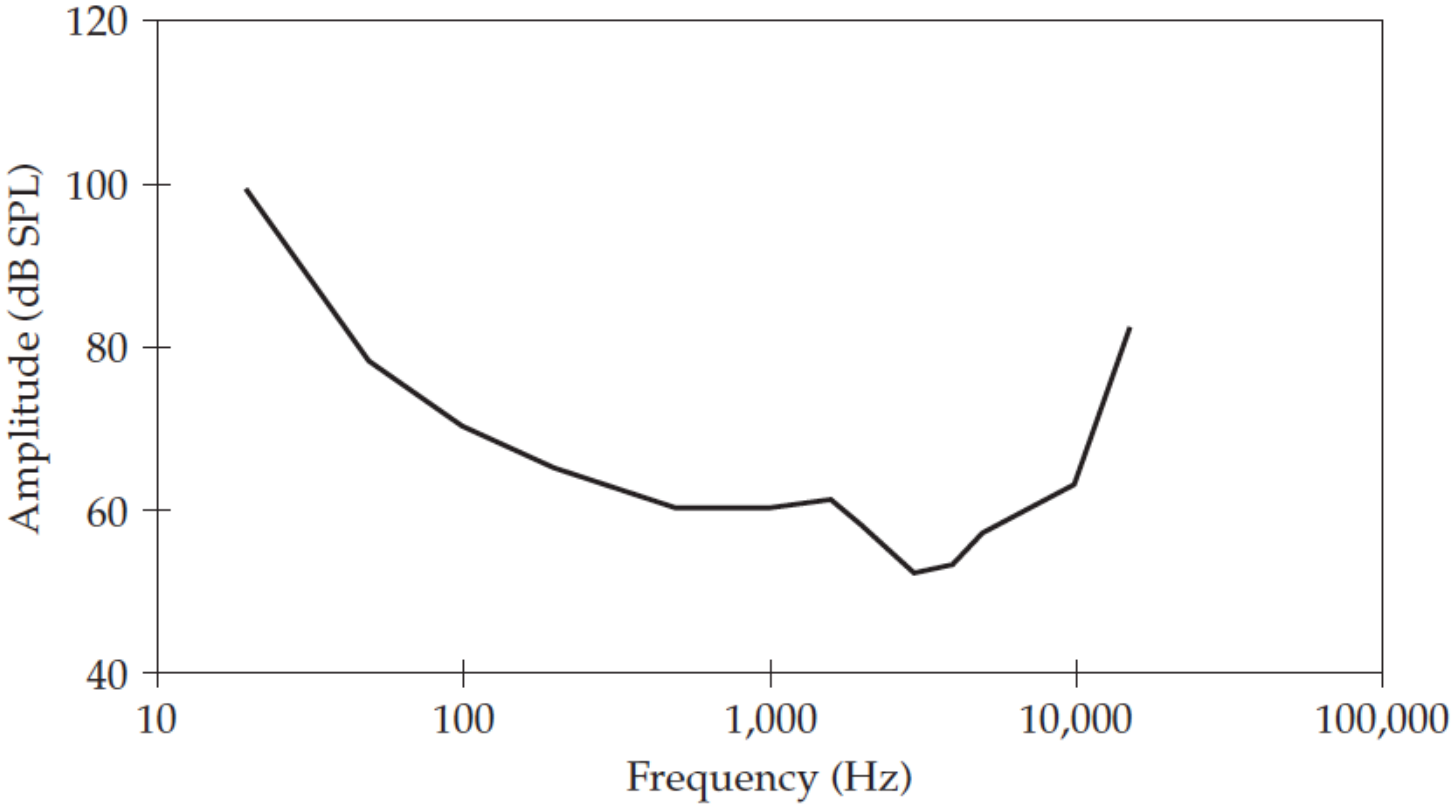
Hearing and Auditory Perception

Sensation of Loudness

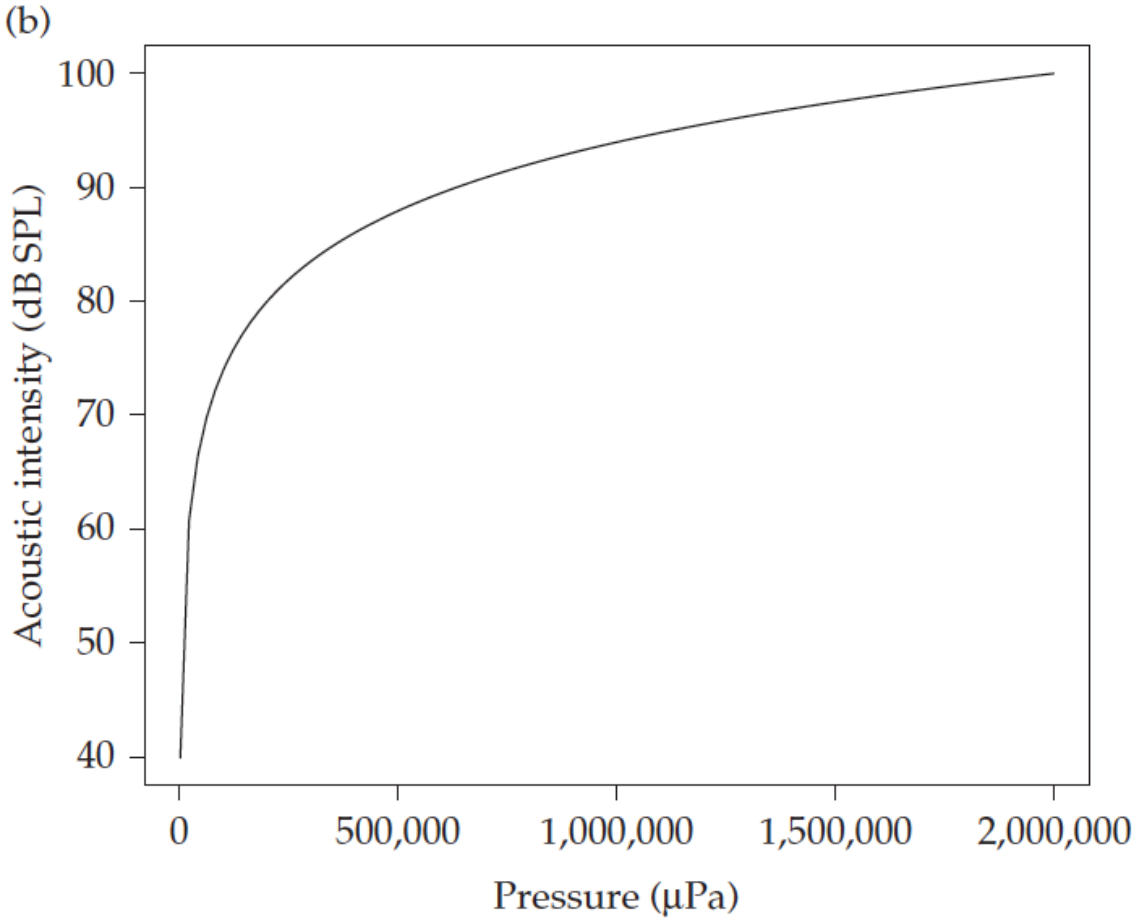
- The sensation of ”loudness” is non-linear
  - Linear pressure: micro-Pascals **µPa**
  - Linear electrical potential: millivolts – **mV**
  - Logarithmic relative energy unit: Decibels – **dB**
  - Perceptual equal-loudness scale unit: **Sone**
  - Perceptual pure-tone loudness unit: **Phon**

