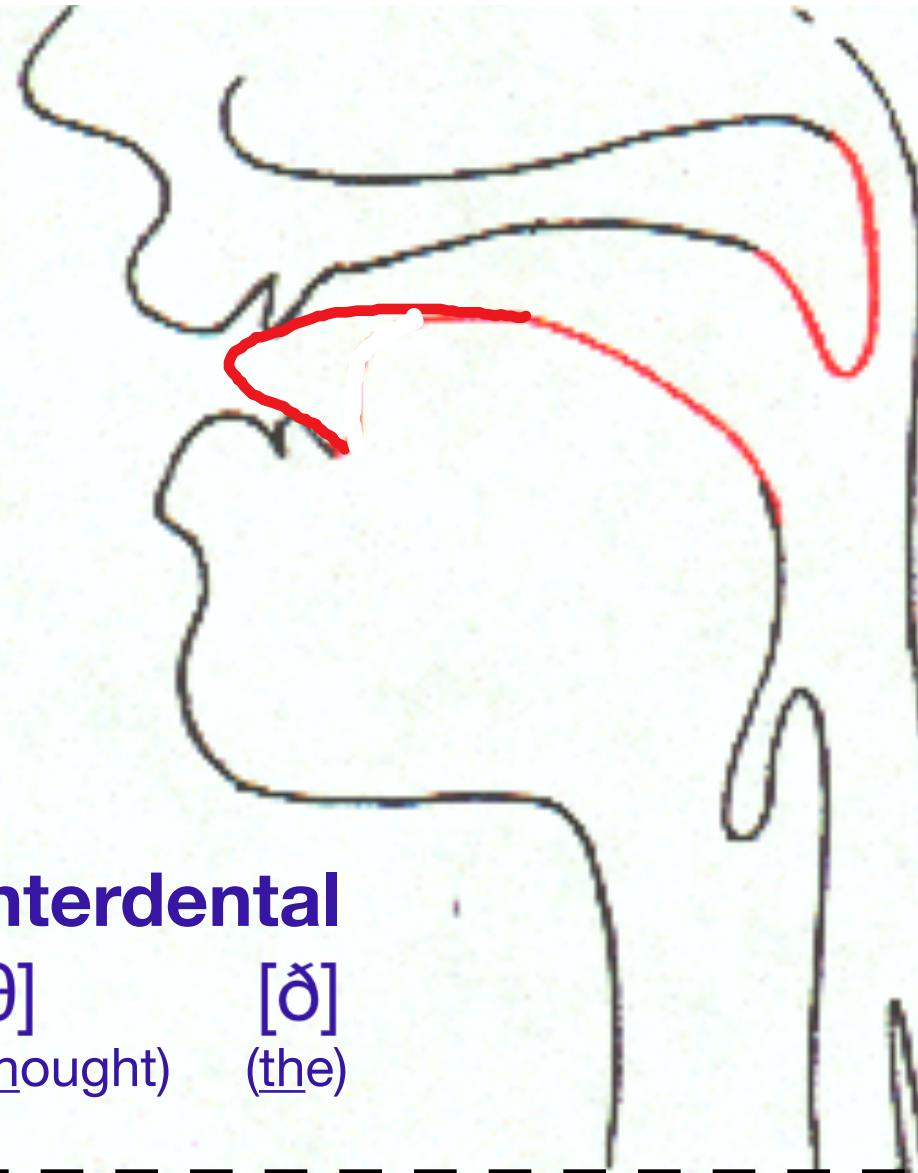


labiodental

[v] [f]

[Extra]

Where is the air flow blocked?



interdental

[θ]

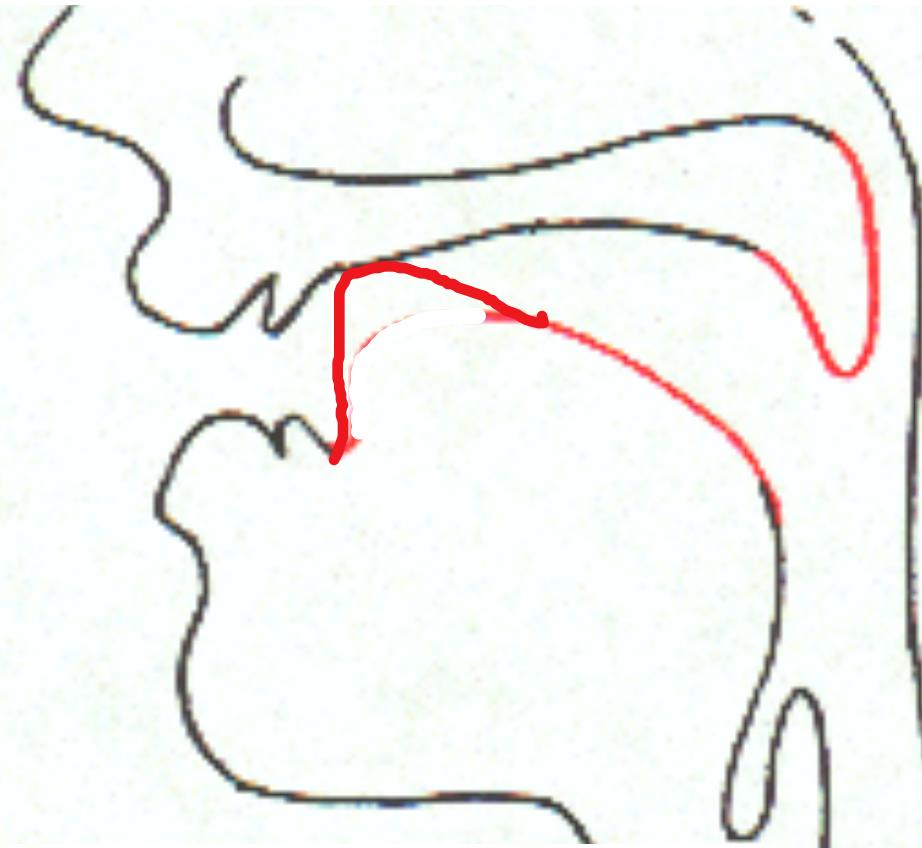
(thought)

[ð]

(the)

[Extra]

Where is the air flow blocked?

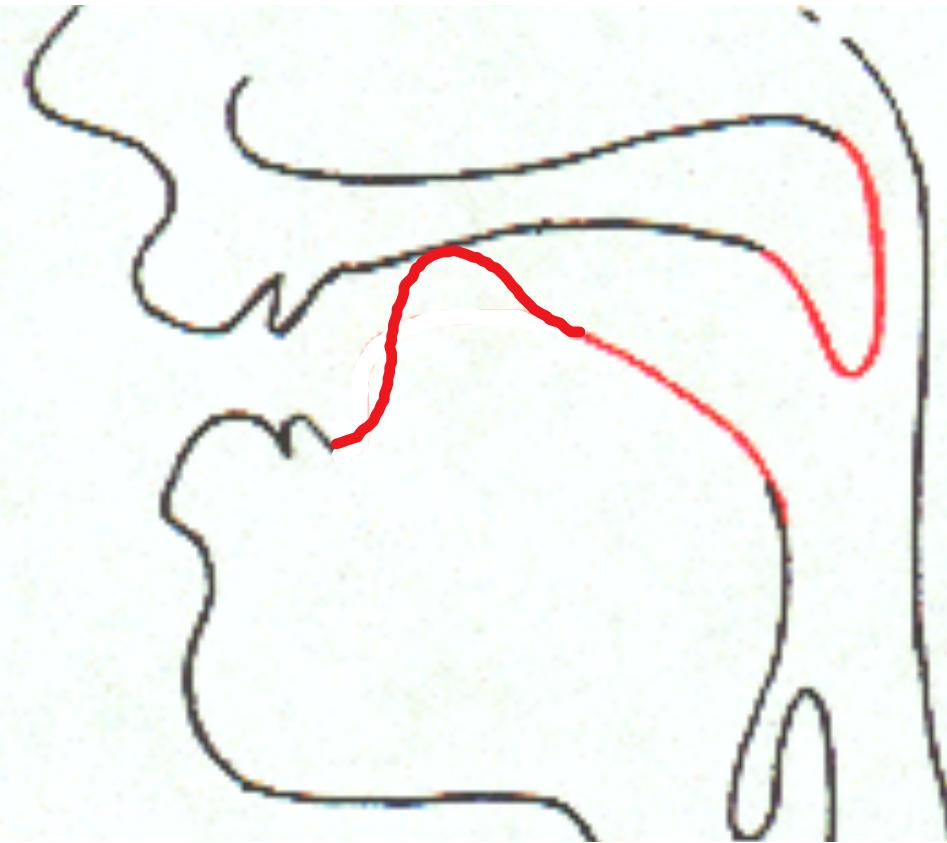


alveolar

[d] [t] [n] [s] [z] [l] [ɹ]
right butter

[Extra]

Where is the air flow blocked?



postalveolar and palatal

[ʒ] [ʃ]

azure shut

[dʒ]

judge

[tʃ]

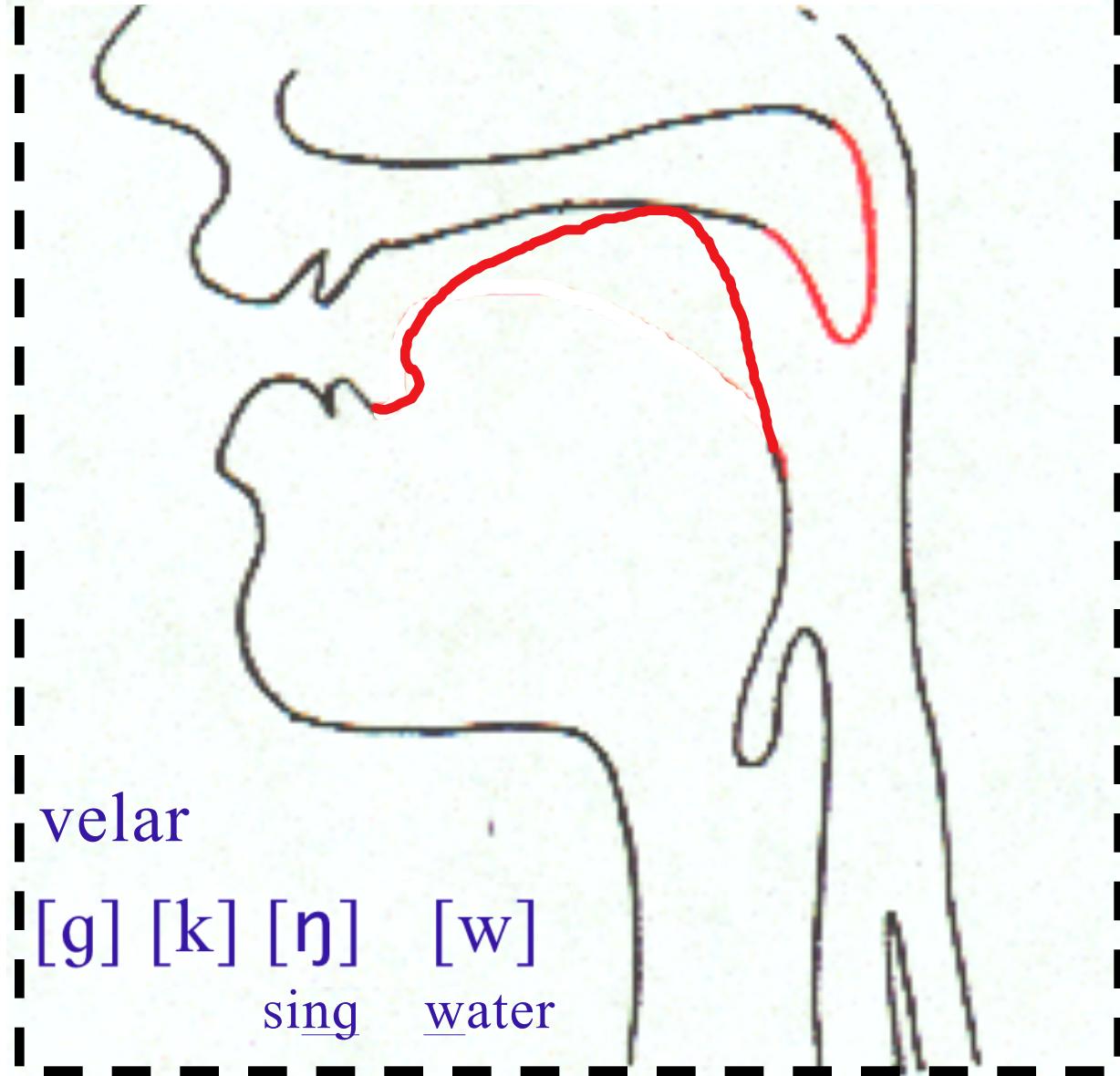
church

[j]

