INTRODUCTION

The sound quality of a cochlear implant (CI) is very different than that of typical acoustic hearing.

Simulating the sound of a cochlear implant can be useful for research and counseling. We want to make the simulations as accurate as possible.

The good news: Common simulations using noise and sine wave vocoders do a good job predicting CI speech intelligibility.

The problem: People with a CI and acoustic hearing in the opposite ear report that common simulations don’t sound like their implant. Vocoder simulations tend to use parameters that do not actually approximate what a CI speech processor does.

Parameters to explore:
- Number of channels
- Spread of cochlear excitation
- Frequency-electrode allocation
- Dynamic range
- Processing strategy
- Pulsatile stimulation, etc.

The strategy to solve the problem:
1. Use a speech perception task that is more subtle than basic intelligibility.
2. Vary vocoders by parameters that are relevant to CI processing and stimulation.
3. Compare the performance of the different vocoders in matching subtle speech perception abilities of the real CI listeners.

METHODS

PARTICIPANTS: 43 young listeners with normal hearing (ages 18 – 32 yrs)
19 listeners with cochlear implants (ages 40 – 67 yrs)

PROCEDE: Click on the word that is spoken →

STIMULI: 9-step continuum of fricative sounds ranging from /ʃ/ (“sh”) to /s/ (adjacent to /ʃ/ and /s/)
spoken by a female or a male talker.

Prerequisites: Differences between /ʃ/ & /s/:
- Center frequency
- Bandwidth
- Amplitude
- Peak frequency

In this condition, the optimal match is approximately /ʃ/.

RESULTS:

All vocoder styles yield better results than the 8-channel noise vocoder.

CONCLUSIONS:

Perceptual categorization of /ʃ/ & /s/ reflects accommodation of vocal acoustic differences between women and men. People with cochlear implants also demonstrate this accommodation.

The most common vocoder simulation of a cochlear implant (8-channel noise vocoder) does not elicit phonetic accommodation.

The phonetic accommodation effects emerges for other vocoder styles that use parameters designed to replicate various aspects of cochlear implant processing.

Phonetic accommodation is a subtle aspect of speech perception that can reveal differences in the ability of a vocoder to accurately predict perception of speech by a person with a cochlear implant.