Engage users and reinvent your fittings with the Beltone HearMax app

Steve Hallenbeck, AuD
Jennifer Groth, MA

Beltone™

ABSTRACT

Along with hearing aid connectivity to smart devices comes hearing aid apps. Hearing aid apps provide the user with both more advanced and at the same time more discreet ways to interact with their hearing aids. Nevertheless, training in using apps takes a backseat in most hearing aid fittings, and they have greater potential for benefit to users than is currently realized. This paper describes a study exploring how the Beltone HearMax app could be incorporated in an interactive fitting to promote greater user engagement as well as accomplish training in app use. Compared to a more conventional fitting method where users take a passive role, outcomes were similar. However, those fit using the app to involve them actively in the fitting preferred fine-tuned settings that were closer to prescriptive targets in the high frequencies than those fit with the conventional method.

Hearing aid fitting today

When fitting a hearing aid, the hearing healthcare professional (HCP) faces the daunting task of matching the needs of each individual end user to the numerous options available with today's hearing aids. This is a complex task. Even if you fit only one brand of hearing aids, you may be choosing from 4 or more different product families, 3 technology levels, 5 styles, 2 or 3 power configurations, 25 features, 4 accessory options and so on just to make a recommendation. Once a product is selected and the actual fitting has begun, the number of possible starting points is staggering. Even if clinically reasonable constraints on adjustment possibilities are assumed, the number of potential frequency responses for a single input level can easily exceed 1,400[1]. As the saying goes, you never get a second chance to make a first impression. In the fitting world, this translates into one chance to get this singular combination correct from among the multitude of options for each person you fit. The common consensus on the best way to come close to that in a hearing aid fitting is to adjust the hearing aid to match a prescriptive target for the individual's hearing loss - preferably with real-ear verification - and to subsequently adjust the settings to accommodate the user's preferences. Validation of the fitting by use of speech recognition testing and standardized questionnaires assessing various outcome domains is also a part of best practice.

How does all this look from the end user's perspective? There is some evidence to suggest that those fit using best practices including verification and validation may require fewer visits to reach a point where they are satisfied[2]. While this is good news that reinforces the important role of the HCP, it is understandable that end users could perceive hearing aids as a "black box" even when dispensed follow a best practice protocol. By "black box", it is meant that the intricacies of what the hearing aid actually does are not transparent to the user. Many fitting activities don't require active participation on the part of the user. And while users will be asked about the sound and how well they are hearing, it may be unclear to them how their feedback ultimately is used in the process.

Engaging patients beyond the black box

A hot topic within healthcare is patient engagement. As an example of what engagement can mean, consider how newer technology such as fitness trackers and other biosensors are engaging patients through gamification, competitiveness and a "cool factor" that can be more compelling in promoting healthy habits than your physician telling you to eat less and exercise more. An article from the Electronic Health Reporter[3] describes patient engagement in terms that highlight the link between patient empowerment and improved outcomes. In addition, some experts in the field suggest that patients are acting like consumers searching for a wellness experience. In any case, by engaging the patient on their own terms, we open the opportunity to improve the outcomes of healthcare.

How can this trend toward greater engagement be applied within hearing healthcare? One unfortunate truth is that despite all of the many advances in hearing aid technology, we still have a category for unused amplification called the "in the drawer" hearing aid. Up to 25% of those who acquire hearing aids don't use them[3,4]. This strongly suggests that high quality amplification by itself is not enough to ensure successful hearing aid users. Moreover, it has implications for the emerging trend toward direct-to-consumer hearing aids, in that greater ease of acquisition of hearing aids does not appear to guarantee successful use and satisfaction.

The idea that hearing aids and the amplification provided are not solely responsible for clinical outcomes is not new. Factors that are not part of the technical intervention itself affect outcomes in hearing aid fittings. Examples are labeling of the hearing aid as well as the nature of the interaction between fitter and end-user[5,6,7]. For example, Naylor et al[8] demonstrated that end users preferred a fitting with an "interactive" nature to one with a "diagnostic" nature. Surprisingly, the study participants attributed their preferences to differences in sound even though the hearing aids and technical fitting were identical in both cases. Although such results represent a cautionary tale to researchers, they highlight the importance and impact that the HCP has from a clinical perspective. In other words, the interaction between HCP and end-user plays a significant role in how the end-user perceives the hearing aids and hearing aid fitting. The results of Naylor et al further suggest that interactions which involve the end user to a greater extent than conventional best practices may lead to even better outcomes.

