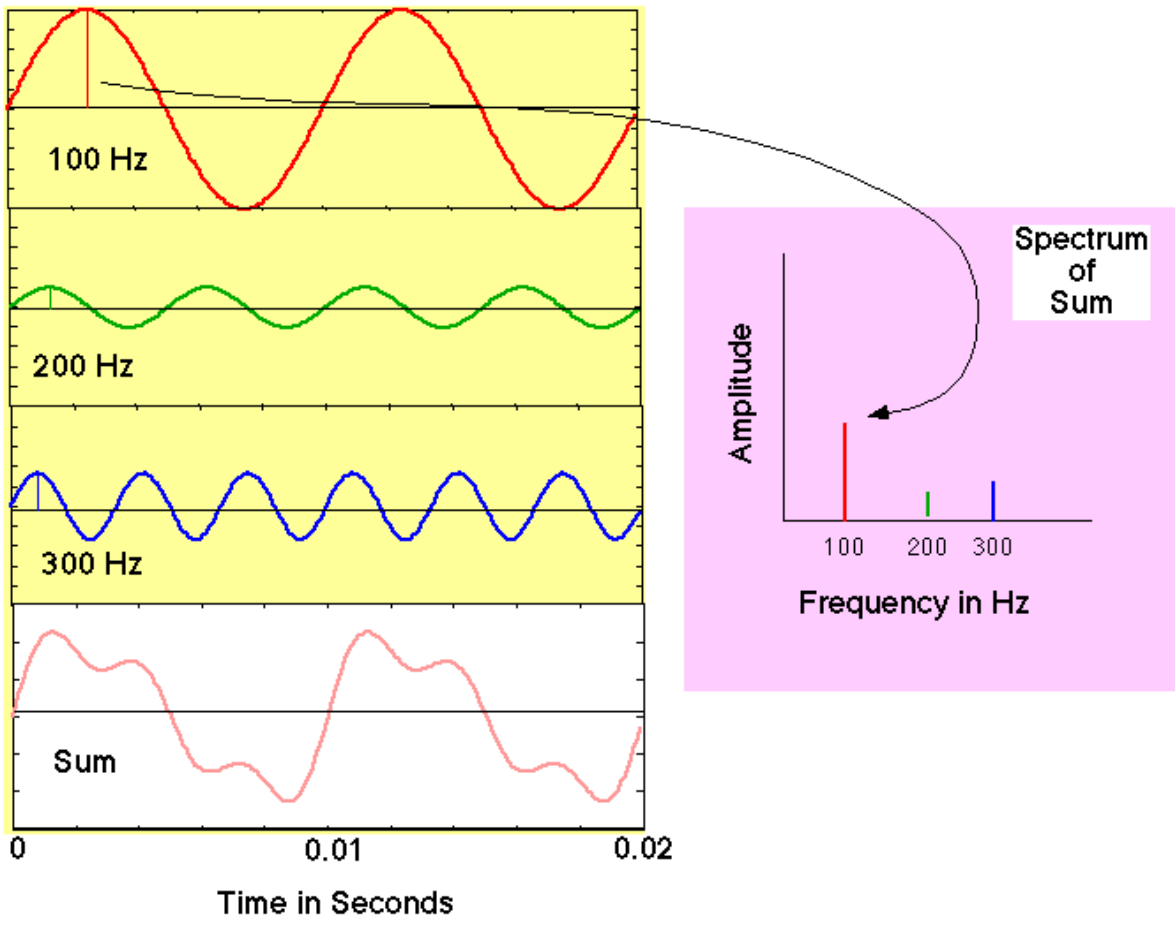
Ling 105
Sounds of Language

Thursday, September 26, 2024

Kevin Ryan

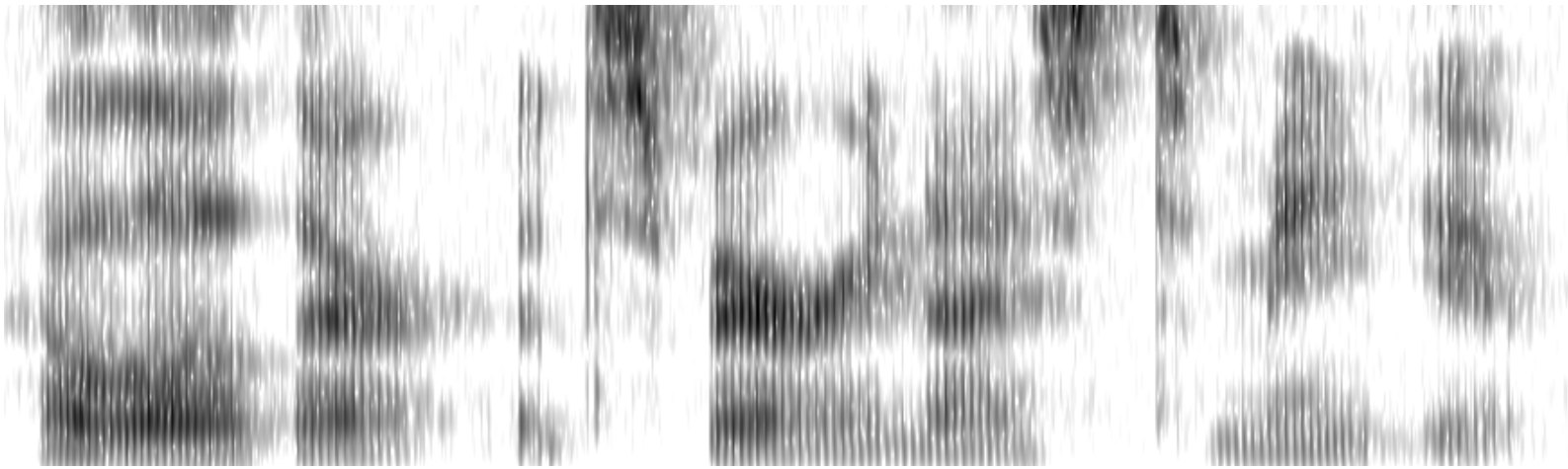
Spectrum & tonal compositionality

- Distribution of frequencies in a time-slice
- x = frequency (Hz); y = amplitude (dB)