you

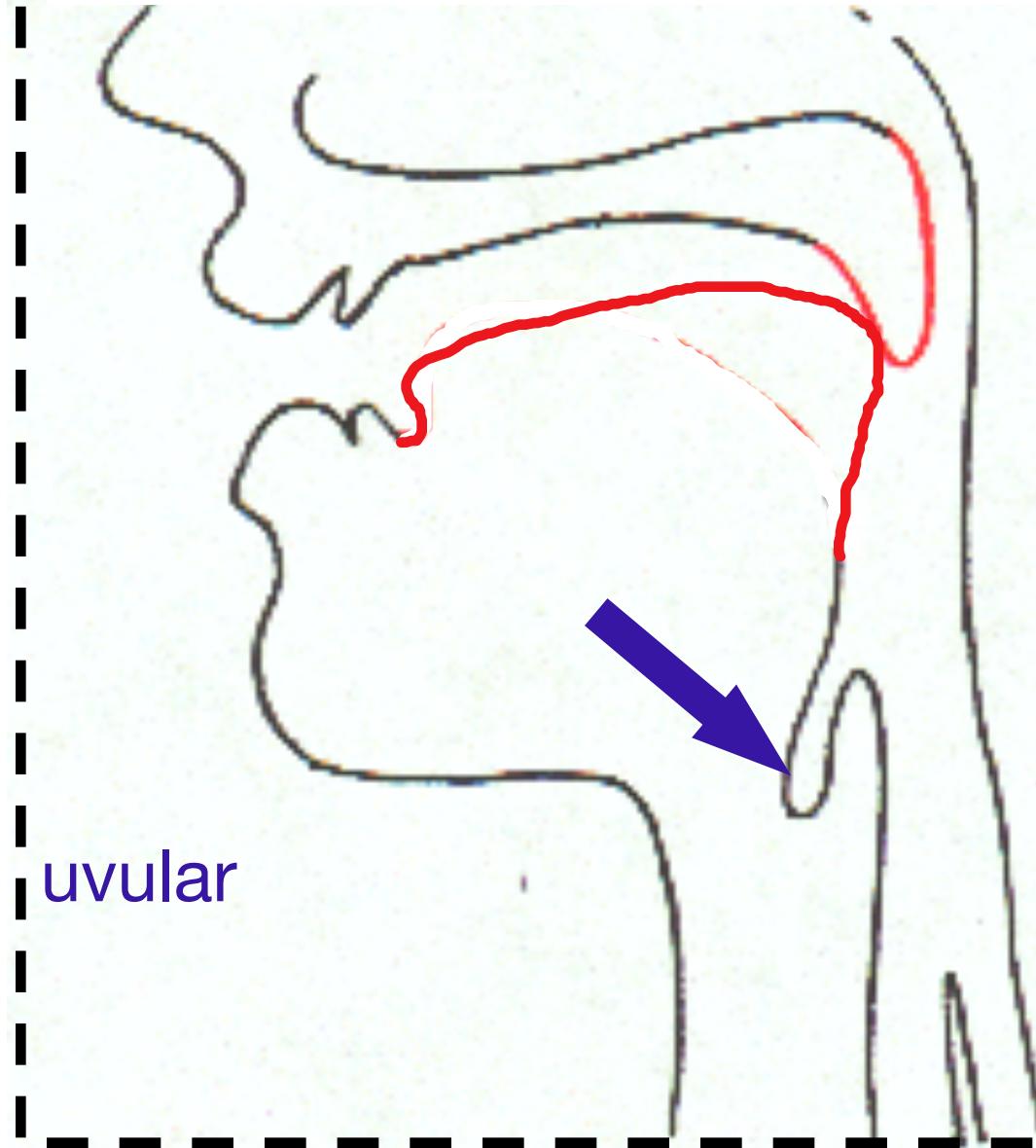
[Extra]

Where is the air flow blocked?



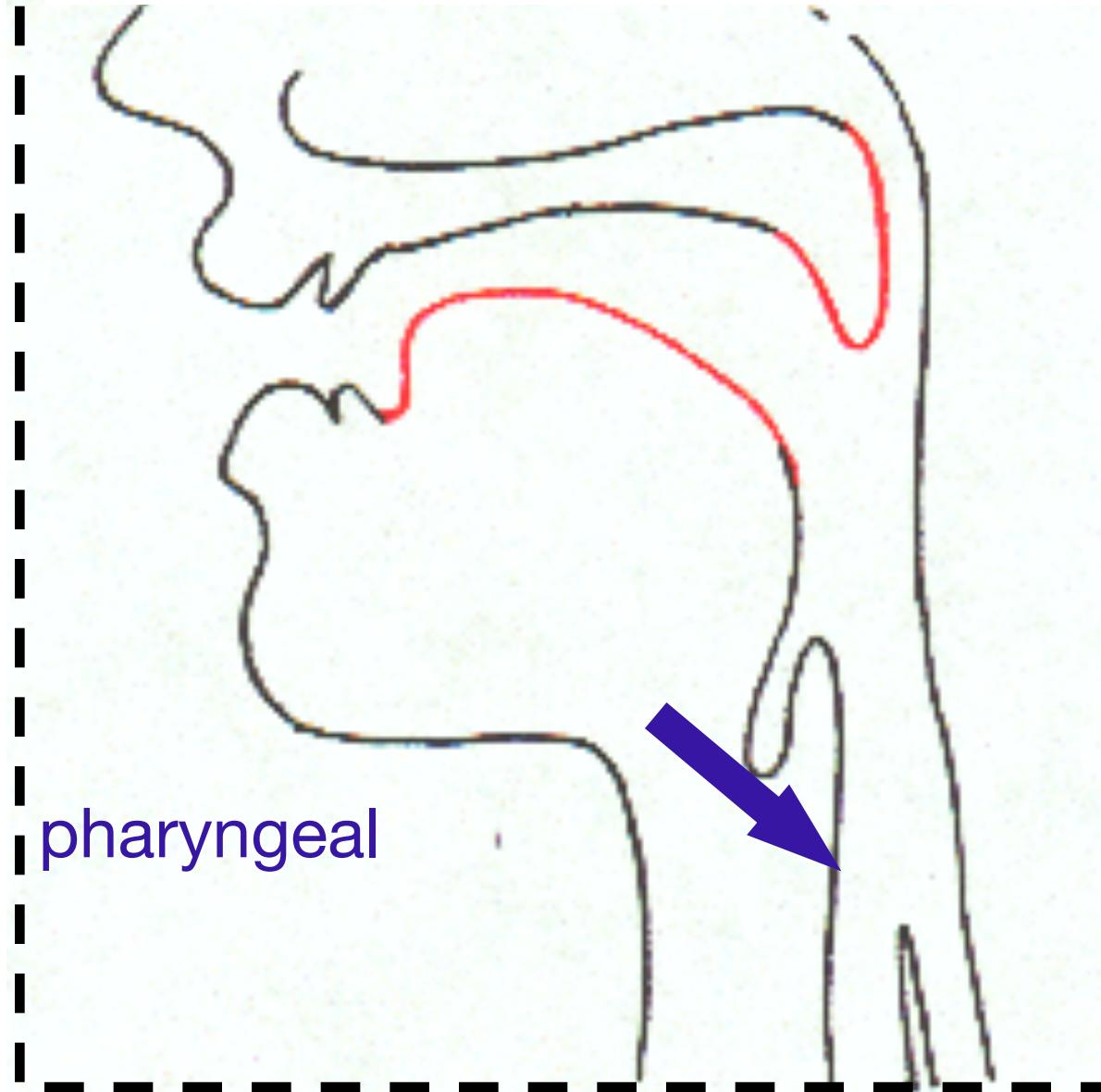
[Extra]

Where is the air flow blocked?



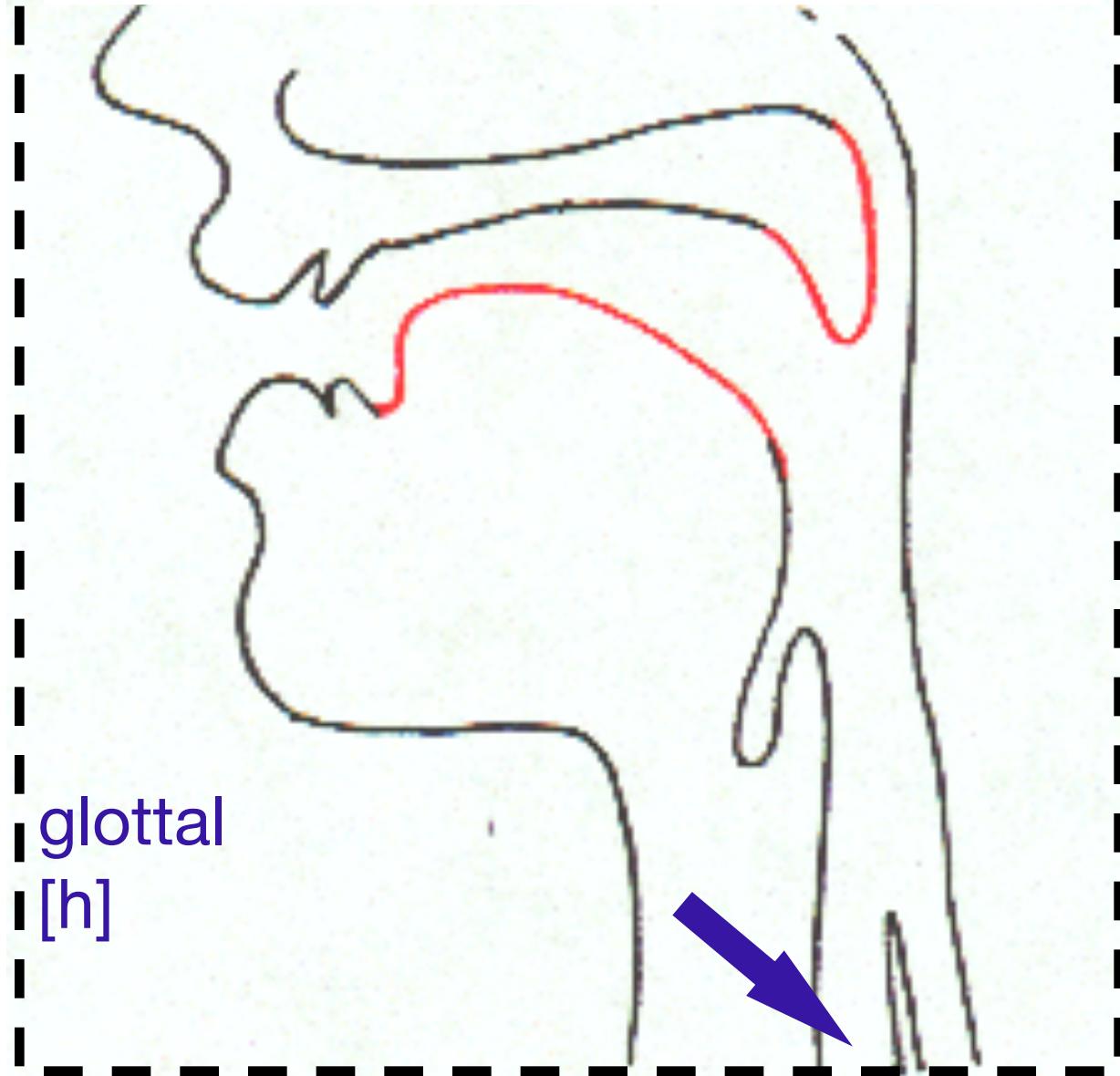
[Extra]

Where is the air flow blocked?



[Extra]

Where is the air flow blocked?



Manner of articulation: How the airflow is blocked

THE INTERNATIONAL PHONETIC ALPHABET (revised to 1993)

CONSONANTS (PULMONIC)

	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Stop	p b			t d				k g			
Nasal		m		n				ŋ			
Trill											
Tap or Flap				r							
Fricative		f v	θ ð	s z	ʃ ʒ		tʃ dʒ				h
Lateral fricative											
Glide							j	w			
Liquid				ɹ l							

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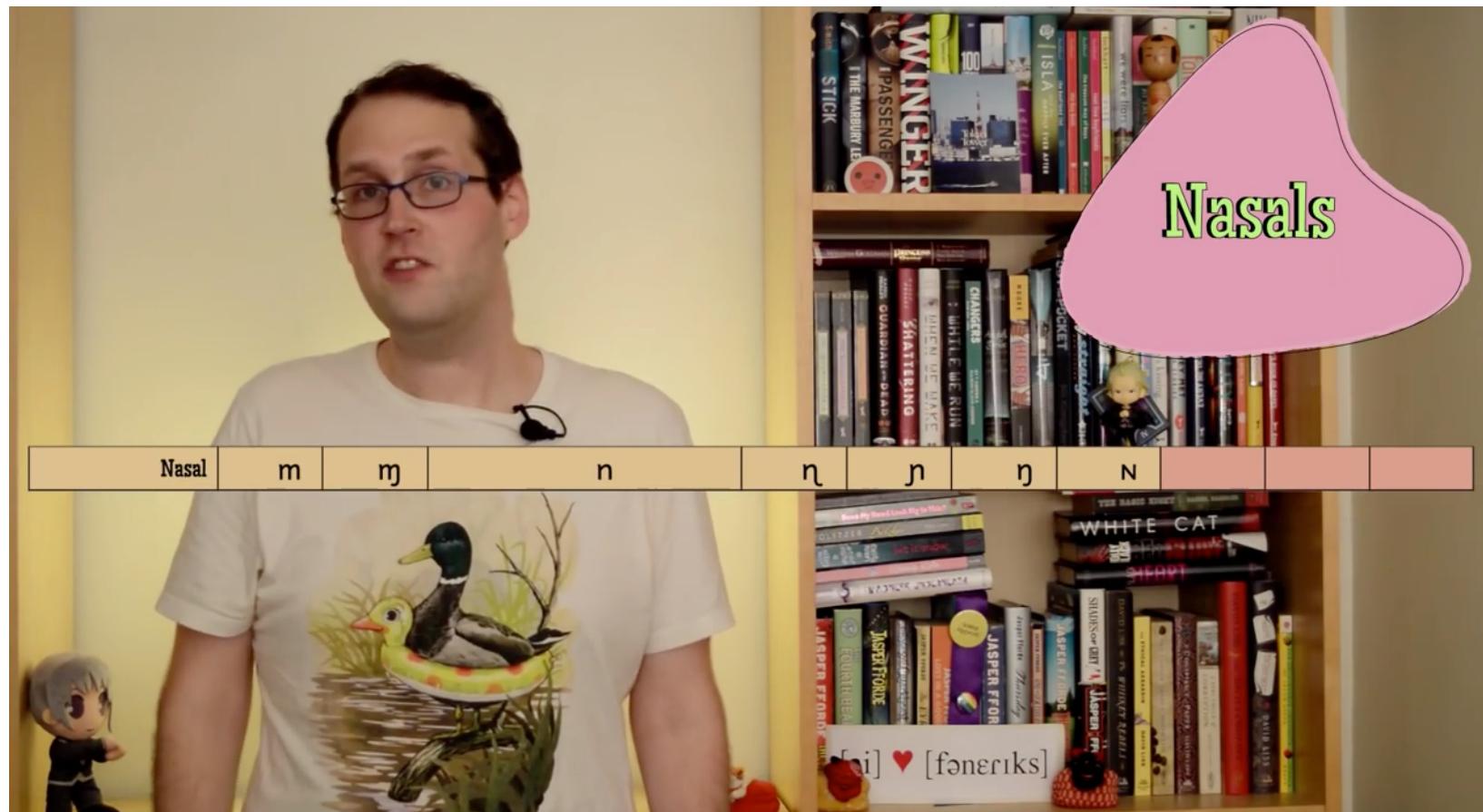
Manner of articulation: How the airflow is blocked

[Extra]

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

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

5:54 - 9:19



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

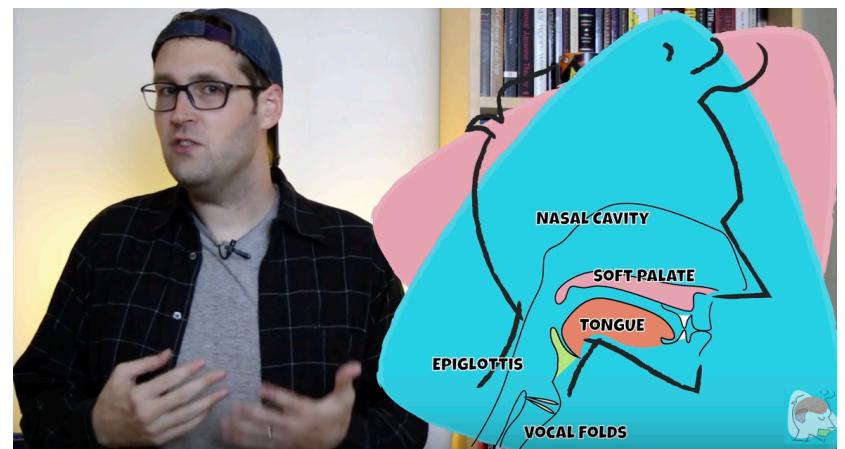
[ɹ] [l]

Tap/Flap

[ɾ] (Like in “water” and “but^ɾter”)

[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**...?”
[tʃ]
becomes
“Wh**a**chould...?”