Sensation of Loudness: Sone

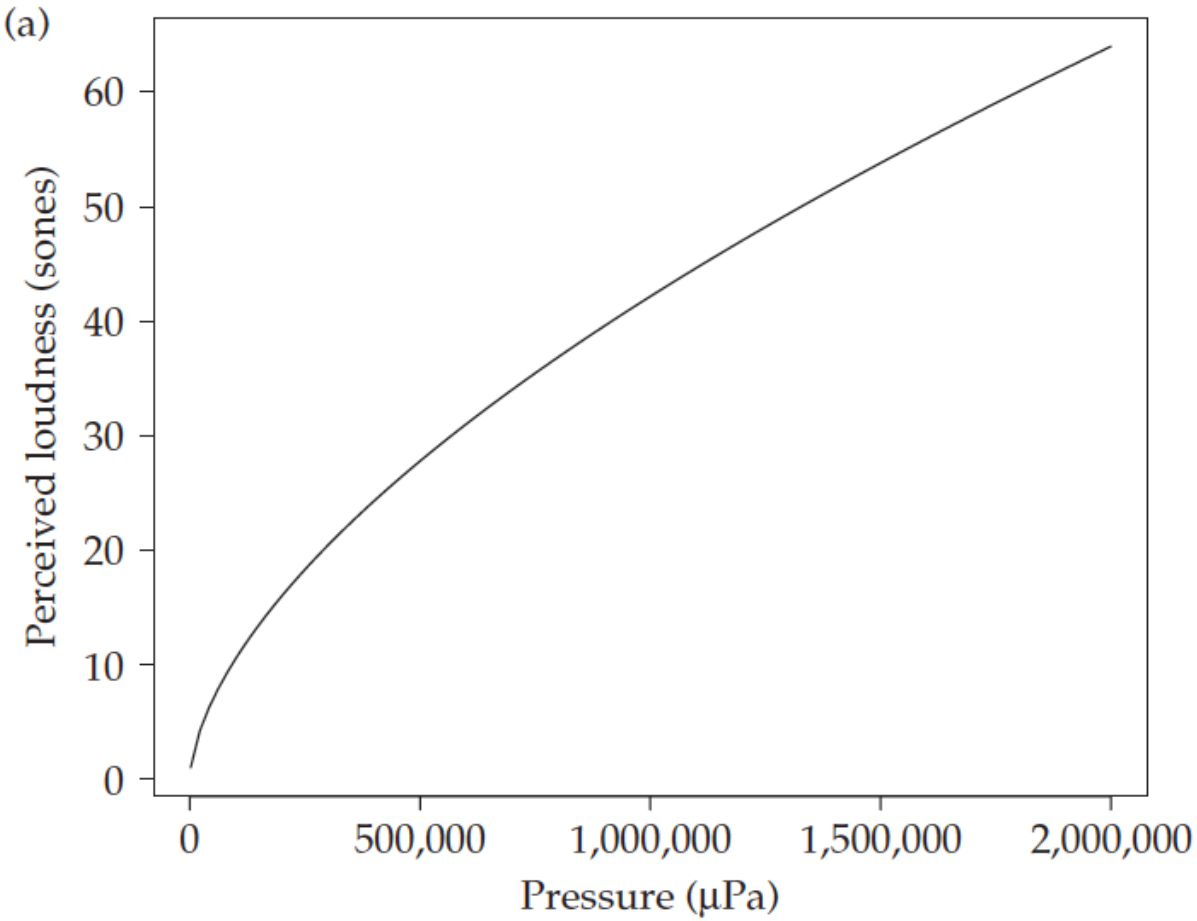
Equal Loudness Scale: Stevens 1936



Sensation of Loudness: dB



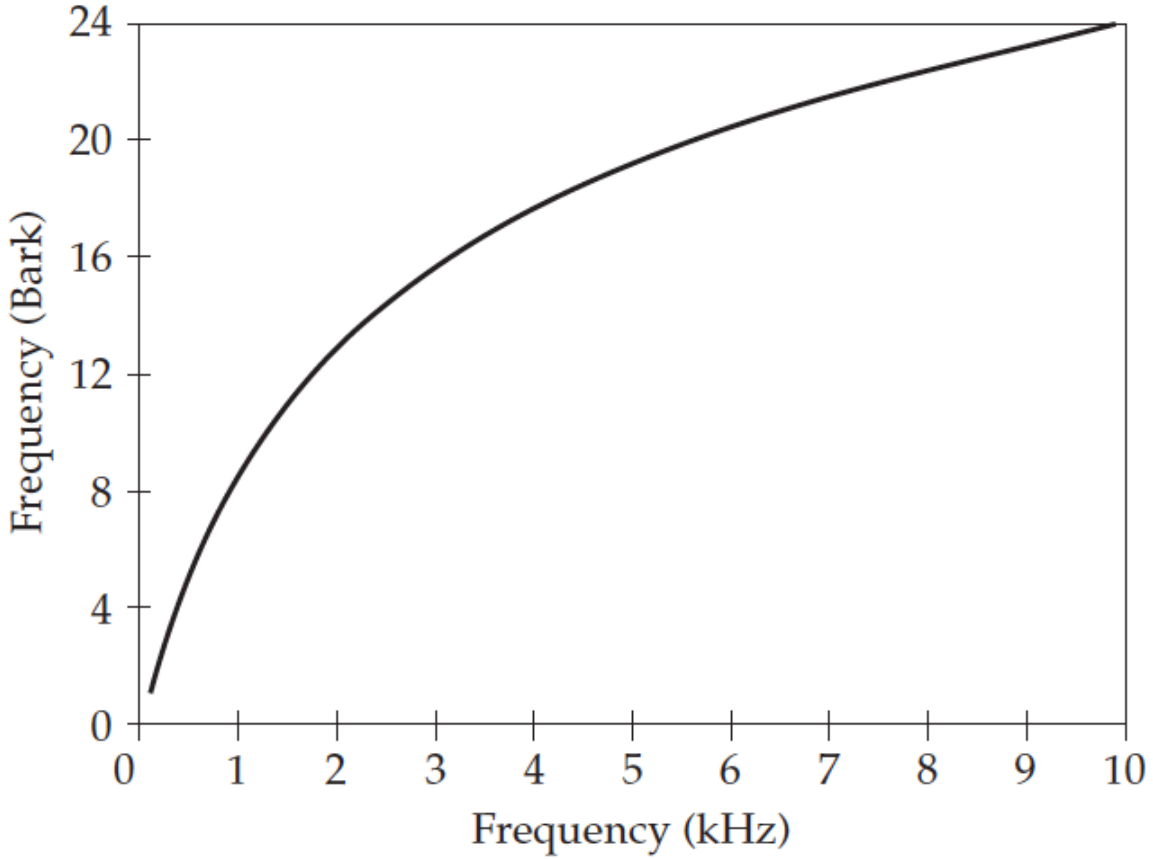
Sensation of Loudness: Sones



Frequency Response

- Frequency response is non-linear
  - Linear frequency: Hertz – **Hz**
  - Equal frequency distance – **Bark**
  - Perceived pitch scale: **Mel**

