



HEARABLES FOR ALL:

An Initiative to Support Hearing Independence through Emerging Technologies



A Report of the Front Porch Center for Innovation and Wellbeing



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Executive Summary

The Consumer Technology Association awarded a grant to the Front Porch Center for Innovation and Wellbeing (FPCIW) to launch our Hearables for All (HFA) project in July 2017. This initiative was designed to address hearing loss and needs through emerging group listening devices and personal sound amplification products (PSAPs). HFA set out to reach 720 individuals through group listening systems, and 120 participants to test PSAPs across 12 senior living and affordable housing communities at Front Porch and CARING Housing communities, as well as at other community-based senior centers and events.

The project reached over 700 people in communities throughout California. In total, 600 participants across different levels of care tried the group listening device, Eversound, and 101 participants tested PSAP devices. The Hearables for All Project confirmed the value of hearing to help promote wellbeing and social engagement:

- 74.9% said that they would wear the Eversound to future events.
- 77.4% felt that their Eversound device increased their understanding of the event.
- Care staff reported a 47.8% increase in observed mood and behavior in care centers (skilled nursing), and a 63.8% mood/behavior improvement in memory care.

We found that there was important value with the Eversound system to help users participate and stay engaged during multi-modal activities, presentations, and meetings.

While the overall satisfaction of PSAPs were mixed due to designs and features, we believe that they produced an important impact among the lives of its users and left behind a valuable body of learnings on older adult adoption of hearable technologies. The participant demographic was diverse in hearing and technology ability, and ages ranged from 61 to 95 years old. Though the majority of participants reported that the devices were not a perfect fit for them, they found value in participating in the program through an increased ability to hear and a higher likelihood to participate in community meetings and activities:

- 57.3% of users agreed that their PSAP devices increased their ability to hear.
- 39.3% agreed that they were more likely to partake in community events.
- 29.1% felt that their PSAP hearable device changed their enjoyment of life for the better.

The project’s participants appreciated FPCIW’s efforts in exploring this important issue on hearing loss, and on opening the door on more readily accessible hearing devices at an affordable price.

Over the last couple of years since the start of this initiative, hearing assistive technologies such as PSAPs and hearing aids have become more accessible to the general consumer market, introducing built-in sensors that track health metrics and can provide instantaneous language translations—features that were only once available in prescriptive hearing aids. FPCIW has only managed to capture a slice of these emerging technologies, and hopes to continue to explore this evolving landscape of wearable devices. This report provides what we hope is an important touchpoint in the adoption of hearing technologies for older adult populations.

Introduction

Hearing Loss Among Older Adults

Hearing loss is an area of high concern—not just at Front Porch, but throughout the older adult population—and has been linked to multiple health and wellbeing challenges among residents. Front Porch community staff frequently report stories of social isolation, disengagement from group meetings and events, loss of appetite, and depression stemming from hearing loss across all levels of care: independent living, assisted living, skilled nursing, and memory care. Yet with the many barriers to health and wellness due to hearing loss, FPCIW also saw an opportunity to address these challenges through some of the emerging technology solutions developing in the consumer hearing marketplace.

An overwhelming body of research highlights the prevalence of hearing loss, and the reasons why the conditions persist. Nearly two-thirds of adults ages 70 and over in the United States experience hearing loss, but fewer than 1 of 3 use a hearing assistive device.^{1,2} One of the barriers of using such devices include their costs which average \$3,000 per pair. Only a few states require health insurers to cover the cost of hearing aids for people of all ages, leaving a lot of users to pay the bill themselves.³

Stigma is an additional barrier to addressing hearing loss. Hearing aid designs have been long been considered clunky, cumbersome, and unfashionable. However, hearing aids today are smaller and more discrete than ever before. People also overestimate their hearing ability, or underestimate their actual hearing loss.⁴ On average, hearing aid users tend to wait 10 years before taking the steps to address

¹ Wattamwar, Kapil, et al. “Increases in the Rate of Age-Related Hearing Loss in the Older Old.” *JAMA Otolaryngology–Head & Neck Surgery*, vol. 143, no. 1, 2017, p. 41., doi:10.1001/jamaoto.2016.2661.

² “Use of Hearing Aids by Adults with Hearing Loss.” National Institute on Deafness and Other Communication Disorders (NIDCD), 2014. <https://www.nidcd.nih.gov/health/statistics/use-hearing-aids-adults-hearing-loss>

³ “Does Your State Mandate Hearing Aid Coverage?” The ASHA Leader, American Speech-Language-Hearing Association, 1 July 2014, [leader.pubs.asha.org/doi/full/10.1044/leader.AAG.19072014.24](https://pubs.asha.org/doi/full/10.1044/leader.AAG.19072014.24).

⁴ Kamil, Rebecca J et al. “Factors Associated with the Accuracy of Subjective Assessments of Hearing Impairment.” *Ear and Hearing* vol. 36,1 (2015): 164-7. doi:10.1097/AUD.0000000000000075

their hearing loss; by that time, one's hearing condition has progressed to a stage of worsened and difficult communication abilities, and increased isolation and health risks.⁵

Auditory health tends to be highly correlated with physical and mental health.⁶ A simple task such as walking across the street requires hearing to pick up subtle cues that help with balance, and to pick up important signals such as traffic noises and possible dangers (i.e. a bus approaching, a person running rushing in the opposite direction). Hearing loss mutes these important signals and requires the brain work harder to process sound, and subconscious multi-tasking may interfere with some mental processing needed to walk safely across the street.

Hearing is an important variable in the assessment of cognitive function, and is associated with incident dementia as well as with declines in several other health and social conditions. Among older adults over the age of 65 years, hearing loss is associated with falls, and gait speed slows when hearing loss is high.⁷ Hearing assistive devices can reduce risks and create a safer experience. Multiple studies additionally suggest that those who maintain good hearing or use a hearing assistive device also have fulfilling social lives and a more positive self-esteem. Connecting with others can help the brain stay active and engaged.

The Hearables For All Project

New and emerging technology products are providing potential opportunities to address the challenges and barriers to hearing loss. Based on changes to policy rules and restrictions on the development of hearing devices, the consumer technology product landscape, and the higher adoption rates of mobile devices among older adults, FPCIW developed the **Hearables for All** initiative to explore and evaluate "hearable" devices that are typically worn or embedded, and designed to enhance a person's hearing experience. While these products may not necessarily target older adult consumers, the Hearables for All initiative explored the opportunities and potential impact of these devices on hearing loss among this growing population of users.

Hearables for All examined and evaluated two types of hearable technologies that supported 1) group or shared hearing experiences such as community meetings and 2) personalized, over-the-counter consumer hearing devices. FPCIW actively reached out to and worked with companies that developed these product solutions, and who provided generous product discounts or equipment loans to support the project study.

FPCIW deployed Eversound, a group listening, portable sound system that uses a wireless microphone to broadcast to multiple headsets. While a number of group hearing systems have been available for some time, we were interested in Eversound for its design and adoption program for older adult users specifically. We deployed Eversound systems to 10 full service retirement communities in all levels of care that included independent living, assisted living, skilled nursing, and memory care; FPCIW

⁵ McCormack, Abby, and Heather Fortnum. "Why Do People Fitted with Hearing Aids Not Wear Them?." *International Journal of Audiology* vol. 52,5 (2013): 360-8. doi:10.3109/14992027.2013.769066

⁶ Weinstein, B.E. "Psychosocial Impacts." Graduate School and University Center, City University of New York, 2014. <https://www.ncbi.nlm.nih.gov/books/NBK233884/>

⁷ Koh, Da Hyun, et al. "Relationships among Hearing Loss, Cognition and Balance Ability in Community-Dwelling Older Adults." *Journal of Physical Therapy Science*, vol. 27, no. 5, 2015, pp. 1539–1542., doi:10.1589/jpts.27.1539.

additionally provided the system to low income residents living in two senior affordable housing communities, and tested the program at events and workshops with other community partners.

The HFA project also tested products with hearable technology developers who designed Personal Sound Amplification Products (PSAPs), which are in-ear devices that provide amplified or enhanced listening experiences that can be managed or controlled through a smartphone app. FPCIW explored NuHeara's IQBuds and IQBoosts, Bose's Hearphones, and the World Hearing Organization's Smart Sound.

Product Overview and Evaluation: Group Hearing System

Eversound

Eversound (eversoundhq.com) is a portable sound system that uses a wireless microphone to broadcast to up to 10 headsets. Packaged into a suitcase-type kit, it is designed for meetings, activities, and other group-based events to provide better listening experiences, especially among people with mild hearing loss, to promote engagement and participation.

FPCIW introduced Eversound to Front Porch communities Carlsbad by the Sea (Carlsbad), Casa de Manana (La Jolla), Claremont Manor (Claremont), Kingsley Manor (Los Angeles), Sunny View (Cupertino), Villa Gardens (Pasadena), Vista del Monte (Santa Barbara), Walnut Village (Anaheim), and Wesley Palms (San Diego). FPCIW also introduced Eversound to CARING Housing Ministries (CHM) communities, the affordable housing community partner of Front Porch, at Good Shepherd Manor (Los Angeles), and La Pintoresca (Pasadena). We also deployed Eversound to communities and local senior centers to collect feedback and assess impact during group activities, workshops, and meetings. In all, FPCIW collected 600 surveys across the communities.

