Provision, perception and use of trainable hearing aids in Australia: a survey of clinicians and hearing impaired adults

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Key words

Trainable hearing aid, survey, provider, hearing impairment

Abbreviations

HA: hearing aid

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Abstract

Objective. This study set out to obtain information on the impact of trainable hearing aids among clinicians and hearing aid users and candidates.

Design. Two online adaptive surveys were developed to evaluate provision, uptake, and experience or expectation of trainable hearing aids.

Study Sample. Responses from 259 clinicians, 81 hearing aid users and 23 candidates for hearing aids were included.

Results. Over half of the clinicians surveyed activated trainable features in hearing aids. Most of these clinicians activated trainable features for selected users, and reported positive findings. Most commonly trainable features were not activated because the hearing aid controls had already been disabled for management or client preference. One-third reported that they had no access to trainable aids or they were unsure about the presence or activation of trainable features. The remaining clinicians never activated trainable features. One in five users reported having used trainable aids and 93% would train again. Over 85% of the remaining hearing-impaired adults were interested in trainable aids.

Conclusions. Positive reports from most providers and users who had experience with the trainable feature support the provision of trainable aids to selected clients, pending more evidence-based data to support the clinical management of such devices.

Introduction

Hearing aids (HAs) are typically fitted based on the individual's hearing loss using established prescriptions aiming to provide benefit by improving audibility of speech and ensuring listening comfort for loud sounds (Abrams et al., 2012). These prescriptions are based on average data (Byrne & Dillon, 1986), and therefore it is expected that some listeners need fine-tuning of the prescribed response (Dillon, 2012; Valentine et al., 2011). Research into the benefit of fine-tuning (any changes made after the initial fitting) is limited and has not shown an improvement in satisfaction as measured using questionnaires (Cunningham et al., 2001; Saunders et al., 2009). However, Saunders et al. (2009) did find those who had fine-tuned HA settings were using their HAs significantly more. In the group of 20 participants who had fine-tuned settings, 40% reported wearing their HAs for 8 hours per day or more, compared to 12.5% in the group of 40 whose HAs were not fine-tuned. Despite limited evidence for the benefit of fine-tuning, clinicians will often be asked to improve users' listening experience and need to decide whether to change the HA settings or counsel the user that they will adapt to the sound (Cunningham et al., 2001; Dillon, 2012).

Fine-tuning can be a complex and drawn-out task due to the number of available HA features, and its dependence on the user's recall and description of the problem (Nelson, 2001; Valentine et al., 2011). Furthermore, an assessment of the changes made to the HA settings is often not possible until the user returns to the same or a similar listening environment and recreating the scene in the clinic is difficult (Dreschler et al., 2008). Most of the difficulties of fine-tuning in the clinic could be overcome by a user-directed process: a trainable feature that is designed to learn the user's preferred settings in different listening environments. Based on the user's consistent changes to the HA controls and concurrent acoustic information from the environment, the trainable feature modifies the HA settings over time to match the user's preference (Dillon et al., 2006). The HA settings that can be trained differ across manufacturers and range from the overall volume, sometimes dependent on the environment, to the inclusion of noise reduction, speech enhancement and directionality. Other trainable algorithms can modify environment specific gain and compression across frequency bands. A summary of the trainable features used in traditional HAs are displayed in Table 1.

The proposed advantages of successful trainable HA fitting for the client and clinician were described by Dillon et al. (2006). They can be summarised as obtaining personalised HA settings in fewer visits and improving satisfaction for clients, and reducing the time needed for HA fitting and fine-tuning for clinicians. Consequently, there could be (i) more time available to clinicians for counselling activities; and (ii) more capacity to provide services to a hearing-impaired population which is expected to increase in size. Although trainable HAs have been commercially available since 2006, there are few reports of perceptions of this HA feature and no reports of its use. It is therefore unclear as to whether the suggested benefits of training HAs for both clients and clinicians would be realized in clinical practice.

Research that has been conducted into trainable HAs has shown that the concept was perceived positively by those already receiving hearing care, and that most research participants could train successfully and preferred their trained settings. A survey by Keidser et al (2007) showed that 93 out of 100 participants ranging in age from 23 to 95 years (median = 77) understood the concept when described to them and that 91% of them thought the concept was positive, with 66% expecting a personal benefit if they could access trainable HAs. Although research into the training process is limited, it shows most volunteers can train their HAs, with 24 out of 26 (Keidser & Alamudi, 2013) and all but “a couple” out of 36 research participants (Palmer, 2012) obtaining a response appropriate for their hearing loss. Listeners’ preference for their trained response has been assessed in the field in three studies: Zakis et al. (2007); Palmer (2012) and Keidser and Alamudi (2013). Although preference was evaluated differently in each study, all report that the majority of participants preferred their trained over the prescribed setting or had no preference for either.

