

# Audiological Screening Protocol Using Novel Tablet Application: A Validation Study

*Anna O'Donell<sup>1,\*</sup>, Ashlyn Wheat<sup>2</sup>, Cheryl Seals<sup>3</sup>, Aurora Weaver<sup>4</sup>*

<sup>1</sup> Undergraduate Student, Department of Speech, Language, and Hearing Sciences, Auburn University

<sup>2</sup> Graduate Student, Department of Speech, Language, and Hearing Sciences, Auburn University

<sup>3</sup> Associate Professor, Department of Computer Science and Software Engineering, Auburn University

<sup>4</sup> Associate Professor, Department of Speech, Language, and Hearing Sciences, Auburn University

Close to 15% of children in the U.S. exhibit some level/type of hearing loss of at least 16 dB HL by the time they enter kindergarten (Niskar et al., 1998). Research supports that access to regular hearing screening programs is not readily available across all populations (Brennan-Jones et al., 2015), which may exacerbate the negative impact of hearing loss on an individual's quality of life – particularly regarding proper academic development and success of school-aged children. This thought process led to the development of the Auburn Graded Early Skills application (AGESapp), which is a user-friendly application that screens hearing in a fast and efficient manner for patients in a variety of settings (i.e., schools, clinics, rural areas). The purpose of this research study is to determine the validity and reliability between the gold-standard four-frequency pure tone hearing screener with American Speech-Language-Hearing Association's (ASHA) guidelines (ASHA, 2005) (e.g., portable audiometer), the AGESapp hearing screener, and selected auditory processing skills test battery which assesses individual auditory skills and cognition.

Data was collected by using an engaging “train station” activity to screen peripheral hearing in children and adults. The AGESapp was designed to mimic the clinical approach to hearing screening, and measured hearing at the following frequencies: 500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz. Each stimuli uses novel frequency mixture of pure-tone (sinusoidal) and noise stimuli in order to stimulate each center frequency region of the cochlea. Stimuli in the AGESapp begins at 50 dB HL, and then decreases after conditioning to a screening level of 20 dB HL for the stimuli with a center frequency at 1000 Hz. Overall, the app randomly screens the remaining test frequencies for each ear at 20-25 dB HL. A mixture of 89 participants (34 adults and 55 children) between the ages of 3-65 years from Auburn University and surrounding community daycares and pre-schools were tested using both the gold standard and AGESapp.

Out of the 89 participants screened, 5 children were re-screened a second time due to instrumental issues and/or participant motivation. The app proves to be ecologically valid for children 6 years of age and younger with a certified professional. Adults and school-age children also prove to be ecologically valid to self-administer the application. We ran the stats in SPSS software to compare the sensitivity and specificity of the AGES app versus the gold standard portable hearing screener. Overall, results indicate that the AGESapp screening was sensitive to referrals on a hearing screening in 67-80% in adults and 43% in children. The AGESapp screening was 100% specific for passing participants who passed the gold standard hearing screening.

This study reveals that the AGESapp is an effective tool to screen hearing to increase efficiency of community and school-based hearing screenings. The work will inform iterations of the application, to increase engagement and ease of use for a wide range of ages (3-65 years old). Further developments of the application are underway, which will test additional hearing, speech, and language skills. AGESapp successfully gives audiological screenings to potential patients in an inexpensive and easy access way. Thus, successfully fulfilling our initial goal.

## Statement of Research Advisor

Anna Grace O'Donell has worked as an undergraduate research assistant in the AMP lab (2020-2021), and as an undergraduate research fellow (2021-2022). She has contributed to the design and development of a novel App in my lab and has been key in progressing the project goals forward. She shows promise for a clinical research career, and drive, as her career aspirations will incorporate elements of grant writing and community outreach in the field of audiology. She contributed to the data analysis for the present study and the interpretation of the study results for publication. Anna Grace has presented these results at the Student Research Symposium at Auburn University, as well as

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\* Corresponding author: ago0006@auburn.edu

a state conference (Speech Hearing Association of Alabama's 2022 convention).

-Aurora J. Weaver, *Speech, Language, and Hearing Sciences*

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## Authors Biography



A.G. O'Donell is a senior-year student pursuing a B.S. degree in Speech, Language, and Hearing Sciences at Auburn University. As the 2021-2022 URF she assisted in design, development of the AGES app, research design, data collection, management, analysis, preparation, as well as dissemination of the finding at a state professional conference. She has accepted a position in University of Louisville's clinical doctorate of audiology 2022 incoming class, where she will continue to pursue a career in Audiology and looks forward to opportunities to use her user her knowledge and skills in clinical research during her graduate studies.



A. Wheat is a first-year doctoral student pursuing a clinical doctorate of Audiology at Auburn University. She obtained her undergraduate degree in Speech, Language, and Hearing Sciences from Auburn and works as a graduate research and teaching assistant for Dr. Aurora J. Weaver. Her contributions to the Audiological Screening Protocol study consists of facilitating data collection, project management and manuscript preparation.



Dr. Cheryl Seals is an associate professor in Auburn University's Department of Computer Science and Software Engineering. Her research areas of expertise are human computer interaction, user interface design, usability evaluation and educational gaming technologies. Seals also works with outreach initiatives to improve computer science education at all levels. The programs are focused on increasing the computing pipeline by getting students interested in STEM disciplines and future technology careers.



Dr. Weaver is an Associate Professor for the Department of Speech, Language Hearing Sciences. She received her Bachelor's degree in Hearing, Speech and Language Sciences, her clinical doctorate in Audiology (Au.D.), and her Ph.D. in Hearing Science from Ohio University, in Athens Ohio. She is the Lead Researcher in the Auditory and

Music Perception Lab where she studies the following areas: Developmental Psychoacoustics, Central Auditory Processes & Diagnostic Audiology. Her responsibilities include oversight of all aspects of the fellowship project.