

Acoustic Phonetics

Lesson 7

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Recognizing stops in a spectrogram

Formant transitions and locus

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Consonant Spectrogram

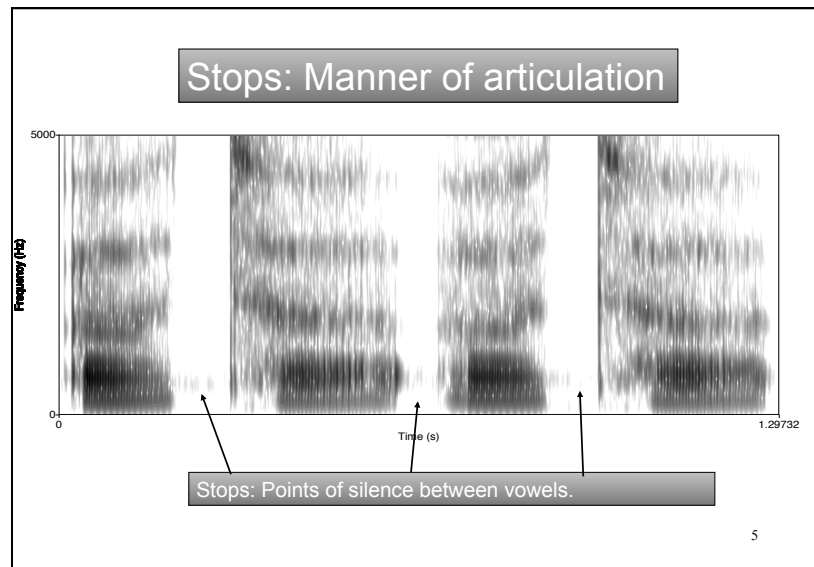
- Acoustic structure more complicated than vowels
- High frequency characteristics
 - especially for fricatives and affricates

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Stops

- General
 - Silence during the closure
 - Burst
 - Virtually no difference during the closure

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Stops (cntd.)

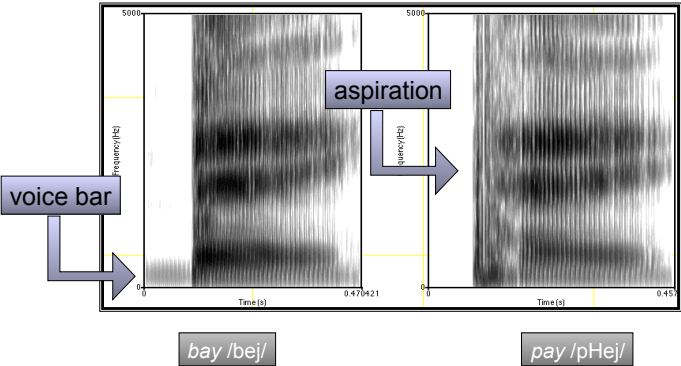
- Voicing distinction
 - **voiced**: vertical striations for voiced sounds, less abrupt burst, frequently weakened to be like fricatives or approximants
 - **voiceless**: generally more abrupt burst

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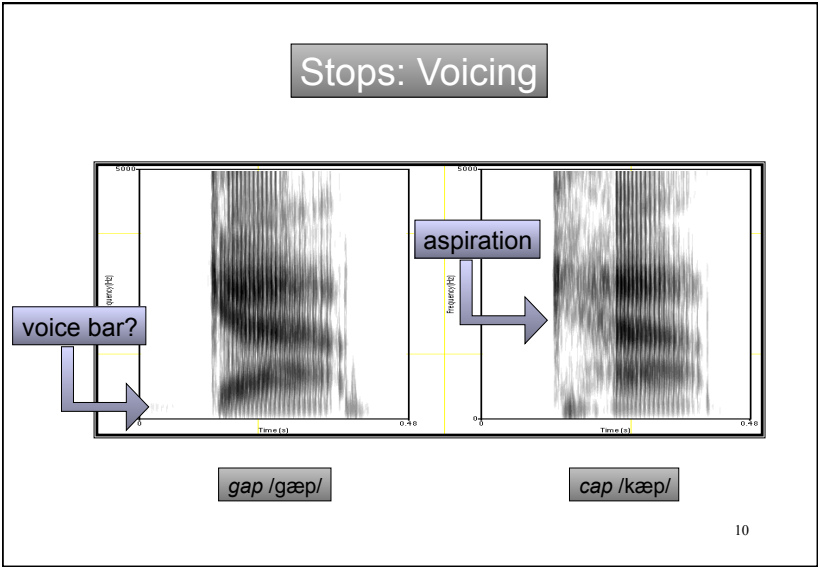
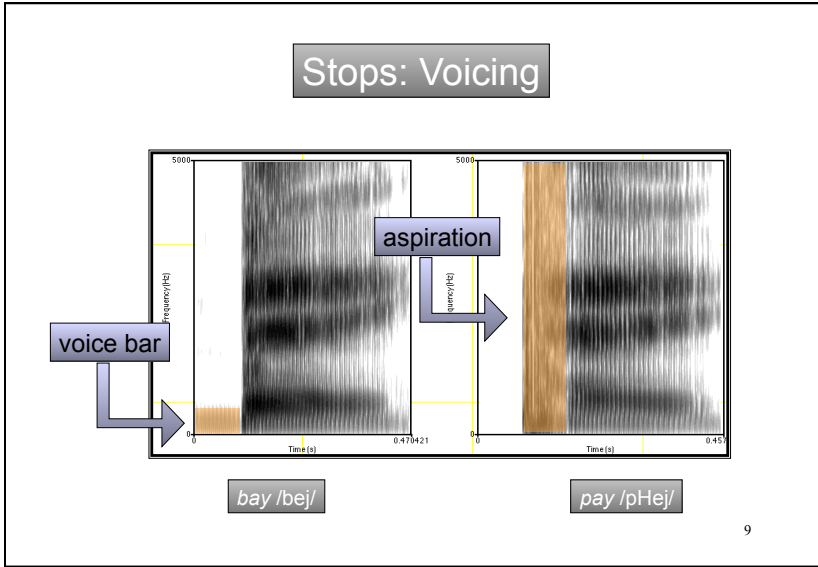
Images of voiced and voiceless stops