- Praat: `5*sin(2*pi*100*x) + 1*sin(2*pi*200*x) + 2*sin(2*pi*300*x)`
- Real example: f0_demo



Spectrogram

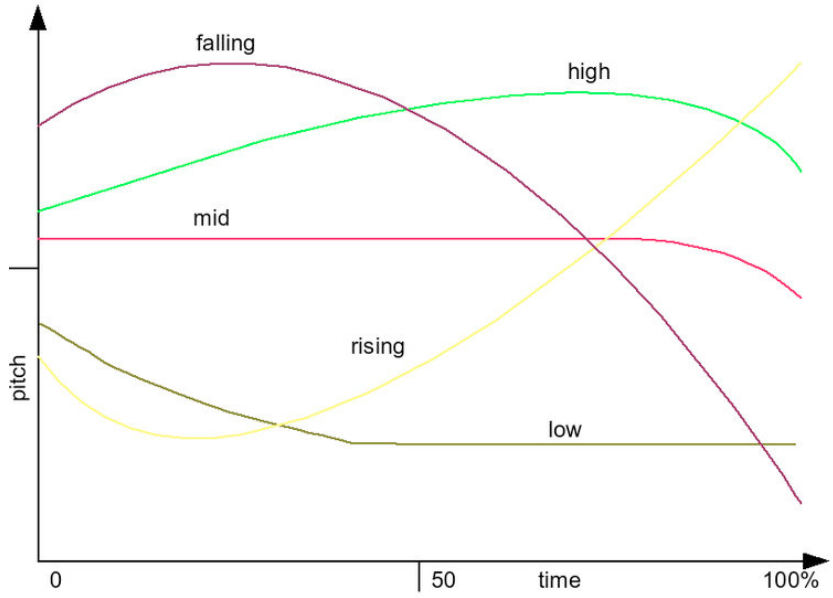
- 3Ds in 2D: x = time; y = Hz; shading = amplitude
- Shows which frequency bands are loudest across time