Frequency Response: Bark



Frequency Response: Bark

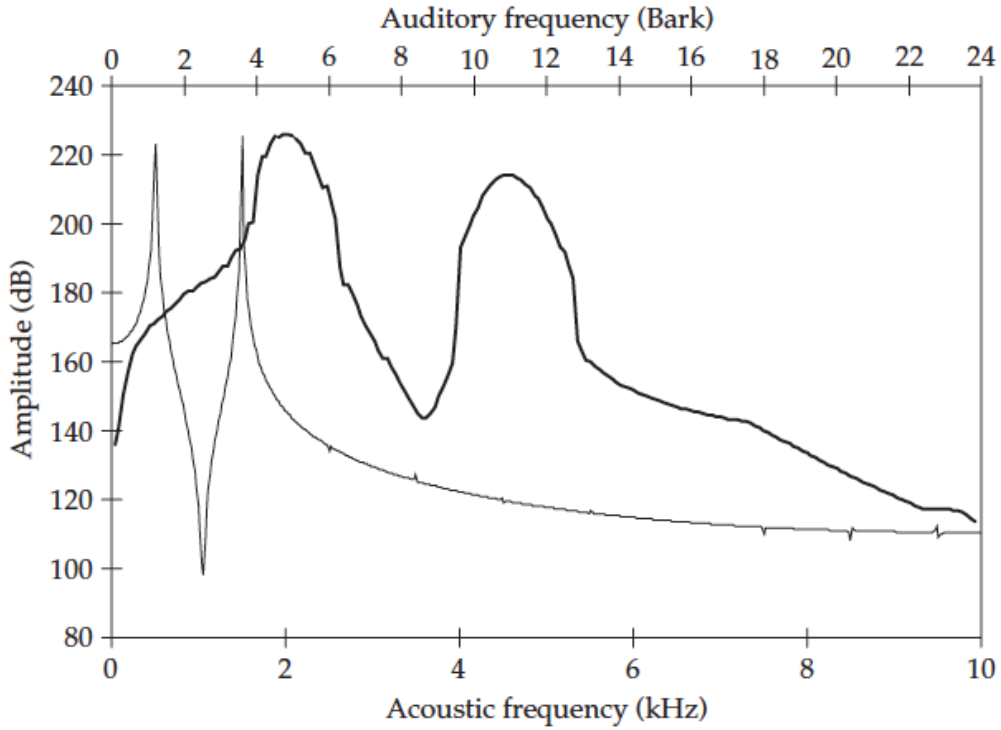
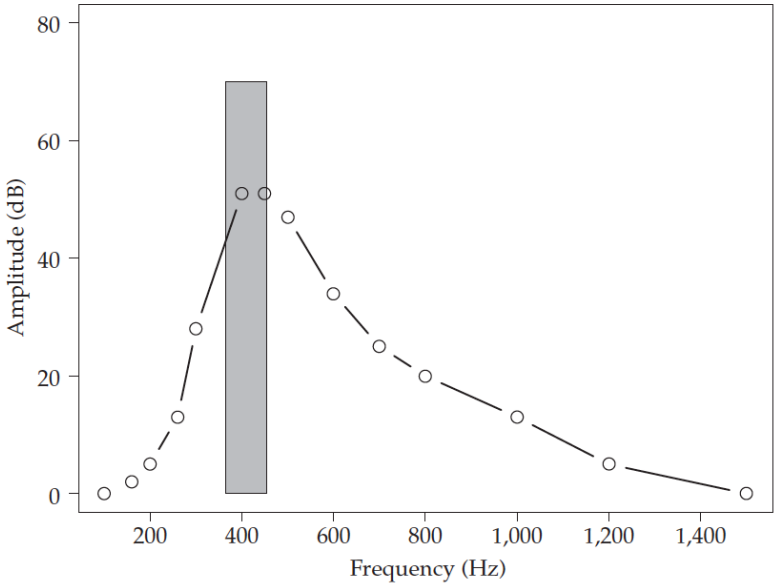


Figure 4.7 Comparison of acoustic (light line) and auditory (heavy line) spectra of a complex wave composed of sine waves at 500 and 1,500 Hz. Both spectra extend from 0 to 10 kHz, although on different frequency scales. The auditory spectrum was calculated from the acoustic spectrum using the model described in Johnson (1989).