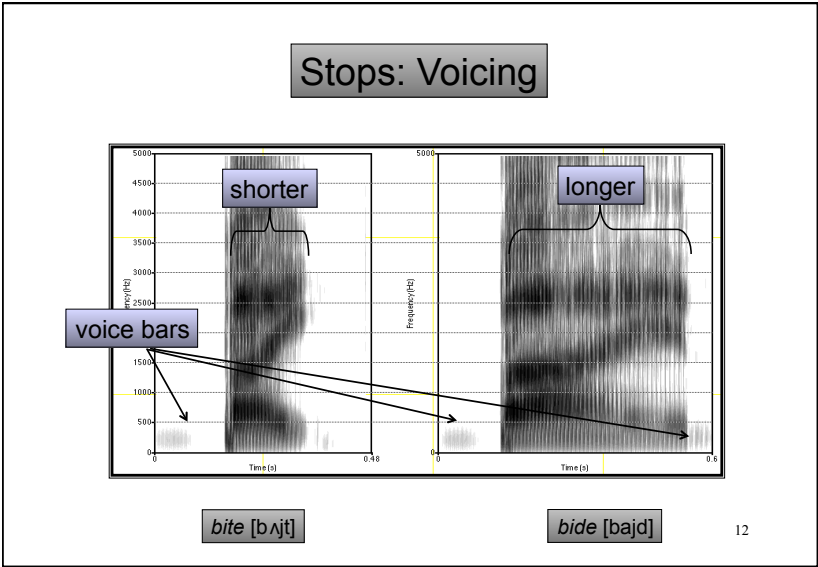
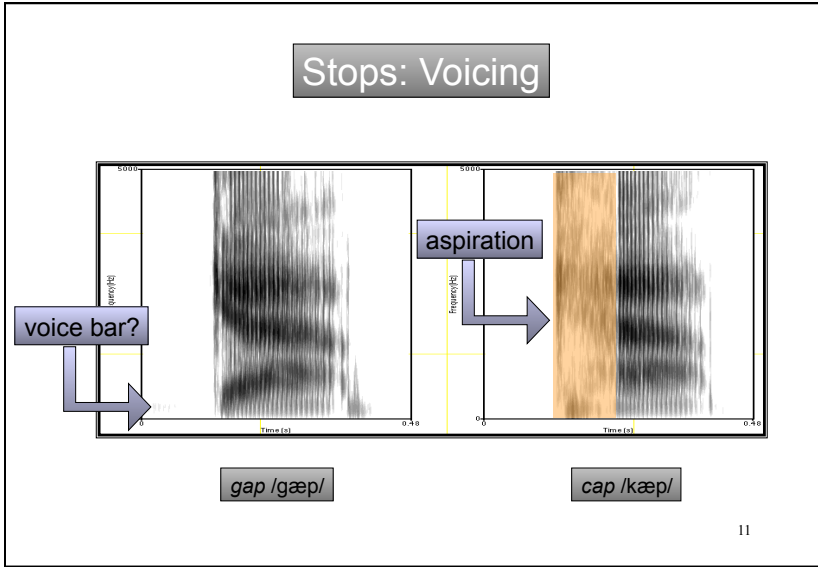
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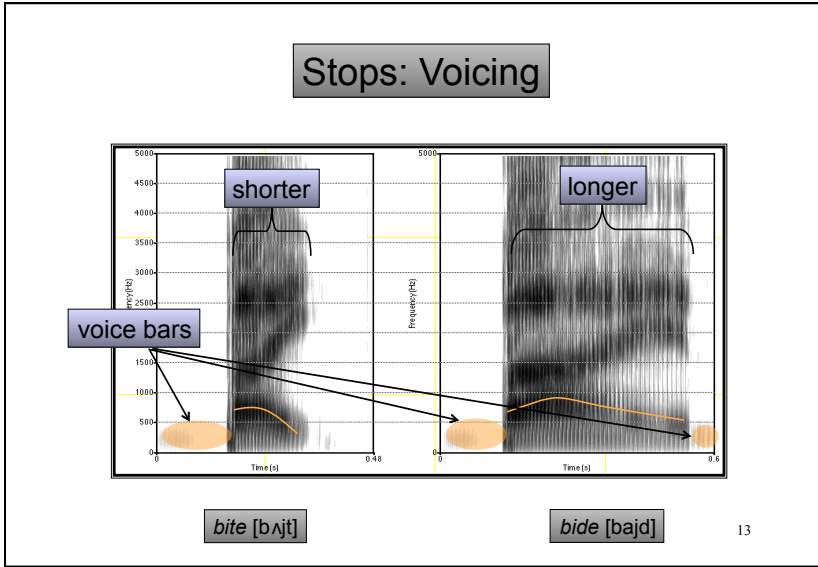
Stops: Voicing



