Acoustic cues underlying the adjustment to talker sex in perception of fricative consonants in listeners with cochlear implants

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INTRODUCTION

Different talkers have different voices. This introduces variability that we need to accommodate in order to identify speech. People with normal hearing can do this, and CI users also accommodate, despite a degraded signal.

Do CI listeners adapt using the same strategy as individuals with normal hearing?

This adaptation is called...

PHONETIC ACCOMMODATION OF TALKER GENDER

A well known example of this is seen in fricatives: /ʃ/ and /s/ ("sh") have different acoustic properties when spoken by a man compared to a woman. Frequency peaks are lower for a man’s voice. A shift in the perceptual boundary between /ʃ/ and /s/ will reflect perception of subtle acoustic differences between talkers [1,2,3]

The problem:

- Perception of talker difference should be based on the perception of vocal tract size (formant spacing)
- CI listeners do not have the spectral resolution to be able to reliably perceive formant spacing [4]
- NH and CI listeners might accommodate using different acoustic features of the talker's voice.

The strategy to solve the problem:

We are independently manipulating parameters of voice acoustics to see which are the strongest contributors to accommodation of talker sex

Isolating potential acoustic cues for talker gender

METHODS

PARTICIPANTS: 8 listeners with cochlear implants (ages 44 – 87 yrs) 20 listeners with normal hearing (ages 18 – 30 yrs)

PROCEDURE: Click on the word that is spoken

STIMULI: 8-step continuum of fricative sounds ranging from /ʃ/ ("sh") to /s/ appended to /ʃ/ and /s/ vowels vocal cues to gender (in the vowel) were acoustically manipulated

RESULTS

- Rate Pitch? In MY phonetic categorization?
  - If CI listeners were using pitch, and they lack harmonic pitch, they must have been using rate (temporal pitch).
  - Is rate pitch a "proxy" cue for vocal tract size?
  - Can NH listeners use rate pitch to accommodate phonetic perception?

CONCLUSIONS

- CI listeners use a different strategy to accommodate differences in voice acoustics.
  - NH listeners rely primarily on vocal tract length
  - CI listeners rely primarily on Fo (pitch)
  - Fo may be used as a proxy for VTL when the signal is too degraded to extract formant information

- The strategy used by CI listeners might explain their difficulties in everyday environments
  - Fo is not the most direct index of vocal tract differences, and is not easy to perceive with a CI
  - This might explain some difficulty CI listeners in perceiving multiple talkers

- Although NH listeners use pitch as a strong cue for identification of gender, they did not utilize pitch to accommodate to different talkers’ voices when it was isolated from VTL information.
  - CI users appear to learn to rely on Fo when access to VTL information is insufficient.


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