Saturation and Masking

- Simultaneous Masking: The detection of sound A is interfered with by sound B with the same frequency and duration but with greater energy. Ex a loud burst of noise may mask a fricative's frication.
- Upward spread of masking: Lower frequency sounds mask higher frequency ones.

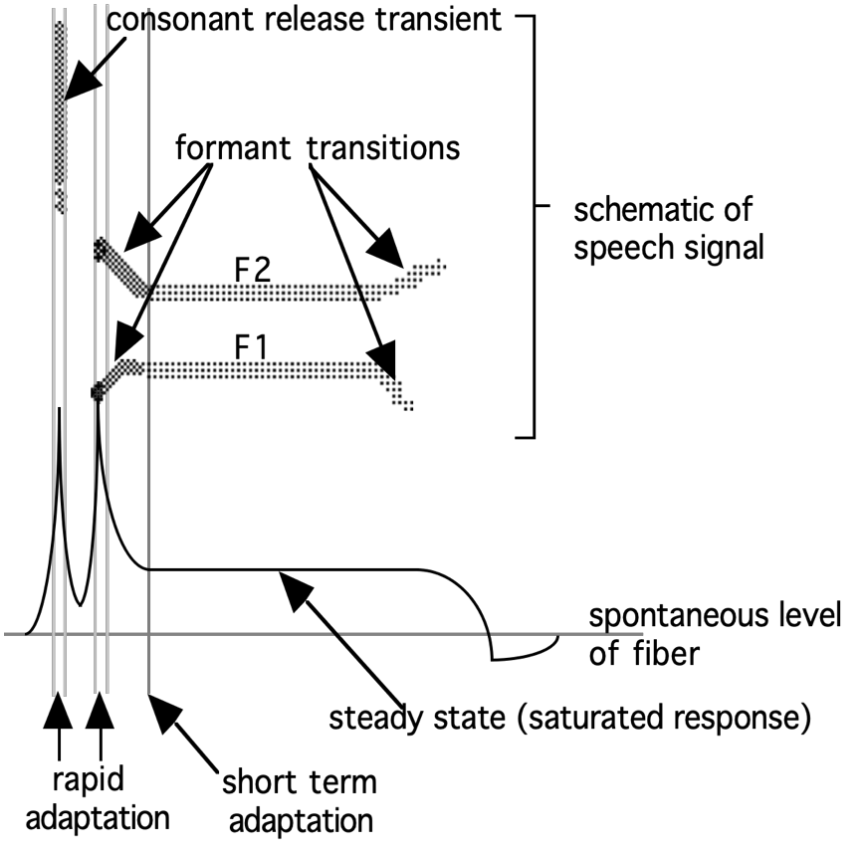


Saturation and Masking

- Saturation: When the auditory nerve fibers (ANF) have responded to a sound at their frequency for a period of time (about 20 ms) they become fatigued and fail to respond until after a short “resting” period (about 20 ms).
- Forward masking: fatigued ANF can’t respond to new sounds in their frequencies while fatigued
- Most observable in lower frequencies (below 3,500 Hz)