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Consonant Spectrogram

- Important information is conveyed on neighboring sounds, especially vowels → **locus**

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What is LOCUS

- Information of formant transition from vowels into obstruents or from obstruents into vowels
 - Vowel formants show a movement towards or away from the place and manner of obstruction

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LOCUS frequency

- The formant transitions are perceptually important cues) to the manner (F1) and the place (F2 & F3) of the consonant.

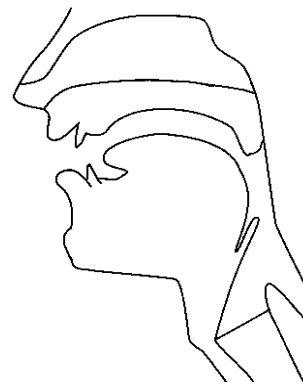
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Shape of the formant transitions

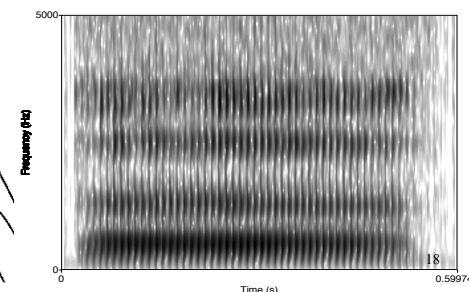
- It varies depending on the neighboring vowel:
 - They start at the formant frequencies for the preceding vowel and/or end at the formant frequencies for the following vowel.
- The **characteristics of the consonantal place and manner** are roughly the same in different vowel contexts

