Introduction

Speech recognition difficulty is a common complaint of older adults with hearing loss. Whereas most hearing aids increase speech audibility in relatively quiet environments, they often fail to improve the signal-to-noise ratio (SNR) in noisy environments. As a supplement to aided listening in noise, an effective speech-perception training program may improve the use of audible speech information, improve communication abilities, and increase the efficacy of hearing aids.

As part of an ongoing study of neural changes, listening effort, and communication benefits of speech-perception training using neuroimaging and pupillometry outcomes, a word-based training program (as described in Humes et al., 2009) was evaluated for older adults with hearing loss.

Preliminary speech recognition results before and after training are reported here for this ongoing project.

Methods

Participants (see audiograms—)

- Training group (speech-perception training for 8-12 weeks): 10 adults (mean age 72.5 years)
- Control group (weekly phone calls for 8-12 weeks): 8 adults (mean age 71.5 years)
- Participants had no previous experience with hearing aids
- Groups matched for age, average hearing loss, test ear, and gender
- Cognitive outcome measures (see Table below)

No significant differences between training and control groups

Speech outcome measures (open set): 400 of the most frequently occurring words in English (four talkers)

Snellman et al., 2010; Boothroyd, 2005

Speech stimuli presented in a background of two novel talkers and sentences.

Stimuli presented via a personal computer with touchscreen interface

- Presentation controlled through custom MATLAB software and delivered to one of a pair of ER-3A insert earphones
- Speech stimuli presented in a background of two talker ICRA noise

Stimuli

- 200 words of the training stimulus (4 talkers produced 50 of the 200 unique words)
- 94 frequent phrases spoken by 4 talkers
- 40 CID (Central Institute for the Deaf) Everyday Sentences (20 Sentences repeated at pre- and post-test [CID1] and 20 additional sentences for post-test only [CID2]; 1 talker; original recording)
- 50 VAST (Veterans Affairs Sentence Test) sentences produced by 4 talkers (200 total)

Training Protocol

For the training group, mean improvement in scores (open set) between pre-test and post-test was largest for the 200 frequent words (~25 rau, p<0.05). This was expected given that these words were a subset of the words used in the training protocol. Smaller, but significant improvements in scores ranging from 7-16 rau were observed for each of the other speech outcomes measures (p<0.05).

For the control group, no significant differences in scores were observed between pre-test and post-test for speech outcome measures (p>0.05) with the exception of a significant decline for CID1 sentences (p<0.05).

No significant differences in age or average high-frequency hearing loss were observed between the training and control groups.

Conclusions

- A majority of participants benefited from word-based speech-perception training, as revealed by significant improvements in speech recognition in noise for trained speech (words and phrases) and untrained speech (CID and VAST sentences). Control participants who did not participate in the training program showed no significant improvements in speech recognition.

- Comparisons of well-matched training and control groups of older adults with hearing loss confirm and extend previous reports of improvements in communication abilities following speech-perception training (Burk & Humes, 2007, 2008; Humes et al., 2009).

- Improvements by the training group in recognition of untrained speech demonstrate that older adults with hearing loss can generalize benefits of word-based speech-perception training to novel talkers and sentences.

- Next Steps (after conclusion of data collection)

  - Associations between training based changes in speech recognition and auditory and cognitive outcomes will be examined to assess participants characteristics that may enhance benefits of speech-perception training.
  - Speech, auditory, and cognitive outcomes will be integrated with MRI and pupillometry results to assess neural systems underlying improvements in speech recognition following speech-perception training.