Saturation and Masking

- Forward masking: Onset advantage

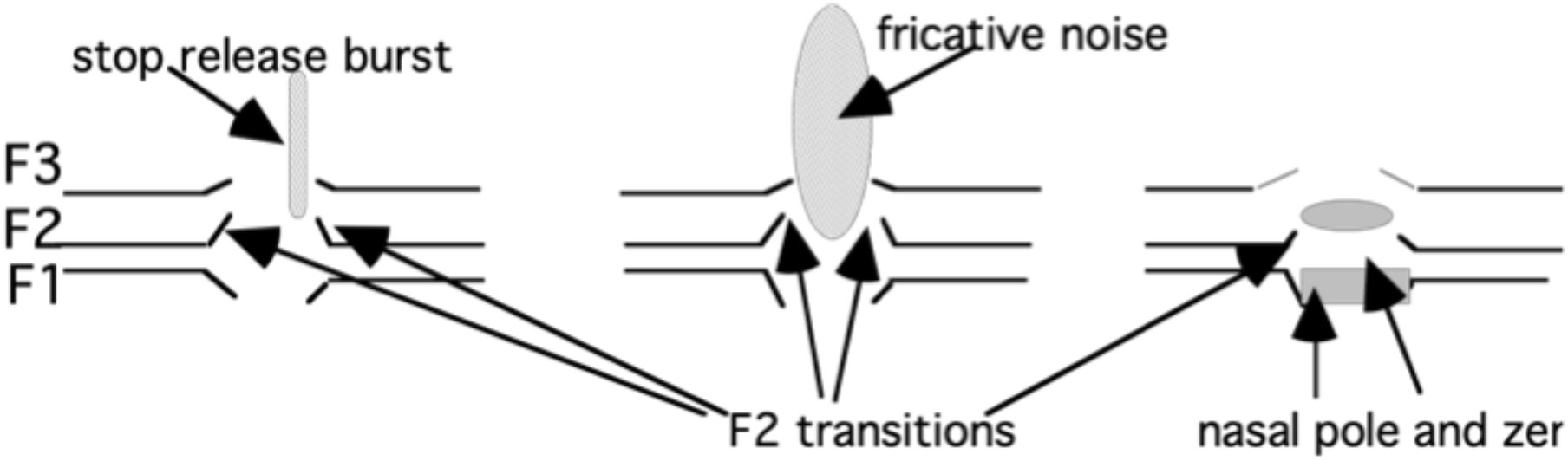


Distribution of information

- Cues: information in the signal that listeners use in recovering the segmental content of the utterance
  - Place cues
  - Manner cues
  - Voicing cues
  - Vowel quality cues