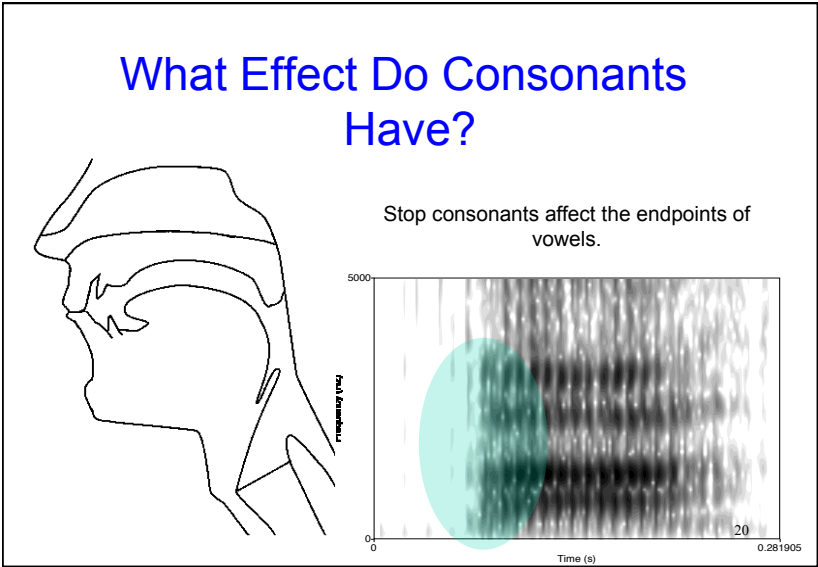
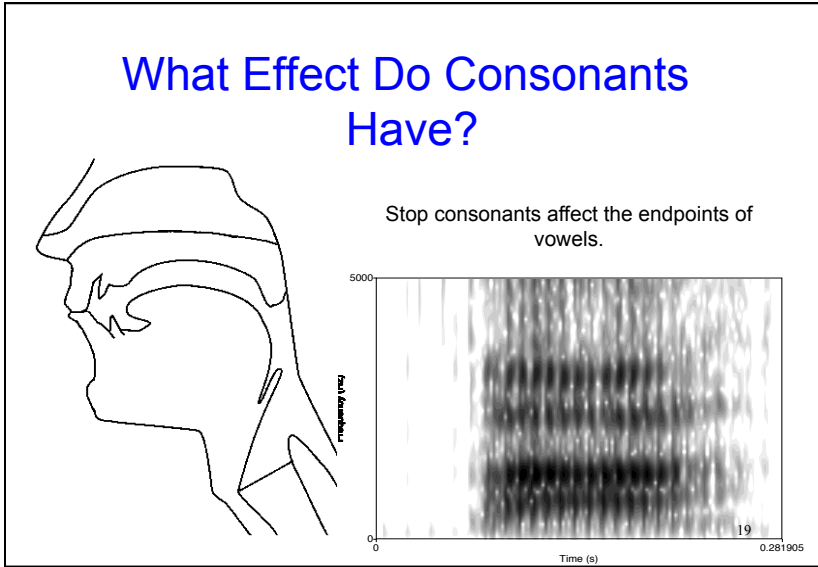
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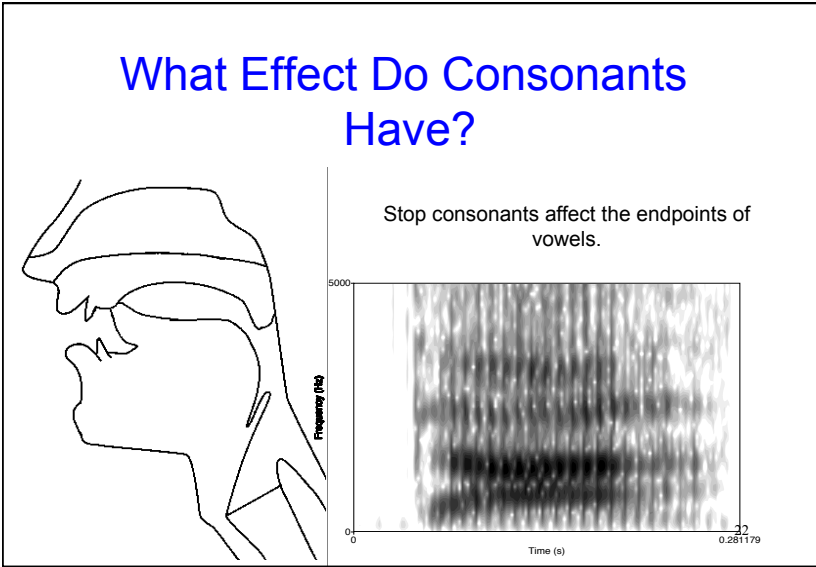
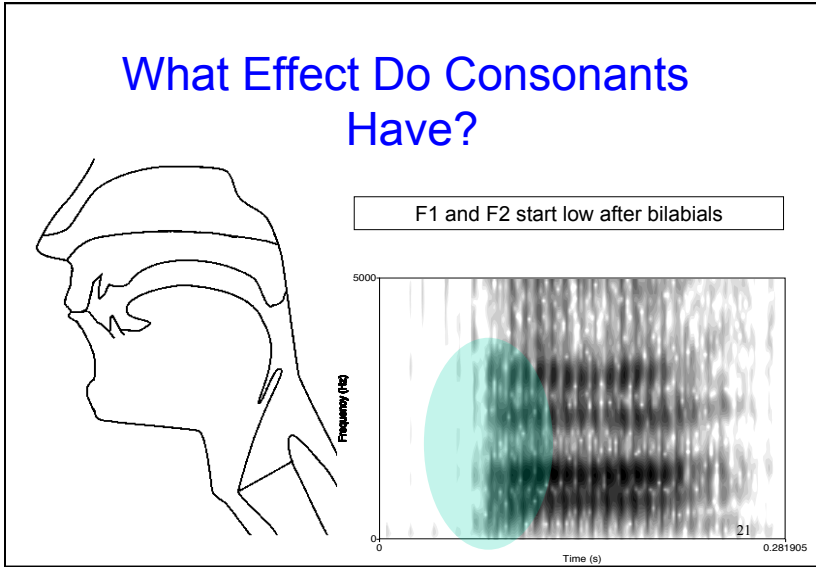
What Effect Do Consonants Have?

