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**The impact of different levels of instruction on the outcomes of using a Personal Sound
Amplifier Product**

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Abstract

Personal sound amplifiers (PSAPs) provide accessible and affordable healthcare to hearing impaired individuals that would otherwise not seek treatment. Like a self-fitting hearing aid, PSAPs do not involve an audiology service. The current pilot study investigated the impact different levels of instruction have on the effectiveness of using a personal sound amplifier product for four participants with mild to moderate sensorineural hearing loss. Basic written instruction and premium audiology services were utilized to teach participants how to use the device. Preliminary data suggested that the acquired knowledge, skills, and outcomes of using the PSAPs were similar between two levels of services after 6 weeks of use.

Introduction

Current estimates place the number of Americans age sixty or older with a measurable hearing loss in at least one ear at 38.7 million (Goman & Lin, 2016). That same study found that the most common degree of hearing loss for this age group was in the mild range (25 – 40 dB). As the American population grows older, so does the number of individuals with hearing loss (Kochkin, 2009). Due to its high incidence, hearing loss is considered a public health issue. Research has shown it can potentially have a negative impact on cognitive, social and physical functioning of adults. Hearing health research over the years has found that hearing loss puts an adult at greater risk for brain atrophy, developing dementia or Alzheimer's disease, depression and isolation (Chung, 2015). Although there have been mixed findings on whether amplification can slow or eliminate these risks, known benefits of amplification include improved communication and quality of life, lower depression scores, improved working memory and increased social engagement (Chung, 2015).

Despite the known negative effects of non-hearing aid use, a recent MarkeTrak survey found that the percentage of hearing aid adoption and ownership in people that admitted to having hearing loss was below 25% (Kochkin, 2009). Hearing aid adoption rates had a positive correlation with degree of hearing loss; as hearing loss degree increased in severity, the percentage of hearing aid users increased as well. This survey focused primarily on trends in the hearing loss population, while a more recent survey investigated the influencing factors for hearing aid purchase. Factors that made these surveyed individuals want to purchase hearing aids in the near future were confirmation that their hearing acuity had declined, insurance coverage and total cost of the devices (Kochkin, 2012). There is a large discrepancy between the number of individuals that would be considered hearing aid candidates and the number of those seeking help (Donahue, Dubno, & Beck, 2009). There have been on-going efforts to address accessible and affordable hearing healthcare for adults, particularly for those with mild to moderately-severe hearing loss who may obtain devices prescribed by audiologists or other hearing healthcare professionals.

Obtaining hearing aids from an audiologist typically includes six major stages deemed as best practice: assessment, treatment planning, selection, verification, orientation, and validation (ASHA, 1998). These stages are: 1) an audiologic and medical evaluation; 2) planning for amplification treatment options; 3) selection of appropriate devices based on type and degree of hearing loss and personal preference; 4) fitting and verification of the device prescribed for the individual's hearing loss; 5) orientation on care, maintenance and usage, counseling on realistic expectations and creation of amplification goals; and 6) subjective and objective outcome verification. These services are provided by an educated, trained, and licensed audiologist. In some cases, these services are provided in a similar or lesser capacity by a hearing aid dispenser.

These services are currently bundled into a single payment model, with the hearing device making up approximately one-third of the bundled cost (Skaggs & Ou, 2017). The high up-front cost deters some individuals from pursuing this route of obtaining hearing aids. Manufacturers have taken this factor into consideration while creating alternative options for individuals in need of amplification, including personal sound amplification products, direct-to-mail devices, and self-fitting hearing aids.

Personal sound amplification products (PSAPs) are worn to transmit amplified sounds to the ear and are available for direct consumer purchase (Mamo et al., 2016). These products are marketed towards individuals with hearing difficulty that may not have the accessible resources to obtain hearing aids. PSAPs are currently not regulated by the Food and Drug Administration (FDA), which puts restrictions on the language allowed on advertisements for these devices. For example, the SoundWorld Solutions PSAP manufacturer markets their products as “sound enhancers” and “hearing devices,” not hearing aids created for hearing impaired adults. In contrast, hearing aids are categorized as Class I medical devices for individuals with hearing loss (Food and Drug Administration, 2016). This category requires manufacturers to pay thousands of dollars towards registration fees, maintain years of customer records and meet strict standards for manufacturing and design (Smith, Wilber & Cavitt, 2016). PSAPs are made available for purchase at a lower cost because the FDA does not require regulation of these products and fitting is possible without use of an audiology service.

An increase in advertisement for direct-mail hearing aids, personal sound amplifier products (PSAPs) and devices billed as “hearing helpers” was observed by Americans in the later 2000s (Kochkin, 2010). Product pricing, extended trial periods and liberal refund policies draw consumers to PSAP products instead of traditional hearing aids (Krumm, 2016). A MarkeTrak

survey investigated how popular these devices are in individuals with reported hearing impairment. The results of this survey estimated that approximately 1.5 million people with hearing loss use PSAPs or direct-mail devices. Subjective measures of hearing loss indicated that most PSAP users reported a mild hearing impairment, compared to most custom hearing aid users reporting a moderate hearing loss. The length of time individuals were aware of their hearing loss averaged 15 years for PSAP users and 6.7 years for custom hearing aid users. Surveyed individuals wearing PSAPs or direct-mail aids earned an average of \$10,000 less per year, wore their devices 7 hours less per day and were less likely to purchase binaural devices compared to the average custom hearing aid patient. The authors concluded that in the absence of PSAP and direct-mail hearing aids, most individuals with hearing loss would not seek amplification assistance but simply live with their hearing loss. The conclusions made from this survey support the initiative to create lower cost and more accessible hearing healthcare.