Band pass filters

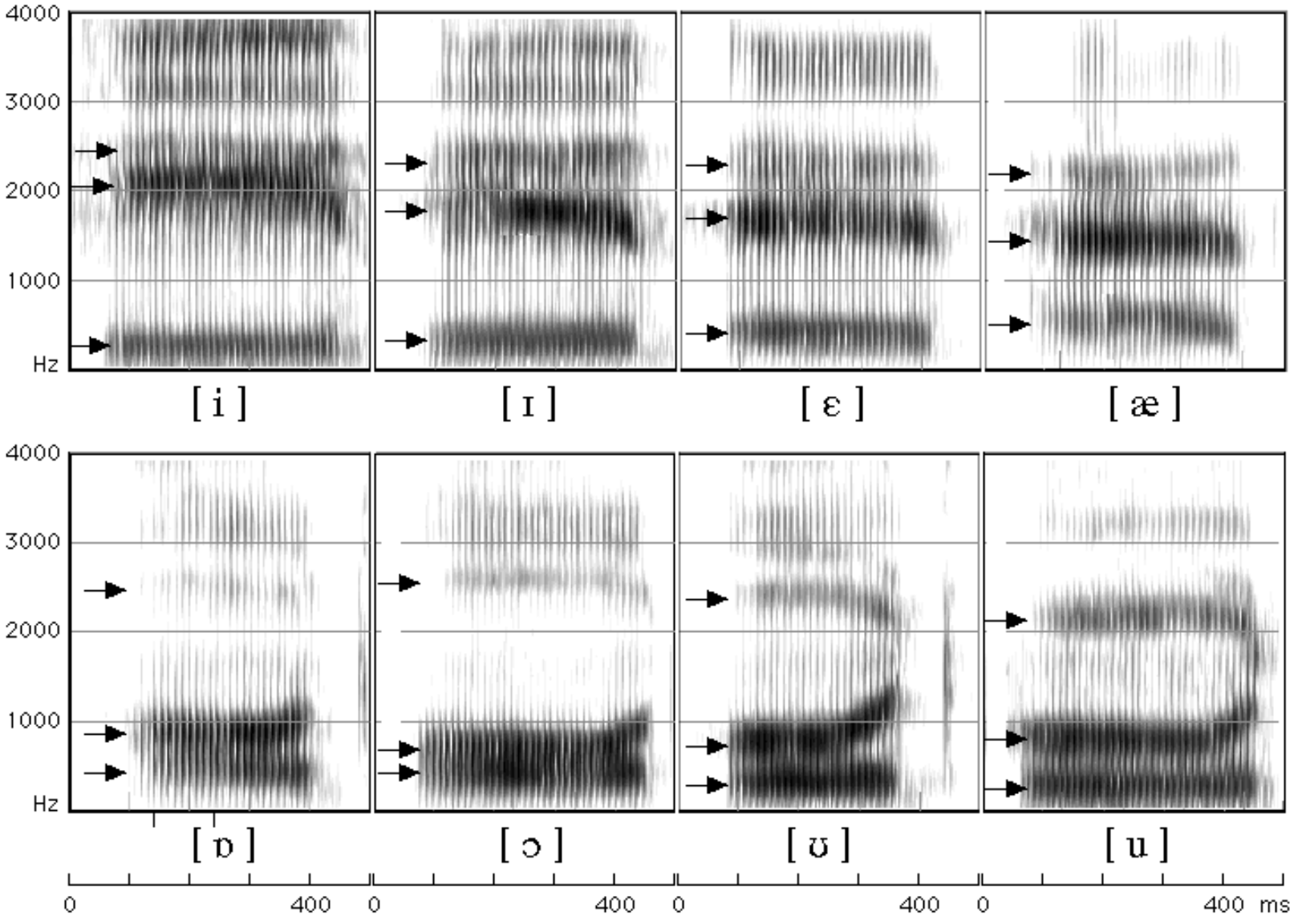
- High- & low-pass filters in Praat (thisisatest.wav)
  - Filter (pass Hann band) on side panel
  - Select cutoffs ("smoothing" must be > 0), e.g.
    - $< 1000, 2000 >$ ("reporting from inside a space helmet")
    - $< 2000, 20000 >$ ("suddenly rather British")
- Yanny-Laurel

Thai tone revisited



- Inspect rising tone
- Get f0: wavelength or "Show pitch"
- Be sure pitch range is calibrated in "Pitch settings": 80 to 140 Hz is good here (f0 in adults ranges from ∼80 to ∼260)
- Watch out for Praat's mixed axes! Pitch is on the right, in blue or purple

Formants: F1, F2, etc.



Formants: F1, F2, etc.

- Plotting
  - Label of axes
  - Ranges of axes
  - Plot some monophthongs
  - How does [ʊ] move at its end? How might one transcribe it more narrowly?

