

Name (Primary Investigator): Andrea Pittman, PhD

Study Investigators: Elizabeth Stewart, AuD, PhD (Dec 2017)

Affiliation(s): Arizona State University

Project Title: Assessing the benefits of advanced hearing aid features for recognizing and learning unknown words

Primary Project Goal: Listener's encounter new information on a regular basis. Hearing loss is known to slow or prevent learning in both children and adults. The goal of this project was to determine if hearing aids improve children's and adults' ability to learn new words and if certain hearing aid features improve learning further.

Knowledge Translation:

Learning new information is part of everyday communication (e.g., second-language learning, on-the-job training, medical terminology, etc.). Most learning begins with new vocabulary. In clinical audiology, only the perception of familiar words is evaluated. This project revealed that listeners with hearing loss who understand familiar words very well, may have trouble identifying and learning new words compared to listeners with normal hearing. Also, certain hearing aid features improve word learning further while other features appear to have little effect. These results translate directly to clinical practice because they reveal a novel aspect of auditory communication that, if successfully remediated, could improve the communication of listeners with hearing loss in a fundamental and meaningful way.

Methods:

Children and adults with hearing loss completed four tasks with words that varied in familiarity: 1) word recognition (all real words), 2) auditory lexical decision (half real, half nonsense words), 3) non-word detection (nonsense words embedded into real sentences), and 4) rapid word learning (all nonsense words). Each participant was tested in one unaided and two aided sessions. Hearing aids were programmed with two memories: one containing an advanced feature and one without. Three hearing aid features were evaluated: 1) high-frequency amplification, 2) frequency lowering, and 3) digital noise reduction in steady-state noise and multi-talker babble. Performance was compared across tasks and groups to determine the effects of age (children, adults) and hearing loss (normal, impaired). It was expected that if hearing loss slows the identification and learning of new words, then performance should improve with amplification. Also, if identification and learning of new words was not restored to normal levels with amplification, then the advanced hearing aid features were expected to improve performance further by improving signal quality further.

Results:

Identification and learning improved significantly with hearing aids. Performance improved further with high-frequency amplification, especially for the most unfamiliar words. Frequency lowering did not improve or detract from performance while digital noise reduction improved performance for about half of the children and adults but reduced performance for the other half. Overall, these results tell us two things. First, hearing aids by themselves and certain hearing aid features improve learning. Second, although a hearing aid feature may not improve learning for everyone, it may work for some. For example, digital noise reduction decreased the level of the noise in the environment without affecting learning. This could be a significant advantage for children and adults in noisy places because it would allow them to continue to listen and learn more comfortably rather than feeling the need to reduce the volume control or remove the hearing aids altogether. The most interesting finding was the lack of a relationship between the listeners' ability to perceive real words and their ability to learn new ones. This tells us that the speech perception tests used clinically settings only tell half the story. The results of this project suggest a novel avenue for improving clinical intervention for both children and adults with hearing loss.

Background information about your research group:

In the Pediatric Amplification Laboratory, the amplification needs of both children and adults with hearing loss are examined through traditional and novel paradigms. Two lines of research are currently underway. First, we are interested to know if hearing loss delays or halts the development of word learning in adolescents compared to their normally hearing peers. Second, we are studying the relation between learning and signal quality in a variety of clinical populations and hearing devices (hearing aids, bone-anchored devices).

References:

- Pittman, A.L., Stewart, E. Odgear, I., Willman, A. (in press). Detecting and learning new words: The impact of advancing age and hearing loss. *American Journal of Audiology*.
- Pittman, A.L., Stewart, E., Willman, A., Odgear, I. (2017). Word Recognition and Learning: Effects of Hearing Loss and Amplification Feature. *Trends in Hearing*. 21, 1-13.

Contact information: andrea.pittman@asu.edu, 1-408-727-8728