Like PSAPs, self-fitting hearing aids (SFHAs) have been introduced to the hearing health market for individuals with severe physical disabilities, people that live in remote areas or third-world countries where professional hearing services are unreliable or unavailable (Wong, 2011). SFHAs are amplification devices that a user can program and fit without the use of an audiologist, audiometric assessment, computer, or software program. The device would be wearable after the assembly, fit and programming procedure was followed in the provided instruction manual. A self-fitting hearing aid should exhibit four features: “automated evaluation of hearing thresholds, an initial fitting to approximate user preferences and serve as the starting point...allow the user to train the device to meet their needs...[and] physical fitting and use of the aid” (Wong, 2011, p. 215). These features are to be performed without the use of a hearing professional. While the idea of a self-fit hearing aid sounds appealing, there are several issues

related to the mentioned features. Concerns include whether the automated threshold evaluation is an accurate measurement that can be applied to the initial fitting, whether conventional prescription methods are close to an individual's preferred settings, whether users are evidently able to obtain good outcome measures, and whether users can follow the written instruction manual successfully. These concerns are warranted as a related study found several older adult variables that may serve as obstacles for the understanding of SFHA instruction manuals (Caposecco, Hickson & Meyer, 2011). These include limited health literacy and age-related deterioration of visual and cognitive function. Difficulty understanding instruction manuals may pose a challenge for potential PSAP users as well.

At the beginning of 2016, the Food and Drug Administration (FDA) announced “the pursuit of better understanding ...and requirements for personal sound amplification products” (Food and Drug Administration, 2016). Since then, researchers have been analyzing electroacoustic capabilities, battery life and microphone directionality of personal sound amplification products. While high-end PSAPs have been found to meet prescription targets and perform at a level comparable to some hearing aids using gently-sloping hearing loss, low-end devices have been found to not measure up to hearing aid standards and specifications (Krumm, 2016). Some devices can even reach maximum output levels of 100 – 120 dB SPL that some individuals may perceive as uncomfortable or even painfully loud. The variability seen by measuring these devices is likely due to the lack of regulation by the FDA. One study measured the objective benefit for a range of PSAPs to determine whether the devices would be an appropriate fit for various hearing loss configurations (Smith, Wilber & Cavitt, 2016). Devices were characterized as high or low-end based on their pricing. Electroacoustic analysis was conducted inside of a Hearing Instrument Test (HIT) box and real-ear measurements were

completed on a KEMAR mannequin using NAL-NL2 prescription targets for seven PSAPs and four hearing aids. Results of each analysis — OSPL90, equivalent input noise (EIN), harmonic distortion, directional benefit and NAL-NL2 targets achieved — showed large variability across the seven devices that were analyzed. The high-end PSAPs and medical grade hearing aids had the lowest internal noise, while lower-end amplifier products had higher internal noise. The two hearing aids achieved the greatest directional benefit and met the most prescription gain targets for gently and steeply-sloping hearing losses. In the cases of internal noise, harmonic distortion, OSPL90 output and prescription target matching, some high-end PSAP devices performed just as well or better than the devices classified as hearing aids. Gain and directional benefit similar to that provided by a low-end hearing aid was also obtained for potential high-end PSAP users with mild to moderate flat and gently-sloping hearing loss. High and low-end PSAPs could not meet targets for steeply sloping losses. No analyses were conducted on individuals with conductive hearing loss due to middle ear dysfunction.

Whether high-end PSAPs provide more benefit to users than low-end devices is not known, though different levels of technology have been compared in hearing aids. One study objectively and subjectively investigated the differences in hearing abilities for adults using high-end and low-end hearing aids in their daily lives (Cox, Johnson & Xu, 2016). Forty-five older adults with mild to moderate hearing loss were randomly given a high-end technology level hearing aid with multiple feature capabilities or a low-end technology hearing aid with limited features. Real-ear aided responses after appropriate hearing aid fittings, subjective questionnaires, and an in-depth exit-interview assessed quality of life, satisfaction, personal experiences and preferences. No significant difference was found between the individuals that received a high-end versus low-end device. The study concluded that “participants did not prefer

premium devices over basic devices following the field trials” (Cox, Johnson & Xu, p. 235).

While high-end PSAPs can be comparable to an entry level hearing aid in objective measurements, results from this study can emphasize that the hearing aid fitting using best practice guidelines, not level of technology, influences hearing aid outcomes.