Formants

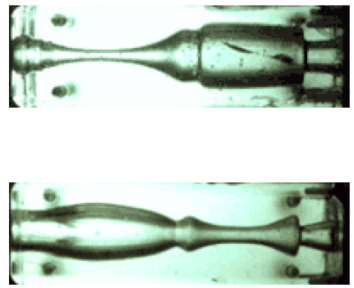
- F1 & F2 reflect the shape of the vocal tract (filter/resonators), not anything about the larynx (source)
- Observe F1 & F2 in "f0 demo"
- Non-f0 formants can shift up or down in tandem as a function of the overall size of the vocal tract (e.g. Praat "Convert gender"; try 2x and 0.5x)
- Why does helium make us squeak?

Tube models

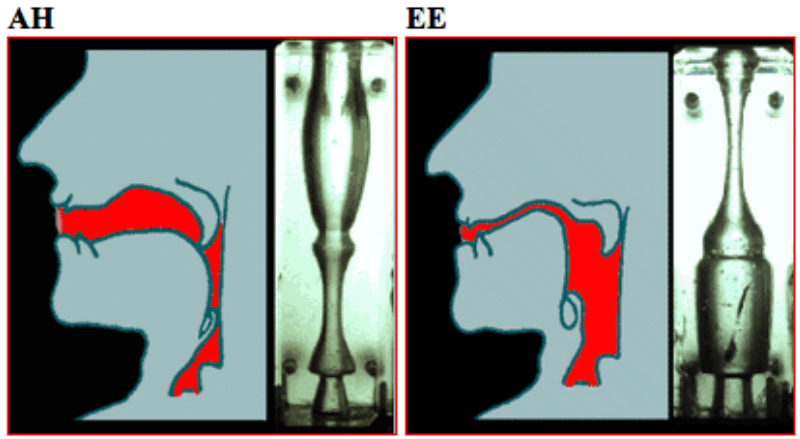
- Easy to simulate vowels with tubes
- The larynx as a duck call (San Francisco Exploratorium)

Tube models

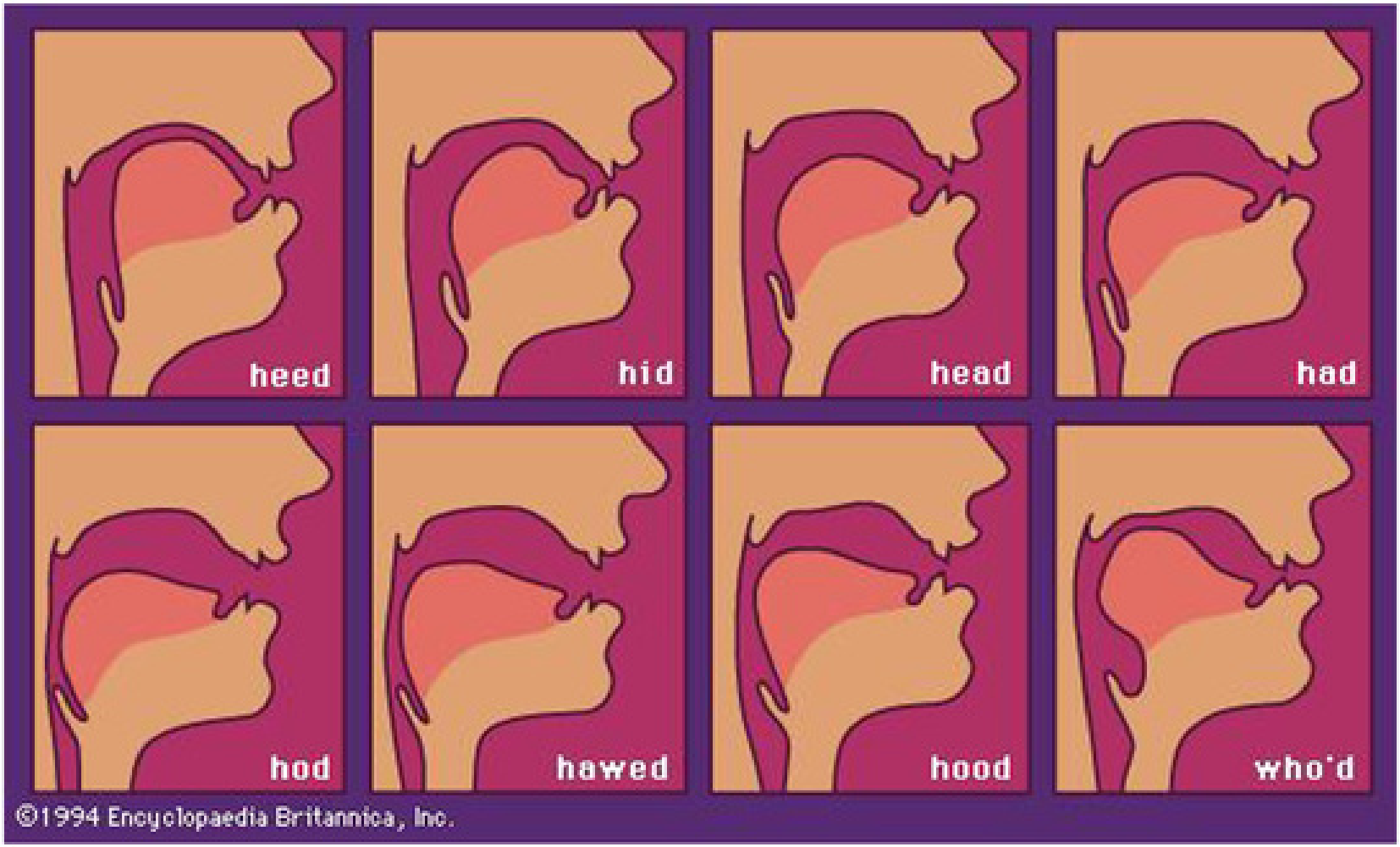
- Attach filters, e.g.



