Auditory Scene Analysis in the Elderly: Attentional and Automatic Processing

Elizabeth Dinces, MD, MS1 and Elyse S. Sussman, PhD1,2
1.Dept of Otolaryngology – HNS, Albert Einstein College of Medicine
2.Dept of Neuroscience, Albert Einstein College of Medicine

Introduction

A common complaint of individuals over the age of 65 is a loss of the ability to discriminate sounds in everyday life, especially in the setting of competing noise or background noise. This can occur even with normal peripheral hearing profiles. We tested the hypothesis that stream segregation in aging requires higher frequency separations due to a breakdown in automatic processing, separate from cognitive deficits, and that attention plays a larger role in aging adults when compared to young adults.

Paradigm

The Basic sound stream is an Intensity Oddball

88% of tones at 71 dB SPL

250 ms silence

deviant tone at 83 dB SPL

with intervening tones Integrated

with intervening tones Segregated

Paradigm modified from ref.1. Oddball control with the orange target tone louder than the standard tones (A.). In the four conditions additional tones are then added in at different frequency separations (1, 5, 11 and 19 semitones above 1046.5 Hz) to create a single stream percept (B.) where the target tone cannot be detected, or a 2-stream percept (C.) where the target tone can be heard despite the additional sounds. In the Attention-diverted condition the subjects have no task and are asked to watch a closed-captioned video and try to ignore the sounds.

Behavioral Results

Bar graphs showing the behavioral scores for the Young (modified from ref. 1) and the Aging subjects. Standard deviations are shown as error bars. The Aging subjects detected 2 streams behaviorally at 5 semitones but could not statistically identify the target within the standard stream until 11 semitones. The Young subjects did better statistically than the Aging subjects in all behavioral measures.

Auditory Event – Related Potentials

AEP data from the Aging subjects (A.) and from the Young subjects (B. modified from ref. 1). The P3b (labeled) is statistically absent in Pz (green) even in the Oddball in Aging subjects. The MMN (labeled) is seen best in the mastoid electrode (pink) due to overlap of other components in the frontal electrodes (black). MMN is present in the Attend condition in Aging at 11 semitones, but only in the Oddball control in the Attention-diverted condition.

Conclusions

Performance on behavioral and electrophysiological measures was reduced in aging when compared to young adults. Stream segregation and target detection results reflect age-related central auditory differences for both attention-driven and automatic processing of target sounds. These differences were seen both behaviorally and in the electrophysiological measures and may explain difficulties aging adults have with hearing target sounds within competing sound streams. Understanding changes in auditory processing in aging will lead to strategies to improve target detection in aging and impaired populations.

Reference


This research was funded by NIH (grant # DC006003), the Hearing Health Foundation and a Resnick Grant from the Albert Einstein College of Medicine.