It is of interest to consider how new technologies might be used to assist in carrying out more interactive fittings. Perhaps allowing end users the option of exploring how they can interact with their hearing aids to make them sound like they want in different situations could contribute to their own confidence in wearing their aids and ultimately their success with amplification. One technology that lends itself well in this endeavor is hearing aid apps. Perhaps apps, given their existence on a rich visual platform serving multiple purposes, offer a way to add value to the hearing aid experience.

A critical eye on hearing aid apps

To learn more about how hearing aid apps are affecting the experience of users, Beltone carried out in-depth qualitative interviews with end users who had a wide range of app experience from a variety of manufacturers. The interviewees were specifically recruited because of their hearing aid app experience. The main findings of these interviews were that:

- Apps can drive decisions on which technology to purchase
- The full feature set provided via apps is underutilized, and
- HCPs are the gatekeepers of app knowledge.

Apps as a purchase driver

The interviews revealed that roughly 40% of this subset of hearing aid users purchased their hearing aids specifically because of the interface with the app. The interviewees described the apps as presenting an image of innovation and technical edge. Furthermore, they felt that apps provided a leap from the current static state of affairs to a dynamic hearing solution making the promise to take control over tough listening situations with increased convenience and less stigma. Interestingly, there also appeared to be a relationship between degree of hearing impairment and motivation for using the app. Those with more severe hearing losses indicated greater interest in optimizing their own hearing experience through the app. Conversely, end users with milder losses were drawn to the app due to convenience and ease of use as well as a decreased feeling of stigmatization. Given that new technology can be daunting to both clinician and patient, knowing what may appeal to a particular individual up front could prove useful when considering who receives which benefit message during the fitting process.

Full features are underutilized

Undoubtedly, the interactive display and visual real estate provided by smart phones has opened the doors to an unprecedented number of control options for the end user. However, the balance of options comes at the cost of more complexity. In the case of app usage, simplicity and ease of use will always trump the listening experience. Self-guided end-user exploration of apps can be very limited depending on the type of user, and only the most superficial features may be widely used. In the case of hearing aid apps, these are basic controls such as volume adjustments and program changes. However, with many of the advanced controls provided across manufacturers, the user can achieve a greater balance between comfort and intelligibility in difficult situations than with basic volume controls. The important implication is that complexity can lead to under-utilization of the full hearing solution, thus not exploiting the potential of the user experience with

the hearing aids. Since self-exploration of the app on the part of the end-user can be relatively low, there is a growing need to incorporate guided app exploration as an integral part of the hearing aid orientation.

Few HCPs seek to add procedures and complexity to their fitting routines. However, integrating app training and hearing aid orientation into the fitting process itself may in fact not make routines more complicated. At the same time, it can add benefits such as greater engagement and better use of the technology in which they have invested. For example, basic pre-fitting procedures (loading in gain/target settings etc.) can be completed prior to the user's arrival. Once this step is completed, the user, under the guidance of the HCP, could establish their own first fit settings using app controls such as overall volume, tone controls and/or advanced features. Using this model, the HCP establishes the subjective first fit simultaneously as they are training the end user how to use the basics of an app. This method does not preclude or replace other clinical verification and validation tools. Moreover, the user can experience the impact of the control changes in real time by engaging with the technology in a contextually relevant manner.

Hearing Care Professionals are the gatekeepers of app knowledge

Another theme revealed in the interviews is that the HCP greatly influences the uptake of app features. In other words, they function as a gatekeeper of app knowledge. If the "on-boarding" to the app features are cursory or non-existent, users are less likely to be interested in exploring them and enjoying the benefits they can offer. One of the great skills HCPs bring to the fitting process is translating user complaints into tangible changes to settings or counselling on expectations to allow the user to continue on their journey. By encouraging the use of apps, some of the guesswork can be taken out of follow-ups. For example, HCPs can see many of the end user adjustments made via the hearing aid app. Since these adjustments are relatively close to those made by fitting software, and occur in a real time real world context, they can help lead fine tuning adjustments and put end user preferences and behaviors in the driver seat. Again, by incorporating app features into the fitting process at an early stage, the opportunity exists to streamline not only the fitting and orientation process, but also the long-term care.

Using the Beltone HearMax app in fitting

It is evident that user engagement in the hearing aid fitting can enhance outcomes. It is also evident that hearing aid apps are underutilized by users – even by those who actually have downloaded them and connected them to their hearing aids. Given that these apps have the potential to enrich the user experience with hearing aids, how might an app be used in the fitting process both to deepen user engagement and to promote use of the app? To answer this question, a study was carried out to evaluate the combined effects of specific clinical narratives and fitting techniques on subjective perceptions of hearing aid performance as well as the impact on hearing aid outcome measures.