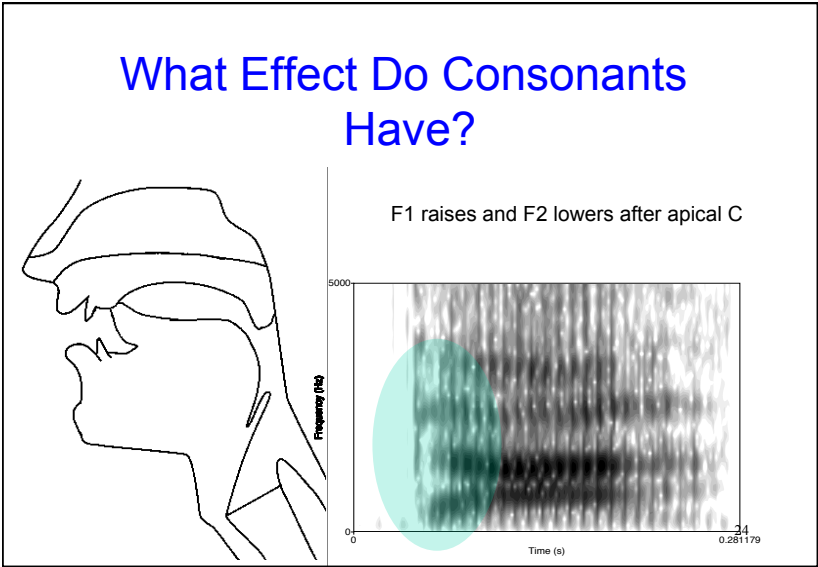
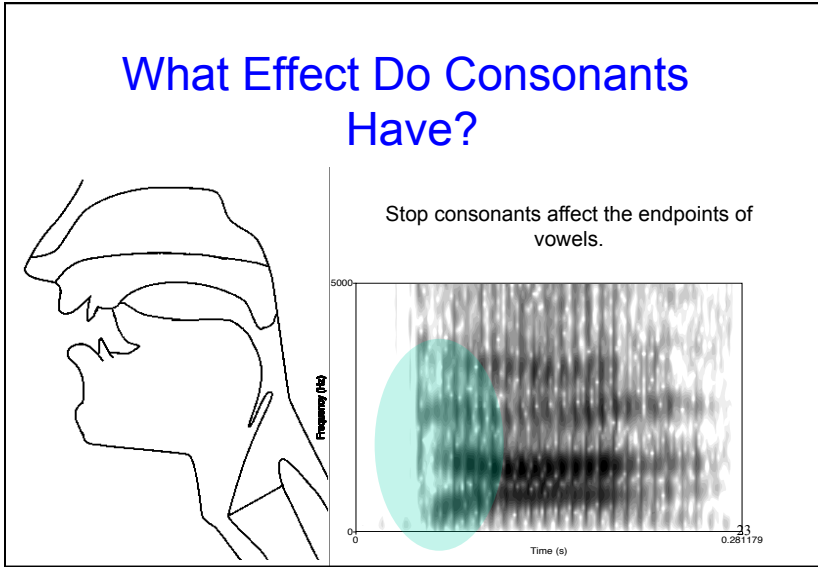


The vocal tract at rest position: a neutral vowel.









Effect of stops on vowels

- Labialization lengthens the vocal tract → formant frequencies lower near the consonant.
- In general bursts of /p/ are shorter than those of /t/ and /k/.
- F2 and F3 of central vowels near next to the consonants /k,g/

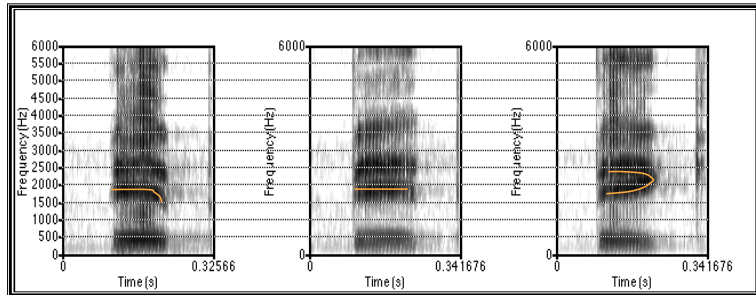
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Place distinction (F2, F3)

- bilabial
 - relatively low F2, F3 locus → rising into and falling out of vowel
 - weak and spread vertical lines
- alveolar
 - F2 locus about 1800 Hz
 - Strong vertical lines
- velar
 - Velar pinch: vowels F2, F3 merging
 - often double burst
 - long formant transitions

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Place of articulation



/d æ b/

/d æ d/

/d æ g/

Labial: F2 goes down.

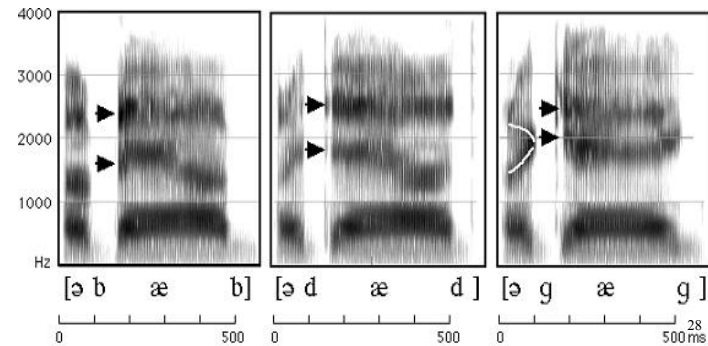
Coronal: F2 steady.

Dorsal: F2 up, F3 down.