Using a prototype trainable HA, seven out of eight participants preferred their trained response when voting in real time between their trained and prescribed settings (Zakis et al., 2007). Referring to an unpublished study, Palmer (2012) reports that 22 out of 36 participants (61%) preferred their trained settings based on diary entries. Lastly, Keidser and Alamudi (2013) established preference based on three measures derived from an exit interview and a diary kept during a comparison trial. Eight out of ten, and three out of four listeners with a consistent preference, preferred their trained over their prescribed response (Keidser & Alamudi, 2013).

Suggestions on how to implement trainable HA fitting in clinical practice have been made (Keidser & Alamudi, 2013; Mueller, 2014). However, no evidence-based guidelines are currently available to assist clinicians, raising questions about how potential users' candidacy is currently evaluated and how best to support clients who choose to train their device. To address this, the overall aim of this study was to investigate perceptions of and experience with trainable HAs as reported by clinicians and hearing-impaired adults. The clinician survey was developed to evaluate (1) the provision of trainable HAs, (2) experiences with fitting trainable HAs, (3) perceived advantages and disadvantages, (4) used or proposed candidacy criteria, and (5) if there was a relationship between clinician demographic characteristics and the willingness to provide a trainable feature. The survey designed for hearing-impaired adults aimed to investigate (1) awareness of the concept of trainable HAs, (2) willingness to use trainable HAs and reasons for this, (3) advantages and disadvantages of usage, (4) if access to trainable HAs would make HA rehabilitation more attractive to HA candidates, and (5) if there is a relationship between client demographic characteristics and interest in using trainable HAs.

Method

Material

Two online surveys (one for clinicians and one for hearing-impaired adults) were developed for the study (the surveys are available in the online version of the journal: http//www.informaworld.com/(DOI number)). Both surveys were built using SurveyGizmo (www.surveygizmo.com) and were adaptive: questions displayed were based on the respondent's familiarity with trainable HAs and previous responses. To balance the exploratory nature of the study and the time needed for completion, most items were forced-choice with the option to provide an additional response. Items and response options were based on several sources: theoretical expectations (Dillon et al., 2006), researchers' experience, group discussions with hearing-impaired adults, and interviews with clinicians. Preliminary surveys were piloted with 8 clinicians and 8 adults with hearing loss.

Both surveys were composed of four sections: 1) qualifying items, 2) contingency items, 3) items on experience or expectations and 4) demographic items. Firstly, qualifying items ensured only the targeted audience participated. Next, contingency items provided a description of trainable HAs and established the degree of experience. Based on their responses, respondents were shown items evaluating their experience with or expectations of trainable HAs. Both surveys closed with demographic items, including for example the inviting organisation.

The format of the questions depended on the section of the survey. Qualifying, contingency and demographic items were all compulsory and in a multiple-choice format. To evaluate experiences or expectations, different formats were used: Likert scale rankings, forced-choice responses with the option to add an item, as well as open-ended questions. In total, participants were shown 18 to 38 items (clinicians) or 14 to 20 items (hearing-impaired adults) based on their experience with trainable HAs. The average completion time for the surveys was just under 15 minutes for clinicians, and around 6 minutes for hearing-impaired adults. Approval for the surveys was granted by the Australian Hearing Human Research Ethics Committee and the Behavioural and Social Sciences

Ethical Review Committee of the University of Queensland. Responses were obtained from July until September 2015.

Analysis

Non-parametric tests were used for analysis: two-group comparisons were made using the Chi-square test for categorical information and the Mann-Whitney U test for ordinal data; differences in continuous variables measured on an ordinal scale between three groups were assessed using the Kruskal-Wallis analysis of variance by rank test. Responses added to a forced-choice list were evaluated for overlap with existing items, and the remainder were reviewed to evaluate common themes (Braun & Clarke, 2006). Comments and responses to open questions were reviewed for information not covered by the survey.

Clinician survey

Design

Clinicians were invited via email by professional organisations: Audiology Australia, the Australian College of Audiology and the Hearing Aid Audiometrist Society of Australia. To qualify for participation, clinicians needed to be practising as an audiologist or audiometrist with a workload involving product training and sales of HAs or adult HA fitting and rehabilitation. Clinicians also needed to indicate they had discussed HA selection in the last month with either adult clients, clinicians or students. Just over 2900 clinicians were contacted and, after a reminder was sent out, a total of 259 clinicians completed the survey. The response rate across the different organisations ranged from 5 to 11% of the membership. The majority of the respondents were from Audiology Australia (77%).

Depending on their experience with trainable HAs, clinicians were asked about training outcome, candidacy criteria, barriers and facilitators for use and advantages and disadvantages to the user, themselves or their practice. Clinicians were also shown a list of trainable HAs and asked to indicate the ones they had fitted.

