Speech Perception

Chapter 13

Review session Thursday 11/17
5:30-6:30pm S249

Outline

• Speech stimulus / Acoustic signal
• Relationship between stimulus & perception
• Stimulus dimensions of speech perception
• Cognitive dimensions of speech perception
• Speech perception & the brain

Speech stimulus

• Phonemes
  – English: 37 phonemes
    • 13 vowel sounds
    • 24 consonant sounds
  – Hawaiian: 11 phonemes
  – Some African dialects: 60 phonemes

Phonemes (IPA – Int’l phonemic alphabet)

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Speech production

Air from lungs
Constriction of air flow
Speech emerges
Vibration of vocal folds

Acoustic signal

• Vowels – vibration of vocal cords and change to shape of vocal tract
  – FORMANTS - peaks in pressure at different frequencies
• Each vowel has characteristic formants

Speech production

Why did Ken set the soggy net on top of the deck?

Sound spectrogram

“Had”
Acoustic signal

- Consonants - produced by a constriction of the vocal tract
- Formant transitions - rapid changes in frequency preceding or following vowels

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Speech stimulus & speech perception

- Segmentation problem

- Variability problem – acoustic signal is so variable
  - Phoneme context (coarticulation)
  - Different speakers

Phoneme context

- Speaker variability
  - differ in pitch, accent, speed in speaking, and pronunciation
Outline

• The speech stimulus
• Relationship between stimulus & perception
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• Cognitive dimensions of speech perception
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Stimulus dimensions of speech perception

• Categorical perception
  – VOT (voice-onset time) & phonemic boundary
• Speech perception is multimodal
  – McGurk effect

Categorical perception

Voice onset time

![Voice onset time graph](image)
McGurk effect

Cognitive dimensions of speech perception

- Top-down processing

- Segmentation affected by context & meaning

‘I scream you scream we all scream for ice cream’

Ganong effect
Ganong effect

Subjects shift their phoneme boundaries to favor phoneme that makes a legal word:

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Speech perception & the brain

- Broca’s aphasia - frontal lobe damage
  - Labored, stilted speech, and short sentences but good comprehension

- Wernicke’s aphasia - temporal lobe damage
  - Speak fluently, but content is disorganized and not meaningful
  - Difficulty understanding others

Experience-dependent plasticity

- < 1 y.o. - infants can differentiate all phonemes

- Brain becomes “tuned” to speech sounds in environment

- Other sound differentiation disappears when there is no reinforcement from environment