A recently published study investigated the effects of service-delivery models on hearing aid outcomes in older adults (Humes et al., 2017). Premium audiology services were utilized for hearing aids; over-the-counter (OTC) and placebo devices were also provided to selected participants. Older adult participants with mild to moderate hearing loss were randomly assigned one of the three devices. The study was double-blinded to avoid researcher and participant bias. Subjective questionnaires and objective speech outcome measures were obtained before and after a six-week trial period. Results revealed more positive outcomes for the audiology service participant group compared to the placebo group. Aided speech recognition performance was significantly better for the audiology service group; self-perceived benefit and satisfaction scores were also significantly better than the placebo group. The OTC group had significantly lower hearing aid satisfaction scores than the audiology service group. A significantly smaller number of OTC participants indicated a desire to keep their amplification devices after the trial compared to the best practice participants. Surprisingly, daily usage time was not significantly affected by level of service provided to the participant. These results confirmed the hypothesis of the study in which individuals having received the audiology best practice service would be most satisfied with their hearing aids and perform better on speech recognition tasks in aided conditions compared to those that did not receive any service with OTC and placebo devices.

Until recently, additional research was limited regarding the outcomes of using self-fit hearing aids and personal sound amplifiers (Wong, 2011). Success of the self-fitting hearing aid

process was recently investigated in Australia (Convery et al., 2017). The study utilized self-fitting hearing aids obtained from SoundWorld Solutions. Twenty previous hearing aid users and an additional twenty non-hearing aid users ranging from 66 to 88 years of age participated in the study. Various questionnaires were administered to measure self-perceived hearing aid efficacy, self-perceived locus of control, cognition, manual dexterity, and health literacy of each participant. Each appointment lasted approximately two hours in the laboratory to engage in the self-fitting process, with or without the presence of a significant other. A written instruction manual and tablet for Bluetooth connectivity was provided to each participant. Success of the self-fitting process was measured based on each participant's performance on seven predetermined "hearing aid steps": 1) identify left and right devices, 2) select ear tips, 3) adjust tubing length, 4) switch on devices, 5) insert devices into ears, 6) perform automatic audiometry, and 7) fine-tune settings. Results found that 55% of participants could fit the device successfully. Although only 60% of participants brought an adult partner to the study, two partners did not assist with the fitting process. Contrary to the hypothesis, partner assistance did not lead to an increase in successful outcomes. Errors made by the participant or partner were not recognized as errors and therefore not corrected. The inability for participants to identify errors on their own is a major concern of this self-fitting procedure. Participants receiving support from someone familiar or knowledgeable about the devices may have led to a greater success rate. The study suggested that future studies examine factors that predict success and the role of support in the self-fitting procedure.

Hearing assistive technology's increased ease of accessibility has raised questions and concerns in the field of audiology (Krumm, 2016). These products propose that audiology service is not a requirement to effectively and adequately fit an amplification device to an

individual with hearing loss, while other professionals advocate for the use of a hearing professional. In addition to the lack of professional assistance, audiologists and hearing aid dispensers alike have expressed alarm regarding the differences in PSAP technology, objective performance, and maximum power output levels (Skaggs & Ou, 2017). Contrary to the professional's concerns about the rise of PSAPs, some believe that it may expand audiology services to more individuals. Some companies that sell devices online have an audiologist on staff for consumer consultation and support. This allows an individual who has purchased an amplification device to have access and guidance to more specific device information, including smartphone connectivity, other assistive devices to improve communication, and developing health, hearing and social goals. Counseling and aural rehabilitation are areas of hearing healthcare that allow "audiologists to distinguish themselves from other providers" (Krumm, p. 18). These audiology-exclusive services will likely be unbundled and used by PSAP distributors to provide increased communication capabilities for an extended population of patients. With that in mind, both PSAPs and hearing aid providers can agree on the shared goal of providing amplification for as many hearing-impaired individuals as possible.

Because hearing device sales might be unbundled from audiology services in the near future with the growth of the PSAP market (Krumm, 2016), it is critical to investigate the impact that different levels of audiology services can have on these direct to consumer hearing devices. The purpose of this pilot study was 1) to compare the acquired knowledge and skills of using the device between two levels of instruction (a written instruction only and premium audiology service), and 2) to investigate the impact of two levels of instruction on the effectiveness of using a specific personal sound amplifier. It was hypothesized that the premium audiology service

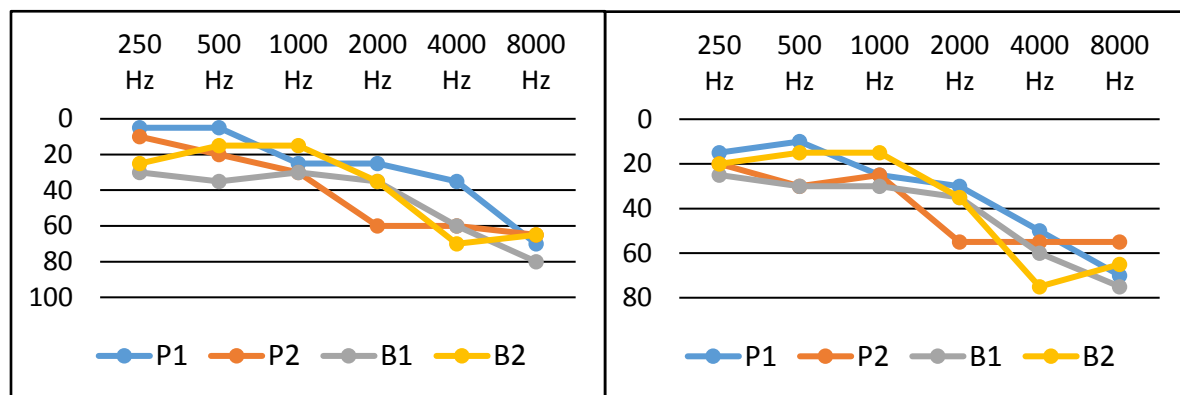
would result in more favorable outcomes and acquired knowledge and skills of the device use compared to those that solely received the written instruction.