Results

Demography

Table 2 shows the characteristics of the clinicians who responded to the survey. Almost half were over 40 years of age (49%), two thirds were women (69%), and the majority were audiologists (79%). Half of the clinicians had up to 10 years of fitting experience (52%). With some professionals combining work environments, the largest proportion worked in private practice (47%), 29% worked for the Commonwealth Government solely providing services under the Australian Government scheme, and 28% worked in independent practice. On average, more audiometrists were male (χ^2 = 14.9; p = 0.001), older (U = 2776; $p < 0.001$) and had fitted hearing HAs for longer than audiologists (U = 4140; $p < 0.01$). The age and gender characteristics of respondents from Audiology Australia were compared to the characteristics of the entire membership. Gender balance was similar, but the responders skewed slightly older than the membership.

Provision of trainable aids

Different provider groups, their demographic differences and reasons for provision of trainable HAs were evaluated. Figure 1 shows the clinicians' responses on activation of the trainable feature. Two thirds of respondents actively decided whether to enable the trainable feature (66%): 53% activated it (referred to as providers) and 13% disabled it (referred to as active non-providers). The remaining 34% of clinicians did not make an active decision on whether to activate the trainable feature, and were labelled passive non-providers. As there were no significant differences in the proportions of audiologists and audiometrists across provider groups, findings from both professions are described together.

Comparison of the three provider groups (providers, active non-providers and passive non-providers) showed they differed significantly in age (H(2, n = 259) = 7.7; p = 0.02) and experience with fitting HAs (H(2, n = 259) = 8.0; p = 0.02). Paired comparisons of the demographic characteristics, showed there was no significant difference between providers and passive non-providers in terms of age (U = 5584; p = 0.4), gender (χ^2 = 0.17; p = 0.7) and years of HA fitting experience (U = 5242; p = 0.1). There were significant differences between providers and active non-providers in terms of age (U = 1794; p = 0.02) and years of experience (U = 1713; p = 0.009). The largest proportion of both groups was aged 31 to 40 years, however, 47% of providers were aged over 41 years compared to 31% of active non-providers. Similarly, the median provider had 11 to 20 years of experience, compared to 6 to 10 years for the active non-provider. Lastly, the active non-providers were more likely to be male (χ^2 = 12.8; p = 0.0003) and younger (U = 1066; p = 0.01) than the passive non-providers, with the median active non-provider reporting to be aged 31 to 40 years and the median passive non-provider 41 to 50 years.

When asked about the availability of trainable HAs, almost half of all providers (47%) reported up to 25% of the HAs fitted were trainable, reaching up to 50% for 28% of the providers. Most of the providers (81%) activated trainable features for selected clients only. The majority of selective providers (n = 73/111) estimated that trainable features were activated for up to 25% of clients with trainable HAs. Although audiometrists had, on average, more HA fitting experience, the proportion of those with experience fitting trainable HAs was not significantly different across professions (χ^2 = 1.1; p = 0.3).

Half of the passive non-providers (51%) indicated they could not order trainable HAs or had not fitted them in the last 6 months, the other half (49%) stated they did not know if they could order trainable HAs or whether a trainable feature was activated. Across these two groups, clinicians were similar in age (U = 729; p = 0.07), fitting experience (U = 804; p = 0.2), and profession (χ^2 = 0.2; p =

0.6) and only differed significantly based on gender (χ^2 = 6.2; *p* = 0.01), with more women unsure about the availability or activation of the trainable feature than men. Furthermore, when asked if they would consider activating a trainable feature if it were available, their responses were not significantly different (*U* = 828; *p* = 0.3).

Just under 65% of clinicians who responded were activating or would consider activating a trainable feature. Most of the providers fitted trainable HAs because they believed such aids could benefit their clients (88%), and because they wanted to find out how it would affect clients' outcomes (43%). Passive non-providers, were asked if they would consider providing the feature if it were available. Opinions were split evenly: a third thought future provision unlikely (33%), another third was neutral (32%), while another third considered provision likely (35%). The following groups of clinicians were asked why they did not or would not activate a trainable feature: providers activating sometimes (n = 111), active non-providers (n = 35), and passive non-providers who considered it unlikely they would activate a trainable feature (n = 29). The most common reasons why providers would not activate a trainable feature was because the HA controls were already disabled (71%) or they thought the user might not understand the concept (68%). In addition to these reasons, passive non-providers feared the user would not be able to train successfully (66%). Lastly, active non-providers had the same concerns, but also preferred manual fine-tuning (49%) and felt the potential user might not have enough experience for successful training (43%).