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Examples -- "a bab, a dad, a gag"

- Bilabial show F1 and F2 together at low frequencies
- Alveolar F2 locus around 1700 Hz
- Velar F2 and F3 merge - velar pinch



[ə b æ b] [ə d æ d] [ə g æ g]

- Bilabial show F1 and F2 together at low frequencies
- Alveolar F2 locus around 1700 Hz
- Velar F2 and F3 merge - velar pinch

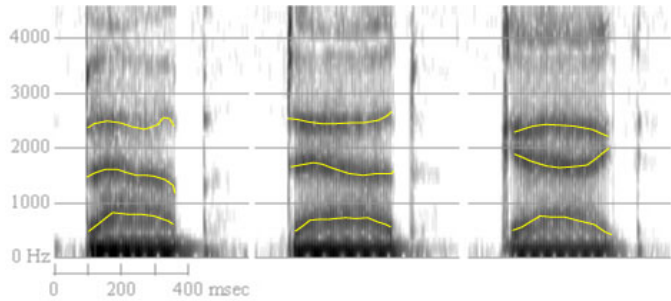
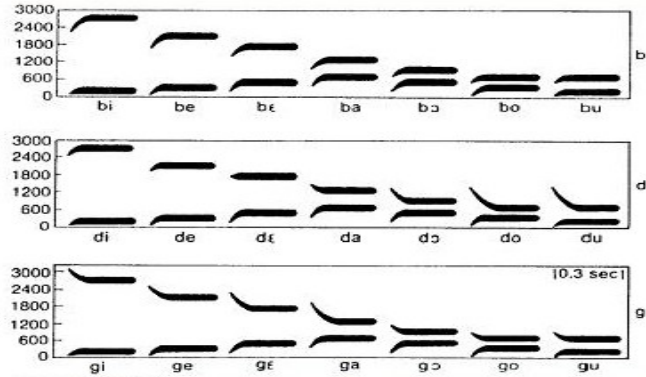


Figure 4. Spectrograms of "bab" "dad" and "gag"

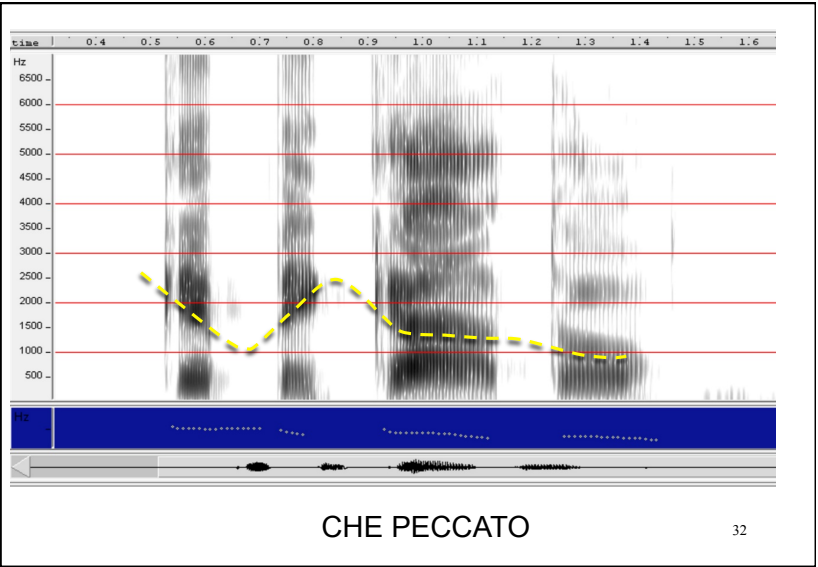
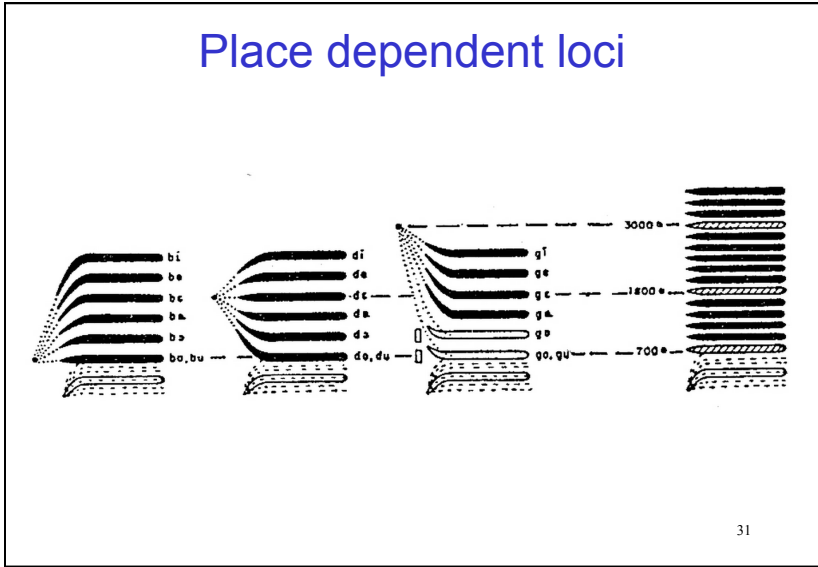
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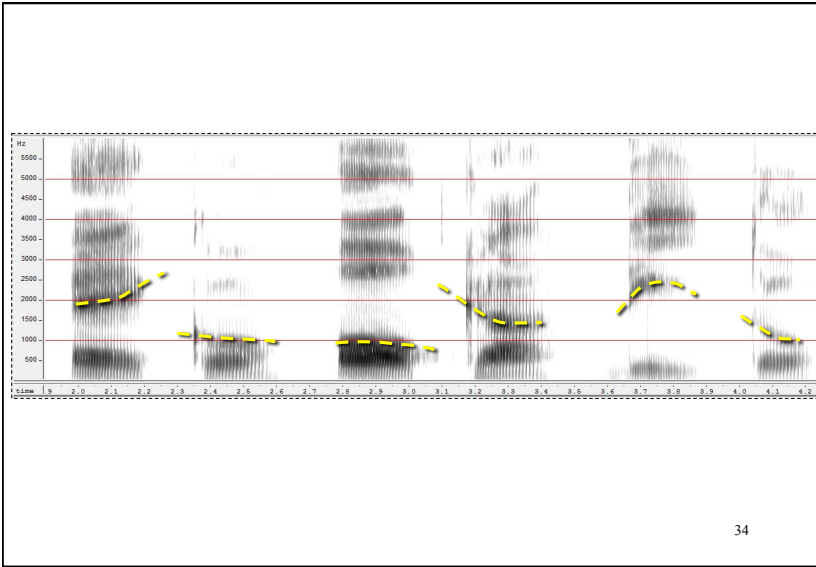
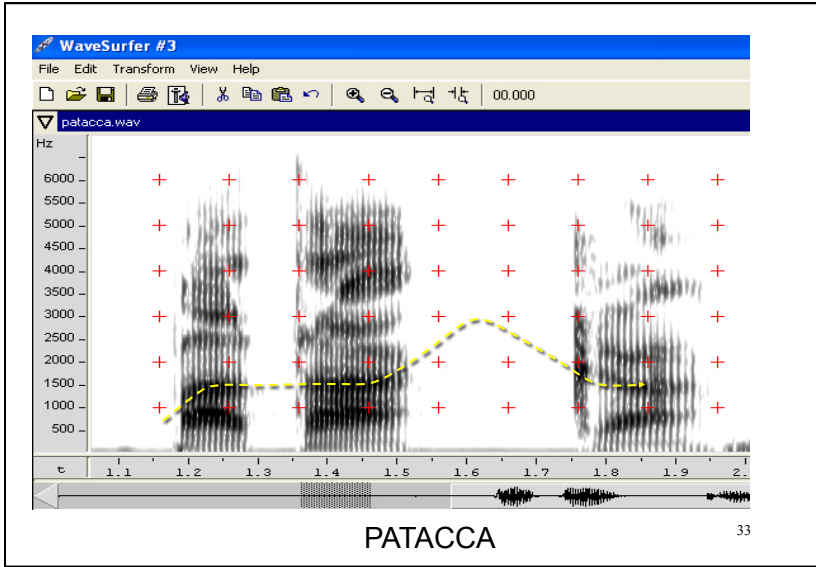
From Rob Hagiwara's webpage: <http://home.cc.umanitoba.ca/~robh/howto.html#>

