

# Vowels

# Vowel and consonant gestures

- How do vowel gestures differ from consonant gestures?
  - (1) consonants are more constricted than vowels
    - exceptions?
  - (2) vowel gestures are formed more slowly and "last longer" than consonant gestures

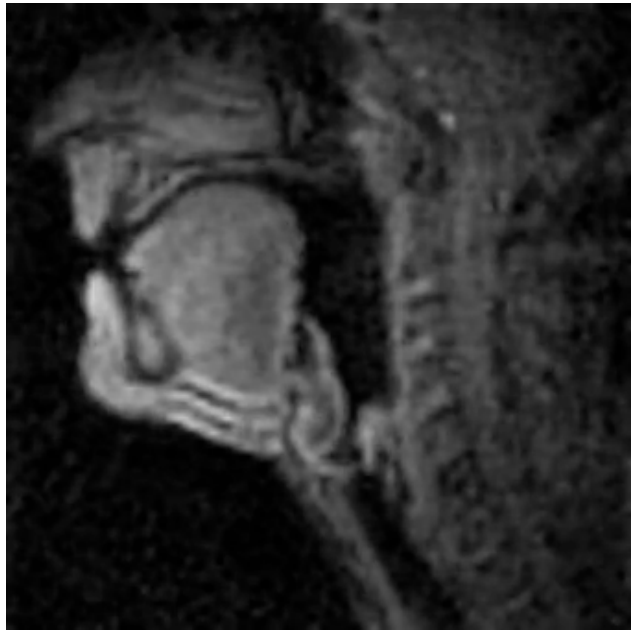
# Vowel gestures

3 basic vowels that occur in almost all languages

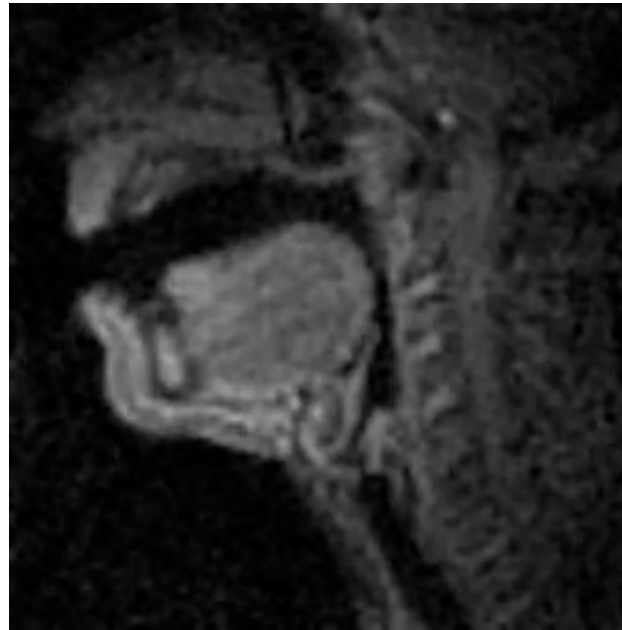
“heed”

“hod”

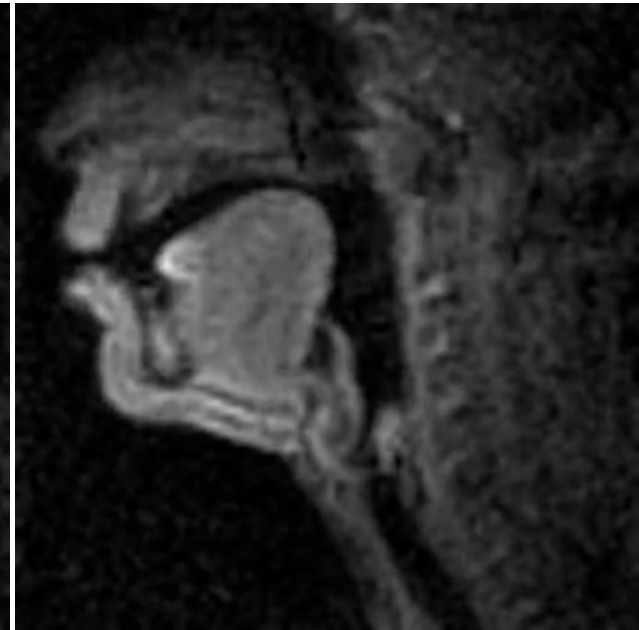
“who’d”