Methods
Participants

Twelve adults (4 female, 8 male) completed the experiment. Their ages ranged from 50-81 years with an average age of 67 years. All were experienced with amplification and were owners of different manufacturers' hearing aids. Their average hearing threshold levels are presented in Figure 1.
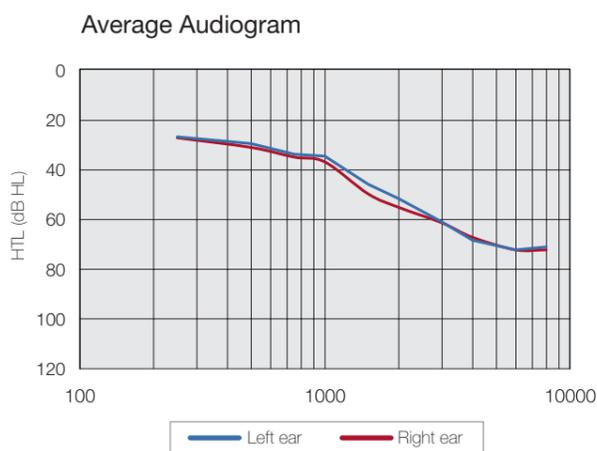
Average Audiogram

Figure 1. Average hearing threshold levels for the 12 trial participants.

Hearing aids

All participants were fit with Beltone Trust receiver-in-the-ear hearing aids with appropriate power receivers and domes for their hearing loss severity and ear canal size. The same hearing aids were used for both phases of the trial. In other words, differences in outcomes were attributable to fitting methods, not to the hearing aids per se. Participants who did not own an iPhone were given one to use during the trial. The Beltone HearMax app was downloaded to the iPhones at the initial fitting.

Design and procedures

Participants were randomly split into two groups of six. All participants experienced each of two types of fittings. To control for order effects, the order of the two fitting types was reversed between the groups. For each of the two fitting types, the initial procedure was to carry out a "first fit" in the Beltone HearMax software, with subsequent real ear verification. Then, participants were exposed to either a conventional way of completing the fitting, or an interactive way involving the Beltone HearMax app. For the conventional method, the audiologist asked participants open-ended questions about the sound of the hearing aids and made adjustments to the fitting based on their initial reactions. For the interactive method, the hearing aids were muted and volume set to the lowest level on the app volume control. They were then asked to increase the volume on the app to a comfortable level to find a starting point. Further fine-tuning based on discussion of use scenarios, possibility for control in those scenarios with practice on the app, and perceptual sound quality was also carried out.

Specifically, the conventional method is a fitting style using open-ended questioning techniques and a passive orientation style to provide the participant with settings that provide audibility for good performance in daily life. The interactive method used 10-point rating scales to assess the participant's comfort with the new hearing aids, and to promote the idea of adaptation as an integral part of the fitting process. The Beltone HearMax app was used to guide first fit adjustment and orientation to the hearing aids.

Figure 2. The conventional fitting style involved the investigator asking the participant open-ended questions about the sound of the hearing aids, and making adjustments in the fitting software based on the responses (left). The interactive style involved having the participant actively use the app to find their preferred volume. At the same time, it was possible to discuss use situations, what hearing difficulties might occur, and what actions the participant could take with or without using the app in those situations (right).

Participants were not made aware that they were testing the fitting method, rather they were told they were testing two different sets of hearing aids and evaluating the battery life. Therefore, the second session was always shorter given the fact that they had been oriented to the use of the device during the first session. All sessions were video recorded with permission from the participants.

Outcome measures

The Abbreviated Profile of Hearing Aid Benefit (APHAB)[9], the Hearing Handicap Inventory (HHIE-S)[10] and the International Outcome Inventory for Hearing Aids (IOI-HA)[11] were used to assess subjective outcomes. In addition, participants were asked to indicate a preference for either the conventional or interactive fitting method. Since they were told that they were evaluating different hearing aids, they expressed their preferences in terms of which hearing aid was preferred. Because all sessions were recorded, it was also possible to analyze the time taken for each fitting method. Finally, the hearing aid settings that resulted from each fitting method were recorded, and wear time was noted from datalogging in the hearing aids.

Results and discussion
Does one fitting method take more time than the other?