After answering items on the availability of trainable HAs at the beginning of the survey, further awareness of the concept was obtained by asking respondents to indicate all the trainable HAs they had fitted. Over 80% of the clinicians who were unsure if they had fitted trainable HAs (n = 34/36), or reporting they could not order them (n = 20/23), had indeed fitted HAs with a trainable feature.

<u>Experiences</u>

Providers (n = 137) were asked if and how they evaluated the trainable feature, what the outcome was and whether activating it had changed their fitting procedures. The majority evaluated the trained settings (83%). Most of these providers evaluated the trained settings by obtaining a subjective report from the user (83%), combined with other approaches: evaluation as part of the fitting (70%), or comparison of the initial and trained HA settings (49%) or measured HA responses (25%). Most providers (91%) reported accepting the trained settings the client had obtained most of the time, and a third reported these were similar to the original settings. Interestingly, a third (37%) reported to keep the settings but provided further fine-tuning. A small proportion of providers (5%) reported that most of the time they would reprogram the pre-trained settings. Most providers (85%) indicated that providing trainable HAs had not, or only slightly, changed their fitting and follow-up procedures, and 3% reported that they had stopped activating this feature.

Advantages and disadvantages of provision

Respondents were asked about advantages and disadvantages of activating trainable features to themselves or their practice, and HA users. An overview of responses from providers and non-providers (active and passive) are shown in Figure 2. Advantages were similar irrespective of experience in providing the trainable feature, however disadvantages differed. Increased client retention and a simpler fine-tuning process were advantages that providers most often reported (58%; 39%) and non-providers expected (57%; 45%). As advantages to the user, increased psychological ownership and an improved outcome were also most frequently selected by both providers (69%; 64%) and non-providers (61%; 61%). While over half of the providers (63%) indicated no disadvantage to themselves, the disadvantage selected by the largest proportion of non-providers (60%) was that the training process could be time-consuming. Providers of trainable HAs were mainly concerned that using a trainable feature could mask slowly developing hearing problems (45%). This was also a concern for non-providers (63%), but accompanied by additional concerns, including: a negative outcome (73%), the need for extra appointments (63%) and the feeling of personal failure in the user (62%). Similarly, more providers (26%) than non-providers (4%) thought there were no disadvantages from using trainable features to their clients.

Used and proposed candidacy criteria

Providers who activated the trainable feature sometimes (n = 111), and passive non-providers who were neutral or likely to activate the feature if it were available (n = 58) reported similar candidacy criteria. A user's cognitive status was the most likely reason for not recommending training by providers (85%) and passive non-providers (91%). The remaining criteria chosen by at least one in two providers and passive non-providers were users' finger dexterity (62%; 76%), personality (59%; 72%), interest in the feature (56%; 72%), HA experience (69%; 66%) and diverse listening needs (57%; 59%). There was no relationship between attitude towards activating trainable features and the demographic characteristics of clinicians: there was no significant difference in age (U = 4869; p = 0.3), fitting experience (U = 4612; p = 0.1), gender (χ^2 = 1.36; p = 0.2) and profession (χ^2 = 1.43; p = 0.2) between those activating or predisposed to activate trainable features (n = 167), and those not or unlikely to activate trainable features (n = 64).

Survey for hearing-impaired adults

Design

Hearing-impaired adults were either research volunteers listed in the National Acoustic Laboratories Volunteer Database or clients of two hearing care providers: Australian Hearing and Neurosensory. Overall, just under 600 participants aged 18 years or over were invited via email and 104 valid responses (81 HA users and 23 HA candidates) were obtained. The response rate for those invited via their provider was 14%, and it was 44% for the research volunteers. HA candidates qualified if they reported any difficulty hearing, ranging from slight to very much difficulty (Dillon, 2008), but had never used HAs. The Australian Government Hearing Services Program provides fully or partially subsidised hearing care to those receiving government support, veterans, and their dependents, as well as indigenous Australians aged 50 years and over. Trainable features are currently available in HAs with a mid-to-high technology level from some manufacturers, requiring the user's financial contribution.

Hearing-impaired adults with training experience answered items on the training process and outcome, while those without experience were asked if and why they would like to train HAs. In addition to basic demographic information, respondents were also asked about their HA use (IOI-HA item 1, Cox & Alexander, 2002) or readiness for change. As the uptake of HAs is a health behaviour change, candidates were asked to indicate which of the following statements matched their readiness for change, with the stages known to be related to compliance with health recommendations (Prochaska et al., 1994). This established if they were in the contemplation (I am not ready to take action now), preparation (I will take action soon) or action stage (I am ready to take action now) (Milstein & Weinstein, 2002). The survey for hearing-impaired adults followed the health literacy guidelines from Caposecco et al. (2011) to ensure accessibility.