Measuring Tools

FPCIW used two measuring tools to monitor the impact of Eversound. One tool involved a simple 5-question survey for participants to self-report their experience with an Eversound headset. The survey asked questions on product feedback and whether the device helped improve one's overall event experience (APPENDIX A). FPCIW collected 343 of these surveys from residential living and senior community centers such as San Diego OASIS.

The second measuring tool was used in memory care and care center (skilled nursing) environments where staff members noted observed moods based on a modification of the Wong-Baker Scale (APPENDIX B), given the challenges of completing self-reported surveys among these populations. Staff members noted a baseline mood on how the participant appeared before the activity, and a follow up mood score after the activity using the Eversound system. The project collected a combined total of 257 non-unique, encounter data points in skilled nursing (n=200) and memory care neighborhoods (n=57).

Project Results

Older adult participants generally reported that, because of their improved hearing experiences through sound amplification made possible with Eversound, they were more likely to attend a group event. Community staff collected these surveys following events and activities. The findings of 343 respondents revealed that:

- 76.4% were “Satisfied” or “Very Satisfied” with the headsets (29.5% and 46.9%, respectively)
- 74.9% said that they would wear the Eversound to future events (29.9% reported “strongly agree” and 44.9% reported “agree”);
- 77.4% were more engaged while wearing the headphones versus not wearing headphones (32.7% indicated “strongly agree” while 44.7% reported “agree”); and
- 77.4% felt that their Eversound device increased their understanding of the event (36.2% “strongly agreed” and 41.2% “agreed”).

Individuals who used the Eversound system at these communities ranged in age and cognition/abilities. Community staff incorporated Eversound during activities and events such as town hall meetings, bingo, presentations, movie nights, and engagement programs from It’s Never too Late (in2l.com), an interactive technology platform installed in Front Porch communities across all levels of care. The nursing and care staff at Front Porch’s Summer House (memory care) reported that participants, when using the Eversound headsets and listening to music smiled more, were more socially engaged, and were more awake.

Data from survey results suggested dramatic improvements in observable mood and behaviors. On a scale of 0 to 10, with “0” being “Happy/Bright Mood”, staff members from our care centers (skilled nursing) reported an overall increase in positive moods of 47.8% (Table 1); care center residents included individuals receiving temporary physical rehab, as well as those in long term care. The outcomes were more dramatic among those living in memory care neighborhoods, where we suspect that higher levels of hearing loss are more prevalent: care staff recorded a 63.8% positive change in observed mood and behaviors.

Table 1. Eversound Mood Scale Results (n=257)

	Baseline mood	Follow-up mood	Change
Care Center (57)	2.3	1.2	47.8%
Memory Care (200)	4.7	1.7	63.8%

The most popular activities when care staff used Eversound were during bus rides and guided tours. Staff reported that their bus ride experience had improved, and that Eversound users stayed engaged as they listened to music and facilitators entertained them with fun facts about landmarks.

Technical Issues

Participants and staff in the Hearables for All project identified several usability issues with the Eversound system. Some of the common technical concerns are highlighted below:

Not directly compatible with some built-in sound systems. Eversound comes with an auxiliary cable allowing the system to plug into a tablet, smartphone, and most sound sources. However, when it came to using it for a television, it often required special cables depending on the television inputs. In some extreme cases, the workaround was putting the Eversound microphone to the speaker if there was no appropriate audio port.

Headset fit can be tight. The Eversound headsets have adjustable headbands and are one-size-fits-all. Based on surveys, community participants reported that the headsets were sometimes

too tight. Eversound passed on this feedback to their product team to explore the possibility of more sizes and better fit options.

Can require up to several turns to activate and reach desired volume. When the Eversound headset was taken out of the charging case, there was sometimes a minor delay for the headset to connect to the system; this delay prompted the user to dial the headset several turns before it activated. The best practice recommended by Eversound was to wait a moment after taking the headset out of the charging case before turning it on.

Inability for Eversound to support multiple microphones directly. Because Eversound only allowed for a single microphone source, it was not ideal for the question and answer moments during presentations. Users who were wearing the headphones were unable to hear what fellow audience members were saying unless the presenters unclipped their lapel microphone and passed it around among the audience, making the setup cumbersome and breaking the conversation flow. A couple of workarounds to this issue was to use a wireless microphone or taping the wireless lapel microphone on to a speaker. Another possibility is using multiple microphones with a mixer in front of the Eversound.

Asymmetrical volume adjustment. Some users reported that their hearing was worse on one side over the other, and that Eversound was not suitable for their hearing needs. Eversound's volume control applies to both ears.

The biggest challenge of installing the Eversound system was overcoming technical compatibility issues with existing sound systems. The ideal setup in a room environment with a sound system was being able to plug the Eversound wireless microphone into an auxiliary port. On the whole, however, many of these technical issues were not insurmountable and ultimately provided users with an improved hearing experience.

Testimonials

Eversound proved particularly useful during regular meetings. Participants who wore their headsets reported that they received a better experience during meetings using the Eversound headsets than without them; they were able to better follow and understand a presenter and stayed engaged throughout the discussion.

"I like how I can hear [the executive director] more clearly and can ask questions at the right time."

"Resident and granddaughter were extremely pleased of how well he can hear and follow along through an entire town hall meeting with such ease. [The] resident was more engaged than in any of these past meetings."

"Excellent audio, much better quality listening in the conference room. Really easy to adjust volume."

"He is losing his hearing on one side of his ear, but with this device he was very happy. [He] usually does not participate in the workshop due to his hearing problem, but he was very satisfied."

Staff members also found important value in using their Eversound system for multi-modal activities. At one community, staff members tried it for their meditation sessions with residents, and incorporated the system during exercise activities. These applications increased participation among residents across all levels of care.

“We have already used Eversound for a staff meditation group. It kept the outside sound out and allowed the participants to enjoy better concentration. We are very excited to explore the many possibilities!”

“Most of these residents go to [yoga] class and never participate. However, today they were focused and actually did the exercise. The instructor was impressed with how well this worked.”

It's Never 2 Late (iN2L, www.in2l.com), a touchscreen-based engagement system, has a wide selection of content that includes music, movies, and brain fitness. In an effort to provide a better hearing experience and increase participation in activities, staff members have used Eversound as a tool to help physically and socially isolated residents engage with the rest of the community. Since the headsets have a range of up to 200 feet from the transmitter, staff sometimes gave residents the headphones to remotely listen in on activities to sample an event, or to participate from another location in the community.

“We had a successful bingo activity this afternoon (thanks to Eversound and iN2L). Some residents sat outside after lunch (while housekeeping was cleaning the clubroom). The residents were able to play bingo and enjoy some sunshine at the same time.”

“We used the wireless headphones to invite residents to the clubroom. We would let them listen to the music and decide if they wanted to participate. [After listening to the music], most of them ultimately decide to come over to the clubroom”

Bus rides were one of the most popular uses of the Eversound. Staff at Front Porch communities reported that ever since they added Eversound to their bus rides, the normally mundane bus trips have greatly improved. Residents tended to stay awake and engaged during bus rides as facilitators entertained them with fun facts and landmarks.

“Resident's mood was a bit unhappy and confused but she increasingly got happy as she was hearing the tour facts. Very hard of hearing but Eversound was a game changer for her.”

“[The Eversound] has really enhanced our trips such as these because...it allows them to truly hear what is being said which in return allows them to follow along and stay engaged.”

“On Friday we took a Fiesta ride to see all of the colorful confetti around town. We took the Eversound headsets for residents who wished to use them and it worked out great! I shared historical facts about the Old Spanish Days Fiesta [acting as a tour guide]. [The] residents in the back were hearing me without difficulty. I kept hearing, “Wow I didn't know that” and “This is a [great] experience”. Our driver Karen and I, were in complete admiration with how well these headsets work and of the enrichment it brought to our ride. Needless to say these headsets will be hitting the road with us again!”

The impact of Eversound among the communities FPCIW introduced them to have been undeniably powerful. Survey data, anecdotal evidence, and interviews point to strong and salient outcomes among

users and care staff. Community users, residents, and staff overwhelmingly have found this system of great value in promoting participation, engagement, community-building activities, and overall health and wellbeing.

Product Overview and Evaluation: Personal Sound Amplification Products (PSAPs)

The second technology platform that the Hearables For All project investigated were personal sound amplification products (PSAPs), which are wearable in-ear devices designed to enhance hearing experiences. PSAPs are designed to meet the specific, personalized hearing needs of the user, and allow them to amplify and filter their sound environment, often through smart phone app control.