TONGUE  
BODY



TONGUE  
ROOT



LIPS +  
TONGUE

Distinct organs:

Traditional description going back to Indian grammarians

# Speech Tasks

- Tasks in speech are gestures that form the consonants and vowels.
- For consonants, the tasks are the formation of constrictions.
  - E.g. the task in common to /p,b,m/ is the closure of the lips. In other words, reduce the distance between the lips (Lip Aperture) to 0 (actually -2).

	Task	Articulators
LP	lip protrusion	upper & lower lips, jaw
LA	lip aperture	upper & lower lips, jaw
TTCL	tongue tip constrict location	tongue tip, tongue body, jaw
TTCD	tongue tip constrict degree	tongue tip, tongue body, jaw
TBCL	tongue body constrict location	tongue body, jaw
TBCD	tongue body constrict degree	tongue body, jaw
VEL	velic aperture	velum
GLO	glottal aperture	glottis

A sagittal cross-section of the human vocal tract. Labels with arrows point to specific anatomical features: VEL (velum), GLO (glottis), TBCL (tongue body constrict location), TBCD (tongue body constrict degree), TTCL (tongue tip constrict location), TTCD (tongue tip constrict degree), LA (lip aperture), and LP (lip protrusion).

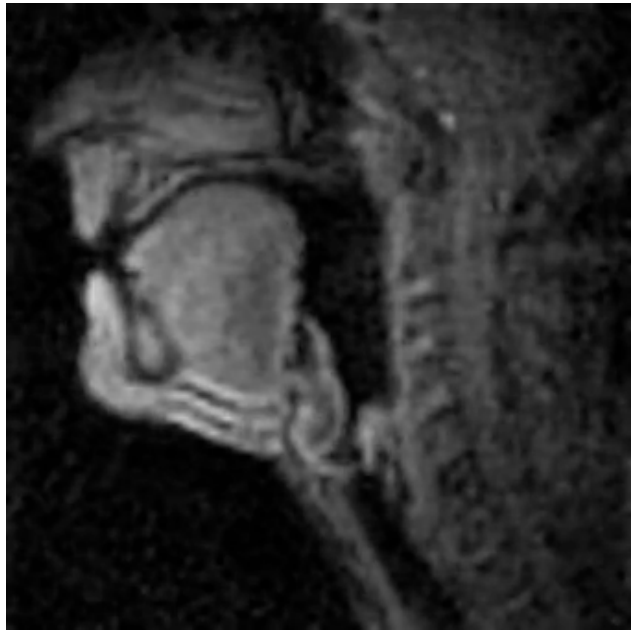
A sagittal cross-section of the human vocal tract. Labels with arrows point to specific anatomical features: velum, tongue tip, tongue body center, upper lip, lower lip, and jaw.

# Hypothesis 1: Vowel tasks are constrictions

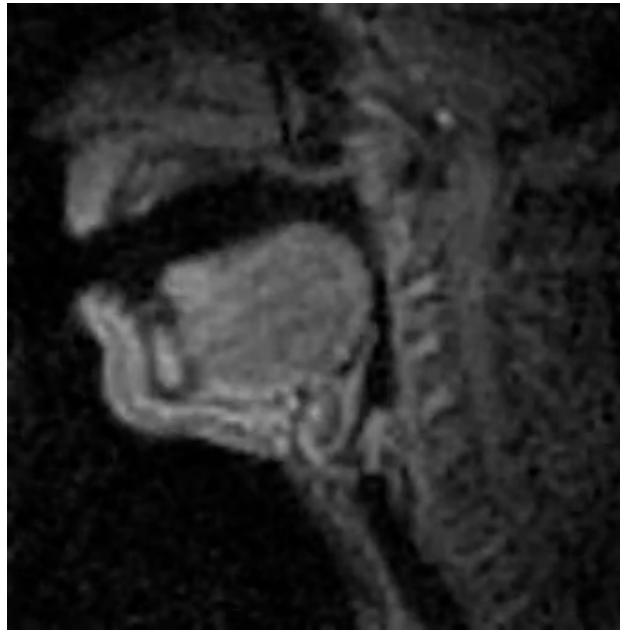
“heed”

