

- **English consonants:**
Review and discussion
- **Reading spectrograms**

Background:

- Discussion questions from last time

0. Today's objectives

After today's class, you should:

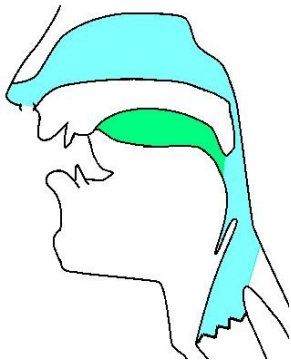
- Feel more confident discussing the predictions of the source/filter model for consonants
- Be able to place boundaries between segments (phones, speech sounds) on a spectrogram
- Identify major class (vowel, fricative, oral stop, nasal stop, {lateral, rhotic, glide}) on a spectrogram
- Narrow down the identity of a segment on a spectrogram: height, backness, voicing, place

1. Practice: Predictions for nasals

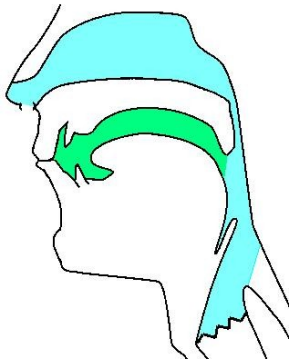
- **For discussion:** Try modeling some nasal filters, assuming these vocal-tract distances
 - Measurements from an X-ray study by Fant (1960), as reported in *AAP* (Johnson 2012)
 - Glottis to uvula - 9cm
 - Uvula to nares (nostrils) - 12.5cm
 - Uvula to lips - 8cm
 - Uvula to alveolar ridge - 5.5cm
- What is the **main tube** for [m]? For [n]? What are the **side tubes**? What **formants** and **antiformants** are predicted?

1. Practice: Predictions for nasals

- Nasals other than uvular [ŋ] have **side tubes**
 - **Main tube** is glottis to nares (as in [ŋ])
 - **Side tube** extends from uvula (where the tubes split) to the place of articulation



[n] side tube: uvula → alveolar ridge



[m] side tube: uvula → lips

2. Practice: Predictions for [l]

- **For discussion:** Try modeling the [l] filter, assuming the same vocal-tract distances
 - Measurements from an X-ray study by Fant (1960), as reported in *AAP* (Johnson 2012)
 - Glottis to uvula - 9cm
 - Uvula to nares (nostrils) - 12.5cm
 - Uvula to lips - 8cm
 - Uvula to alveolar ridge - 5.5cm
- What is the **main tube** for [l]? What is the **side tube**? What **formants** and **antiformants** are predicted?

3. The central ("retroflex"?) approximant [ɻ]

- Much like vowels, this sound is acoustically defined; its articulations can be quite variable
 - Some speakers have a true retroflex articulation, with the tongue tip turned up and approximating the postalveolar region
 - Other speakers are “tongue bunchers”, using the body of the tongue to articulate [ɻ]
- What is the primary **acoustic characteristic** of [ɻ] that distinguishes it from other approximants?
 - See *V&C* reading, and *AAP* Ch 6, pp 140-141

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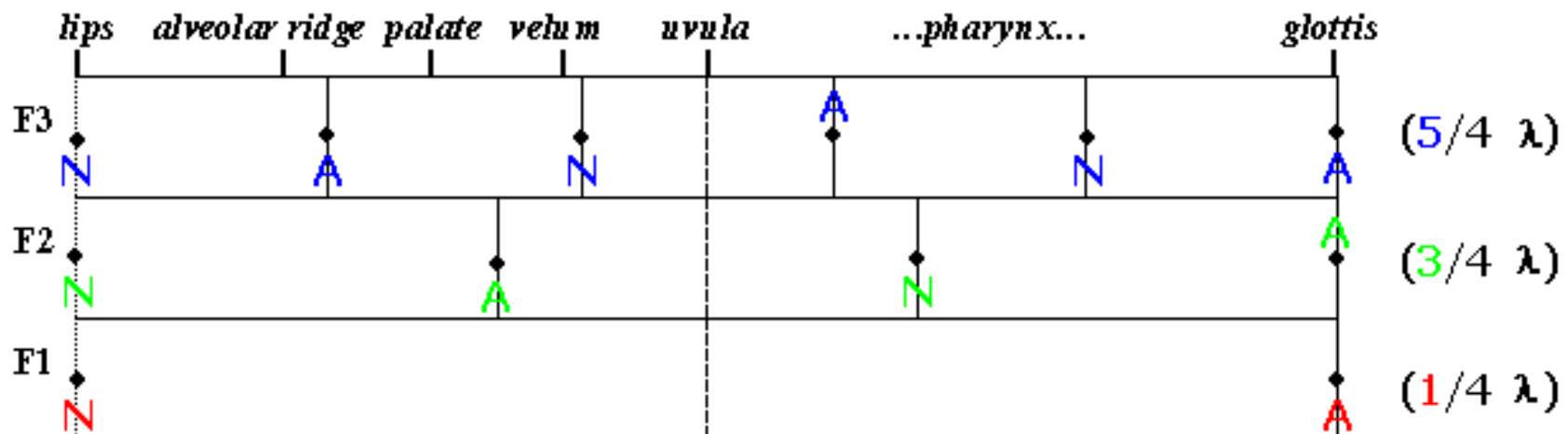
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- What is the primary **acoustic characteristic** of [ɻ] that distinguishes it from other approximants?
 - See V&C reading, and AAP Ch 6, pp 140-141
 - [ɻ] has a **very low F3**

3. The central ("retroflex"?) approximant [ɻ]

- To consider: What kinds of articulations will lead to a **lowered F3**, according to perturbation theory?

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- To consider: What kinds of articulations will lead to a **lowered F3**, according to perturbation theory?



- FYI: A [paper](#) showing diagrams of productions of AmEng [ɹ] — “retroflex” vs. “bunched”

(Zhou, Xinhui, et al. 2008. A magnetic resonance imaging-based articulatory and acoustic study of ‘retroflex’ and ‘bunched’ American English /r/. *JASA* 123(6): 4466-4481.)

4. Glides

- **Glides** are very, very similar to **vowels**
 - **Duration** and **position** (within the syllable) are the main differences
 - Glides are shorter than vowels
 - Vowels form the 'nucleus' of a syllable; glides do not

4. Glides

- Glides on a spectrogram: “very short vowels” (usually next to a “real” vowel)
- Where is the vocal-tract perturbed in glides?
 - [j] — **palatal** constriction
 - like a high front V
 - [w] — **labial** and **velar** constrictions
 - like a high back round V
- So what should formants look like in [w] and [j] compared to schwa?

5. Review: Fricatives

- What is the source in a fricative?
- What is the filter?
- What is special about the filter in [f]?
- How do these concepts from class relate to center of gravity and dispersion from Lab #07?
- Spectrograms: *five* vs. *six*

6. More spectrogram practice

- Where are the **boundaries** between segments?
 - segment — technical term for a single speech sound (consonant or vowel)
- What is the **major class** of each segment?
 - vowel, oral stop, fricative, nasal, approximant (lateral, [r], glide)
- What other characteristics can we identify?
 - **voicing, place** for consonants
 - **height, backness (+rounding)** for vowels