PSAPs are not hearing aids, nor are they intended to replace them. According to the U.S. Food and Drug Administration (FDA), hearing aids are medical devices, intended to compensate for hearing loss, require a prescription by a licensed audiologist, and regulated by the FDA; PSAPs, on the other hand, are designed to increase environmental sounds for non-hearing impaired consumers and do not require a prescription, thanks to recent FDA guidelines that promote their development for consumers. PSAPs are relatively new to the assistive hearing space and come at a significantly reduced price per pair (\$300 to \$500) in comparison to hearing aids (\$1,500 to \$10,000). These devices therefore tend to be attractive to consumers due to their affordability, accessibility, and features. It is important to note that FPCIW maintained throughout the HFA initiative to individuals and communities that hearing loss is a condition that requires medical attention and an appropriate health professional to evaluate and prescribe an intervention.

The emerging and nascent PSAP technology space has been undergoing a constantly changing and unstable marketplace. FPCIW had examined several off-the-shelf PSAP devices available in the market before and during the course of the Hearables for All project. Doppler Labs, maker of the Here One buds that initially inspired this study, received critical acclaim and high praise for its innovation and design, and ushered in a new class of PSAP devices. However, due to funding and other financial challenges, Doppler unfortunately shuttered its business near the beginning of the HFA project.

FPCIW used a high-level set of criteria to select our PSAP solutions for the HFA project. The PSAP devices needed to 1) be available to consumers, 2) allow for smartphone app control/configuration, and 3) be affordable (\$200 to \$500). FPCIW ultimately selected NuHeara IQ Buds (nuheara.com) and Bose Hearphones (bose.com). A third PSAP solution that we selected for our project, Smart Sound from World Hearing Organization, did not fully conform to the above criteria, but made its way late into the project under some unique circumstances, and an opportunity to test an alternative solution; Smart Sound enabled us to explore an alternative type of PSAP that had a stronger alignment to hearing aid devices.

NuHeara manufactures a pair of wireless in-ear buds called IQBuds (\$250) that are controlled by a smartphone app to increase or decrease the hearing environment of the user. NuHeara provided 6 devices to FPCIW at a discount for our testing, and offered support and recommendations to the project on consumer fit and training strategies. Midway during the project, Nuheara released a new product called the IQbuds Boosts, which provided additional feature sets such as user hearing assessments that helped customize his/her settings; NuHeara provided FPCIW three of these devices during our study.

During the early phase of the project, Bose reached out to FPCIW upon reading a press release on the Hearables for All project. FPCIW purchased and received some Bose Hearphone PSAP units on loan to test with, for a total of 10 devices. The Hearphones (\$500) are earbuds connected to a collar and, like the NuHeara buds, are controlled by a smartphone app to adjust volume and sound environment.

In April 2018 near the end of our testing phase, World Hearing Organization (WHO), which produces Smart Sound, reached out to FPCIW to engage with our study. WHO generously donated over a dozen devices for testing. Smart Sound is based on hearing aid technology that was also marketed as a PSAP; its price point was also on the high end at \$1500 a pair with a form factor very similar to hearing aids. Unlike with Bose and the NuHeara, Smart Sound did not require a smartphone, and instead had two preset buttons. CIW explored this solution with a single but large cohort to evaluate its impact on individuals with low hearing abilities.

The PSAP study was a resource-intensive deployment that required a multitude of program elements in support of our testing activities. The customized and personal nature of these products, varying comfort levels of technology among users, and diverse user hearing abilities, contributed to the design of a complicated yet important set of approaches to recruitment, training, follow-up, and data analyses.

Participant Recruitment, Training, and Support

FPCIW introduced PSAPs to 101 residents across 7 retirement and senior affordable housing communities, representing a socially and economically diverse population of older adults. Based on product use breakdown, 43 individuals used Bose Hearphones, 43 used NuHeara products, and 15 used Smart Sound, yet not every participant completed the entire 3-week trial of devices. The project captured a total of 62 surveys.

The recruitment of participants involved a general resident presentation and meeting that discussed the prevalence and consequences of hearing loss, as well as the importance of addressing hearing conditions. FPCIW provided disclaimers that we were not health professionals, and encouraged audience members to seek out formal hearing assessments from licensed audiologists. These meetings were used as recruiting opportunities to enroll volunteers into the HFA PSAP project.

Upon selection and agreeing to participate, PSAP users in the study underwent an instructional training program. The overall population of PSAP users in the HFA project was diverse in technology adoption, hearing ability, and smartphone ownership; some participants owned and used hearing aids and simply were curious of the potential of PSAPs. If a participant did not own a smartphone, the project issued one for the course of their involvement. During the typically 1-hour training sessions, FPCIW staff and volunteers helped each participant learn to use and operate the smartphone app and the PSAP device issued to him/her. As a component of our training program, FPCIW developed a toolkit containing all instructional information and reference materials (APPENDIX E). The FPCIW team additionally provided weekly “office hour” support and check-in calls to address any technical support or technology adoption issues.

Survey Measures and Data Collection

FPCIW used several data collection methods to evaluate the impact of PSAPs on older adults. Prior to each community meeting and presentation, we distributed and collected the Hearing Handicap Inventory for the Elderly (HHIE) survey (see APPENDIX C), a self-reported evaluation tool, to help us

assess the hearing needs of participants. Additional questions to this survey helped to determine appropriate fit for participants volunteering for the project, which lasted at least 3 weeks for participants at each community. FPCIW also distributed a post survey based on initial HHIE results, and on the International Outcome Inventory (see APPENDIX D), a hearing aid evaluation tool. Finally, participants took part in focus group discussions or interviews to share more detailed feedback on their experiences.

Baseline and Follow-up Survey results

FPCIW distributed community-wide baseline surveys based on the HHIE questionnaire. Each question on the HHIE questionnaire asked participants how they perceived the social and emotional events of hearing loss. Each answer was scored from 0 to 4 and was tabulated from a total of 10 questions. Across all the 7 communities that participated, FPCIW collected a total of 319 surveys.

As a general guideline, FPCIW targeted participants with mild-to-moderate hearing loss (a score of 10 to 24) based on results from the HHIE questionnaire. During the course of the study, we also included volunteer participants who had no hearing handicap (0-8 score) and those who had a severe hearing handicap (26 to 40 score).

Following is a breakdown of hearing abilities based on our hearing surveys:

- Average age of PSAP users was 79.6 years old (ages ranged from 61 to 98)
- 39.6% indicated no to mild hearing loss (score of 0 to 8)
- 36.7% indicated mild to moderate hearing loss (score of 10 to 24)
- 23.7% indicated significant hearing loss (score 26 to 40)

Our PSAP users had a wide variety of use case scenarios they wanted to apply their devices to. Many users complained of not being able to hear in social settings and were most interested in using their PSAPs to help them hear in dining areas. The ability to listen to a television at home at a low/normal volume was a common refrain.

In focus group discussions, residents who were current hearing aid users reported that their PSAP's functioned very similar to their hearing aids. Hearing aid users were impressed with how inexpensive the devices were compared to their hearing aids, but commented that the battery life of these PSAPs were not long enough for people who used their hearing aid on a full-time basis, despite the fact that PSAPs are not designed to replace hearing aids.

Participants without hearing aids provided mixed responses. Some noted very positive feedback on the ability to control and adjust the sound during conversations, meetings, and listening to the television. Others, however, reported the devices did not properly fit, did not provide enough sound amplification, or were hard to control. The battery charge of PSAP devices (3 to 8 hours) were mildly satisfactory. Some participants who never owned a smartphone found using a smartphone, the PSAP device, and the app somewhat difficult—these critical responses were unsurprising, given the highly personal preferences of devices designed to fit into older ears and the need for basic smartphone skills.

[PSAP Synopsis](#)

The purpose of the Hearables For All PSAP initiative was not so much to identify the best overall product, but to assess their impact and viability as a hearing enhancement solution for older adults. Our

study strongly suggests that the older adult population is as highly diverse as any demographic, and as varied in tastes and concerns with technology products that are as personal as hearable devices.

The product satisfaction of the PSAPs were mixed due to a majority of it attributing to taste, aesthetics, and battery life; but despite these diverse personal preferences, many users reported results that suggested that the PSAPs they tested actually improved their ability to hear engage with their community. The majority of users, 57.3%, “agreed” or “strongly agreed” that their devices helped them increase their ability to hear. When asked about their hearing difficulties while wearing the device, more than half (54.2%) reported “slight difficulty” or “no difficulty” in using their PSAPs. While only less than 30% believed that their hearable devices “changed their enjoyment of life” “quite a lot” or made it “very much better, that is almost one third of participants who experienced impactful benefits from improved hearing experiences due to these devices. And finally, the 39% of participants who “agreed” or “strongly agreed” that their PSAPs made them more like to partake in community events is proof positive that assistive hearable devices can reduce social isolation due to hearing loss.