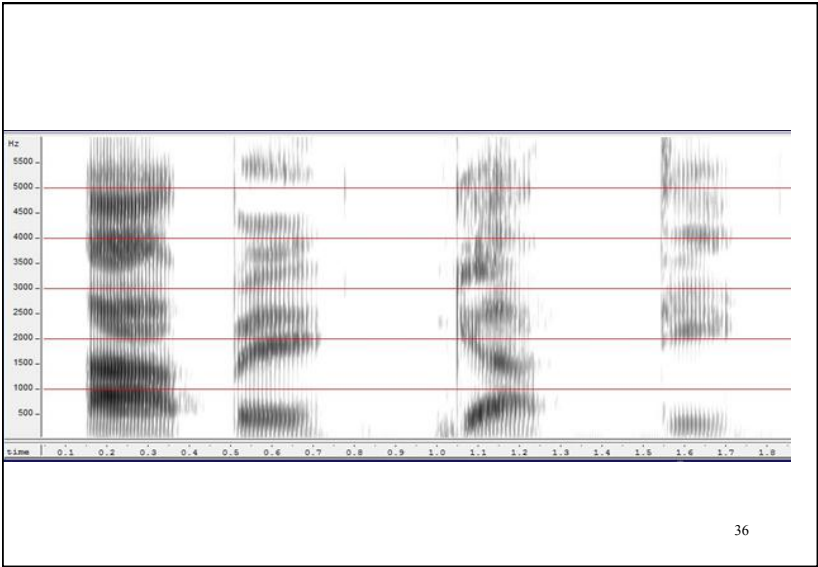
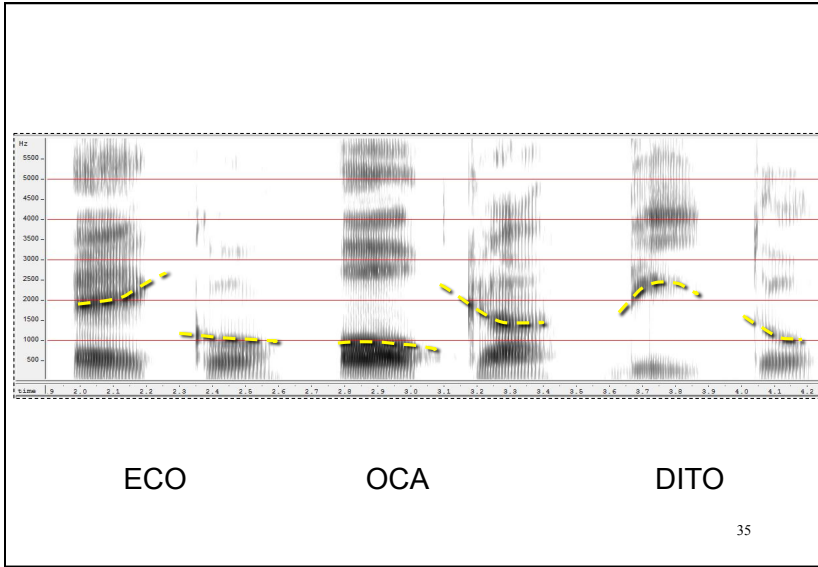
Place dependent loci