- Compare to vocal tract configurations



- F1 $\sim$ pharynx; F2 $\sim$ oral cavity (as always, bigger = lower)

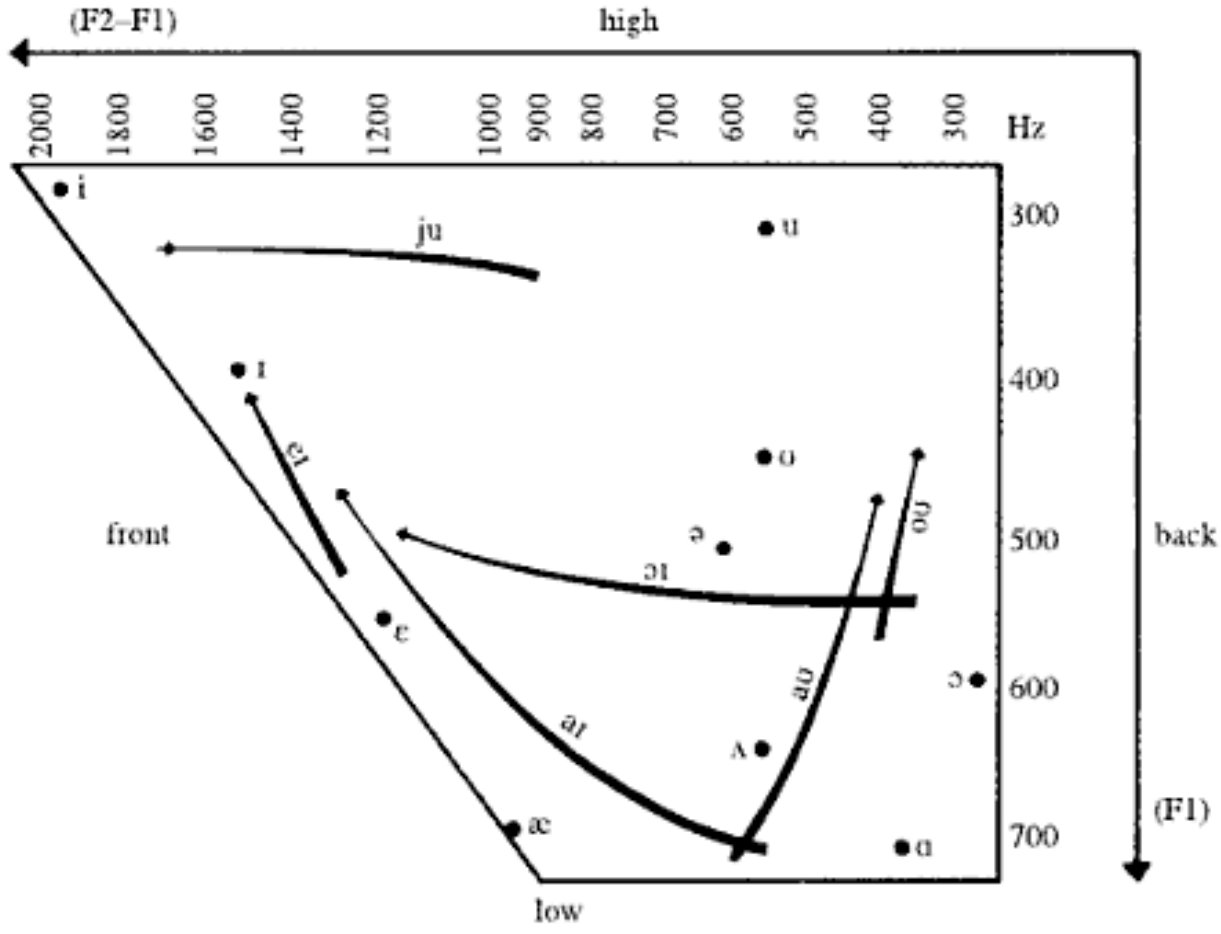

heed
hid
head
had
hod
hawed
hood
who'd
©1994 Encyclopaedia Britannica, Inc.