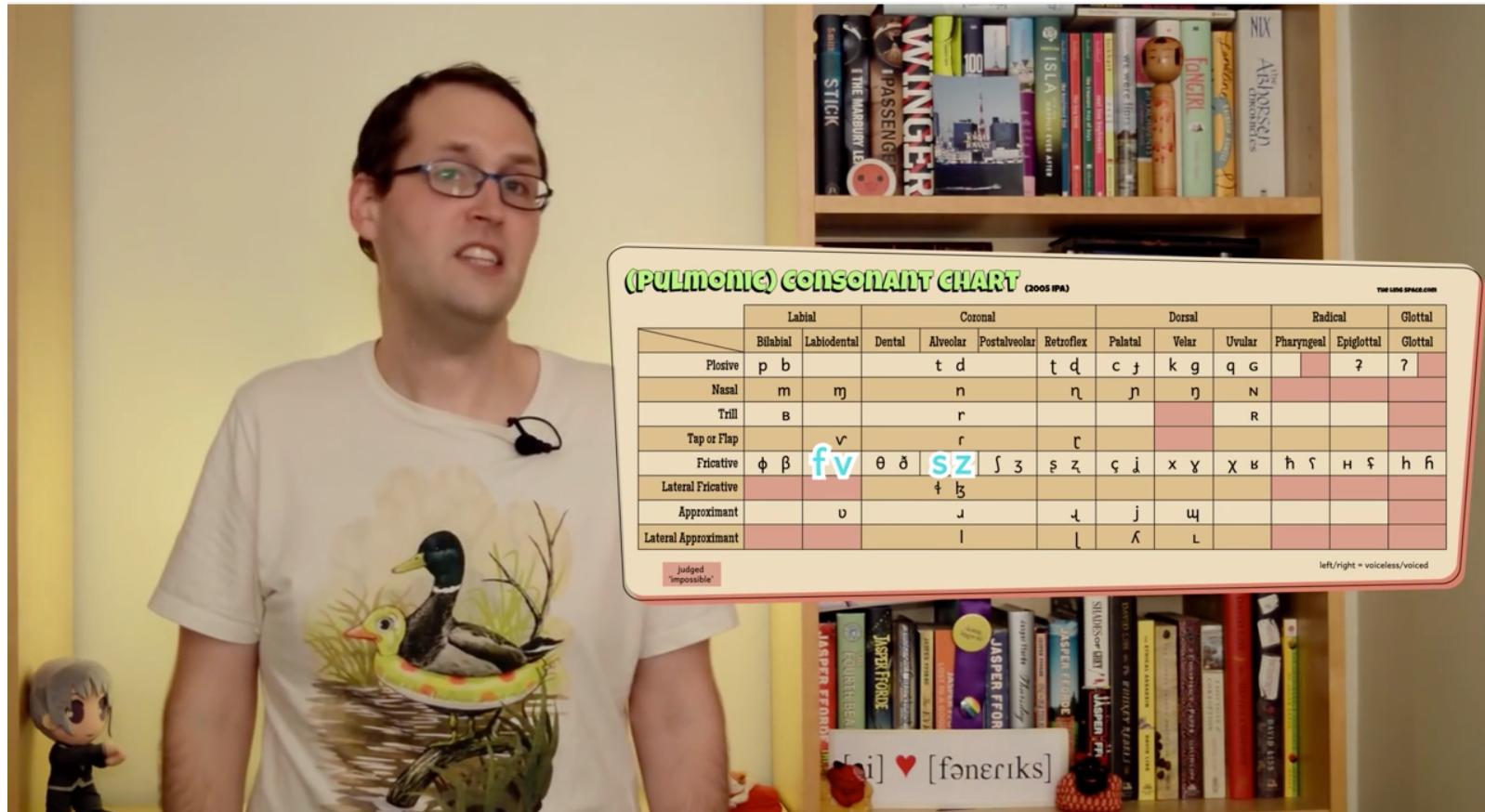
“What **did** **you**...?”
[dʒ]
becomes
“What **did** **zha**...?”
[dʒ]
becomes
“Wh**a**ja...?”

Voicing: What the vocal folds are doing

[Extra]

<https://www.youtube.com/watch?v=zEaPQP3pXQc>
<http://www.thelingspace.com/episode-20>

9:20 - 9:52



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

Voicing – usually indicated by position in cell

Voiceless voiced

CONSONANTS (PULMONIC)

	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Stop	p b			t d				k g			
Nasal	m			n				ŋ			
Trill											
Tap or Flap				r							
Fricative		f v	θ ð	s z	ʃ ʒ		tʃ dʒ				h
Lateral fricative											
Glide							j w				
Liquid				j l							

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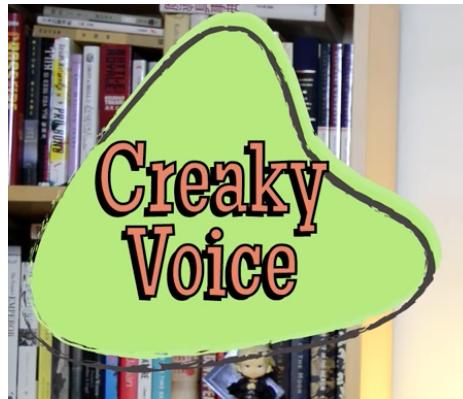
Other Glottal States (besides just +/-voiced)

[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		t d̪	c ɟ	k g	q ɢ		ʔ
Nasal		m	m̪		n		n̪	ŋ	ɳ	N	
Trill		B			r					R	
Tap or Flap				r̪		t̪					
Fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç ɟ	x ɣ	χ ʁ	ħ ʕ	h ɦ
Lateral fricative				ɬ	ɭ						
Approximant		v		ɹ		t̪	j	w̪			
Lateral approximant				l̪		ɺ	ɻ	L			

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

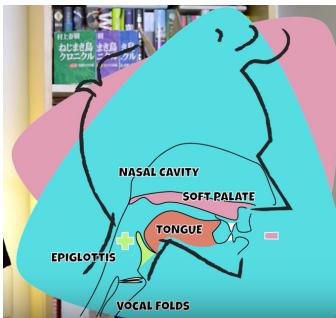
Other ways of producing consonants

[Extra]

<https://www.youtube.com/watch?v=JKP10ARLnzM&feature=youtu.be>
Discusses clicks, implosives, and ejectives



Clicks	Voiced Implosives	Ejectives
○ Bilabial	b Bilabial	p' Bilabial
Dental	c Dental/Alveolar	t' Dental/Alveolar
! Post-Alveolar	f Palatal	k' Velar
‡ Palatoalveolar	g Velar	s' Alveolar Fricative
Alveolar Lateral	ç Uvular	' (Ejective Marker)



Vowels

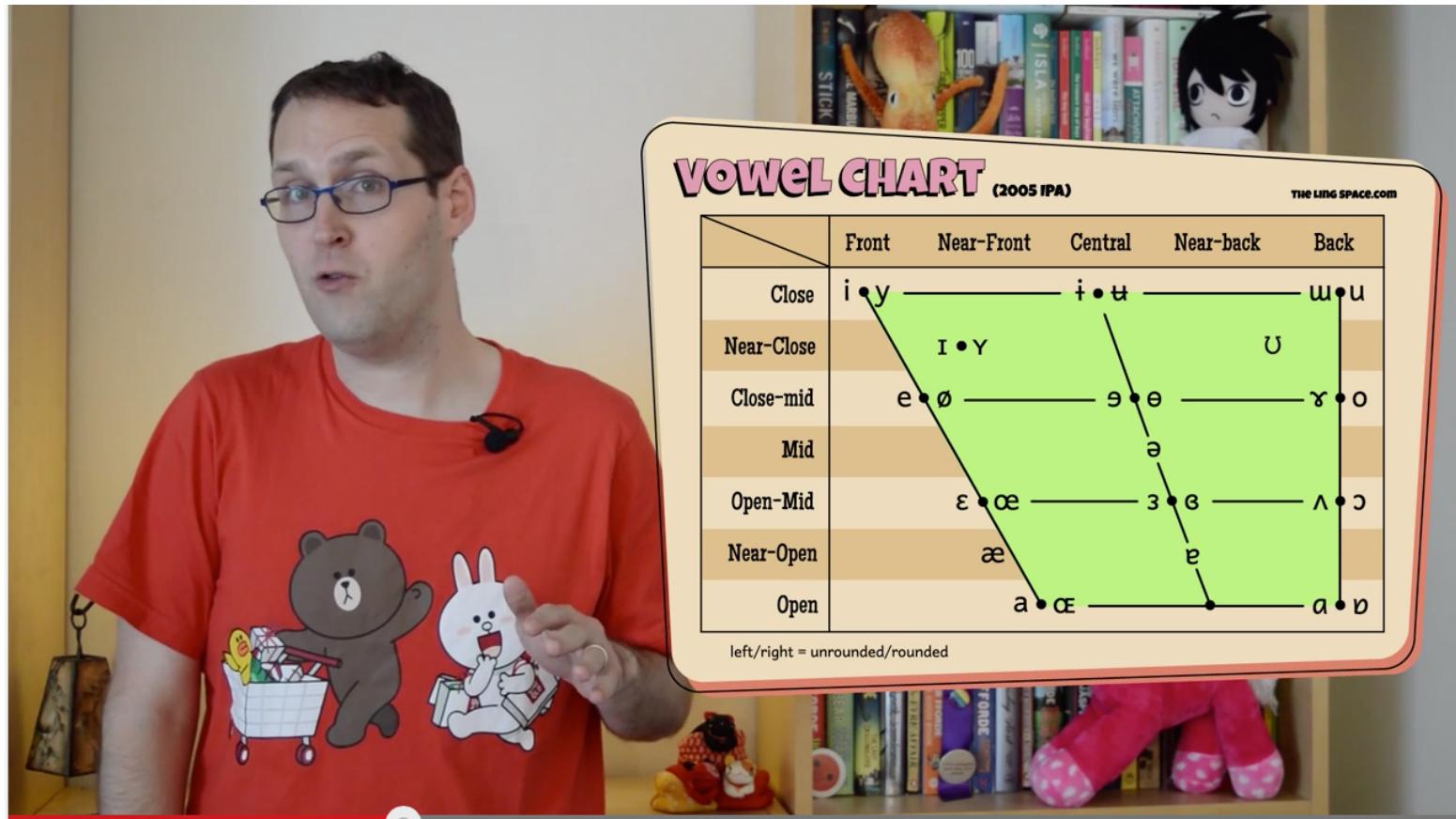
[Extra]

Vowels

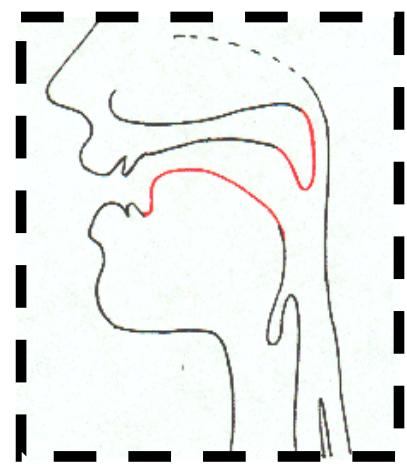
<https://www.youtube.com/watch?v=arMntA15A0s>