Table 2. Total PSAP user survey results (n=62)

On a scale of 1-5 how satisfied were you with your PSAPs?					
1 (Not Satisfied)	2	3	4	5 (Very Satisfied)	4 or 5
27.4%	14.5%	17.7%	17.7%	22.6%	40.3%
On an average day, how many hours did you use your PSAPs?					
None	Less than 1 hour a day	1 to 4 hours a day	4 to 8 hours a day	More than 8 hours a day	
4.6%	33.9%	33.9%	13.9%	13.9%	
The PSAPs increased my ability to hear while I was wearing them.					
Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Agree or Strongly agree
9.8%	16.4%	16.4%	39.3%	18.0%	57.3%
When you use your PSAPs, how much difficulty do you STILL have in that situation?					
Very Much Difficulty	Quite a lot of Difficulty	Moderate Difficulty	Slight Difficulty	No Difficulty	Slight Difficulty or No Difficulty
13.6%	8.5%	23.7%	27.1%	27.1%	54.2%
I was more likely to partake in community events while wearing my PSAPs.					
Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Agree or Strongly agree
18.0%	16.4%	26.2%	29.5%	9.8%	39.3%
Considering everything, how much has PSAPs changed your enjoyment of life?					
Worse	No Change	Slightly Better	Quite a lot better	Very Much Better	Quite a lot better or Very much better
7.3%	36.4%	27.3%	21.8%	7.3%	29.1%
I would recommend PSAPs to other residents.					
Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Agree or Strongly agree
12.1%	12.1%	22.4%	36.2%	17.2%	53.4%

NuHeara IQBuds and IQBuds Boosts

NuHeara (nuheara.com) is an audio wearables company based in Perth, Australia. NuHeara developed the IQBuds and the IQBuds Boosts, wireless earbuds connected to smartphones using the NuHeara app, and can also be controlled through touch sensors on the device itself. By tapping the touch sensors, users can turn the device on and off, change their hearing environment, and pick up phone calls without always holding a smartphone. There were 37 NuHeara IQBuds users and six NuHeara IQBuds Boosts users during the course of the study.

The NuHeara app on the smartphone is another option to control the NuHeara IQBuds (Figure 1); the app can provide remote control to manually tapping on the device to turn it on/off and switch hearing environments. However, with the NuHeara app, users could further adjust and augment their hearing experience according to their personal hearing preferences such as bass, treble, and balance controls (Figure 2).

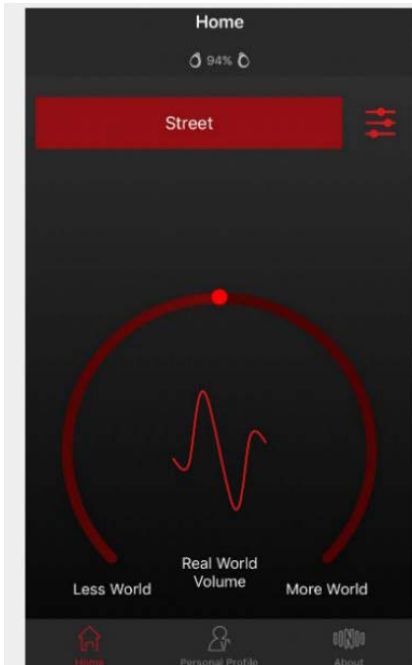


Figure 4. NuHeara app home screen.

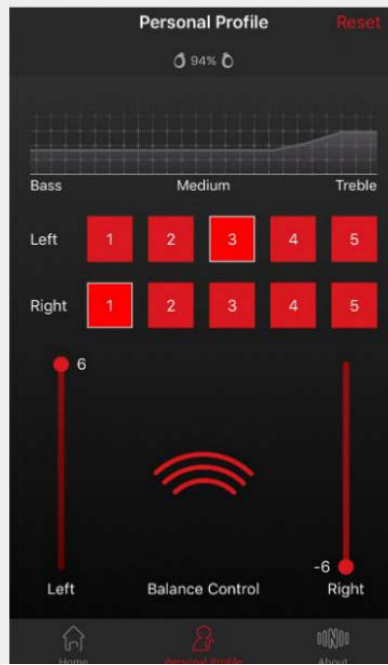


Figure 4. Users can use the NuHeara app to adjust

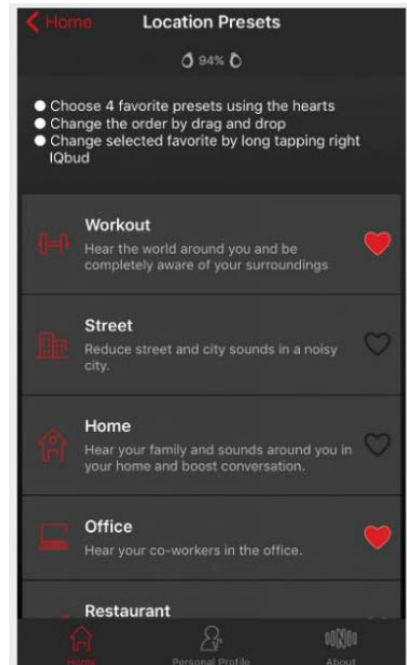


Figure 4. Users can choose up to four settings based on their noise environment.

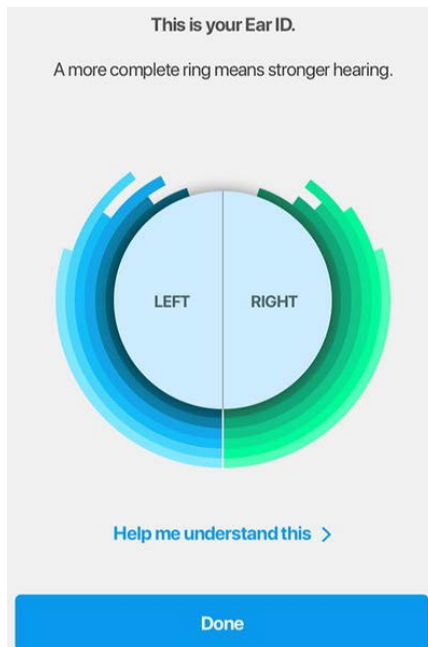


Figure 1. NuHeara EarID results are provided at the end of the Hearing Assessment.

There are a total of seven location presets which include “workout”, “street”, “home”, “office”, “restaurant”, “driving”, and “airplane”. Users can select location presets as shortcuts through the NuHeara app and can select up to four shortcuts (Figure 3); users can then activate and change environment settings through a tap of the touch sensor.

In mid-2018, NuHeara released a new product called IQBuds Boosts. One key change to the product was their Ear ID™ Audiometric Hearing Assessment that calibrates the IQBuds to the user’s hearing profile through a series of hearing tests to measure to hear a spectrum of tones. The hearing assessment takes about ten minutes to complete and afterwards, the user is provided the results of his/her Ear ID (Figure 4). Six participants experimented with the IQ boosts. With the initial Hearing Assessment, it eliminated the need to manually fine tune device to their hearing during participant trainings.

Participant Survey Results

Participants’ responses to the NuHeara buds were mixed. When asked about product satisfaction on a scale from 1 to 5, with 5 being very satisfied, 36.8% gave the product a 4 or 5 rating, while 57.9% reported a 2 or 1. Factors that came into product satisfaction of NuHeara were appearance, fit, and user

experience. The participant’s comfortability with handling a smartphone also played a factor in product satisfaction.

Participants in the study generally used their devices often enough to assess their experiences. In frequency of use, about half of the participants used IQBuds between 1 to 4 hours per day (54.6%) while 36.4% reported using it less than 1 hour per day, while 4.6% used it between 4 to 8 hours per day. Most common uses were for the dining room, personal conversations, and watching television. When asked if NuHeara IQBuds increased their hearing ability, more participants responded that the products improved their hearing than not. 53.4% either “Strongly Agreed” or “Agreed”, while 24.6% said that they “Disagreed” or “Strongly Disagreed”

Following their experiences with their devices, Participants were also asked to think about the situation where they most wanted to hear better, and how much difficulty they still had in that situation, such as in dining rooms and presentations. 21.1% reported continuing to experience with “very much difficulty”, 5.3% said with “quite a lot of difficulty,” and 26.3% reported “moderate difficulty;” On the other end of the spectrum, 21.1% reported “slight difficulty” and 26.3% said “no difficulty” in using the IQBuds in noisier environments.

Table 3. NuHeara user survey results.

On a scale of 1-5 how satisfied were you with your NuHeara IQBuds?				
1 (Not Satisfied)	2	3	4	5 (Very Satisfied)
36.8%	21.1%	5.3%	10.5%	26.3%
On an average day, how many hours did you use your NuHeara IQBuds?				
None	Less than 1 hour a day	1 to 4 hours a day	4 to 8 hours a day	More than 8 hours a day
4.6%	36.7%	54.6%	4.6%	0%
The Nuheara IQBuds increased my ability to hear while I was wearing them.				
Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
9.5%	19.1%	19.1%	42.9%	9.5%
When you use your NuHeara IQBuds, how much difficulty do you STILL have in that situation?				
Very Much Difficulty	Quite a lot of Difficulty	Moderate Difficulty	Slight Difficulty	No Difficulty
21.1%	5.3%	26.3%	21.1%	26.3%
I was more likely to partake in community events while wearing my Nuheara IQBuds.				
Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
23.8%	19.1%	23.8%	28.6%	4.8%
Considering everything, how much has NuHeara IQBuds changed your enjoyment of life?				
Worse	No Change	Slightly Better	Quite a lot better	Very Much Better
11.8%	58.9%	11.8%	5.9%	11.8%

I would recommend NuHeara IQBuds to other residents.				
Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
23.8%	4.8%	23.8%	33.3%	14.3%

Issues

Design. Users reported appearance and design were concerns with the NuHeara buds. Across every focus group in the NuHeara group, participants preferred something that was more flesh tone and more discrete.