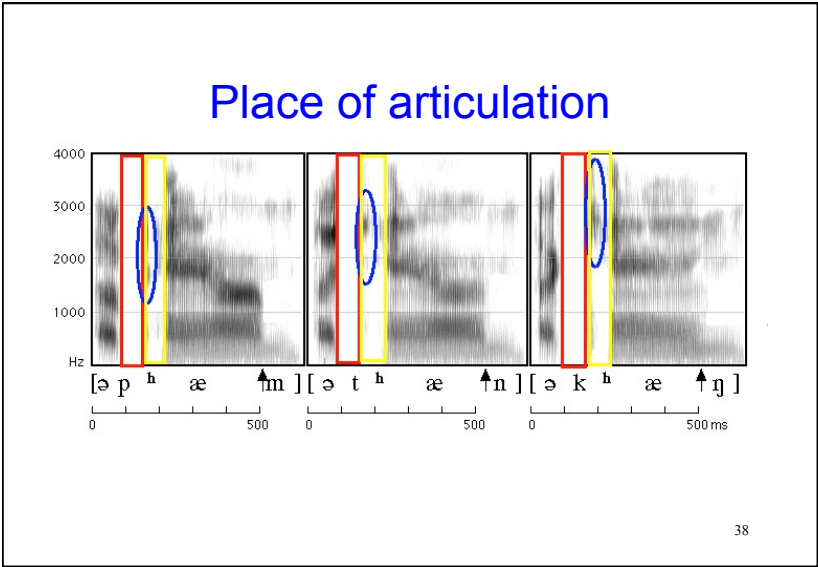
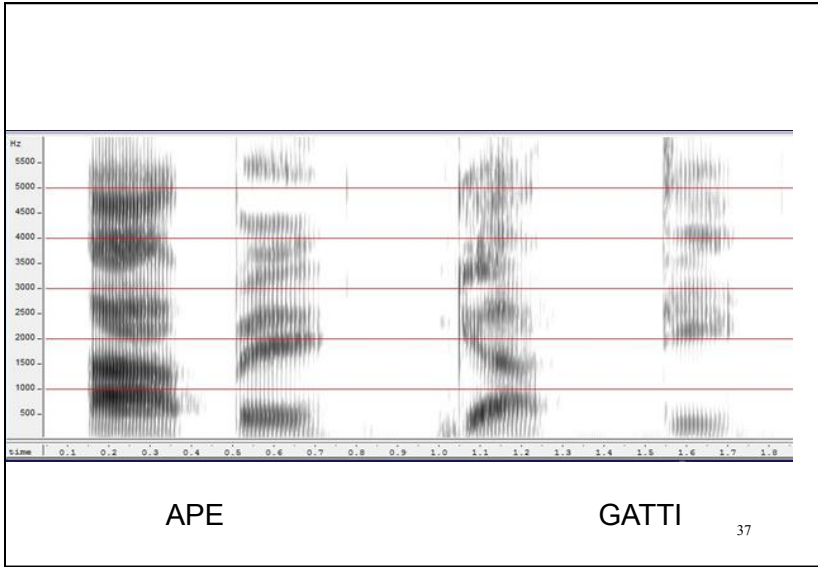


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A remark on spectrograms

- Spectrogram is not the only cue for acoustic distinction of speech sounds.
- Both waveform & spectrogram provide information about the speech sounds.

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VOT

Voice Onset Timing

- Indicates the time interval between the explosion of a stop and the beginning of the glottal vibrations of the following vowel
- English and Italian voiceless stops are characterized by a positive VOT
- Voiced stops can be characterized by a negative or slightly positive VOT (the vibrations begin before the beginning of the vowel)

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