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

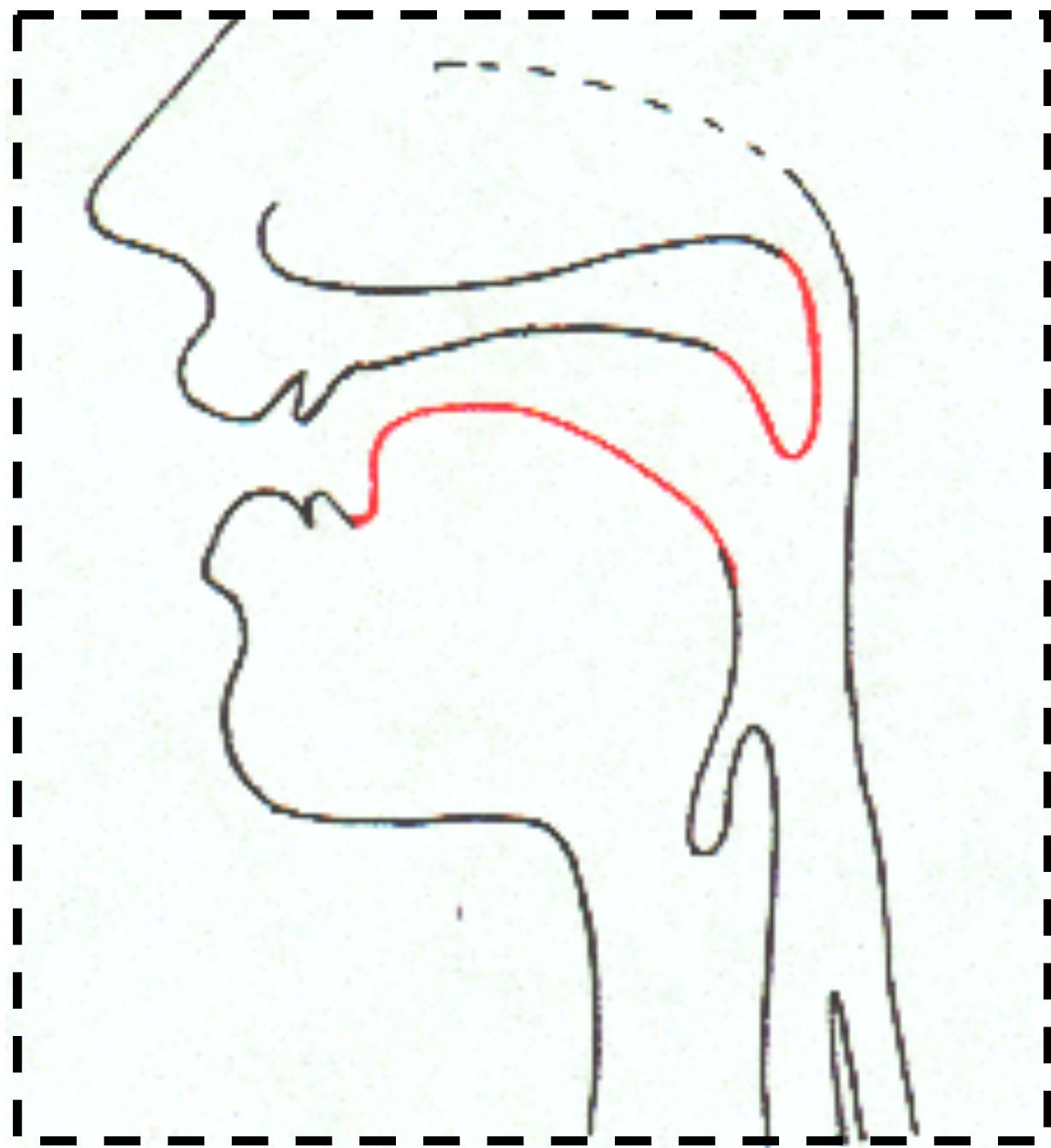
beginning through 4:10



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

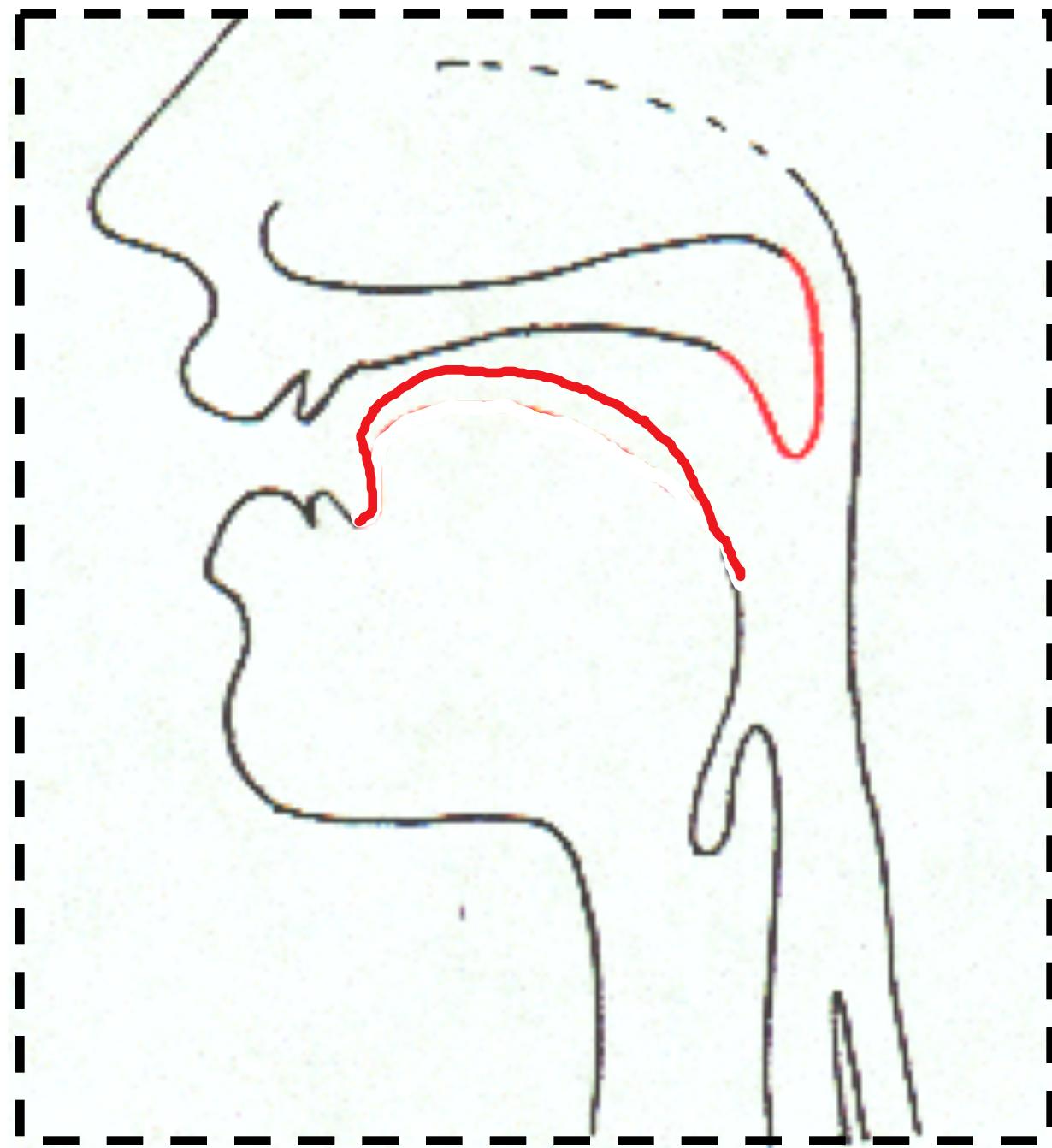


[Extra]



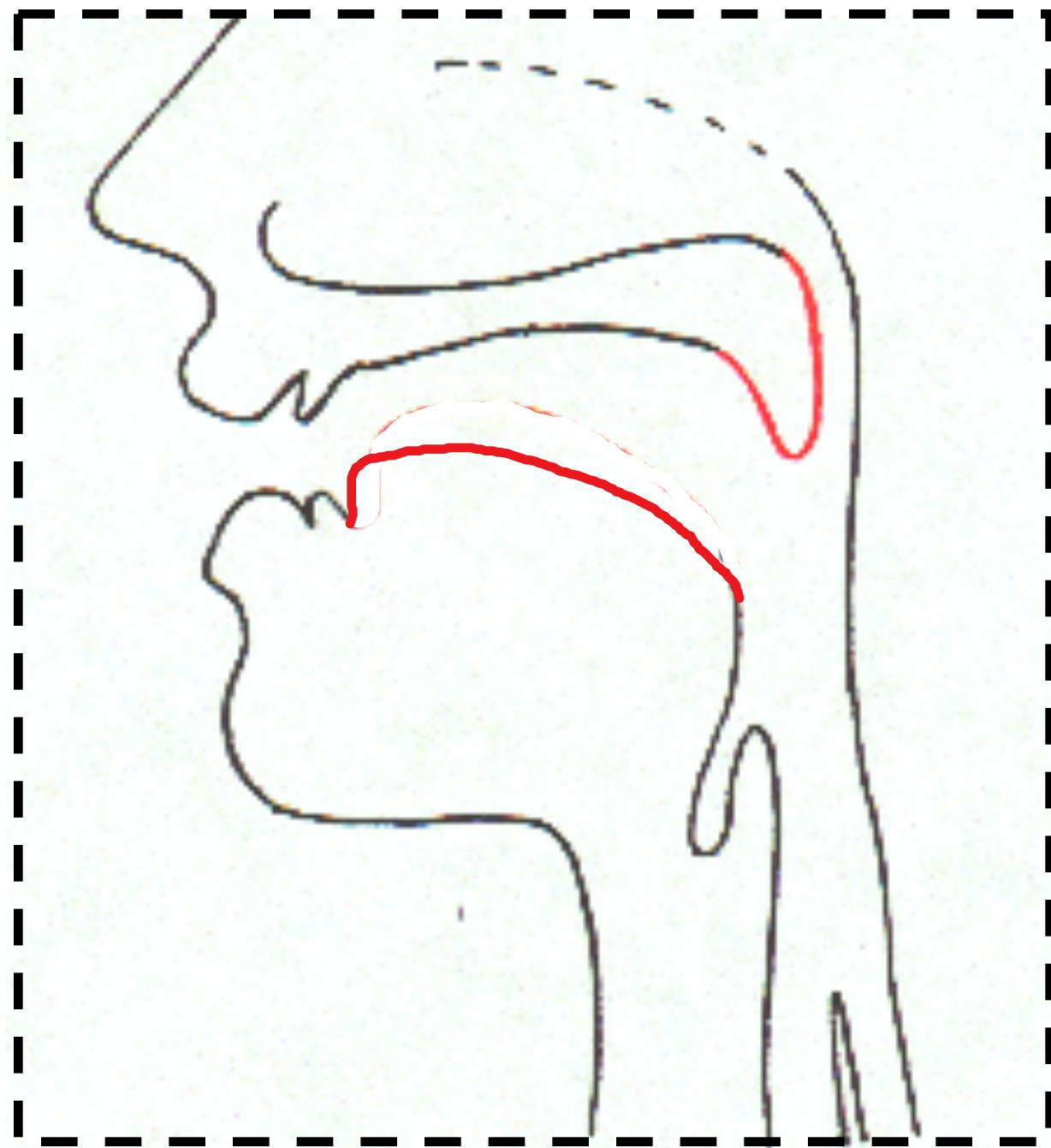
[Extra]

i



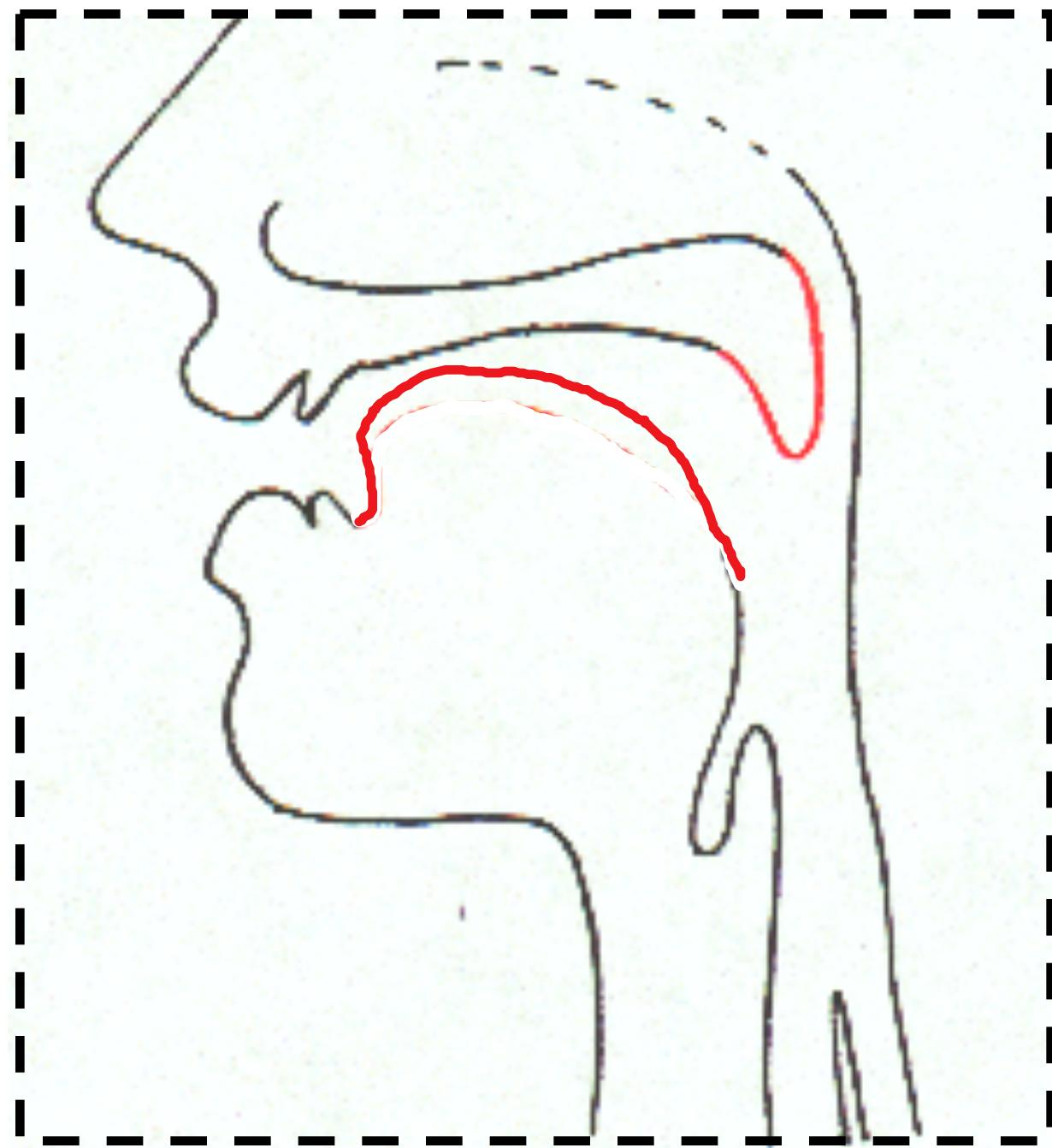
[Extra]