Methodology

Participants

A total of four participants between the ages of 55 and 80 years completed the pilot study (male: 2; female: 2). All had bilateral, symmetrical mild to moderate sensorineural hearing loss and no previous hearing aid experience. Hearing symmetry was defined as an interaural difference of less than 15 dB HL across the frequencies of 500, 1000, 2000, and 4000 Hz. Individual air-conduction thresholds for the participants are displayed in Figure 1. The Montreal Cognitive Assessment (MoCA) was administered prior to beginning the study. Scores for all participants were at or above 26, ruling out potential cognitive impairment. This project was approved by the local Institutional Review Board.

Figure 1: Pure tone air conduction thresholds (dB HL) for all four participants, left ear on the left panel and right ear on the right panel.



Devices

The commercially available PSAP used in the present study was the CS50+ device obtained from SoundWorld Solutions (Figure 2). The device had Bluetooth capacity and an associated application for smartphone use. The device had three presets and each preset had three programs. A unique personal profile could also be created within the smartphone application.

Figure 2: Sound World Solutions CS50+ Personal Sound Amplifier Product (PSAP). (Source: Soundworldsolutions.com)



Written Instruction

The original manual for the device was first evaluated using readability measures that included the Flesch Reading Ease and Flesch-Kincaid Grade Level and the Suitability Assessment of Materials (SAM), a rating scale used to evaluate the suitability of written healthcare materials. Evidence-based practice guidelines for the design of effective instruction materials for self-fitted hearing devices were followed to develop a new effective instruction manual for the PSAP. Four steps (planning, design, assessment of suitability, and pilot testing) were applied in the present study. Two independent audiologists evaluated the new instruction for suitability. The written instruction was presented as the basic service. For the premium service, best practice guidelines were followed in addition to providing the written instruction (ASHA, 1998).

Procedures

A total of two visits were arranged. During the initial visit, pure-tone air (octave frequencies of 250 – 8000Hz) and bone conduction (octave frequencies of 500 – 4000Hz) audiometric testing was performed bilaterally for all participants in a sound-treated booth. Two participants were assigned to each of the two levels of instruction – basic (i.e., written instruction only) and premium audiology service (i.e., interaction with the research audiologist). Participants receiving the basic service were provided two devices (one for each ear) along with the written instruction manual. Premium service recipients were also given two devices and the written instruction. Fine tuning was additionally performed within the device's capabilities to meet NAL-NL2 prescription targets. The output sound pressure levels from each device were verified on ear using Audioscan Verifit2 real-ear-measurement equipment. Loudness ratings for both ears were assessed and balanced. A full orientation on care, use and maintenance was provided after the fine tuning and real ear verification. All four participants returned for the second visit after 5-6 weeks of use for a final evaluation. The two participants that received the basic service are referred to Basic 1 and Basic 2, and those who received the premium service are Premium 1 and Premium 2. The Abbreviated Profile of Hearing Aid Benefit (APHAB), the short form of the Spatial Hearing Questionnaire (SHQ-S), the short form of the Speech, Spatial and Qualities of Hearing Scale (SSQ12), and the screening version of the Hearing Handicap Inventory for the Elderly (HHIE-S) questionnaires were administered during both visits. The International Outcome Inventory for Hearing Aids (IOI-HA) was collected during the second visit. The Revised Hearing Aid Skills and Knowledge (HASK) test (adapted from Saunders et al., 2017) was used to assess the hearing device use skills and knowledge for the participant. Both aided and unaided speech perception performance was evaluated using the Revised Performance

Perceptual Test (R-PPT) (Wetmore & Ou, 2016). Aided speech intelligibility index was assessed for each ear for the most commonly used program for all participants. An informal exit-interview was conducted to obtain additional subjective outcomes at the end of the session.

Results

Revised Hearing Aid Skills and Knowledge (HASK) test

Table 1 displays the results from the Revised Hearing Aid Skills and Knowledge test. Each participant scored higher on the skill portion of the test than on the knowledge portion. The knowledge scores were similar between those with the basic and premium service. The skill scores were slightly higher for those with premium service compared to the basic service. The poorest performance for the revised HASK test was observed on one of the participants in the basic service group.

Table 1: The scores of the Revised Hearing Aid Skills and Knowledge (HASK) test for each participant.