“The look and design of the design was very ugly, I want something that would hook on my ear and possibly less ugly. They regularly fell out and I was concerned about losing them.”

“They were not women friendly. We’re all wearing earrings. I found that box impossible for me to open. They were not user friendly in so many ways – not a lot of contrast, tiny printing that would be difficult to read.”

Fitting. The NuHeara buds can be sensitive to fit. If it was not snug in the ear canal, then the buds would not connect to the phone and the app would not activate. The fear of the buds falling out discouraged some participants from using them outside of their home.

“They were heavy and fell out, even after adjusting them.”

Case design. Some participants thought the buttons on the NuHeara IQBuds case would help them open the case. The button, in fact, was used to help indicate the battery life of the charging case. In addition, the case’s slippery design and lack of grooves made it difficult to open the case.

“I would find a way to make the case less slick, it’s like a bar of soap. If the texture was more like a pebble, it would be much easier to open. In time, I may learn to open it better.”

Difficulty using a smartphone. There was difficulty using the smartphone to control IQBuds, especially if the participant did not have sufficient experience with using a smartphone. Using the phone app was sometimes frustrating—some participants in the focus group reported they would have preferred not use the phone to manage the device.

“I don’t like using these touch phones and don’t want to have to rely on it. I’d rather use [the IQBuds] without a phone.”

“I had a lot of trouble. I’ve never had a smartphone before, but I’ve used computers for years. I pick up the iPhone pretty rapidly but I had difficulty with the app. I couldn’t make any adjustments. I wasn’t really able to do anything with it.”

Testimonials

Simple to charge. In focus group discussions, participants appreciated the fact that they did not need to change the battery.

“Simple to charge. I don’t need to put in a battery.”

“I like the fact you can charge it.”

Personal conversations. The IQBuds were helpful in personal conversations. Participants in focus groups and surveys reported they liked how they could hear their friends or family more clearly. They also liked how the IQBuds helped with reducing distracting background noises.

“I don’t think I need hearing aids, I’m not sure if I have any hearing loss, but if I did, these are what I would use. There are a few people that speak too low, they mumble, and sometimes I will have to ask them to speak up. What this corrected, which is marvelous, is it got rid of extraneous sound.”

“I expected to hear every word everyone spoke, and I was able to do that after the training. It works for me.”

“I am not hearing impaired. But it helped me hear even better. I heard everything! It helped me focus and I was hearing words correctly. I would recommend the product.”

Bose Hearphones

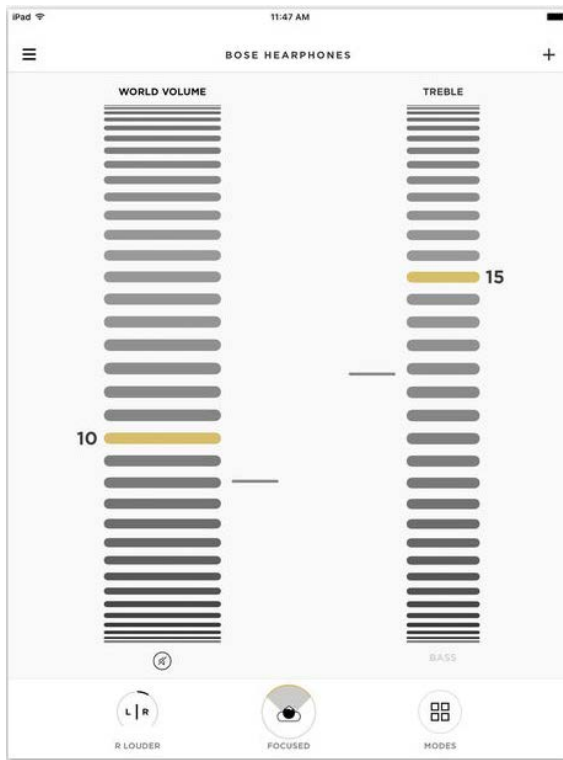


Figure 5. Bose Hearphones app. Users can change volume and frequency of what they hear, hearing balance, bass, and treble levels.

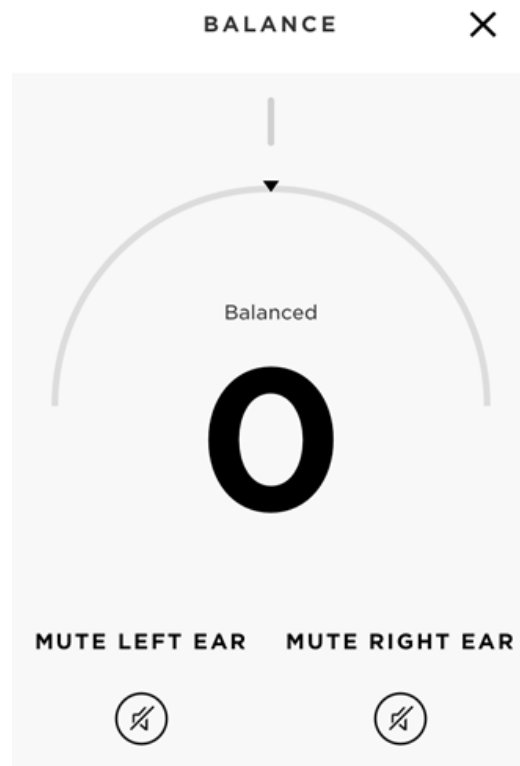


Figure 6. Users can control how much sound they would to hear on one ear side.

Bose (Bose.com) is a widely known brand for their audio devices and equipment. Bose Hearphones cost around \$500, and are marketed as “conversation-enhancing headphones” to help a user hear in louder

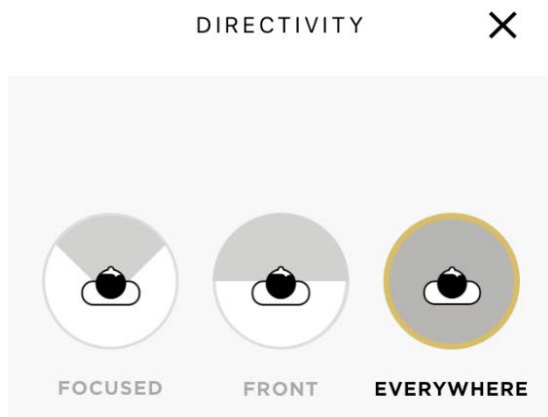


Figure 7. Bose Hearphones users can adjust the directivity of they want to hear. They can block unwanted, distracting background noise to hear and participate better in conversations and events.

environments. Similar to the NuHeara products, they are also controlled by a smartphone app, allowing users to control the noise environment around them. Users are able to control the volume of the external sound, called the “world volume,” by scrolling between -50 to +100, with +100 being the loudest, while -50 to 0 is the same noise cancellation technology in other Bose headphones. Users are also able to change the frequency based on their hearing needs by either increasing treble or bass of their world volume (see Figure 5). There were 43 participants who tried the Bose Hearphones during the study.

Users can also further customize their hearing experience by controlling their left and right ear balance. If a user has a harder time being able to hear through the right ear, s/he can increase the world volume to hear more on the right side (Figure 6).

Users can also change how much sound they would like to hear through their Hearphones by adjusting the hearing direction, or “directivity” (Figure 7). Users can choose one of three levels of directivity. The “Everywhere” setting allows users to hear sounds from all directions. The “Everywhere” setting is ideal for situations where the user is walking across the street or watching television. The “Front” setting allows users to focus on conversations with people in front of them and reduce noise from behind. For examples, a user can use the “Front” setting if they were talking with a group around the table at a restaurant. The third setting is “Focused”, allowing the user to focus on a conversation with someone in a noisy environment.

Participant Survey Results

When asked about product satisfaction with the Bose device on a scale between 1 to 5, with 5 being “very satisfied,” product satisfaction was mixed. The battery life, appearance, ease of use, and carrying a smartphone were factors in the product satisfaction which we further discuss in the “Issues” section below. Like the NuHeara products, the participant’s comfortability also played a factor in product satisfaction: 31.0% reported “not satisfied” giving it a rating of a 1 out of 5. 6.9% gave a 2 rating, 24.1% gave it a 3 rating, 13.8% gave it a 4 rating, and 24.1% gave it a 5 rating.

When asked how often they used their PSAPs per day, 33.3% reported they used it for less than 1 hour per day, 33.3% between 1-4 hours per day, 16.7% between 4-8 hours per day, and 10% more than 8 hours per day. Participants used the Bose for certain situations such as watching TV, participating in a dinner conversation, or watching a lecture.