æ



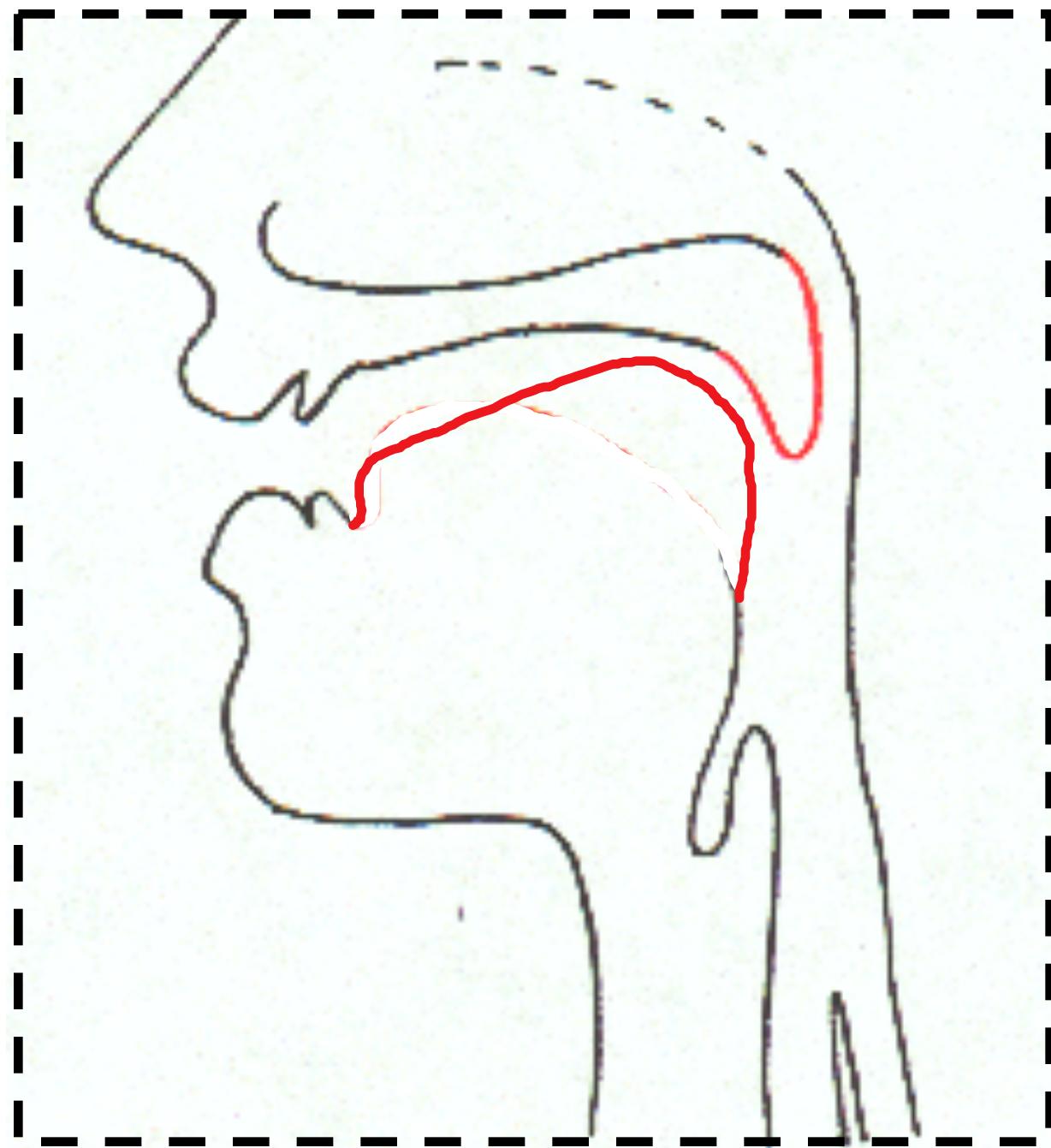
[Extra]

i



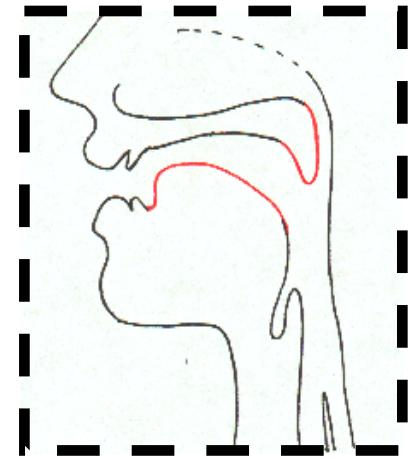
[Extra]

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*

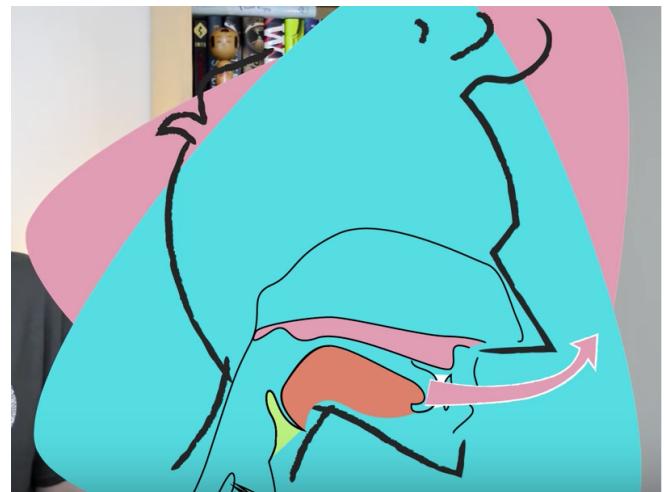
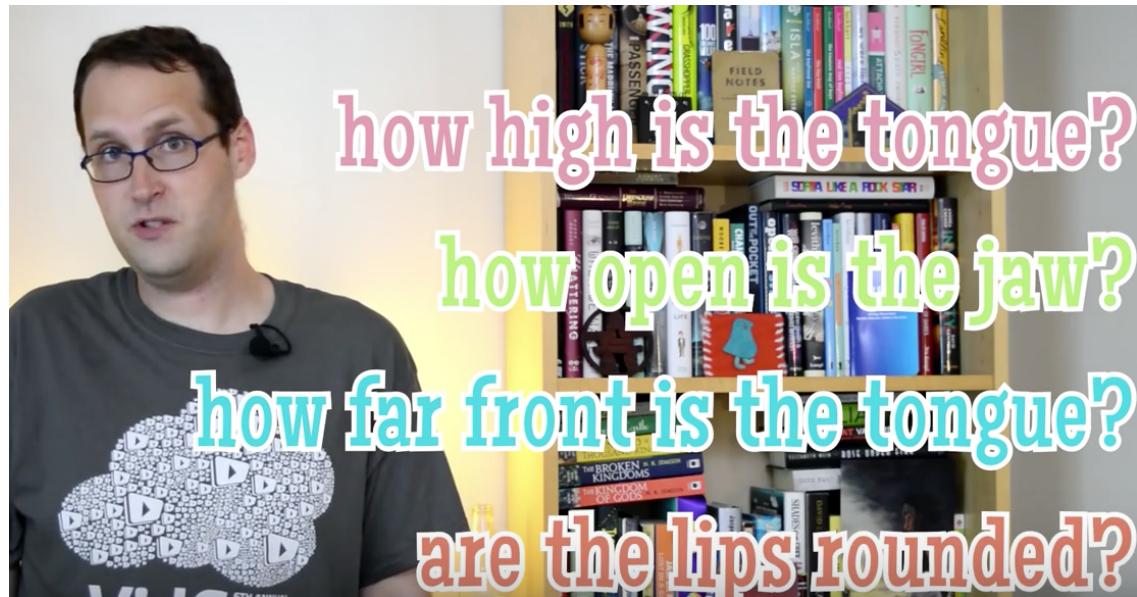
- (4) Tense or not tense your mouth
(tense, lax)

More precision when talking about vowels

[Extra]

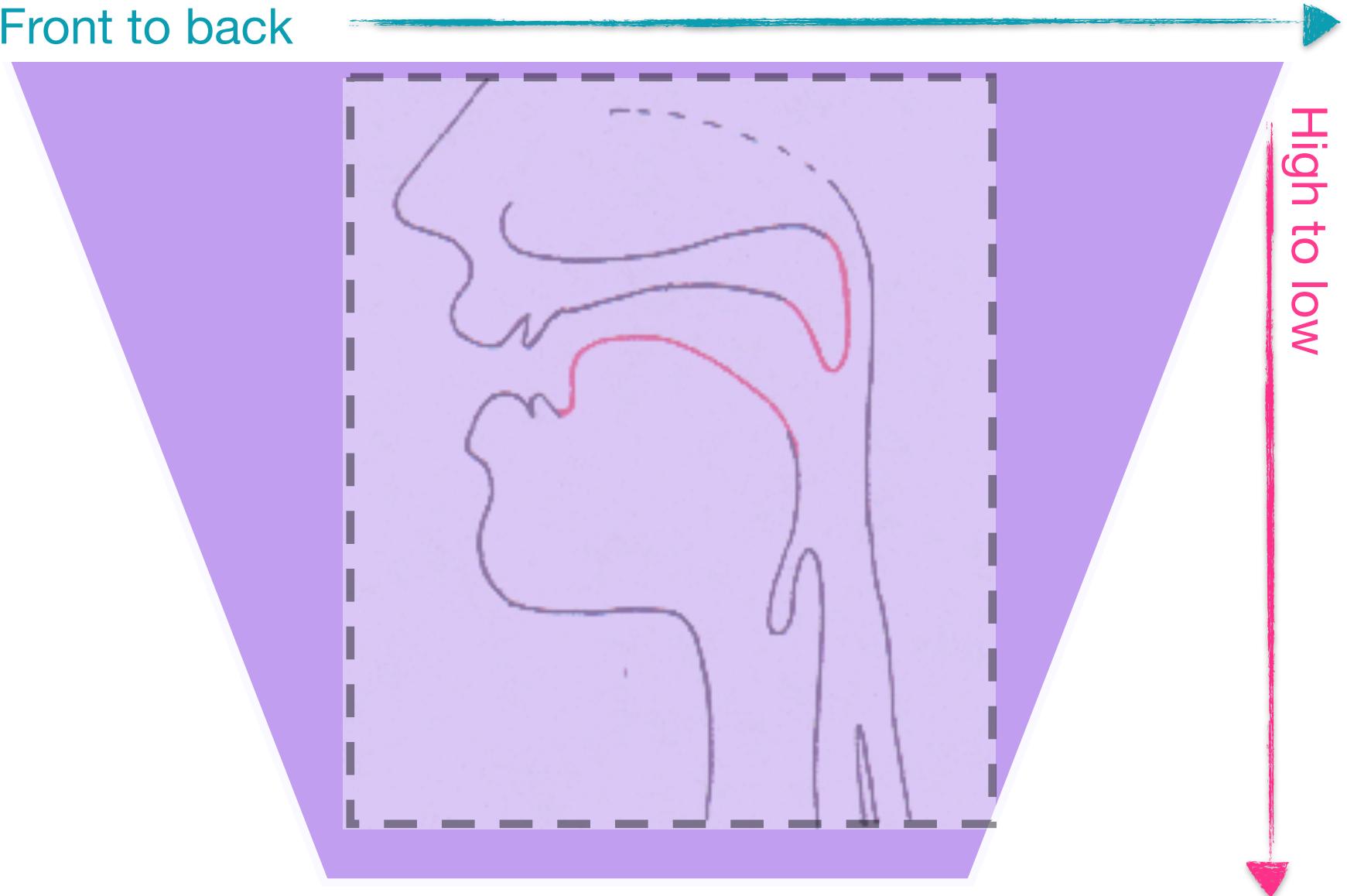
<https://www.youtube.com/watch?v=jl4zGRSYqkE&feature=youtu.be>

Discusses frequency & formants relevant for describing vowels



So what vowels do you have?

Front to back



So what vowels do you have?

Front to back



i

“sheep, sleep”

I

“ship, slip”

High to low



So what vowels do you have?

Front to back



i

I

e

ɛ

“laid, spade, trade”

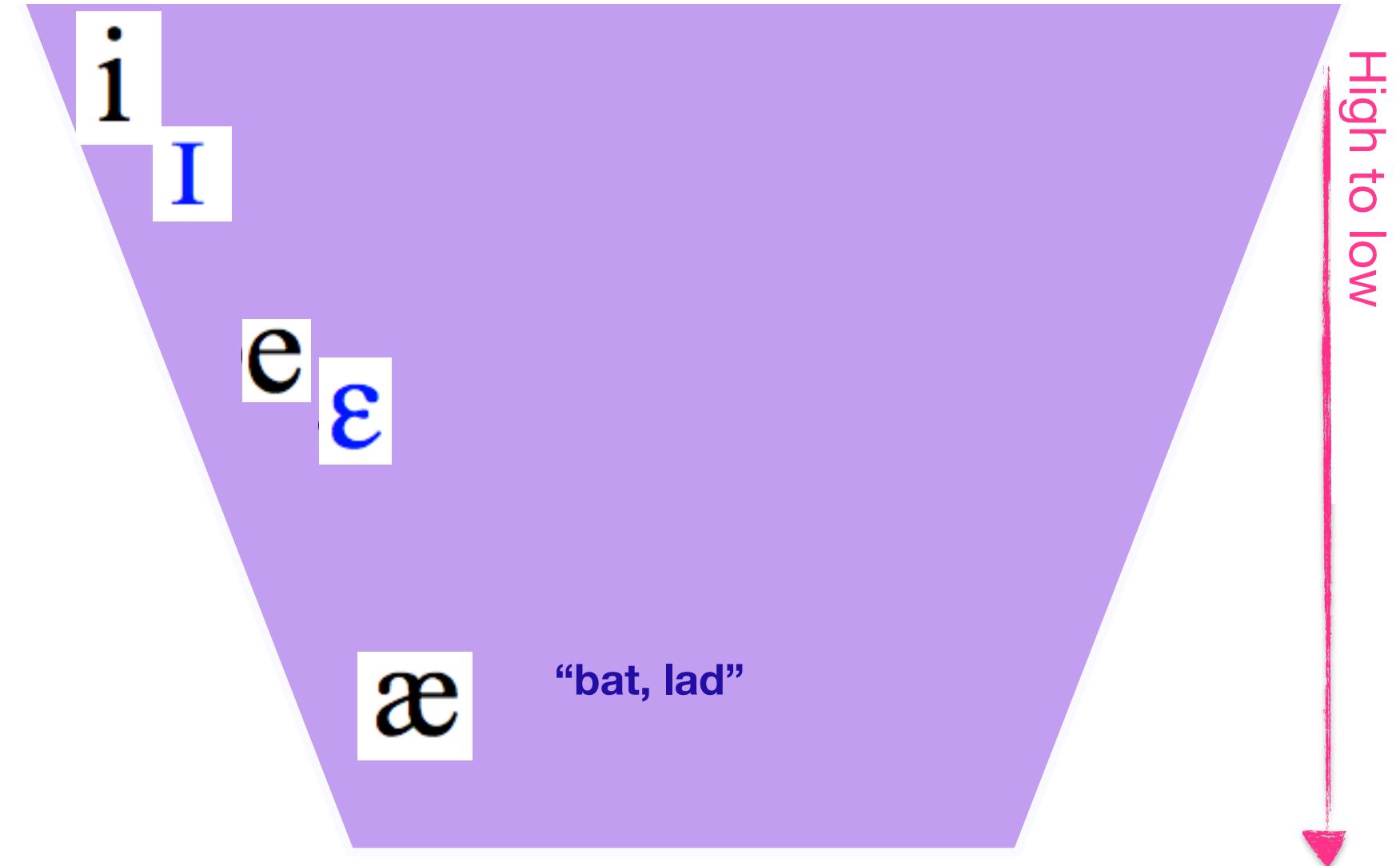
“led, sped, tread”

High to low



So what vowels do you have?