Results

Demography

The majority of respondents were over 60 years of age (82%), retired (74%) and HA users (78%) (Table 3). More men (60%) than women responded and 70% had completed a degree beyond high school. Unsurprisingly, the HA users reported more difficulty hearing ($U = 421$; $p < 0.0001$) and a longer duration of hearing loss ($U = 442$; $p < 0.0001$) than the candidates. As could be expected (Bekkers, 2010), the research volunteers had a significantly higher level of education than the hearing centre clients ($U = 686$; $p = 0.009$). There was also a difference in education level between those with trainable HA experience and those with non-trainable HA experience ($U = 239$; $p = 0.002$). The 15 participants with trainable HA experience had, on average, a lower level of education than users of non-trainable HAs (n = 66). As the proportion of HA users who had used the trainable feature was similar for the research volunteers (18%) and hearing centre clients (19%), they were evaluated as one group.

Awareness

HA users (n = 81) were first asked if they had heard about trainable or learning HAs and then shown a description and asked if they had trained. Only 11% of HA users had heard about trainable HAs, but those with trainable HA experience were four times more likely to recognise this phrase than those without such experience.

Advantages and disadvantages of use

The 15 HA users who reported to have trained (19% of HA users; Figure 3) were asked about their impressions of the process, outcome and any experienced advantages or disadvantages. The majority (n = 13) found it easy to train their HAs, however one respondent reported an overall negative experience, being the only one to report worse sound quality after training. The positive findings reported by the majority of users was reflected in the advantages they had experienced. They had obtained personalised settings (n = 8), felt more involved in their hearing care (n = 5) and made fewer changes to their HA controls over time (n = 5). Additionally, a third of trainable HA users (n = 5) reported no disadvantages. Seven participants did report a disadvantage, most commonly that training was time consuming (n = 3). While two users reported that training improved sound quality, they also selected the response option “Worse sound quality: I didn’t like the settings I obtained” as a disadvantage. Only the respondent with an overall negative outcome thought it unlikely they would train again. There was no significant difference in gender (*Fisher’s* $p = 0.3$), age ($U = 395$; $p = 0.2$) and hours of HA use ($U = 420$; $p = 0.4$), between HA users with and without experience of trainable devices.

Willingness to train hearing aids

Users of non-trainable HAs (n = 66) and HA candidates (n = 23) were asked about their willingness to use trainable HAs. Over 85% of these participants indicated they would like to try training, or be given the option to train, respectively; selecting personalising their HA settings for different situations as the most common reason (85%). There was no significant difference in age ($U = 375$; $p = 0.5$), gender (*Fisher's* $p = 0.2$) and education ($U = 380$; $p = 0.5$) between those willing (n = 87) and not willing (n = 11) to trial trainable HAs. In the small group of those who preferred not to train (n = 11), the eight HA users mainly indicated they preferred professionals to set their HAs (n = 6), whereas the three candidates were especially concerned about the potential extra cost (n = 3). Lastly, the 23 HA candidates were asked whether knowing about trainable HAs made them feel more ready to obtain HAs. Half (52%) felt more ready to obtain a HA, with another third (35%) unsure. There was no relationship between candidates' willingness to try HAs and their readiness for change (*Fisher's* $p = 0.4$).

Discussion

This first study looking into the application of trainable HAs found that these are being used selectively in clinical practice. As the trainable feature is not available in all technology levels and brands, and is only provided to selected clients, the actual number of users fitted is naturally limited. This is further evident by the relatively small proportion of surveyed HA users who were fitted with trainable HAs. Providers of trainable aids were older and had more experience than those never activating trainable features. This observation is in line with findings on patient-centredness in audiology, with older audiologists who had practiced longer showing a significantly greater preference for increased client-involvement in hearing care (Laplante-Lévesque et al., 2014). Although half of the clinicians activated the trainable feature, awareness of this feature amongst clinicians and clients was still relatively low. It seems the trainable feature is not as actively promoted as it could be, potentially due to the lack of evidence-based information on candidacy for and outcomes with trainable HAs.

Reports from the majority of providers and users with trainable HA experience were positive. Most providers accepted the trained settings the clients had obtained, but a third of the providers continued fine-tuning after training. The survey did not reveal the reasons why further fine-tuning was provided and more systematic research is needed to determine the reasons for this, for example, because the training period had been too short, users needed more support in how to train effectively or the training algorithm did not enable the user to alter the hearing aid settings they wished to change. Only one HA user fitted with the trainable feature reported an overall negative experience. This finding is similar to outcomes from other trials where a minority of participants obtained settings that were inferior to those prescribed (Keidser & Alamudi, 2013; Palmer, 2012). Two users of the feature in the current study reported seemingly contradictory experiences, indicating training had improved sound quality, but also citing the disadvantage that they obtained settings they did not like. It is open to speculation whether these users found training improved sound quality but not sufficiently so.