Formants in whispering

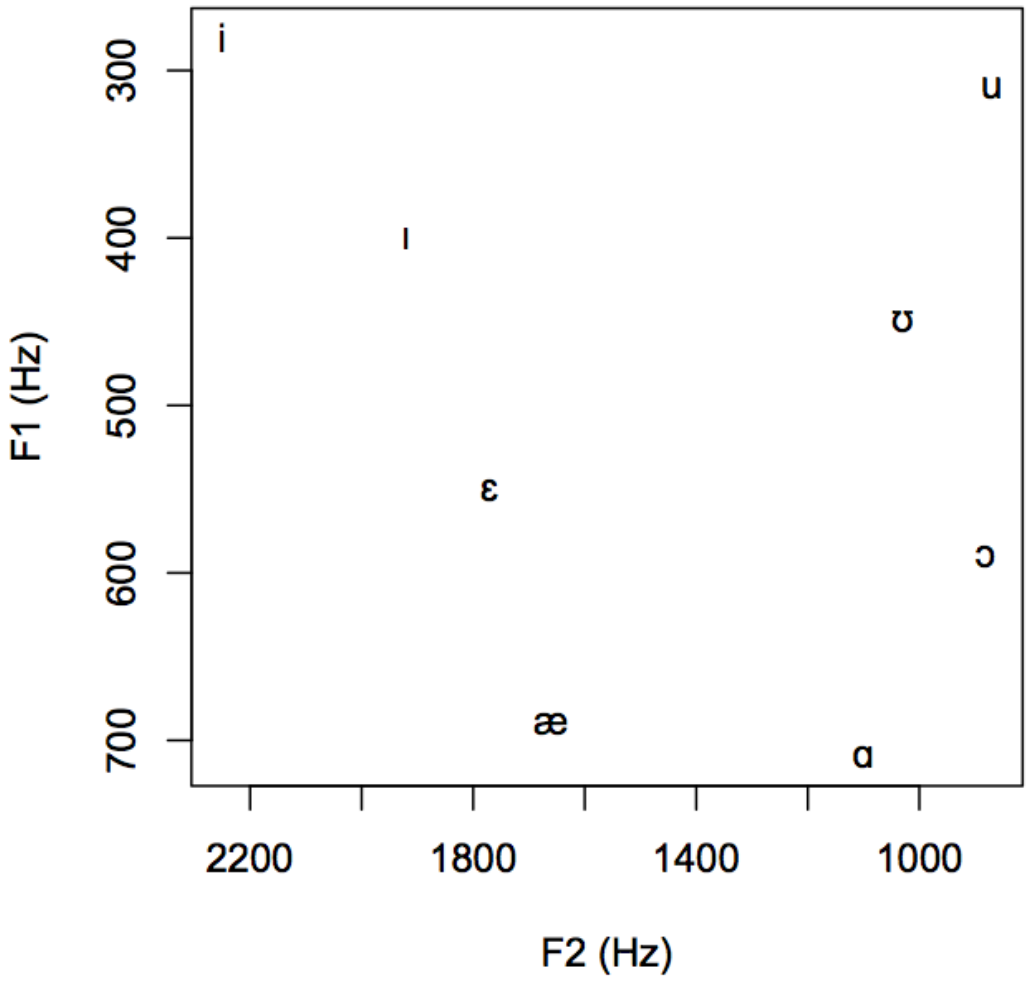
- Whispered sounds have no f0
- But quality is still sometimes identifiable
- Does perceived pitch correspond more to F1 or F2?
- An early recognition of formants:

  "The filling of a very deepe flaggon with a constant streame of beere [...] sounds ye vowells in this order: w, u, ω, o, a, e, i, y"
  — Isaac Newton, 12 years old (1665)

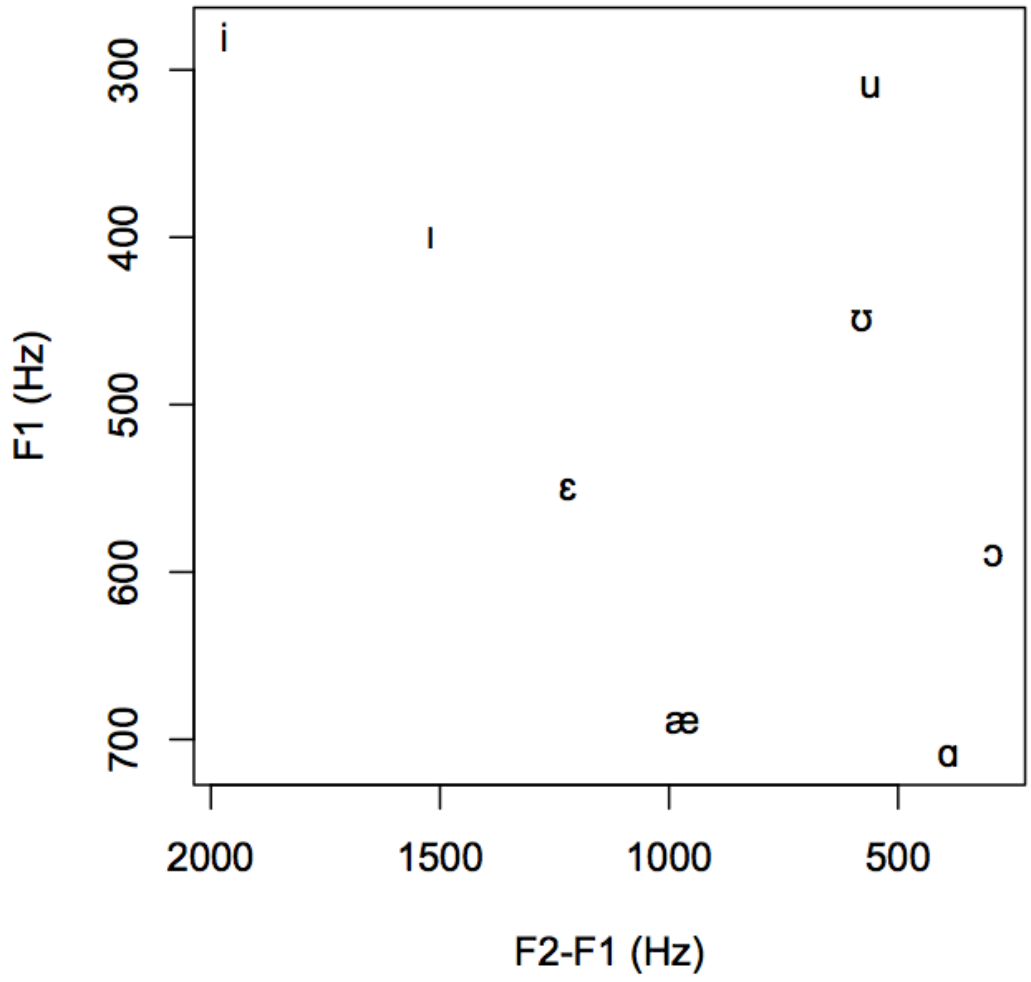
Acoustic vowel space



F1 vs. F2 raw



F1 vs. (F2–F1)



F2 vs. F2–F1 for "backness"

- Subtle difference, but L&J's rationale for using F2–F1:
  - Lip rounding decreases F2
  - This makes rounded vowels appear too far back, assuming we want the chart to represent vowel place (lingual position), not lip position
  - Subtracting F1 corrects for rounding, tilting the space counterclockwise (i.e. pushing lower vowels to the right)

Logarithmic transform of axes