	Knowledge (% correct)	Skill (% correct)
Premium 1	61.1	80.0
Premium 2	61.1	73.3
Basic 1	77.8	80.0
Basic 2	61.1	63.3

Outcome measures

Raw global scores for each of four participants on the IOI-HA, unaided and aided APHAB, SSQ12, SHQ-S, and HHIE-S are shown in Figure 3. Across the individuals, aided listening conditions typically elicited better scores than unaided. All four participants scored higher (better) in the aided SHQ-S condition and lower (better) on the aided HHIE-S. Unaided and aided APHAB questionnaire results for all four participants were compared to elderly norms (Figures 4 – 7). All four participants had increased aversiveness to loud sounds with the PSAP

devices, and all but one participant had an equal or increased difficulty in reverberant environments.

The Revised Performance-Perception-Test (R-PPT) included both subjective and objective speech recognition performance (SNR50) using the same QuickSIN test material. Figure 8 displays both aided and unaided data for all four participants. Two out of four participants self-perceived an improvement of 2 dB in the aided condition compared to unaided, whereas three out of four participants performed similarly between aided and unaided conditions when tested objectively.

Aided audibility obtained with real-ear measurements for average and soft speech using each participant’s most used mode/program and volume are shown in Table 2. Overall, the Premium users that had verification during the initial fitting received greater aided audibility for soft and average speech compared to the Basic users that only had verification at the end of the study. Although the basic service recipients did not go through the real ear verification during the initial fitting, the aided audibility was similar among the participants in this group.

Table 2: Aided Speech Intelligibility Index (SII) obtained for both average and soft speech using NAL-NL2 prescription targets for each device.

	Average (70 dB SPL)	Soft Speech (50 dB SPL)
Premium 1 Left	84	62
Premium 1 Right	83	65
Premium 2 Left	66	45
Premium 2 Right	71	51
Basic 1 Left	76	53
Basic 1 Right	77	58
Basic 2 Left	67	59
Basic 2 Right	70	70

Figure 3: The global scores measured for each of four participants together with the grand means, on the IOI-HA, APHAB, SSQ12, SHQ-S, and HHIE-S.

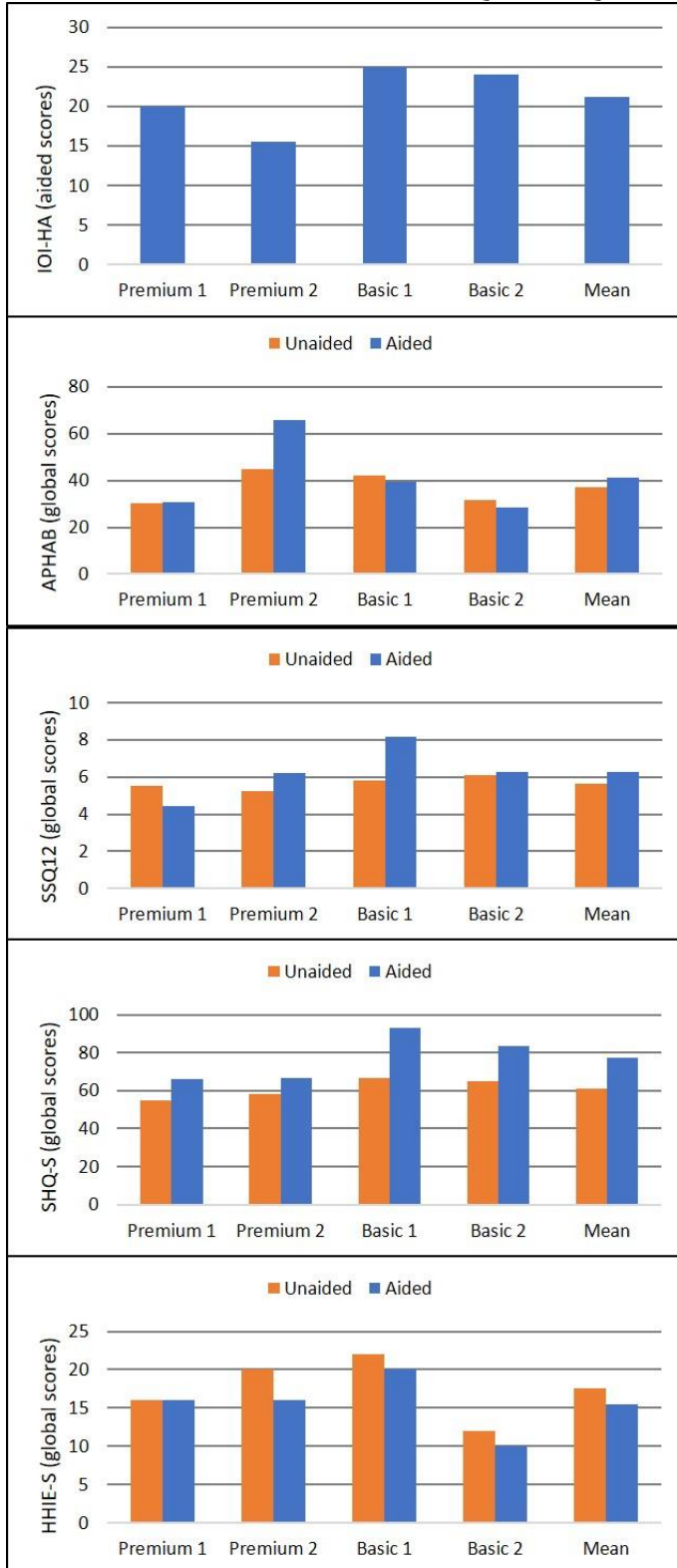


Figure 4: Premium 1 unaided and aided APHAB % of problem scores compared to Elderly norms.