Both providers and users with experience of the trainable feature indicated more advantages than disadvantages from having the trainable feature activated, and the largest proportion of both providers and users experienced no disadvantages from providing and using trainable HAs. Parallels can be drawn between the advantages providers attributed to users and the advantages users reported themselves. Providers mainly indicated users had increased psychological ownership and an improved outcome, with users reporting feeling more involved with their hearing care and obtaining personalised settings. This observation is of interest as self-management has been shown to result in greater adherence to treatment and better outcomes in other health areas (Ory et al., 2013; Simmons et al., 2014).

A comparison with proposed advantages reported by Dillon et al. (2006) and Keidser et al. (2007), shows that these benefits have been realised only to a certain degree. A third of providers reported having more time available when fitting trainable HAs; however the majority also reported limited changes to their fitting and follow-up procedure. It is possible that the number of trainable HAs fitted has not been sufficient to change practices, or that deviation from standard practice has been limited because of the need to comply with the requirements of the Australian Government Scheme for the provision of hearing aids. Half of the trainable HA users indicated the advantage of obtaining personalised settings, with a third reporting that they made fewer changes to the HAs over time. Attending fewer appointments was not a clear advantage for many users, in line with providers reporting trainable HAs had a limited impact on their fitting practices. Perhaps there is a need to review clinical practices and appointment structures to allow for some of the potential benefits of providing trainable HAs to take effect.

Interestingly, the selection criteria for when to activate the trainable feature were similar irrespective of providers' experience with providing the feature. Two common criteria were poor cognitive status and finger dexterity, both associated with older age. Without the availability of evidence-based criteria, providers selected factors known to influence HA manipulation (Erber, 2003; Kricos, 2006; Kumar et al., 2000) as important for training HAs. This is further supported by providers indicating the most common reason why training was not offered, was that the HA controls had already been deactivated.

This survey found over 85% of hearing-impaired adults expressed interest in trainable HAs. Comparison with survey results from hearing centre clients before trainable HAs were commercially available, showed this result was similar to the 91% of respondents who found the training concept positive but higher than the 66% of participants who expected a personal benefit from training (Keidser et al., 2007). A general positive attitude towards new technology has been observed with

HA users reporting better outcomes with a “digital” (Bentler et al. 2003) or “new” HA (Dawes et al., 2013) compared to a “conventional” HA, even though the HAs compared were identical. Despite the expressed interest in training, it is unlikely all those willing to train would be suited for using the feature, considering the requirement for manipulation of small controls and repeated HA adjustments. Potential users might underestimate the need to, or overestimate their ability to (Doherty & Desjardins, 2012; Dullard & Cienkowski, 2014), make adjustments. Finally, half of the candidates indicated that knowing about trainable HAs made them feel more ready to obtain a HA. Despite this positive result, the next step to taking action cannot be assumed. Laplante-Lévesque et al. (2012) found that 24% of adults who had decided upon an intervention after shared decision making had not taken action 6 months later.

The main limitation of this study is the potential response bias created by the recruitment methods. Firstly, the invitation sent to clinicians mentioned that experience with trainable HAs was not necessary to complete the survey, but lack thereof might have stopped some from participating, increasing the proportion of clinicians with trainable HA experience in the study sample. Secondly, all users and potential users had received some degree of hearing care, suggesting their attitude towards HAs was likely more positive than among hearing-impaired people who had not sought help (Meyer et al., 2014). Of interest is that the experience with and attitude towards training among the research volunteers, who made up 26% of respondents, was not different from the hearing centre clients. Another limitation was the low number of clinicians responding, even though the majority of members were expected to be working in adult hearing aid fitting. Potential reasons for the low response rate could include the time advised it would take (up to 20 minutes) or unfamiliarity with the topic. A further limitation was that the proportion of trainable hearing aid users captured may be underestimated; either because users did not recognise that they were provided with a trainable HA from the description provided in the survey, or they have forgotten, or because their clinician may not have advised them about the activation of this feature. A final limitation was that this study was set up to obtain an overall picture of the provision and activation of trainable hearing aids. As the majority of providers indicated they provided trainable aids from more than one manufacturer, their impressions are based on a mix of different trainable features. More systematic research is needed to examine if provision of and experience with trainable features differ between the various implementations.

Overall, the results suggest a future for trainable HAs, but further research is needed to help clinicians support people with hearing impairment to obtain the best possible training outcome. There are currently no evidence-based candidacy criteria or guidelines on how to assist clients during the training process. To develop such guidelines, it is necessary to obtain a better understanding of the efficacy of different training strategies.

Conclusion

Given the positive reports from most providers and users who had experience with the trainable feature, trainable HAs could be provided to selected clients, pending the availability of evidence-based guidelines for recommending and managing trainable aids.

