Hearing Loss and Working Memory in Young Adults

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Abstract

This study examined the relationship between hearing loss and working memory in young adults with normal hearing (ages 18-35) through the analysis of two NIH toolbox assessments completed by participants when exposed to moderate hearing loss using an atraumatic methodology. This study is relevant for a variety of health professions.

Introduction

- By 2050, it is estimated that over 900 million people will have disabling hearing loss that is said to impact two-thirds of adults over 70 years of age and is expected to rise (WHO, 2018).
- Cognitive decline in older adults has been studied in previous literature and symptoms of aging, such as hearing and memory loss, are widely recognized as standard for the aging process (McCoy et. al, 2005).
- Hearing can be a primary factor when comprehending spoken language; this can subsequently impact auditory memory tasks.
- Research on this topic bears important questions in regard to (potential) degree of memory loss when compared to hearing loss severities that may exist in young adults.
- Approximately 37.5 million Americans over the age of 18 report some level of hearing loss and one in four U.S. adults have symptoms of noise-induced hearing loss (NIDCD, 2017).
- Etiology and management of hearing loss may differ for young versus older adults due to variance in lifestyle. Healthy hearing habits may not cross the mind of a young adult with work, family, and social life with which to concern themselves.
- Given the correlation between hearing loss and short-term memory deficits in older adults (McCoy et. al, 2005), one might assume this same correlation exists in young adults. However, further research is needed to determine if this correlation remains constant in the younger population.

Methodology

- Eighty participants were recruited to complete two assessments on a secure University of Arkansas iPad. The NIH Toolbox app provides access to the NIH Toolbox for Assessment of Neurological and Behavioral Function.
- Participants completed the assessments in the two of the following conditions:

(1) Normal Hearing
(2) With bilateral standard ear plugs and circumaural noise cancelling headphones in place (simulating a moderate hearing loss)

- All participants completed the assessment in the condition of "normal hearing." Participants were then randomly assigned to a mild or moderate hearing loss group for the second data collection day (bilateral earplugs vs. circumaural headphones).
- As is recommended by the NIH Toolbox App Manual, a minimum of seven days were scheduled between data collection days 1 and 2 to minimize the risk for learning test items. Using a custom battery for this study, participants completed two tests:

(1) NIH Toolbox List Sorting Working Memory Test (LSWM)
(2) NIH Toolbox Picture Sequence Memory Test (PSMT)

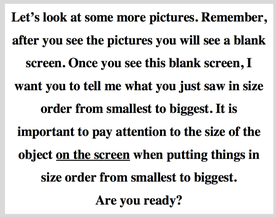

Figure 1. LSMT

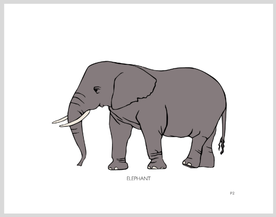

Figure 2. LSMT

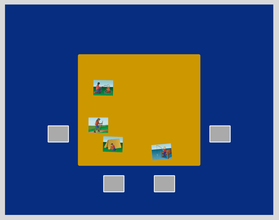

Figure 3. PSMT

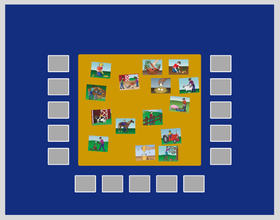

Figure 4. PSMT

Results

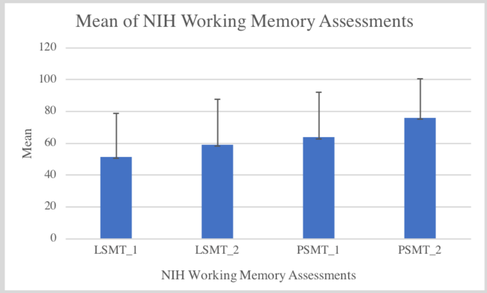

Figure 5. List Sorting Working Memory Test (LSMT) and Picture Sequence Memory (PSMT) Test Day 1 and Day 2

- Seventy-seven participants completed both trails and demographically included 12 males and 65 females ages 18-34 (M= 20 years)
- Ethnicity of participants: Latinx (*n*=1), American Indian (*n*=3), Caucasian, (*n*=75), African American (*n*=3), unreported (*n*=1)
- Participants passed an initial hearing screening and otoscopy before trails were initiated.
- A Repeated Measures Analysis of Variance (ANOVA) was conducted to compare the effect of hearing loss on working memory in young adults in the normal and moderate hearing loss condition after completion of:

(1) LSWM Test
(2) PSMT

The effect of hearing loss was not statistically significant as indicated in Pillai's Trace statistical analyses: F (2,74) = .575, p=.565, $p > .01$

Report	LSMT_1	LSMT_2	PSMT_1	PSMT_2
Mean	51.46	59.31	63.79	76.10
N	80	77	80	77
Std. Dev	27.27	28.42	28.23	24.44

Figure 6. LSMT and PSMT Data Analysis Day 1 vs. Day 2

- An improvement in scores over time was noted when the controlled condition (normal hearing) was compared to the condition of hearing loss: LSWM_1 (p=.008) and LSWM_2 (p=.326). PSMT_1 (p=.000) and PSMT_2 (p=.654)
- A correlation analysis was conducted; a high correlation between the two trials was noted: (r=.652, p=0.01)

Discussion

Results indicate the difference between control and test trials were not statistically significant as an increase in scores over time when testing in the control condition is compared to the test condition. One possible cause for this could be a learned effect of the assessments used. However, per the recommendations in the test manual, control and test conditions occurred a minimum of seven days apart. To examine the possibility of a learned effect, a correlation analysis was conducted. The correlation analysis depicted a high correlation between the two trials, indicating a likelihood of a learned effect. Researchers believe there were additional factors to explain this.

An acute moderate hearing loss was established in participants, which could be presumed to have less impactful results than a long-term hearing loss. The acute hearing loss may have created an effortful effect, the idea that any degree of hearing loss may cause one to exert an extensive amount of effort and attention towards auditory stimuli. (Doherty & Desjardins, 2015). Participants may have directed their attention more intentionally to the task to avoid mistakes they were unexpectant of during trial one.

Recommendations

- Application of randomized trials
- Recruitment of evenly distributed age, race, and gender
- Larger sample size
- Implement the moderate hearing loss longer than the test time alone (to simulate a chronic loss)

Although information processing seems to be more efficient in young adults (John & Cole, 1986), it can be hypothesized that a moderate hearing loss may impact working memory for all ages. Additional research is needed to explain these differences in hearing loss and working memory across the lifespan.

References

John, D. R., & Cole, C. A. (1986). Age Differences in Information Processing: Understanding Deficits in Young and Elderly Consumers. *Journal of Consumer Research. 13(3),* 297. doi: 10.1086/209070

National Institutes of Health (NIH) and Northwestern University. (2006-2017). NIH Toolbox for Assessment of Neurological and Behavioral Function Administrator's Manual.

National Institute on Deafness and Other Communication Disorders (NIDCD). (2017). Hearing loss increases with age. Retrieved from https://www.nidcd.nih.gov/health/statistics/hearing-loss-increases-with-age

World Health Organization (WHO). (2018) Deafness and hearing loss. Retrieved from http://www.who.int/news-room/fact-sheets/detail/deafness-and-hearing-loss

A comprehensive list of references is available upon request via email: ashtonerobbins@gmail.com

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