“hod”

“who’d”

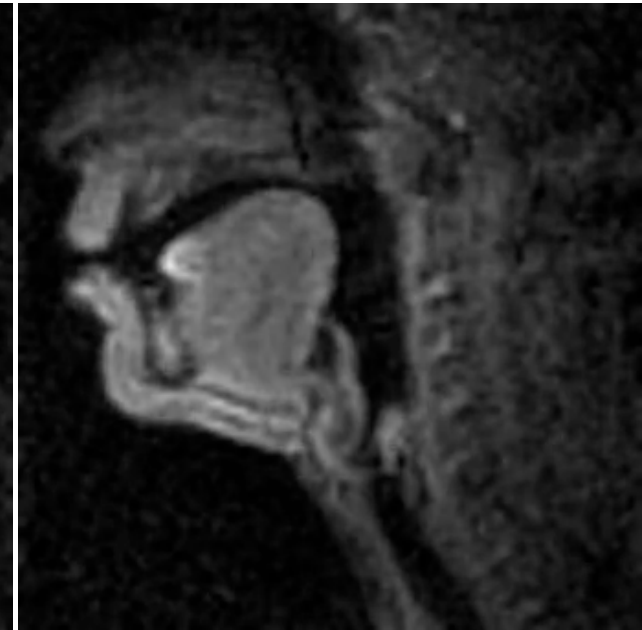


TBCL =  
PALATAL



TBCL =  
PHARYNGEAL

TRCD\*



LIPS +  
TONGUE

TBCL = VELAR

LA

# Larger vowels systems

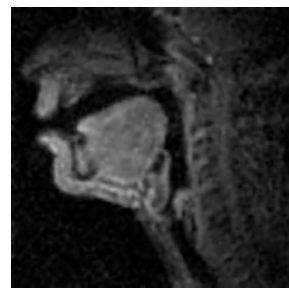
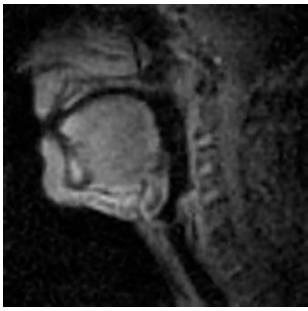
- Traditional description of vowels going back to British phoneticians in the 19th century (A.M. Bell, Henry Sweet)
- Three dimensional classification:
  - front-back position of tongue body
  - high-low position of tongue body
  - round-unrounded lip
- The description has been the basis for uncovering phonological regularities and alternations and patterns of historical sound change.

← FRONT BACK →



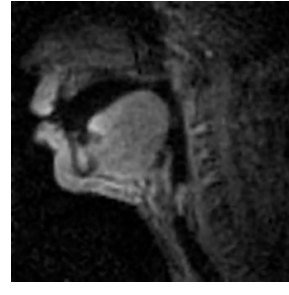
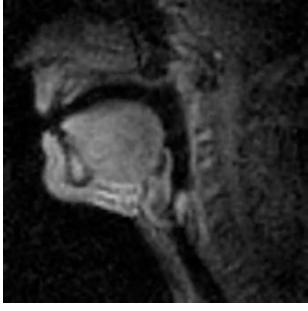
“heed”

“who’d”



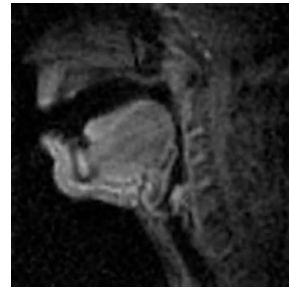
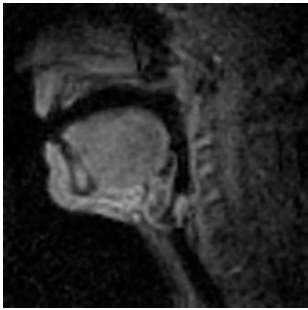
“hid”