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Declaration of interest

The second author is a co-author of the patent on trainable hearing aids but has no personal financial gain from the patent. The other authors declare no conflict of interest.

Tables

Table 1. Trainable features used in hearing aids from the main manufacturers.

Manufacturer	Training name	Trained HA settings
Bernafon	Data Learning	Overall gain
Interton	Learning volume control	Overall gain
Oticon	Life Learning	Environment specific overall gain, level-dependent
Phonak	Self Learning	Environment specific overall gain
	User Preference Learning	Environment specific, frequency selective volume, directionality, noise cancellation, wind noise and reverberation suppression
	User Preference Tuning	As User Preference Learning, but only applied after clinician accepts settings
ReSound	Environmental Learner	Environment specific overall gain
Siemens	DataLearning	Overall gain
	SoundLearning	Overall gain and compression in four frequency bands
	SoundLearning 2.0	Environment specific overall gain and compression in four frequency bands
Sonic	Data Learning	Overall gain
Starkey	Self Learning	Overall gain
Unitron	Self Learning	Environment specific gain, noise reduction, speech enhancement, (directionality)

Table 2. Demographic characteristics of clinicians (n = 259)

Variable	Response category	Number of responses	Percentage
Age (years)	<25	7	3
	25 to 30	43	17
	31 to 40	83	32
	41 to 50	76	29
	51 to 60	37	14
	older than 60	13	5
Gender	female	180	69
	male	75	29
	indeterminate/intersex/unspecified	4	2
Profession	audiologist	205	79
	audiometrist	54	21
Fitting experience (years)	< 1	12	5
	1 to 5	63	24
	6 to 10	60	23
	11 to 20	73	28
	21 to 30	29	11
	31 to 40	20	8
	> 40	2	1
Work setting	Commonwealth government	75	29
	private practice	122	47
	independent practice	72	28
	private hospital/ medical practice	9	3
	not-for-profit	20	8
	manufacturer	9	3

Table 3. Demographic description of the hearing aid users and candidates *(n = 104)*

Variable	Response category	*All (n = 104)* Number of responses	Percentage
Age (years)	18 to 30	4	4
	31 to 40	3	3
	41 to 50	3	3
	51 to 60	8	8
	61 to 70	31	30
	71 to 80	39	37
	81 to 90	15	14
	older than 90	1	1
Gender	female	42	40
	male	62	60
	indeterminate/intersex/unspecified	0	
Employment	student; apprentice	3	3
	employed full-time	11	11
	employed part-time	10	10
	house duties (stay at home parent)	1	1
	unemployed	2	2
	retiree	77	74
Education	primary	3	3
	year 10	14	13
	high school – year 12	15	14
	TAFE/ technical college	34	33
	university	38	37

		Aid users (n = 81)		*Candidates (n = 23)*	
Variable	Response category	Number of responses	Percentage	Number of responses	Percentage
Hearing difficulty	no difficulty	2	2	0	
	slight difficulty	9	11	9	39
	moderate difficulty	26	32	13	57
	quite a lot of difficulty	27	33	1	4
	very much difficulty	17	21	0	
Duration hearing loss (years)	less than 1	0		0	
	1 to 5	11	14	11	48
	5 to 10	17	21	6	26
	10 to 20	21	26	5	22
	20 to 30	10	12	0	
	30 to 40	5	6	0	
	over 40	17	21	1	4

List of figures

References

Abrams H.B., Chisolm T.H., McManus M. & McArdle R. 2012. Initial-fit approach versus verified prescription: comparing self-perceived hearing aid benefit. *J Am Acad Audiol*, 23, 768.

Bekkers R. 2010. Who gives what and when? A scenario study of intentions to give time and money. Soc Sci Res, 39, 369-381.

Bentler R.A., Niebuhr D.P., Johnson T.A. & Flamme G.A. 2003. Impact of Digital Labeling on Outcome Measures. *Ear Hear*, 24, 215-224.

Braun V. & Clarke V. 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3, 77-101.

Byrne D. & Dillon H. 1986. The National Acoustic Laboratories' (NAL) New Procedure for Selecting the Gain and Frequency Response of a Hearing Aid. *Ear Hear*, 7, 257-265.

Caposecco A., Hickson L. & Meyer C. 2011. Assembly and insertion of a self-fitting hearing aid: design of effective instruction materials. *Trends Amplif*, 15, 184-195.

Cox R.M. & Alexander G.C. 2002. The International Outcome Inventory for Hearing Aids (IOI-HA): psychometric properties of the English version. *Int J Audiol*, 41, 30-35.

Cunningham D.R., Williams K.J. & Goldsmith L.J. 2001. Effects of Providing and Withholding Postfitting Fine-Tuning Adjustments on Outcome Measures in Novice Hearing Aid Users: A Pilot Study. *Am J Audiol*, 10, 13-23.