The video recordings of the sessions were analyzed to determine the time used to complete each fitting. On average, each fitting method took 45 minutes. There were two investigators who each fit 6 participants, and no differences in time taken were observed between them. This suggests that individual style has

more impact on the time needed for completing fitting than whether a conventional or interactive approach is used.

Does fitting method influence wear time?

In the first trial period, participants wore the hearing aids an average of 11.3 hours per day, while they wore them an average of 12.4 hours per day in the second trial period. Thus there was a small, but not significant trend for participants to wear the hearing aids more during the second trial period than during the first. Because order effects were controlled, it is also possible to compare the effect on wear time of fitting method. Figure 3 shows the wear time in the period following the conventional fitting versus the wear time following the interactive fitting. Similar to the slight trend to wear the hearing aids more during the second trial period, there was also a slight but insignificant trend to wear the hearing aids more following the interactive fitting than the conventional fitting. Five participants wore the hearing aids more hours per day following the conventional fitting, while 7 participants wore the hearing aids more hours per day following the interactive fitting. Only one participant showed a difference in wear time per day of more than 2 hours for the two fitting methods.

Based on these data, the fitting method does not appear to have much impact on wear time. This means that a fitting with an interactive style can be expected to yield equally good results in terms of compliance in using the hearing aids on a regular basis as the more conventional style
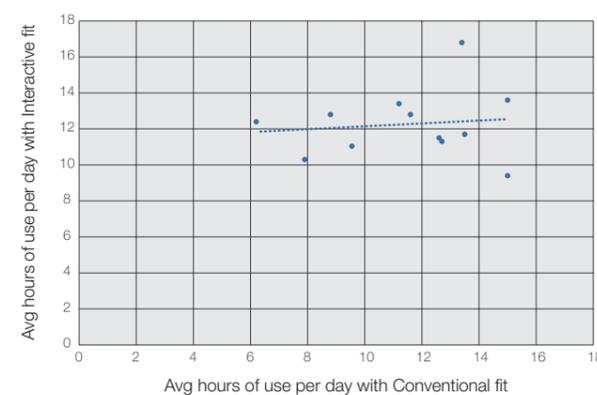

Figure 3. Wear time for the interactive fitting method as a function of wear time for the conventional fitting method. There was a slight trend for participants to wear the hearing aids more following the interactive fitting.

Are there differences in subjective outcomes dependent on the fitting method?

No significant differences were observed between fitting methods for the APHAB, HHIE-S or the IOI-HA. This suggests that both fitting styles resulted in similar benefit of the hearing aids. Participants did not spontaneously express a preference for either type of fitting method. However, when fit using the interactive style, they had greater interest in using the app.

How did the fitting method influence the hearing aid settings?

When the conventional fitting method was used, the gain settings relative to Audiogram+ prescriptive targets were lower than when the interactive method was used. Furthermore, the conventional method resulted in gain settings that were about 5 dB under target in the high frequencies. Participants who actively participated in fine-tuning their hearing aids via the app wore the hearing aids with gains that were above target in the lower frequencies, and matching target through 4kHz. The average gains worn by the participants per fitting method are shown in Figures 4 and 5.

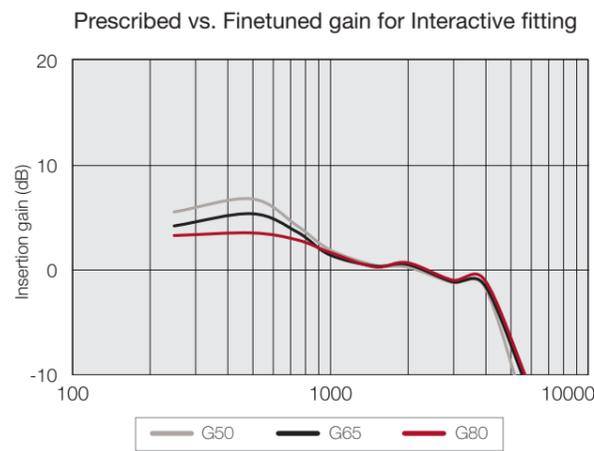Prescribed vs. Finetuned gain for Interactive fitting

Figure 4. Difference between prescribed and fine-tuned gains when the interactive fitting method was used. Gains were slightly above target in the lower frequencies and matched target through 4 kHz.