When asked if the Bose Hearphones increased hearing ability, 58.6% reported “Agree” or “Strongly Agree”. When asked how often they used their PSAPs per day, 33.3% reported they used it for less than 1 hour per day, 33.3% between 1-4 hours per day, 16.7% between 4-8 hours per day, and 10% more than 8 hours per day.

Feedback on wearing their Bose Hearphones out in the community were mixed. 41.3% either “Strongly agreed” or “Agreed” that they were more likely to partake in community events while wearing their devices, but 34.5% “Disagreed” or “Strongly disagreed” with that statement.

Some participants reported that the appearance of the Bose Hearphones could be improved: they expressed that they did not like the look of the Bose product, and the design itself deterred them from wearing it outside of their home. They felt wearing the device in public would make them stand out and identify them as someone who was hard-of-hearing. Residents at the focus group reported they preferred to wear something a little more discreet in public.

Our Bose users tended to have a net positive recommendation of their devices. When asked if they would recommend Bose Hearphones to other people, about half said they would recommend (37.9%) or strongly recommend Bose Hearphones (13.8%) to others. Though most of the participants liked the product, some reported it was not something they would own themselves. On the question of “Considering everything, how much has Bose Hearphones changed your enjoyment of life?”, 28% replied that it was “quite a lot” or “very much” better.

Table 4. Bose Hearphone user survey results.

On a scale of 1-5 how satisfied were you with your Bose Hearphones?				
1 (Not Satisfied)	2	3	4	5 (Very Satisfied)
31.0%	6.9%	24.1%	13.8%	24.1%
On an average day, how many hours did you use your Bose Hearphones?				
None	Less than 1 hour a day	1 to 4 hours a day	4 to 8 hours a day	More than 8 hours a day
6.7%	33.3%	33.3%	16.7%	10%
The Bose Hearphones increased my ability to hear while I was wearing them.				
Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
10.3%	13.8%	17.2%	41.4%	17.2%
When you use your Bose Hearphones, how much difficulty do you STILL have in that situation?				
Very Much Difficulty	Quite a lot of Difficulty	Moderate Difficulty	Slight Difficulty	No Difficulty
7.1%	10.7%	25.0%	32.1%	25.0%
I was more likely to partake in community events while wearing my Bose Hearphones.				
Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
20.7%	13.8%	24.1%	24.1%	17.2%
Considering everything, how much has Bose Hearphones changed your enjoyment of life?				
Worse	No Change	Slightly Better	Quite a lot better	Very Much Better
4.0%	32.0%	36.0%	24.0%	4.0%
I would recommend Bose Hearphones to other residents.				

Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
6.9%	17.2%	24.1%	37.9%	13.8%

Issues

Battery life. Full-time hearing aid users who participated in the study reported the battery life of their Hearphones ran up to 12 hours. Though this was relatively a long battery life in comparison with the NuHeara device, for example, it was still not enough for a full-time hearing aid user; this feedback also overlooks the fact that PSAPs are designed to only be for occasional use, and not as a replacement for hearing aids.

Appearance, fit, and comfort. Due to its appearance, some participants were self-conscious wearing the device outside of their homes to the dining hall and other public activities, even if their hearable devices would have helped them hear better.

“I only used it watching TV at home. I was self-conscious wearing it outside of home. It did not help me hear.”

“If I were to use hearing aids -- I would not want to have a collar around my neck, strings hanging from my ears and buds sticking out of my ears”

The product itself is all black and its markings are engraved into the design. The monotone color and the lack of contrast made it difficult for some users with low-vision to handle the device. Participants from the focus group and the surveys suggested that they would like to have a contrasting color marked throughout the Hearphone to indicate controls. Another suggestion from the residents was to have the device be a flesh tone color so wearing them would be more discrete while in public.

Carrying a smart phone. This issue was reported more by residents who have never owned a smartphone. One concern was that purchasing the Hearphones would also mean purchasing a smartphone and pay the recurring costs of mobile device ownership. Participants expressed that the costs of a mobile device and a smartphone plan or internet plan were barriers.

Additionally, residents who had never used or owned a smartphone had to not only learn how to use the app, but also learn how to operate a smartphone. This added layer meant that users had to learn how to use two devices during the course of the three-week trial. Veteran smartphone users, however, also reported they had “too many apps” on their phone.

“I carry too many apps on my phone and don’t have time to “play with the app.”

“The product was good, but I did not like the idea of buying a smart phone.”

Turning on and off the device. Many residents reported throughout the study that turning on and off the device was a difficult task, especially for those with dexterity issues. Some of the users reported that they needed to press the button with enough force to the point it where hurt their fingers. To reduce the frequency of pressing the button, we modified the settings on the app where if the earbuds were not in the ear for five minutes, the Hearphones would automatically turn off. This workaround removed the need for the users to turn off the device. The participants suggested that if the button were larger, it would be easier to push; they also recommended a sliding switch for better manual control.

Testimonials

Watching TV. The “front focus” mode was helpful for several participants watching TV with their Bose Hearphones. Instead of turning up the television volume to potentially disturb their neighbors, they used the Bose Hearphones to turn up their “world” volume.

“I found that with the TV volume low and the headset control it was good very low.”

Blocking unwanted noise. A common complaint among hearing aid users is that hearing aids amplify too much sound, making it difficult to focus on sounds the user wanted to hear. Participants reported that their Hearphones helped improve their event-going experiences by blocking unwanted noise pollution.

“Musical events (cello concert), public events, movies, and people speaking I could hear it all clearly.”

“They greatly improve my ability to hear those around and in front of me, whereas my hearing aids amplify everything around me which can be too much and make it difficult to focus on a conversation.”

“It was very helpful -- very good with announcement of the [bus] stops and blocking out the noise.”

Adjusting the volume. Hearing aid users who tried out the app reported they liked the ability to adjust the volume during certain situations with the Bose device. Among most hearing aid users, the ability to adjust the volume is a feature that was not available to them.

“I found it was very helpful after using the hearing aids for several years. You can adjust the volume which is not possible with the hearing aid. Also it’s very clear and good.”

Smart Sound

Smart Sound is manufactured by the World Hearing Organization, Inc. based in San Jose, CA. Unlike the Bose Hearphones and NuHeara IQBuds, Smart Sound does not have a smartphone application. In addition, Smart Sound batteries are not rechargeable and required battery replacement every 14 days. The Smart Sound product had a volume control feature, did not offer balance control, and had the ability to modify bass and trebles tones. Users can choose from 2 prescription options by pressing a switch/button on the devices for hearing losses (RX1 for flat and power, Rx2 for high frequency sloping losses). Smart Sound costs about \$1500 per pair making it the priciest of the devices tested.

FPCIW included Smart Sound into the study to provide some comparative testing against some of the concerns and issues raised by prior PSAP users. These issues included barriers such as protruding/non-discreet designs, requiring a smart phone/app, and low battery life. Smart Sound was available at the time to consumers on a limited basis, and was positioning itself as a PSAP device. A total of 15 participants who took their Smart Sound devices home for 3 weeks to test with.

Participant Survey Results

When asked about overall product satisfaction from a scale from 1 to 5, the participants responded with a mixed reaction that was similar to the two PSAPs we previously tested. 18.2% of users responded “Very satisfied” (5 out of 5), 36.4% responded “satisfied” (4 out of 5), 18.2% responded “neither” (3 out

of 5), 18.2 % responded “not satisfied” (2 out of 5) and 9.1% responded “Very dissatisfied” (1 out of 5). The factors that contributed to product satisfaction levels were the cost, larger size (than a hearing aid) due to the battery, too much sound, and limited options to adjust the volume.

Participants used Smart Sound for several hours per day compared to Bose and NuHeara products. 60% of the participants used the Smart Sound for more than 8 hours a day, while 30% used the Smart Sound for 4 to 8 hours per day.

When asked if they experienced difficulty wearing Smart Sound, 40% of users reported “no difficulty” while 20% said “slight difficulty.” Because the devices did not require having a smartphone, refined volume control was not available through an additional device.

The majority of the users reported that Smart Sound increased their ability to hear. Based on the survey, 36.4% responded with “strongly agree” and 27.3% responded “agree.” Though the participants indicated that Smart Sound increased their ability to hear, during the focus group however, some reported they received too much sound.

When asked if the participants were more likely to partake in community events while wearing Smart Sound, almost half reported “agree” (45%) where residents would wear it in group exercise classes and presentations; 36.7% of the participants said they were indifferent and 18.2% said they disagree that wearing Smart Sound would help increase their likelihood to participate in events.

When asked if Smart Sound improved their enjoyment of life, a majority reported at least “slightly better” or above, with 36.4% responding “slightly better”, 36.4% “quite a lot better”, and 9.1% “very much better.” The ones who responded positively to the device said they appreciated the background noise after not being able to hear for so long.

Table 5. Smart Sound user survey results.