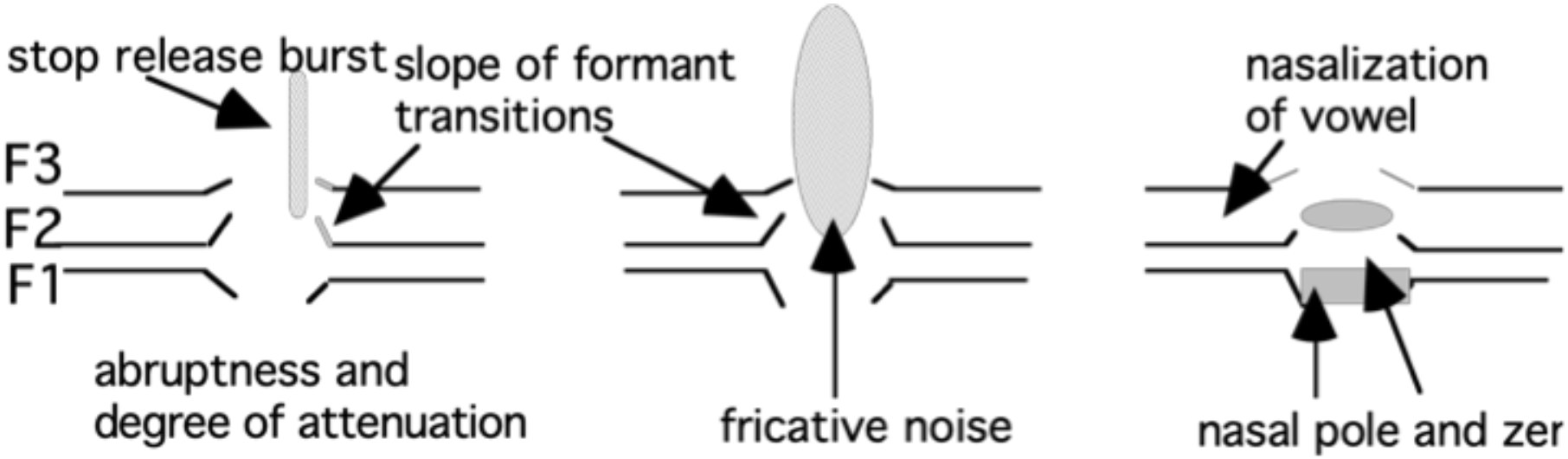
Distribution of information

- Place cues



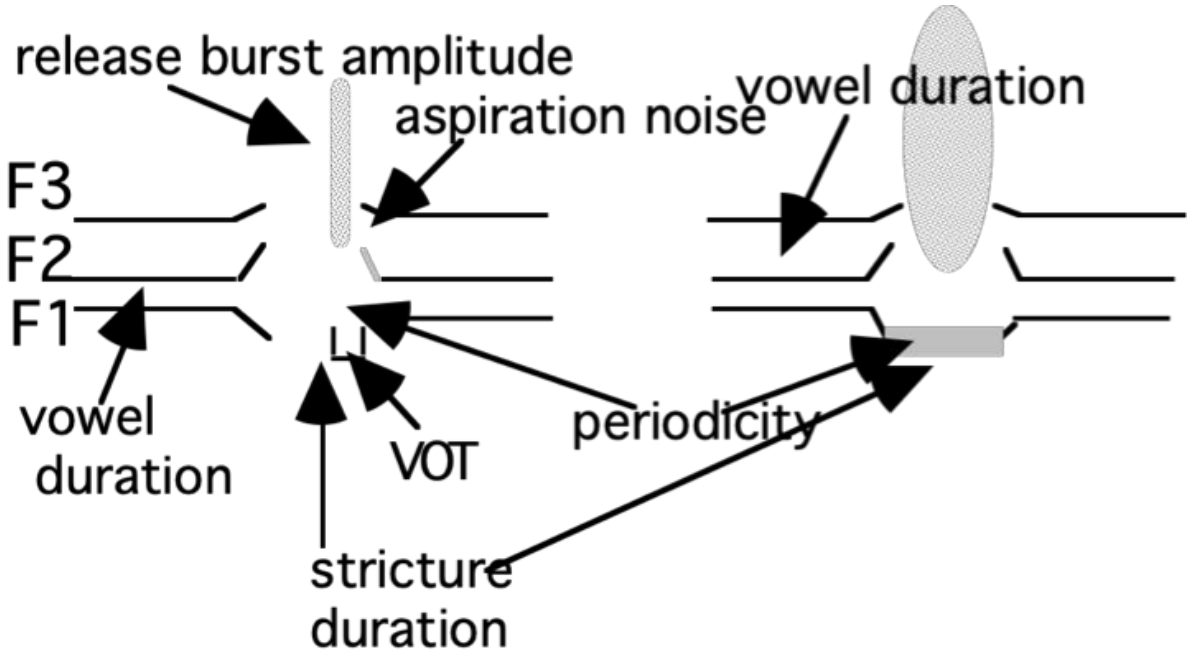
Distribution of information

- Manner cues



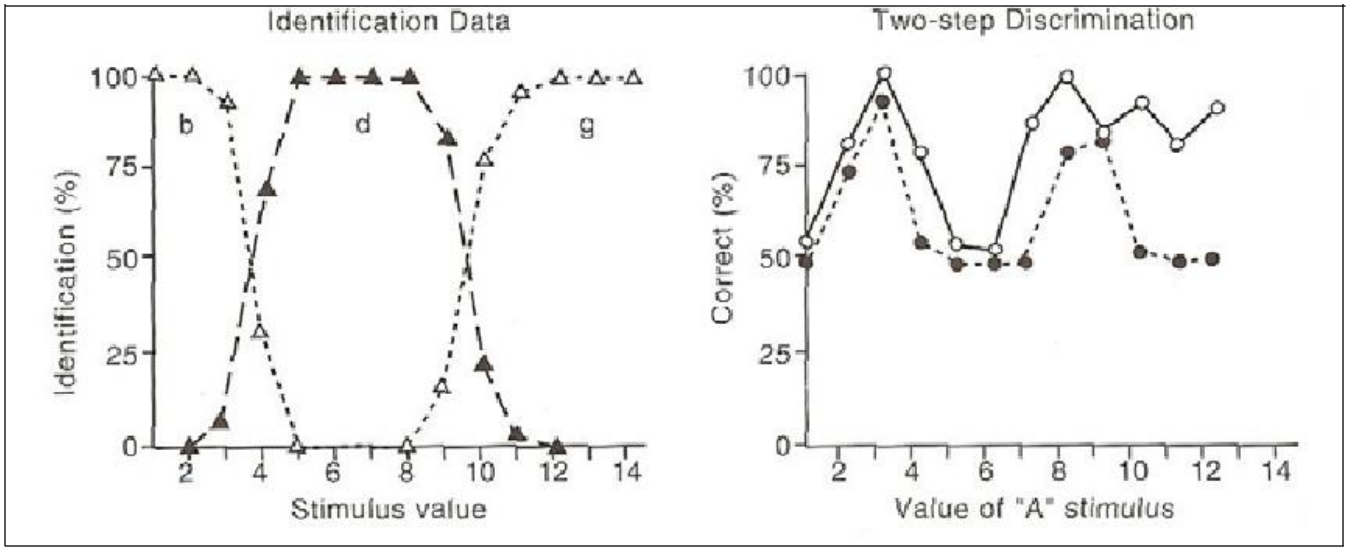
Distribution of information

- Voicing cues



Speech Perception

- Phonetic knowledge shapes speech perception
  - Your phonemes and allophones bias your response to a stimulus