Front to back



So what vowels do you have?

Front to back



i

I

“Luke, who’d, suit”

u

U

“look, hood, soot”

e

ɛ

High to low

æ

So what vowels do you have?

Front to back



i

I

e

ɛ

æ

U

u

“coat, wrote, hoed”

ɔ

“caught, wrought, hawed”

ɑ

High to low



So what vowels do you have?

Front to back

i

I

e

ɛ

æ

U

u

O

ʌ C

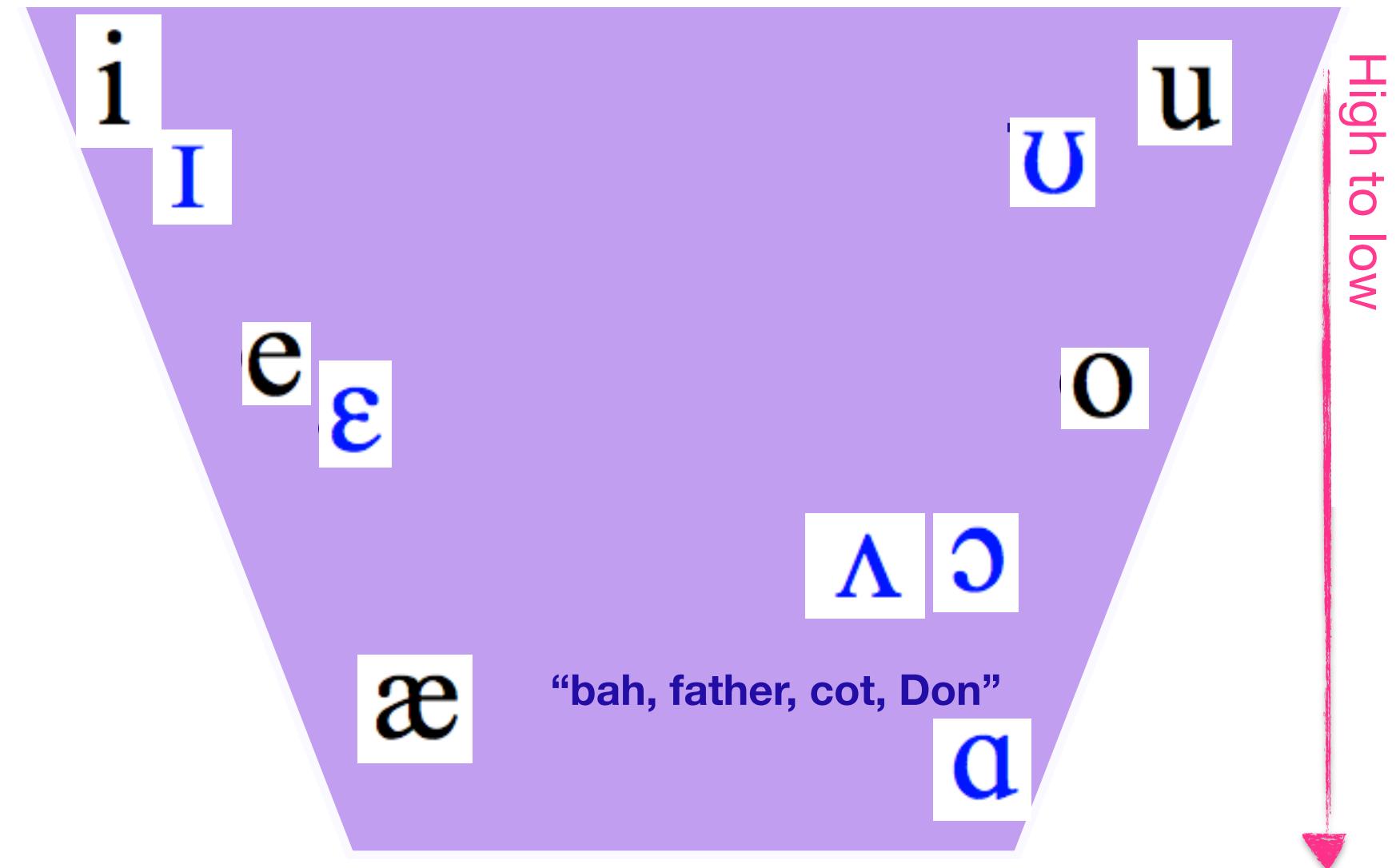
“cut, rut, hut”

High to low



So what vowels do you have?

Front to back



So what vowels do you have?

Front to back



High to low

i

I

e

ɛ

æ

ə

ʌ

a

ʊ

u

ɔ

“metallic, Texas”

[Extra]

Here they are!