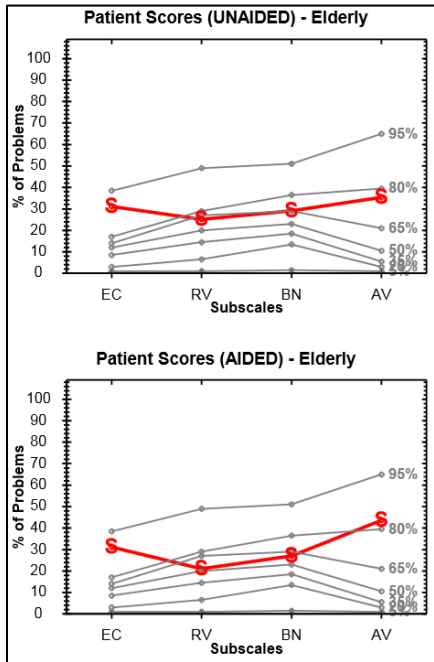


Figure 5: Premium 2 unaided and aided APHAB % of problem scores compared to Elderly norms.

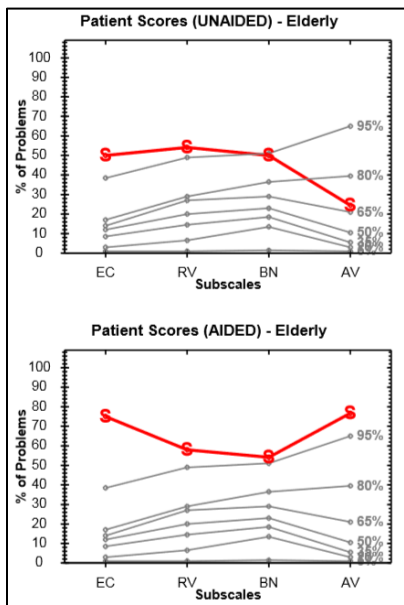


Figure 6: Basic 1 unaided and aided APHAB % of problem scores compared to Elderly norms.

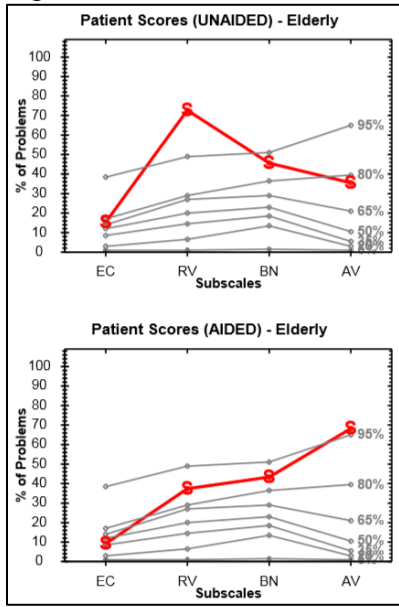


Figure 7: Basic 2 unaided and aided APHAB % of problem scores compared to Elderly norms.

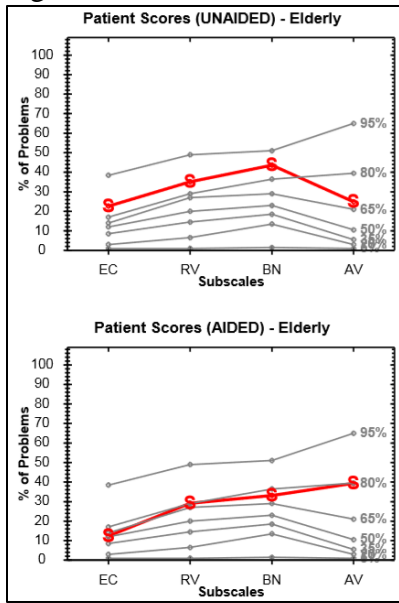
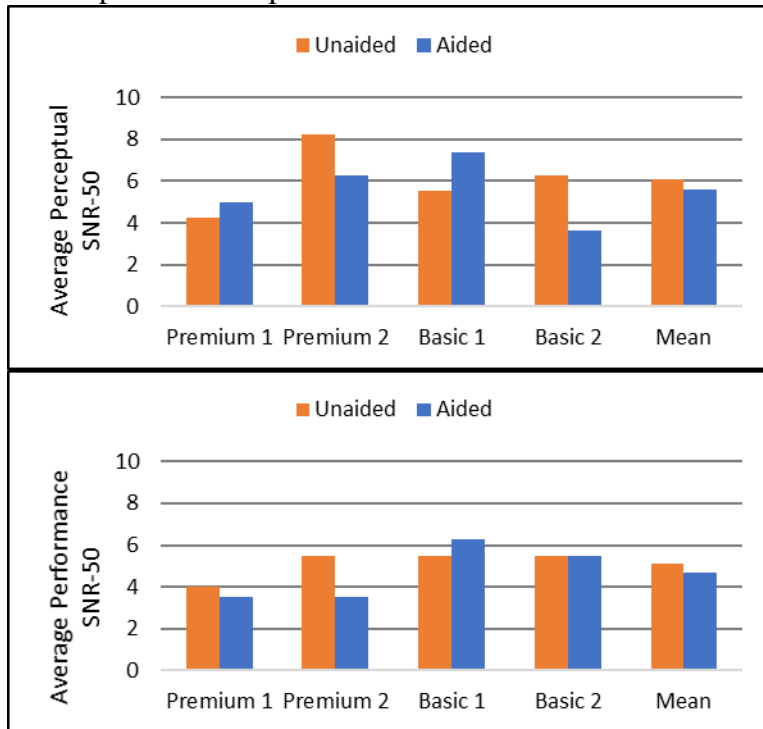