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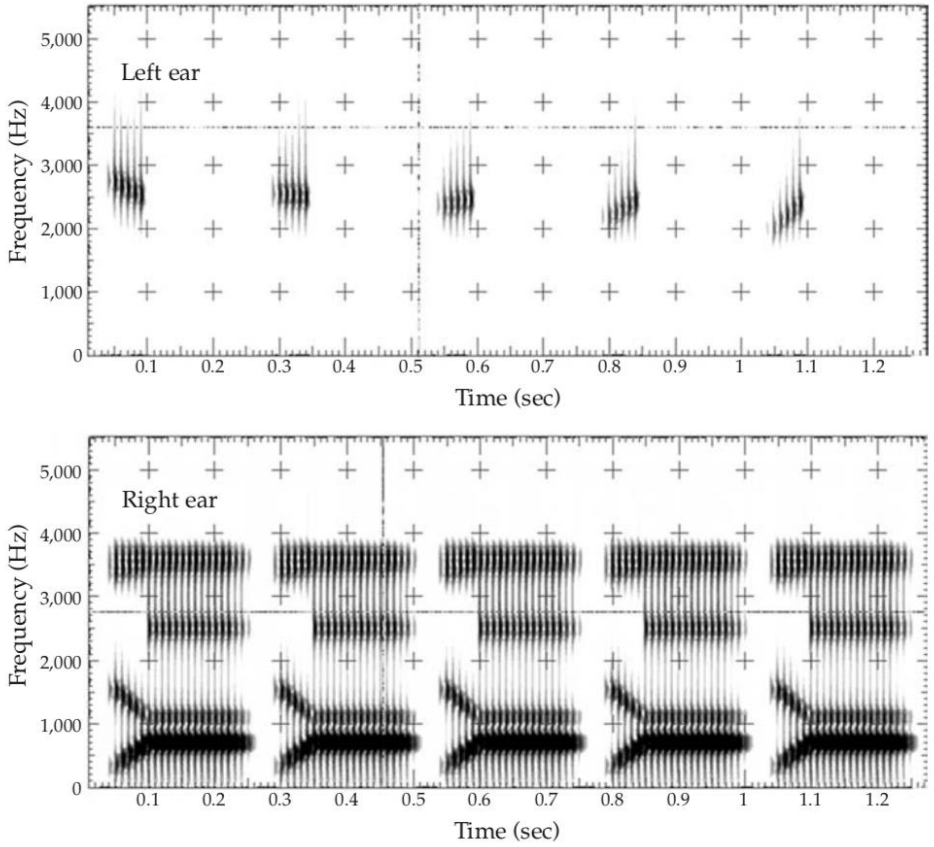

Speech Perception

- Linguistic knowledge shapes speech perception

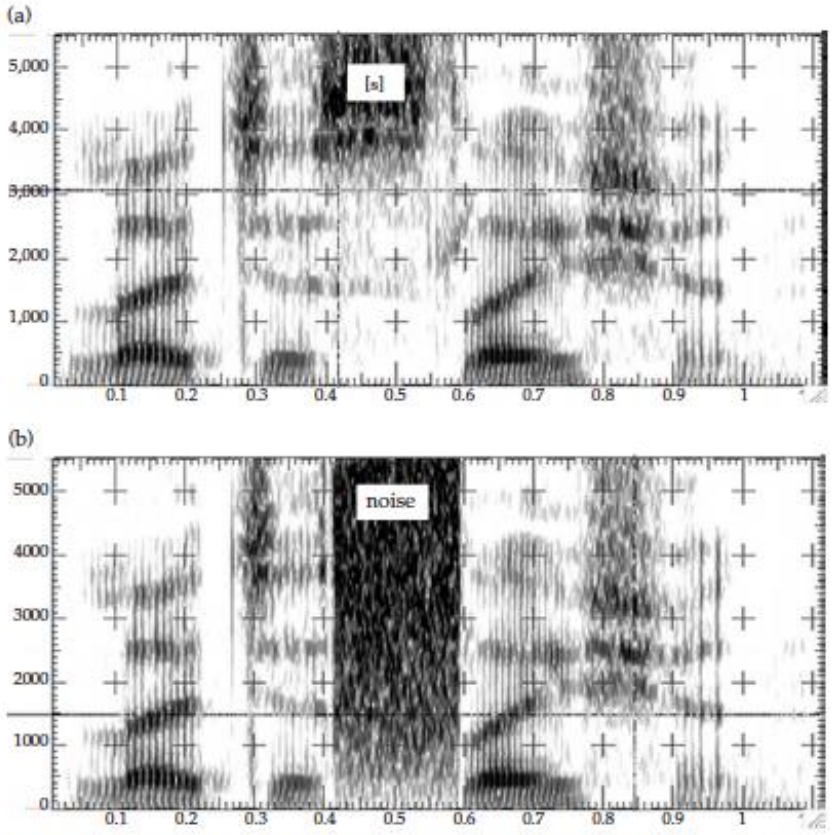

Figure 5.7 (a) Spectrogram of the word "legislation" with the [s] noise marked. (b) The same utterance again, but with the [s] replaced by broadband noise.