Front to back

i

I

e

ɛ

æ

e

ʌ

a

ʊ

u

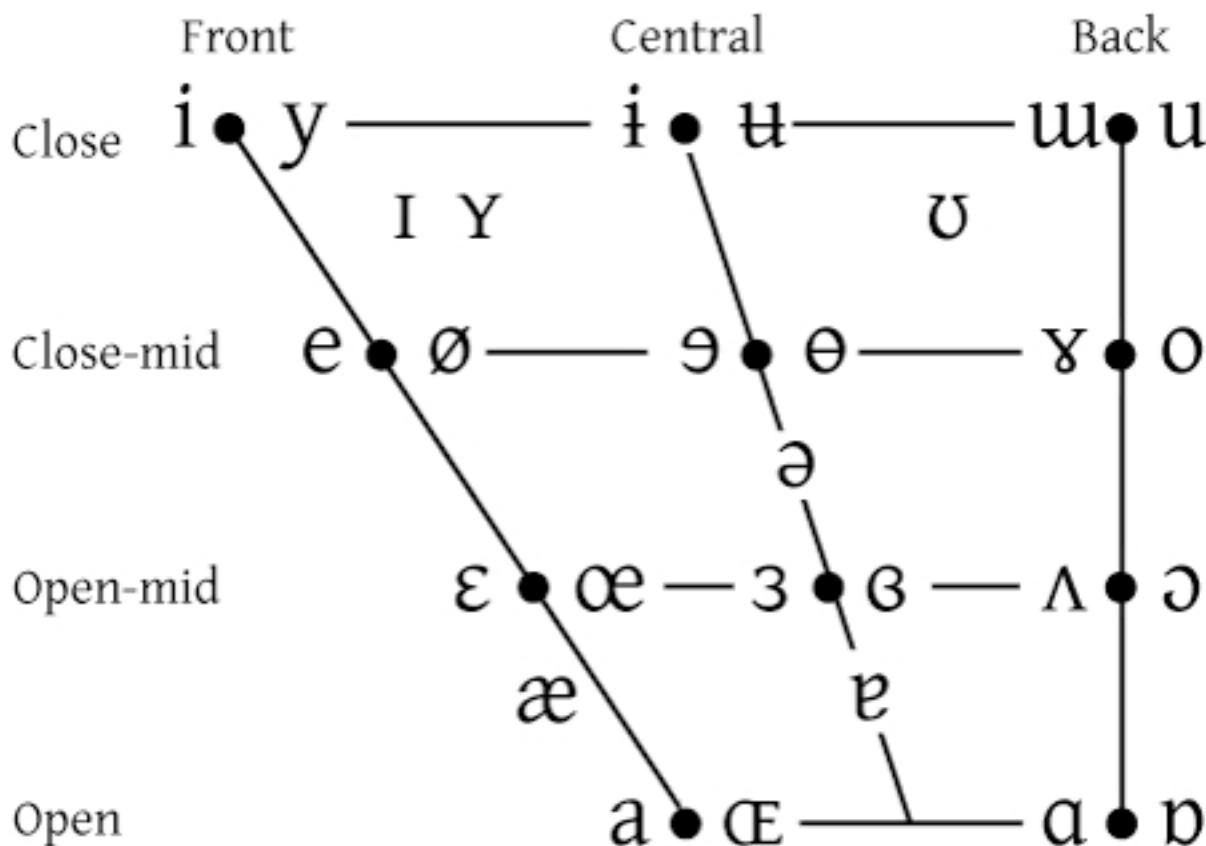
ɔ

High to low



The full(er) vowel chart

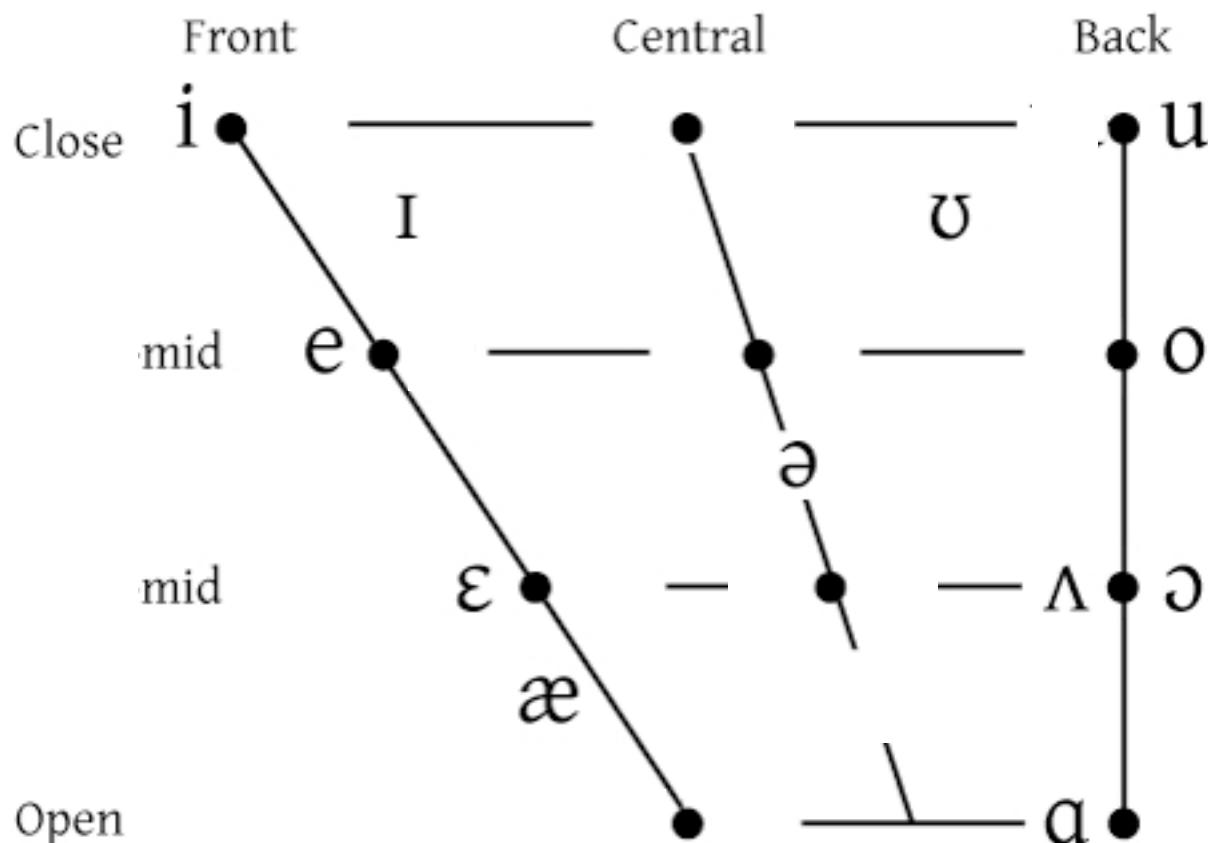
VOWELS



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

The parts we care about for this class

VOWELS



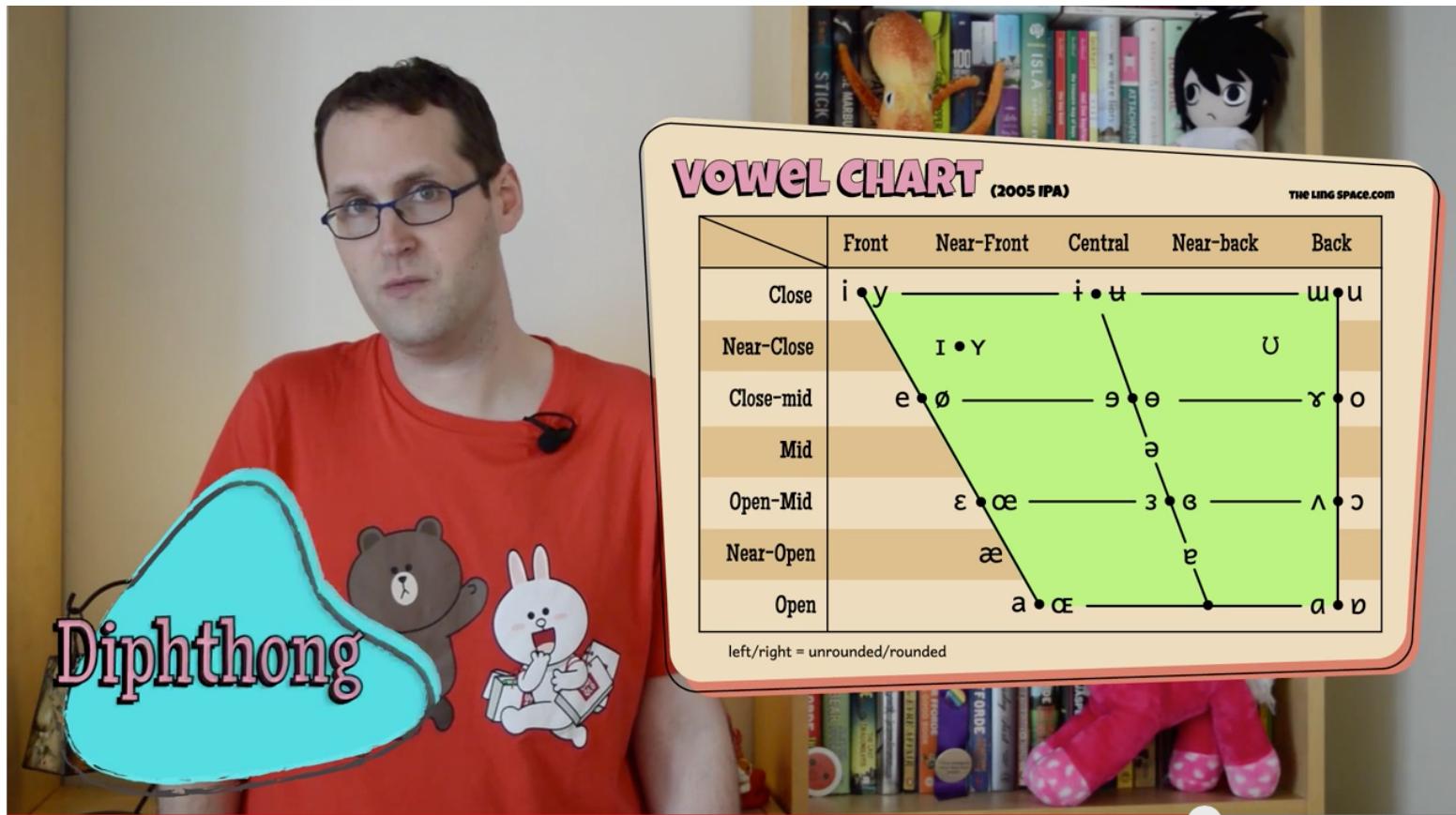
Where symbols appear in pairs, the one to the right represents a rounded vowel

[Extra] Diphthongs

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

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

7:02 through 7:38

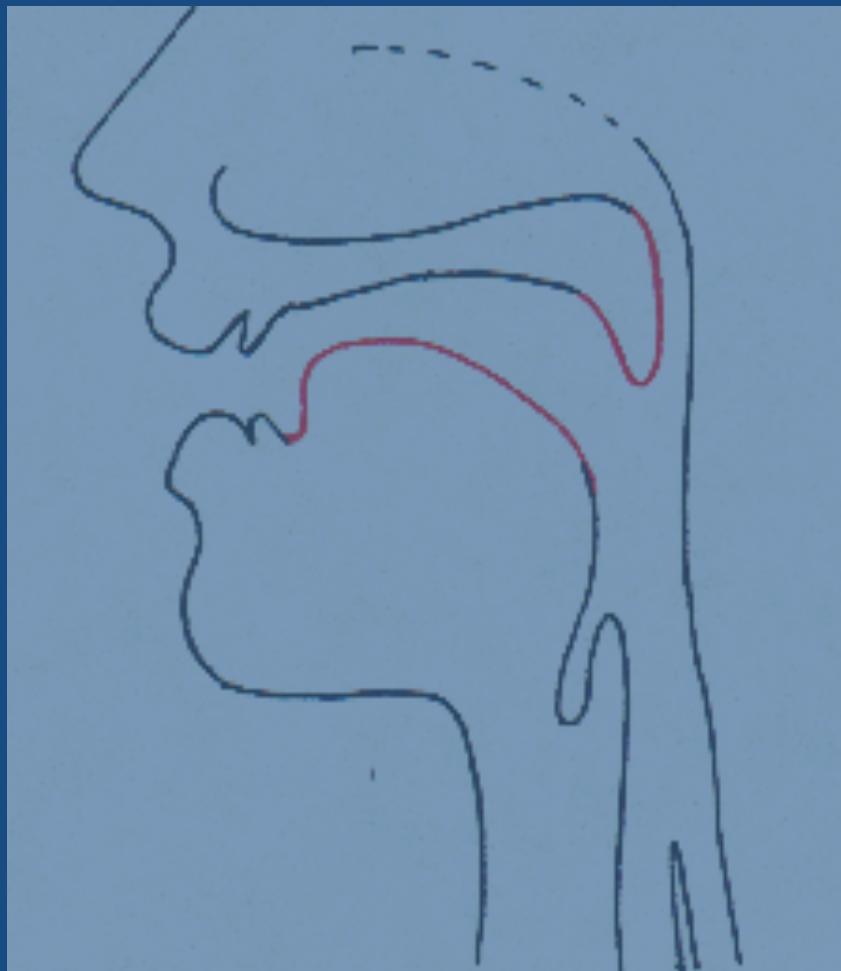


Diphthongs: Two vowel-ish sounds together

Front to back

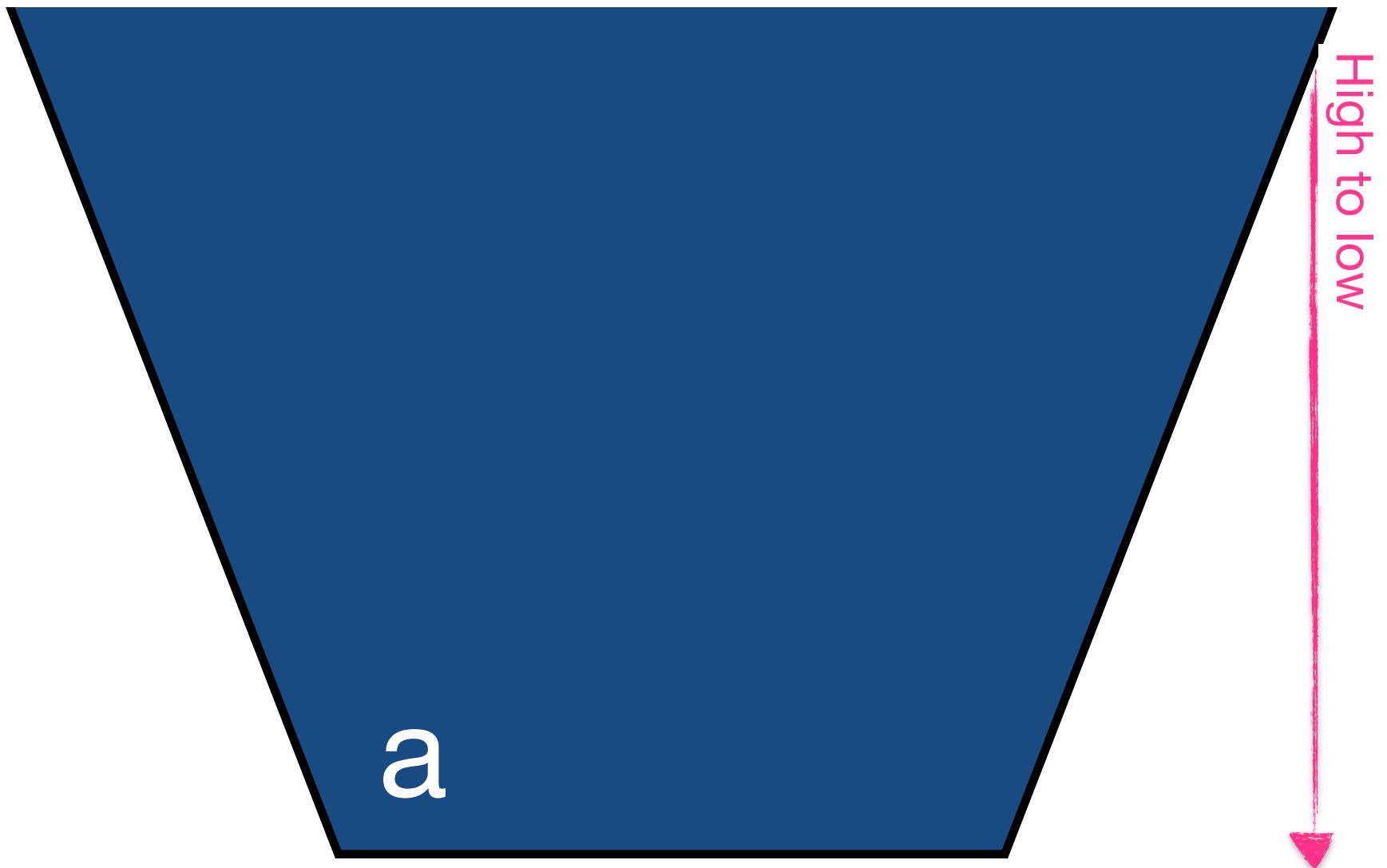


High to low



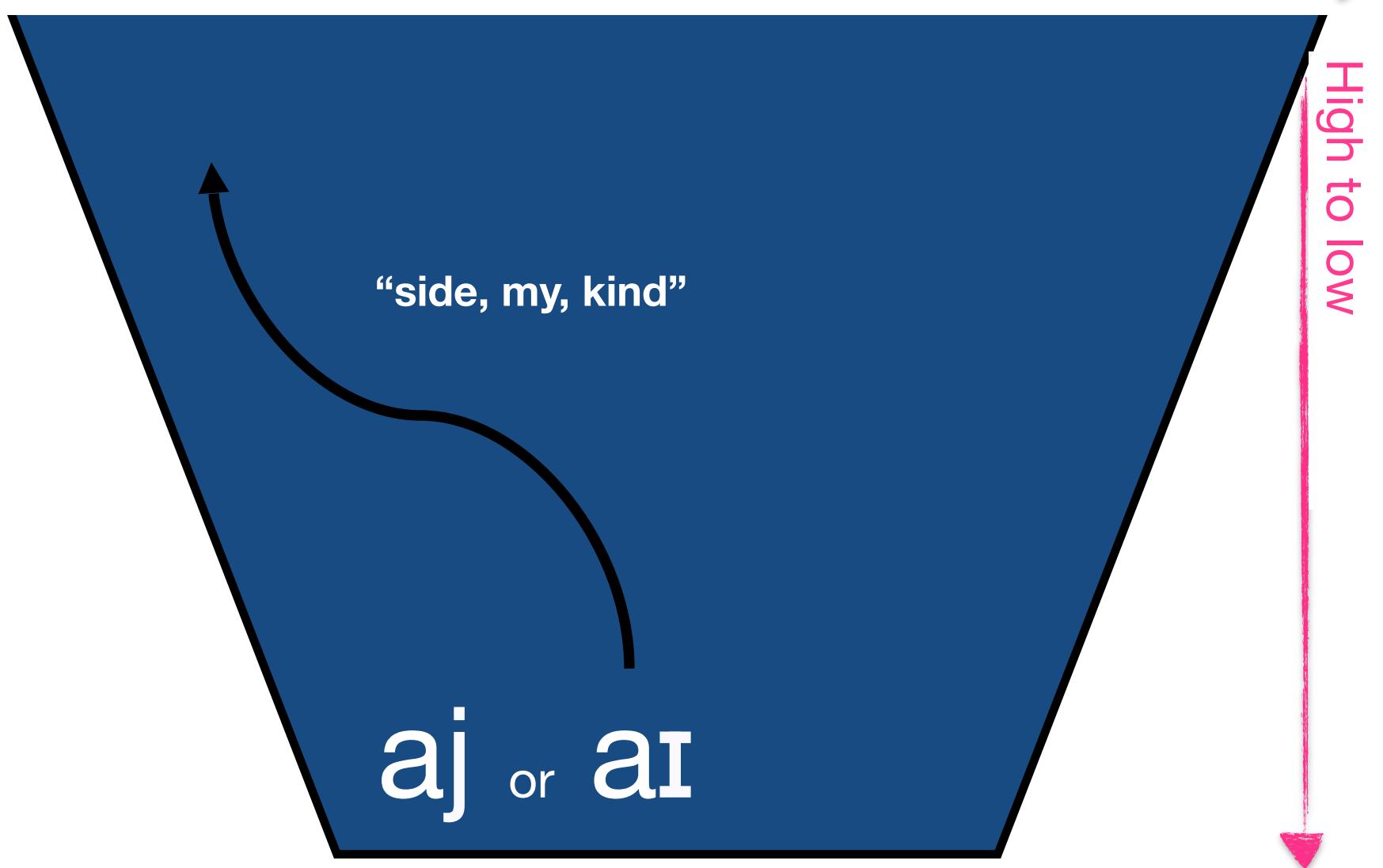
Diphthongs: Two vowel-ish sounds together