Dawes P., Hopkins R. & Munro K.J. 2013. Placebo effects in hearing-aid trials are reliable. *Int J Audiol*, 52, 472-477.

Dillon H. 2008. Outcomes for wearers of hearing aids and improving hearing aid technology - Denis Byrne Memorial Lecture *Audiology Australia XVIII National Conference*. Canberra.

Dillon H. 2012. Problem solving and fine-tuning *Hearing Aids*. Sydney, Australia: Boomerang Press, pp. 354-374.

Dillon H., Zakis J.A., McDermott H.J., Keidser G., Dreschler W., et al. 2006. The trainable hearing aid: What will it do for clients and clinicians? *Hear J*, 59, 30-36.

Doherty K.A. & Desjardins J.L. 2012. The Practical Hearing Aids Skills Test-Revised. *Am J Audiol*, 21, 100-105.

Dreschler W.A., Keidser G., Convery E. & Dillon H. 2008. Client-based adjustments of hearing aid gain: the effect of different control configurations. *Ear Hear*, 29, 214-227.

Dullard B.A. & Cienkowski K.M. 2014. Exploring the Relationship Between Hearing Aid Self-Efficacy and Hearing Aid Management. *SIG 7 Perspectives on Aural Rehabilitation and Its Instrumentation*, 21, 56-62.

Erber N.P. 2003. Use of hearing aids by older people: influence of non-auditory factors (vision, manual dexterity). *Int J Audiol*, 42 Suppl 2, 2S21-25.

Keidser G. & Alamudi K. 2013. Real-life efficacy and reliability of training a hearing aid. *Ear Hear*, 34, 619-629.

Keidser G., Convery E. & Dillon H. 2007. Potential Users and Perception of a Self-Adjustable and Trainable Hearing Aid: A Consumer Survey. *Hear Rev*, 14, 18-20, 24, 26, 31.

Kricos P.B. 2006. Audiologic management of older adults with hearing loss and compromised cognitive/psychoacoustic auditory processing capabilities. *Trends Amplif*, 10, 1-28.

Kumar M., Hickey S. & Shaw S. 2000. Manual dexterity and successful hearing aid use. *J Laryngol Otol*, 114, 593-597.

Laplante-Lévesque A., Hickson L. & Grenness C. 2014. An Australian survey of audiologists' preferences for patient-centredness. *Int J Audiol*, 53, S76-S82.

Laplante-Lévesque A., Hickson L. & Worrall L. 2012. What makes adults with hearing impairment take up hearing aids or communication programs and achieve successful outcomes? *Ear Hear*, 33, 79-93.

Meyer C., Hickson L., Lovelock K., Lampert M. & Khan A. 2014. An investigation of factors that influence help-seeking for hearing impairment in older adults. *Int J Audiol*, 53 Suppl 1, S3-17.

Milstein D. & Weinstein B.E. 2002. Effects of information sharing on follow-up after hearing screening for older adults. *J Acad Rehab Audiol*, 35, 43-58.

Mueller H.G. 2014. Trainable Hearing Aids – Friend or Foe for the Clinician? *Audiology Online*. Article 24696. Retrieved from: http://www.audiologyonline.com/

Nelson J.A. 2001. Fine tuning multi-channel compression hearing instruments. *Hear Rev*, 8, 30-35.

Ory M.G., Ahn S., Jiang L., Smith M.L., Ritter P.L., et al. 2013. Successes of a National Study of the Chronic Disease Self-Management Program: Meeting the Triple Aim of Health Care Reform. *Med Care*, 51, 992-998.

Palmer C. 2012. Implementing a gain learning feature. *Audiology Online*, Article 11244. Retrieved from: http://www.audiologyonline.com/

Prochaska J.O., Velicer W.F., Rossi J.S., Goldstein M.G., Marcus B.H., et al. 1994. Stages of change and decisional balance for 12 problem behaviors. Health Psychol, 13, 39-46.

Saunders G.H., Lewis M.S. & Forsline A. 2009. Expectations, Prefitting Counseling, and Hearing Aid Outcome. *J Am Acad Audiol*, 20, 320-334.

Simmons L.A., Wolever R.Q., Bechard E.M. & Snyderman R. 2014. Patient engagement as a risk factor in personalized health care: a systematic review of the literature on chronic disease. *Genome Med*, 6, 16.

Valentine S., Dundas J.A. & Fitz K. 2011. Evidence for the use of a new patient-centered fitting tool. *Hear Rev*, 18, 28-34.

Zakis J.A., Dillon H. & McDermott H.J. 2007. The design and evaluation of a hearing aid with trainable amplification parameters. *Ear Hear*, 28, 812-830.