On a scale of 1-5 how satisfied were you with your Smart Sound?				
1 (Not Satisfied)	2	3	4	5 (Very Satisfied)
9.1%	18.2%	18.2%	36.4%	18.2%
On an average day, how many hours did you use your Smart Sound?				
None	Less than 1 hour a day	1 to 4 hours a day	4 to 8 hours a day	More than 8 hours a day
0.0%	10.0%	0.0%	30.0%	60.0%
The Smart Sound increased my ability to hear while I was wearing them.				
Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
9.1%	18.2%	9.1%	27.3%	36.4%
When you use your Smart Sound, how much difficulty do you STILL have in that situation?				
Very Much Difficulty	Quite a lot of Difficulty	Moderate Difficulty	Slight Difficulty	No Difficulty
10.0%	10.0%	20.0%	20.0%	40.0%

I was more likely to partake in community events while wearing my Smart Sound.				
Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
0%	18.2%	36.7%	45.5%	0%
Considering everything, how much has Smart Sound changed your enjoyment of life?				
Worse	No Change	Slightly Better	Quite a lot better	Very Much Better
9.1%	9.1%	36.4%	36.4%	9.1%
I would recommend Smart Sound to other residents.				
Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
0.0%	12.5%	12.5%	37.5%	37.5%

Issues

Lack of control. Though not having a smartphone removed the additional learning curve for the Smart Sound users, the built-in volume control was different than what was available to Bose and IQBuds users. Smart Sound only had two settings for users to choose from, and 4 setting on a user adjustable volume control built in dial. A participant in the focus group, who was a hearing aid user, reported this limited featured served as a “handicap” because she could not fine tune Smart Sound.

“I was hoping there would be more room for adjustments. I found that there were only 4 [volume level] settings on it -- that was something of a handicap. I felt that when I needed to hear better, I set it at a [volume level] 3, but I got this horrible feedback...you couldn’t adjust it more gradually.”

Receiving too much noise. Because of a lack of volume and intonation control, users experienced too much noise through their Smart Sound which was uncomfortable in noisier environments such as the dining room. They preferred that their devices amplified their hearing in front of them rather than their entire surroundings.

“It was least helpful in the dining room because it tends to increase the crowd noise.”

“The dining room was too noisy and chaotic. Too much sounds. I want to pick sounds in front of me, not behind me.”

Testimonials

Appearance. Out of the three devices tested during the study, Smart Sound was the most discrete wearable with its flesh tone color and battery pack tucked behind the ear.

“I was overall pleased with the thing. They were invisible.”

Hearing ability. Though some users complained of receiving too much background noise through the Smart Sound, others welcomed it and did not consider it a distraction; they felt that after not being able to hear background noise for so long, they appreciated the ability to hear more through Smart Sound.

“I was unaccustomed to hearing background noise so well! You hear the traffic, the dishes, the yakking of people in there. There’s not anything wrong with that. I was just not used to it.”

“Wife and I would usually walk around the neighborhood. I could hear the traffic better. I could hear the background noise better in the dining room. Sitting on the balcony, I could hear the traffic noise from the 101 [freeway].”

Watching television. Smart Sound users reported that wearing their device was helpful while watching television, where they did not need to turn up the television volume.

“My wife always complained that I had the TV on too loud. Now I can set it at half volume.”

Conclusion

The ability to hear well is more than having good hearing: it is about improving one’s overall experience. It’s about maintaining and engaging in conversations in crowded areas. It’s about feeling better about not distracting your neighbors playing the television or the radio too loud. Hearing well is about one’s personal safety in responding to important danger signals in the home and the external environment.

FPCIW found that group listening systems can be important tools to promote wellbeing and social engagement. Eversound, as a technology solution fundamentally designed to engage an older adult audience, can produce meaningful impact for individuals experiencing hearing loss—this technology can be especially critical for care staff and service providers who need a solution to help them connect with their community members.

While some users in our HFA PSAP study concluded that the device they tested was not the perfect fit for them, the majority of our participants reported an increased ability to hear, and had only slight or no difficulty in being able to hear in environments because of their hearable devices. On the whole, our project users appreciated the invitation to explore emerging technologies, and found value in participating in the program. The participants learned about the various options on more readily-accessible hearing devices at a reasonable price. As a research team, we discovered these assistive devices benefited those who needed to increase their hearing ability in select situations with more noise pollution rather than wearing them on a full-time basis.

We were encouraged by the enthusiasm that participants were willing to explore new technologies that could potentially address hearing loss concerns. The introduction of new hearable devices with an array of features continues at an accelerated pace, several of which didn’t exist before the HFA project began. Indeed, as PSAPs and assistive hearing products continue to innovate to generally meet the needs of people with hearing loss, we can comfortably predict an increase in the adoption of such devices among older adults and that will address many of the issues that our project users have identified in design, usability, and cost.

Media Highlights

From the start of the Hearables for All project, FPCIW has been promoting its project through media channels and our website (fpciw.org). The website currently hosts a Hearables for All “impact story” (<http://fpciw.org/story/hearables-for-all/>), which features a video of a user testing a PSAP device.

A copy of our press release can be found on our “Spotlight” blog section on the FPCIW site (<https://bit.ly/2V18pVN>). As a result of our press announcement, several media outlets have published stories of the initiative:

Health Central, “Hearables’ Help Overcome Hearing Problems in Groups” <https://www.healthcentral.com/article/hearables-help-overcome-hearing-problems-in-groups>

Hearingtracker.com, “Hearables For All: This Initiative Brings New Personal Amplifiers to Older Ears” <https://www.hearingtracker.com/blog/hearables-for-all-this-initiative-brings-new-personal-amplifiers-to-older-ears/>

Minding Our Elders, “Hearables” Help Overcome Hearing Problems in Groups” <http://www.mindingoureldersblogs.com/2017/12/hearables-help-overcome-hearing-problems-in-groups.html>

Voice & Viewpoint, “OASIS Tech Fair Makes Connections for Older Adults” <http://sdvoice.info/oasis-tech-fair-makes-connections-for-older-adults/>

FPCIW has published a photo gallery of moments throughout the Hearables for All project which is currently available on its website (<http://fpciw.org/resources/photos/?ftg-set=hearables-for-all#1>).

Front Porch has additionally promoted the HFA initiative through its social media channels including Twitter @FrontPorchCS, Facebook @frontporchcommunities, and LinkedIn ([linkedin.com/company/front-porch](https://www.linkedin.com/company/front-porch)).

Resources

Did you know you can do a hearing test over the telephone? The National Hearing Test is considered a reliable over-the phone screening test. Free for AARP Members, \$8 for non-members.

“The National Hearing Test”
https://www.nationalhearingtest.org/wordpress/?page_id=2730

“Ask the Experts: Can you Test Your Hearing Over the Phone?” by Jeanine Barone <http://www.berkeleywellness.com/self-care/preventive-care/article/can-you-test-your-hearing-over-phone?ap=402>

The Complete Guide to Hearable Technology in 2019
<https://www.everydayhearing.com/hearing-technology/articles/hearables/#hearingaids>

Additional Information

Research has shown that the effects of hearing loss are far-reaching and can cause other co-morbidities such as depression.

“Why Hearing Loss Affects much more than your Ears.” by Marelize Wilke, Health24. <https://www.health24.com/Medical/Hearing-management/News/why-hearing-loss-affects-much-more-than-your-ears-20181213>

Overview of why hearing aids have a high cost and the hope for improving Personal Sound Amplification Products (PSAPS).

“Better, More Affordable Hearing Aids”
<http://www.berkeleywellness.com/healthy-community/health-care-policy/article/making-hearing-aids-better-and-more-affordable?ap=402>

The Johns Hopkins Center on Aging and Health conducted a study comparing five PSAPs and a hearing among older adults with mid-to-moderate hearing loss.

“Personal Sound Amplification Products vs. a Conventional Hearing Aid for Speech Understanding in Noise” by Nicholas S. Reed, AuD, Joshua Betz, MS, Nicole Kendig, AuD, Margaret Korczak, MS, PhD3, Frank R. Lin, MD, PhD.

In The Media

“Hearing aids: You ain’t heard nothing yet”
<https://www.cbsnews.com/news/hearing-aids-you-aint-heard-nothing-yet/>

“U.S. approval for Bose hearing aid a blow to traditional makers”
<https://www.reuters.com/article/us-bose-fda/us-approval-for-bose-hearing-aid-a-blow-to-traditional-makers-idUSKCN1MI1KP>

APPENDIX A: Eversound Survey

EverSound Feedback Survey

Name (First, Last) _____ Date: ____/____/____

Event: _____

Please answer the following questions regarding whether you agree or disagree with the statement provided.

