Changes in Audiovisual Integration in Aging

Alyssa Lynn

Department of Psychology, Western University

Undergraduate Summer Research Internship

Supervisors: Dr. Ryan Stevenson and Laura Schneeberger (MSc Candidate)

August 15, 2022

Statement of Contribution

I created the Qualtrics survey and refined it with insights from Laura Schneeberger, a MSc. candidate in Dr. Ryan Stevenson's lab. I contributed to the preregistration of the study to the Open Science Framework. I conducted a literature review and composed an introduction using evidence from the articles I reviewed. I assisted Laura Schneeberger with research into sensory screening tools for the study.

Abstract

The proposed study will examine changes in audiovisual integration between younger and older adults. Audiovisual integration enables us to associate and bind related auditory and visual information and experience it as a single percept (Spence, 2007). Being able to properly integrate is crucial in our everyday lives. When perceiving speech, audiovisual integration binds visual information from lip movements with auditory information from the speaker's utterances so that speech can be perceived multimodally. With age, our auditory and visual sensory acuity tends to decline with audiovisual integration being impacted as a result (Brooks et al., 2018; Mahoney et al., 2011). We aim to examine the audiovisual integration abilities of younger adults and older adults using a multisensory battery. The multisensory battery consists of the following audiovisual tasks: an audiovisual detection task, a speech in noise task and a discrimination task. Group performance (e.g., reaction times and accuracy) on these tasks will be analyzed and compared to determine how audiovisual integration may differ throughout the lifespan. Changes in audiovisual integration with age can make it difficult to understand speech in noisy environments and can increase the risks of falls, and automobile collisions (DeLoss, Pierce & Andersen, 2013; Jones & Noppeney, 2021). By investigating age-related changes in audiovisual integration, we aim to better understand which abilities are most impaired so specific interventions can be developed to reduce dangerous and debilitating events. We will begin piloting this study in August 2022 on healthy younger adult members of the Sensory Perception Lab at Western University.

Method

Participants

For our pilot study, we will recruit 15 healthy younger adults (aged 18-26 years) through the Brain and Mind Institute at Western. All participants will be pre-screened for self-reported eye disease (e.g., macular degeneration), neurological disorders (e.g., Parkinson's disease), as well as any significant hearing loss using a Hearing Handicap Inventory (Ventry and Weinstein, 1982). Participants will also be required to have normal or corrected-to-normal vision and hearing. Participants will receive $10 per hour of participation. This study was approved by Western University's Research Ethics Board.

Materials

Screening

Audiometry will be used to evaluate the participant's hearing sensitivity, acuity, and resolvability. Normal hearing status is achieved if the participants can identify up to 30dB at 4000Hz or above 25dB at 2000Hz with accurate perception at other frequencies. Participants will sit in a sound-proof booth and wear headphones through which a tone will be presented. Before beginning the test, participants will be instructed to press a button whenever a tone is detected. Tones will be presented at varying volumes and frequencies to test the hearing threshold. Time intervals between tone presentations will be random to prevent participants from predicting when a tone will occur. Participants' responses will be recorded by the researcher on a sheet of paper. Audiometric assessment will take about 10 minutes.

The Sloan ETDRS Format Near Vision Chart will be administered to assess near vision. This test is administered at 80cm and is used to determine visual acuity at near distances. The chart has 17 rows with five letters in each row. The font size of each row becomes progressively smaller and therefore the ability to read smaller rows is associated with better visual acuity at near distances. Each eye will be tested separately with a different version of the Sloan ETDRS Format Near Vision Chart to prevent practice effects. The ETDRS Visual test will take about 5 minutes to conduct. To assess distance vision in participants the Revised Series Sloan Letter ETDRS Distance Vision Chart will be used at 4 meters. The chart consists of 14 rows with five letters in each row. Like the Sloan ETDRS Format Near Vision Chart, the font sizes of letters decrease with each subsequent row. The ability to read later rows on the Revised Series Sloan Letter ETDRS Distance Vision Chart is associated with better distance visual acuity. Each eye will be tested separately with a different version of the Revised Series Sloan Letter ETDRS Distance Vision Chart to prevent practice effects. To test the participant's contrast sensitivity the Pelli-Robson Contrast Sensitivity Chart will be tested at 1 meter. The Pelli-Robson Contrast Sensitivity Chart tests visual contrast sensitivity and will take about 5 minutes to administer.

Multisensory Battery

Tasks in the multisensory battery were chosen to range in difficulty and are ordered from earliest perception to later processing. The range of tasks in the battery will examine a spectrum of audiovisual integration abilities in participants.

Audiovisual Detection Task

A sound pressure level meter and a photometer will be used before the task to measure the sound intensity and luminance respectively. Auditory, visual, and combined audiovisual stimuli will be presented randomly for a span of approximately 30 minutes. The auditory stimuli will be presented at 800Hz within 40dB of white noise. The tones will range from 35-69.5 dB SPL with 70 pure tones occurring every half decibel. Gabor patches subtended at a visual angle of 9 degrees with a frequency of 30 cycles per degree (excluding exact horizontal and exact vertical orientations) will be used for the visual stimuli. The auditory and visual stimuli will be presented simultaneously in the audiovisual condition and reaction time will be recorded.

Speech in Noise Task

Auditory, visual, and audiovisual stimuli will be presented to participants. The auditory alone conditions will consist of the presentation of spoken monosyllabic words while the visual condition will consist of the mouthing of words. In the audiovisual condition, spoken monosyllabic words and mouthing of words will be presented simultaneously. These conditions will be presented at varying levels of background babble to increase/decrease difficulty. The speech in noise task will take approximately 15 minutes to complete and the accuracy of the response will be recorded.

Discrimination Task

This task will be a replication of that designed and tested by Laurienti and colleagues (Laurienti et al., 2004). Auditory stimuli will be verbalizations of the words “red” or “blue” while the visual stimuli will be red or blue circles presented in the middle of the screen. The audiovisual condition will be the auditory and visual stimuli presented simultaneously. Participants will be instructed to press the R or B when a red or blue stimulus is presented either verbally, visually, or both. Stickers with the letter R or B will be placed over the X and M keys, respectively, to indicate response buttons. This task will take about 7 minutes to complete, and reaction time and accuracy will be recorded.

References

Brooks, C. J., Chan, Y. M., Anderson, A. J., & McKendrick, A. M. (2018). Audiovisual Temporal Perception in Aging: The Role of Multisensory Integration and Age-Related Sensory Loss. *Frontiers in Human Neuroscience*, *12*, 192. https://doi.org/10.3389/fnhum.2018.00192

DeLoss, D. J., Pierce, R. S., & Andersen, G. J. (2013). Multisensory Integration, Aging, and the Sound-Induced Flash Illusion. *Psychology and Aging*, *28*(3), 802–812. https://doi.org/10.1037/a0033289

Jones, S. A., & Noppeney, U. (2021). Ageing and multisensory integration: A review of the evidence, and a computational perspective. *Cortex*, *138*, 1–23. https://doi.org/10.1016/j.cortex.2021.02.001

Mahoney, J. R., Cotton, K., & Verghese, J. (2019). Multisensory Integration Predicts Balance and Falls in Older Adults. *The Journals of Gerontology: Series A*, *74*(9), 1429–1435. https://doi.org/10.1093/gerona/gly245

Spence, C. (2007). Audiovisual multisensory integration. *Acoustical Science and Technology*, *28*, 61–70. https://doi.org/10.1250/ast.28.61