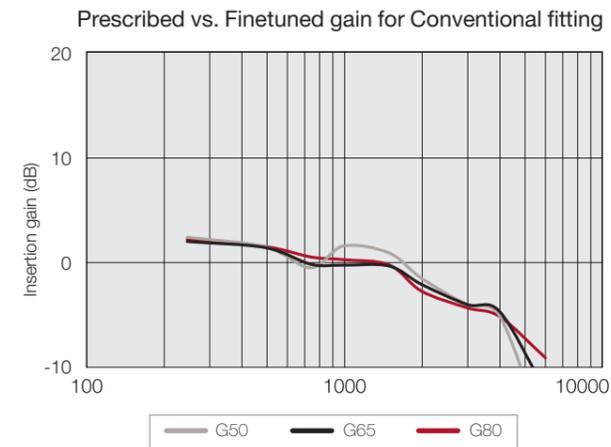Prescribed vs. Finetuned gain for Conventional fitting

Figure 5. Difference between prescribed and fine-tuned gains when the conventional fitting method was used. Gains were above target in the lower frequencies and below target from 2kHz and above.

The positive fine-tuned offsets in the low frequencies that were observed for both types of fittings could be due to a perceptual preference for greater volume or fullness of the sound. It could be further attributable to the fact that all but two of the participants were fit with non-occluding domes, and that the fitting prescription did not take fitting acoustics into account. A similar finding was reported in a study of self-fitted hearing aids, where hearing aid owners "fit" their own losses with experimental hearing aids set above the gains of their own devices[12].

It is interesting to consider why the conventional method resulted in lower fine-tuned gains in the high frequencies, as this runs counter to conventional wisdom that hearing aid users often prefer less high-frequency emphasis. This could be due to the interplay of two factors. One is that fitters - faced with the subjective comment that sound quality is tinny or sharp - default to reducing the high frequency gain and then ask "does that sound better?". This is the most common solution for tinny sound quality and may have occurred in the conventional fittings. The other factor is that the interactive fitting essentially taught the participants how they could control sound quality and access to sound in different listening situations. This is a bit different than explaining how to use a program button to switch to a "noise" program in that there is visual support to show and reinforce the action, and it is relatively easy to discuss varying listening scenarios to learn and practice using the app to control the hearing aids. Perhaps using the app in this way promoted a sense of ownership of the fitting that would encourage them

to consider how they would hear in many situations rather than focusing on their immediate experience in the fitting situation. Considering that high frequency audibility is essential in promoting optimal speech understanding, engaging users in the fitting with the app may be a valuable way to help users easily accept and adapt to appropriate gains.

Using apps within the fitting process can facilitate a rehearsal of daily use during the initial fitting. While this accomplishes the task of familiarizing the user, it also opens the opportunity to deepen the understanding of how the user intends to use the system and gain insight into how the user perceives the control. For example, while a volume control is technically a mechanism for increasing or decreasing the loudness of the hearing aid, end user perception is that a volume control can provide " greater access to or awareness of" their sound environment. Conversely, lowering the control creates a more comfortable sound experience. Equalization controls, like those for high frequency treble sounds and low frequency bass sounds seem intrinsically simple to HCPs. However, end users may not as easily make the connection that increasing treble could improve intelligibility or that decreasing bass could change the perception of their own voice. Again, there is an opportunity to make this translation part of the orientation and education process to deepen the end user experience.

Pulling it all together from the beginning

As new technologies come online, HCPs have the opportunity to reinvent their processes to incorporate the technology in an efficient manner. In this paper, we have explored one way to introduce the technology during the fitting process, but in fact technology readiness can be broached even earlier in the journey toward better hearing. For example, adding questions regarding technology attitudes - both in terms of utility as well as recreation - to intake forms and questionnaires will open the channels of communication on the topic before the assessment even begins. Commonly HCPs ask (often on many intake forms) "Do you have problems with the TV?" While this is a relevant question, it fails to capture a broader area of connectivity and the subsequent impact on a user's life. A revised approach could include a checklist for recreational uses of technology such as:

Check the following that apply to you:

- Listen to music through a smartphone/mp3 player
- Use headsets for work or video gaming systems
- Use video phone calls such as Facetime or Skype when communicating with loved ones
- Family/neighbors report the TV is too loud

By capturing this information early on, HCPs can begin to prioritize which features are right for which users and thus improve the efficiency of the fitting process.

The fitting of the future

In order for the fitting of the future to become the reality of today, HCPs must incorporate the hearing system mentality into their daily clinical routine. They can augment their intake forms to include questions about technology attitudes and opportunities for situational use. Furthermore, they can engage users through demonstration and illustration to make concepts very tangible. Finally, these demonstrations can be enhanced through contextually relevant training based upon the true end user intent. With current app technology we are opening the door for an engaging technological hearing experience from end-to-end.

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