“hood”



“head”

“hoed”



“had”

“hod”



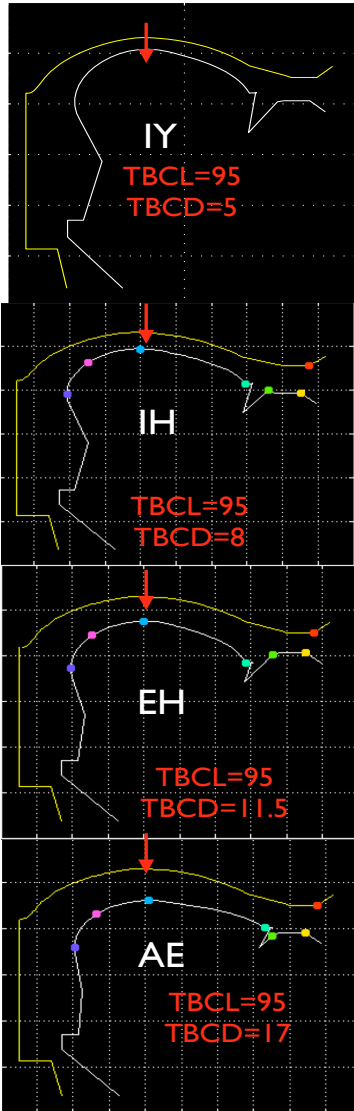
HIGH



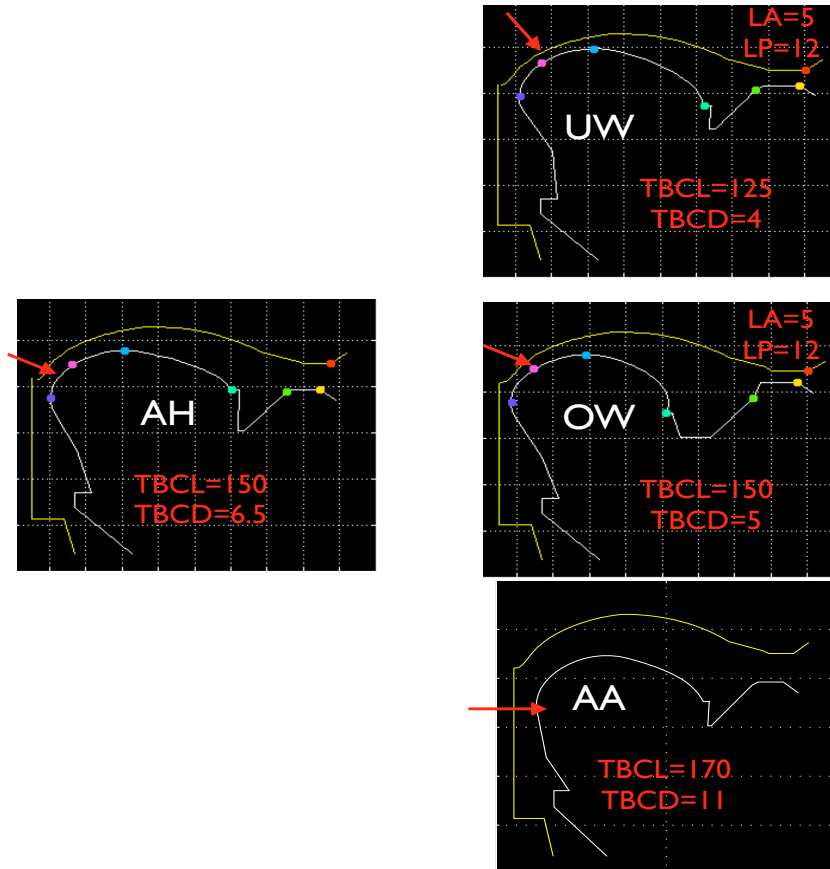
LOW

# Constriction Tasks for Vowels?

FRONT:  
TBCL = 95



BACK:  
TBCL > 95



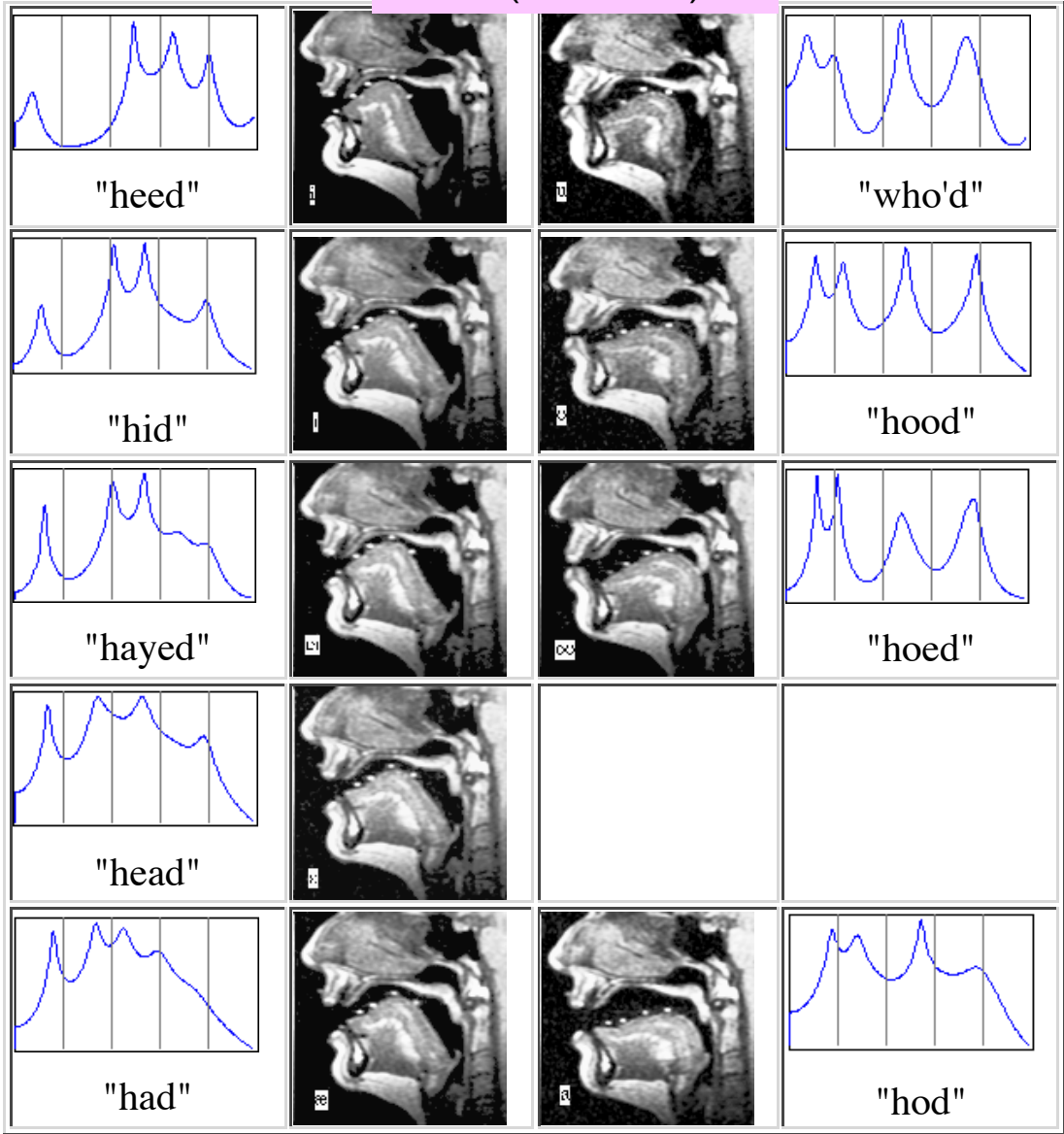
But... Height in front vowels is modeled using TBCD  
Height in back vowels is modeled using TBCL  
Parallel behavior of front and back vowels in languages is not well captured



# Hypothesis 2: Vowel tasks are formant frequencies

F2 (Backness)

F1 (height)



Learn pattern of articulator synergies that achieve acoustic tasks during motor learning