Figure 8: Unaided and aided Revised Performance-Perceptual Test scores with the grand mean for all four participants. The top panel is for the perceptual portion of the test and the bottom is for the performance portion.



Discussion

The results did not support the first hypothesis that the premium service would result in better knowledge and skills of device use compared to the basic service. The Revised Hearing Aid Skills and Knowledge (HASK) test revealed similar results between the participants who received two levels of instruction. Premium 1, Premium 2 and Basic 2 users achieved virtually identical percent correct for the knowledge portion of the test. It was unexpected that Basic 1 user earned the highest knowledge score. The Premium 1 and Basic 1 users, both of which were females, earned the highest skill scores, followed by the Premium 2 user and Basic 2 user. The Premium participants had the greatest difficulty with the storage and troubleshooting portions of the knowledge subtest, and the phone-use portion of the skills subtest. The Basic users had the same difficulty with the skills subtest, while the difficulty on the knowledge subtest was in regard to changing the PSAP modes.

The results also did not support the second hypothesis that the premium service could result in favorable outcomes using the PSAPs compared to the basic service. Outcome measurements in the current pilot study included IOI-HA, unaided and aided APHAB, SSQ12, SHQ-S, HHIE-S questionnaires and an informal exit interview. The higher the score of the IOI-HA, the greater the benefit with the device. If the first item (at least one hour of daily PSAP use) and second item (helped moderately in the situation where users most want to hear better) of the IOI-HA were used to indicate the PSAP use success, two participants from the Basic service group were successful users. All four participants reported perceiving difficulty in reverberant environments, background noise, aversiveness and ease of communication. The Premium 1 and Basic 2 users perceived similar difficulty in these same environments while utilizing the PSAP, while the Premium 2 user perceived a greater percentage of problems and the Basic 1 user perceived reduced difficulty while using the PSAP. The higher the number scored on the SHQ-S, the greater the self-reported spatial hearing ability is perceived. All participants perceived better spatial hearing ability while utilizing the PSAP devices. It appeared that the Basic users perceived bigger improvement of spatial hearing ability compared to the Premium users. The SSQ12 questionnaires measure the subjective ability and experience while hearing and listening in different communication situations. A greater score is indicative of improved ability to listen in the hypothetical environment. The SSQ12 revealed the Premium 1 user felt a decreased ability to listen with the PSAP. The Basic 2 user felt a similar listening ability while utilizing PSAPs and Premium 2 and Basic 1 indicated improved listening ability across the hypothetical questionnaire situations. The HHIE-S measured perceived emotional and situational hearing handicaps in aided and unaided listening conditions. Both Basic users and the Premium 2 user

perceived a slight reduction in hearing handicap while utilizing PSAPs. The Premium 1 user perceived the same hearing handicap.

In addition to the subjective outcome measurements, objective outcomes were measured using revised PPT. Both Premium users and Basic user 1 perceived their performance on the task to be greater than that of their true performance. Basic user 2 was the only participant that performed better than they believed.

The informal exit interview provided insight into some qualities of the PSAP devices that were not evaluated by other outcome measures. Excessive feedback and wind noise were major concerns for three out of the four participants. The participants with normal or near-normal low frequency hearing thresholds complained of occlusion. The Premium user's major complaint was that the PSAPs were loud and overwhelming, even with volume lowering capabilities. The most frequent listening situation that participants perceived the most benefit was while watching television. The Premium 2 user, whom had the most hearing loss, previously considered purchasing a similar device but after this experience, changed his mind. Both Basic users reported negative impressions of the size and appearance of the device. After the experience with this PSAP and improved ability to hear, Basic 2 is now considering amplification options for her everyday life. Premium 2 reported that should her hearing loss decline, amplification options would be considered. The Premium users indicated that the written instruction was helpful to refer to after receiving the formal orientation in the office. Premium users were the only ones that used the different PSAP modes. The Basic users also reported utilizing the written instruction, however, both denied using the modes for different environments.

Feedback was a major concern for these participants that inhibited their perceived benefit and lowered their anticipated use time. While only one of the participants indicated an interest in

purchasing a similar device for the reduced price that does not include the audiology service, half of the participants reported an improved interest in pursuing amplification options after this study.