Front to back



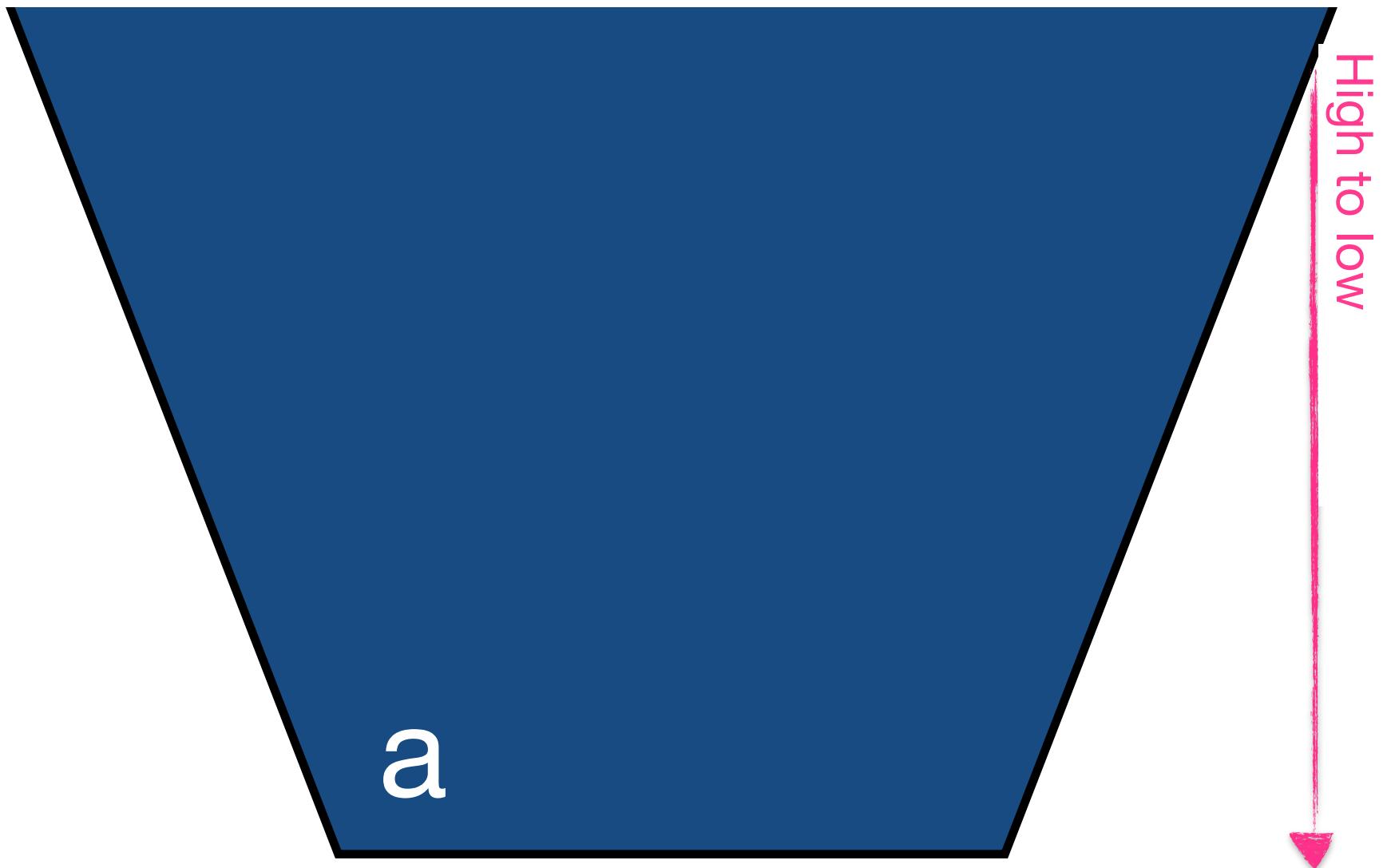
Diphthongs: Two vowel-ish sounds together

Front to back



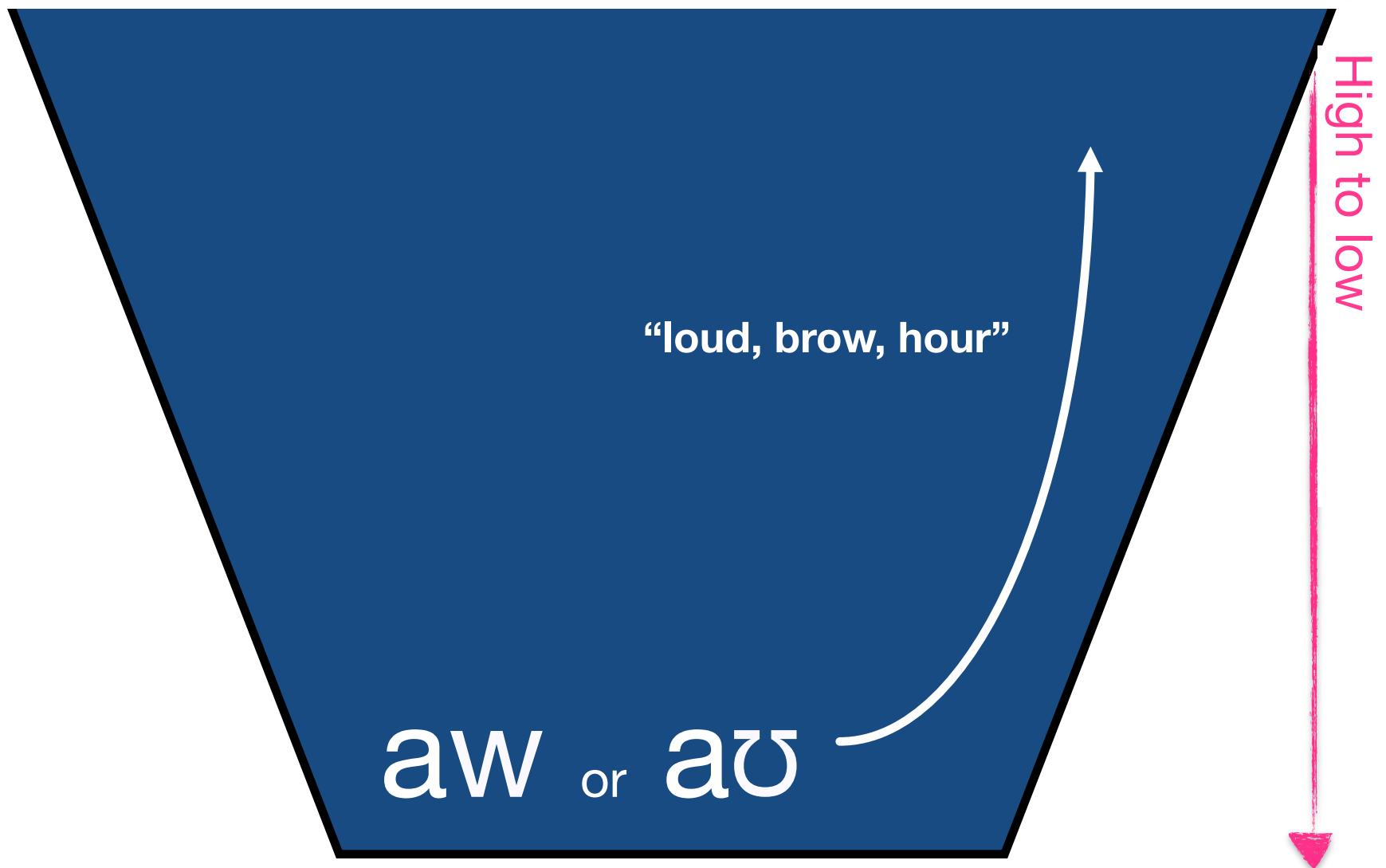
Diphthongs: Two vowel-ish sounds together

Front to back



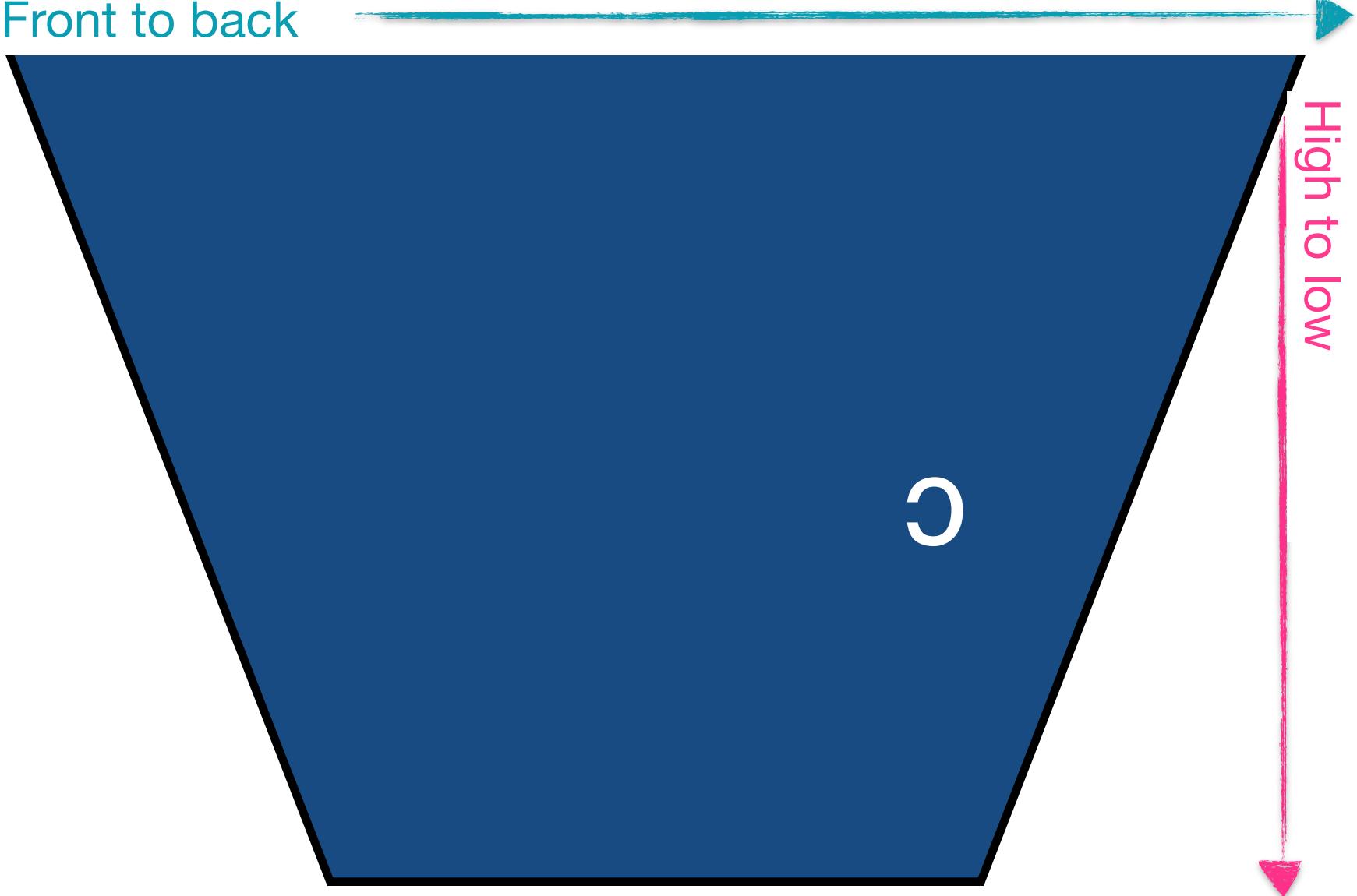
Diphthongs: Two vowel-ish sounds together

Front to back



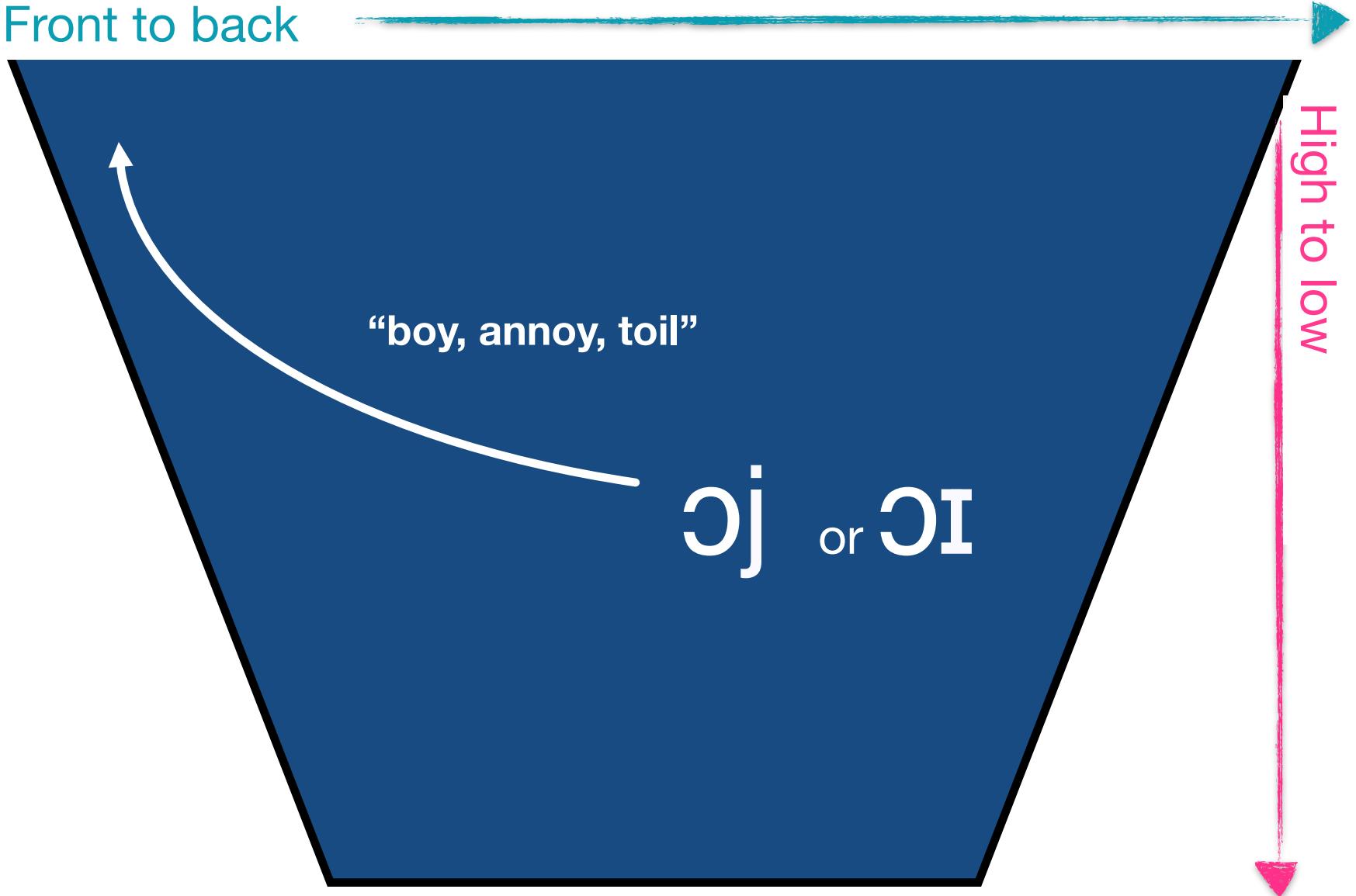
Diphthongs: Two vowel-ish sounds together

Front to back



Diphthongs: Two vowel-ish sounds together

Front to back



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.