- 1. On a scale of 1-5 how satisfied were you with your EverSound experience?
1 (Not satisfied) 2 3 4 5 (Very satisfied)

- 2. I would wear the EverSound headphones to future events.
Strongly agree Agree Neither agree or disagree Disagree Strongly disagree

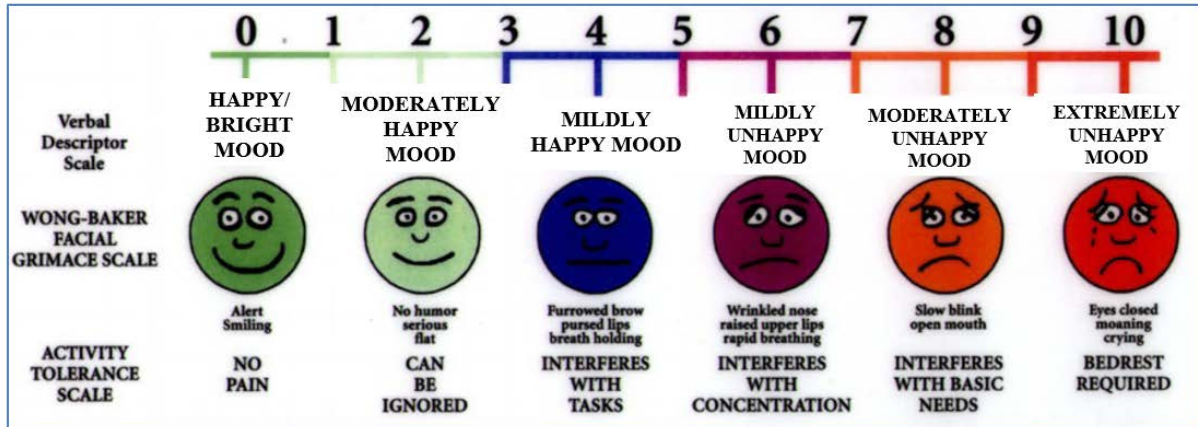
- 3. I felt more engaged while wearing the EverSound headphones.
Strongly agree Agree Neither agree or disagree Disagree Strongly disagree

- 4. The EverSound increased my understanding and/or cognition of the event.
Strongly agree Agree Neither agree or disagree Disagree Strongly disagree

- 5. The EverSound headphones make me more likely to attend future events.
Strongly agree Agree Neither agree or disagree Disagree Strongly disagree

Comments, concerns, or issues? _____

APPENDIX B: Wong-Baker Facial Grimace Scale



Wong-Baker FACES Pain Rating Scale

Instructions: For each Eversound session, note the Baseline Mood from your observation, according to the scale above. After the session, note the Follow-up Mood and any brief observations.

Resident (First Name Last Initial)	Activity	Date/Time	Baseline Mood (#)	Follow-up Mood (#)
1.				
NOTES (OPTIONAL)				
2.				
NOTES (OPTIONAL)				
3.				
NOTES (OPTIONAL)				
4.				
NOTES (OPTIONAL)				
5.				
NOTES (OPTIONAL)				
6.				
NOTES (OPTIONAL)				
7.				
NOTES (OPTIONAL)				
8.				
NOTES (OPTIONAL)				
9.				
NOTES (OPTIONAL)				
10.				
NOTES (OPTIONAL)				

APPENDIX C: Hearing Handicap Inventory for the Elderly Survey (HHIE)

First Name: _____ Last Name: _____

Community: _____ Date: _____

Age: _____ Gender/Sex: (Circle one) Male / Female

Please check “yes,” “sometimes”, or “no” in response to each of the following items. Do not skip a question if you avoid a situation because of a hearing problem. If you use a hearing aid, please answer the way you hear without the aid.

Hearing Wellness*

1. Does a hearing problem cause you to feel embarrassed when meeting new people?

Yes Sometimes No

2. Does a hearing problem cause you to feel frustrated when talking to members of your family?

Yes Sometimes No

3. Do you have difficulty hearing when someone speaks in a whisper?

Yes Sometimes No

4. Do you feel handicapped by a hearing problem?

Yes Sometimes No

5. Does a hearing problem cause you difficulty when visiting friends, relatives, or neighbors?

Yes Sometimes No

6. Does a hearing problem cause you to attend religious services less often than you would like?

Yes Sometimes No

7. Does a hearing problem cause you to have arguments with family members?

Yes Sometimes No

8. Does a hearing problem cause you difficulty when listening to TV or radio?

Yes Sometimes No

9. Do you feel that any difficulty with your hearing limits or hampers your personal or social life?

Yes Sometimes No

10. Does a hearing problem cause you difficulty when in a restaurant with relatives or friends?

Yes Sometimes No

Hearing Health and Technology

11. Have family, friends, or acquaintances ever suggested you wear a hearing aid?

Yes No

12. Have you ever worn a hearing aid?

Yes No

13. Have you ever been diagnosed with a hearing loss condition?

Yes No

14. Do you currently own a smartphone?

Yes No

15. Would you be interested in volunteering to test non-prescription Personal Sound Amplification Products (PSAPs)?

Yes No

*****END OF SURVEY (Please return this to the front desk)

*Survey: Ventry, I.M., & Weinstein, B.E. (1983). Identification of elderly people with hearing problems. ASHA, 25, 37-42. Copyright 1983 by American Speech-Language-Hearing Association.

APPENDIX D: Exit Survey

Hearables for All User Survey (BOSE)

***Please fill out the following survey after wearing your Personal Sound Amplification Products (PSAPs), answer the questions as if you are/were wearing them as it relates to the question. Please complete this survey and bring it to the focus group on Wednesday, February 7th at 1 PM at the San Andreas Vault.**

Thank you,

Aaron Mizak

First Name: _____ Last Name: _____

Community: _____ Date: _____

Age: _____ Gender/Sex: (Circle one) Male / Female

Please check “yes,” “sometimes”, or “no” in response to each of the following items. Do not skip a question if you avoid a situation because of a hearing problem. If you use a hearing aid, please answer the way you hear without the aid.

Hearing Wellness

16. Does a hearing problem cause you to feel embarrassed when meeting new people?

Yes Sometimes No

17. Does a hearing problem cause you to feel frustrated when talking to members of your family?

Yes Sometimes No

18. Do you have difficulty hearing when someone speaks in a whisper?

Yes Sometimes No

19. Do you feel handicapped by a hearing problem?

Yes Sometimes No

20. Does a hearing problem cause you difficulty when visiting friends, relatives, or neighbors?

Yes Sometimes No

21. Does a hearing problem cause you to attend religious services less often than you would like?

Yes Sometimes No

22. Does a hearing problem cause you to have arguments with family members?

Yes Sometimes No

23. Does a hearing problem cause you difficulty when listening to TV or radio?

Yes Sometimes No

24. Do you feel that any difficulty with your hearing limits or hampers your personal or social life?

Yes Sometimes No

25. Does a hearing problem cause you difficulty when in a restaurant with relatives or friends?

Yes Sometimes No

Hearing Health and Technology

26. Have family, friends, or acquaintances ever suggested you wear a hearing aid?

Yes No

27. Have you ever worn a hearing aid?

Yes No

28. Have you ever been diagnosed with a hearing loss condition?

Yes No

Part 2: INTERNATIONAL OUTCOME INVENTORY – PSAP (IOI-HA)

29. Think about how much you used your PSAP device over the past three to four weeks. On an average day, how many hours did you use your PSAPs?

	less than 1	1 to 4	4 to 8	more than 8
None	hours a day	hours a day	hours a day	hours a day
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

30. Think about the situation where you most wanted to hear better, before you got your present PSAPs. Over the past two weeks, how much has the hearing aid helped in that situation?

Helped not at all	Helped slightly	Helped moderately	Helped quite a lot	Helped very much
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

31. Think again about the situation where you most wanted to hear better. When you use your present PSAPs, how much difficulty do you STILL have in that situation?

Very much difficulty	Quite a lot of difficulty	Moderate difficulty	Slight difficulty	No difficulty
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

32. Considering everything, do you think your present PSAPs is worth the trouble?

not at all worth it	slightly worth it	moderately worth it	quite a lot worth it	very much worth it
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

33. Over the past two weeks, with your present PSAPs, how much have your hearing difficulties affected the things you can do?

- | | | | | |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Affected very much | Affected quite a lot | Affected moderately | Affected slightly | Affected not at all |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

34. Over the past two weeks, with your present PSAPs, how much do you think other people were bothered by your hearing difficulties?

- | | | | | |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Bothered very much | Bothered quite a lot | Bothered moderately | Bothered slightly | Bothered not at all |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

35. Considering everything, how much has your present PSAPs changed your enjoyment of life?

- | | | | | |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| worse | no change | slightly better | quite a lot better | very much better |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Part 3: Product Satisfaction Survey

36. On a scale of 1-5 how satisfied were you with your Bose Hearphones?

- 1 (Not satisfied) 2 3 4 5 (Very satisfied)

Please answer the following questions regarding whether you agree or disagree with the statement provided.

37. The Bose Hearphones increased my ability to hear while I was wearing them.

- Strongly agree Agree Neither agree or disagree Disagree Strongly disagree

38. I was more likely to partake in community events while wearing my Bose Hearphones

Strongly agree Agree Neither agree or disagree Disagree Strongly disagree

39. I would recommend Bose Hearphones to other residents.

Strongly agree Agree Neither agree or disagree Disagree Strongly disagree

40. I wish I had more time with the Bose Hearphones.

Strongly agree Agree Neither agree or disagree Disagree Strongly disagree

41. I will consider purchasing Bose Hearphones.

Strongly agree Agree Neither agree or disagree Disagree Strongly disagree

Feedback for the Front Porch Center for Innovation and Wellbeing Team:

APPENDIX D: HFA Toolkit