Limitations

Since this was a pilot study with only four participants, the conclusion was preliminary. The variation in subjective outcome measurements between the Basic and Premium service participants could be due to expectations. Having a premium audiology service could have increased the expectations for PSAPs use for the Premium participants. The Basic users may have had similar expectations as if they ordered the PSAPs on their own. The cases of increased listening difficulty may be due the feedback and overwhelming loudness concerns that most users reported. The Basic 2 user was only able to wear one device due to persistent static problems from the other device and distance of living from the study site. Both the Premium users revealed infrequent use of the devices due to their dissatisfaction, and Basic 2 due to his profession as a farmer and long hours working outdoors. In addition, the examiner did not use appropriate prompting for the troubleshooting portion of the knowledge subtest when administering the HASK to the Premium participants.

Another limitation to this pilot study is in regards to the written instruction. The written instruction manual provided to each participant was rewritten from the manufacturer's original to improve readability. The instructions that were provided to participants might have been an improvement compared to what they would have received had they ordered the device themselves. Rewriting the manual may have reduced potential perceived benefit and could explain the lack of differences between the Basic and Premium users. Increased benefit may

have been seen if the premium service had been compared to the original manufacturer instruction manual and not the rewritten one.

Conclusion

While subjective outcomes measurements revealed a variety of results across participants, all participants indicated perceiving some benefit with the PSAPs. It appeared that the basic service with only written instruction available may result in similar acquired knowledge, skills and the outcomes of the PSAPs use compared to the premium audiology service.

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References

- ASHA Ad Hoc Committee on Hearing Aid Selection and Fitting (1998). Guidelines for hearing aid fitting for adults. *American Journal of Audiology*, 7, 5-13.
- Convery, E., Keisder, G., Seeto, M. & McLelland, M. (2017). Evaluation of the self-fitting process with a commercially available hearing aid. *Journal of the American Academy of Audiology*, 28(2), 109 – 118.
- Caposecco, A., Hickson, L. & Meyer, C. (2011). Assembly and insertion of a self-fitting hearing aid: Design of effective instruction materials. *Trends in Amplification*, 15(4), 184-195.
- Cox, R. M., Johnson, J. A. & Xu, J. (2016). Impact of hearing aid technology on outcomes in daily life I: The patient's perspective. *Ear and Hearing*, 37(4), 224-237.
- Donahue, A., Dubno, J. R., & Beck, L. (2010). Accessible and Affordable Hearing Health Care for Adults with Mild to Moderate Hearing Loss. *Ear and Hearing*, 31(1), 2–6.
- Food and Drug Administration. (2016). The FDA engages in stakeholders on opportunities to improve hearing aid usage and innovation. Retrieved from <http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm480239.htm>
- Goman, A. M., & Lin, F. R. (2016). Prevalence of hearing loss by severity in the United States. *American Journal of Public Health*, 106(10), 1820-1822.
- Humes, L. E., Rogers, S. E., Quigley, T. M., Main, A. K., Kinney, D. L. and Herring, C. (2017). The effects of service-delivery model and purchase price on hearing-aid outcomes in older adults: A randomized double-blind placebo-controlled clinical trial. *American Journal of Audiology*, 26(1), 53-79.
- Kochkin S. (2009). MarkeTrak VIII: 25-year trends in the hearing aid health market. *Hearing Review*, 16(11), 12-31.

- Kochkin S. (2010). MarkeTrak VIII: Utilization of PSAPs and direct-mail hearing aids by people with hearing impairment. *Hearing Review*, 17(6), 12-16.
- Kochkin S. (2012). MarkeTrak VIII: The key influencing factors in hearing aid purchase intent. *Hearing Review*, 19(3), 12-25.
- Krumm, M. (2016). Disruption, opportunity and the future of audiology. *The ASHA Leader*, 21, 16-18.
- Mamo, S. K., Reed, N. S., Nieman, C. L., Oh, E. S., and Lin, F. R. (2016). Personal sound amplifiers for adults with hearing loss. *The American Journal of Medicine*, 129(3), 245-250.
- Saunders, G. H., Morse-Fortier, C., McDermott, D. J., Vachhani, J. J., Grush, L. D., Griest, S. & Lewis, M. S. (2017). Description, normative data, and utility of the Hearing Aid Skills and Knowledge Test. *Journal of the American Academy of Audiology*, 0(0), 1 – 14.
- Skaggs, M. & Ou, H. (2017). Audiology services for PSAP users. *The Hearing Journal*, 70(3), 26-28.
- Smith, C., Wilber, L. A. and Cavitt, K. (2016). PSAPs vs hearing aids: An electroacoustic analysis of performance and fitting capabilities. *Hearing Review*, 23(7):18, 1-12.
- Wetmore, M. & Ou, H. (2016) Developing a Revised Performance-Perceptual Test Using Quick Speech-in-Noise Test Material. International Hearing Aid Research Conference, Tahoe City, CA.
- Wong, L. L. N. (2011). Evidence on self-fitting hearing aids. *Trends in Amplification*, 15(4), 215-225.