

Investigating the knowledge, skills and tasks required for hearing aid management: Perspectives of clinicians and hearing aid owners

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Abbreviations: SD: Standard Deviations.

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ABSTRACT

Purpose: To identify hearing aid owners' and clinicians' opinions of the knowledge, skills and tasks required for hearing aid management and the importance of each of these to overall success with hearing aids.

Method: Concept mapping techniques were used to identify key themes, wherein participants generated, sorted and rated the importance of statements in response to the question "What must hearing aid owners do in order to use, handle, manage, maintain and care for their hearing aids?" Twenty-four hearing aid owners (56 to 91 years of age; 54.2% male) and 22 clinicians (32 to 69 years of age; 9.1% male) participated.

Result: Participants identified 111 unique items describing hearing aid management within six concepts: 1) "Daily Hearing Aid Use"; 2) "Hearing Aid Maintenance and Repairs"; 3) "Learning to Come to Terms with Hearing Aids"; 4) "Communication Strategies"; 5) "Working with Your Clinician"; and 6) "Advanced Hearing Aid Knowledge". Clinicians' opinions of the importance of each statement varied only slightly from the opinions of the hearing aid owner group. Hearing aid owners indicated that all six concepts were of similar importance, whereas clinicians indicated the concept "Advanced Hearing Aid Knowledge" was significantly less important than the other five concepts.

Conclusion: The results highlight the magnitude of information and skill required to optimally manage hearing aids. Clinical recommendations are made to improve hearing aid handling education and skill acquisition.

INTRODUCTION

The World Health Organization estimates that there are over 360 million people in the world living with a disabling hearing loss (WHO, 2014). Hearing loss is most commonly managed with hearing aids, provided as part of an aural rehabilitation program. The rehabilitation program includes the hearing aid device to optimize hearing function, instruction on the use and management of the device, perceptual training to improve communication, and counselling to enhance social participation and quality of life (Boothroyd, 2007). Where the clinician is primarily responsible for the selection and programming of hearing aids, the hearing aid owner remains responsible for the ongoing use, handling, maintenance and care of hearing aids (described hereafter as hearing aid management). Thus, education and training regarding hearing aid management is an essential component of any hearing rehabilitation program (Boothroyd, 2007; Meister, Lausberg, Kiessling, von Wedel, & Walger, 2002; Solheim, Kværner, Sandvik, & Falkenberg, 2012).

Such training is generally delivered verbally by the clinician on the day of the hearing aid fitting (initial programming session) and throughout subsequent follow-up appointments if indicated (Ferguson, Brandreth, Brassington, & Wharrad, 2015). Supplemental written information is rarely provided (Kochkin et al., 2010). It is recommended that hearing aid training include how to maintain and operate a hearing aid effectively, how to troubleshoot common problems, counselling on the potential benefits and limitations of hearing aid technology, and techniques to enhance communication (Boothroyd, 2007; Reese & Hnath-Chisolm, 2005; West & Smith, 2007). Although clinical guidelines stipulate that hearing aid management training should be included as part of the rehabilitation program (American

Speech-Language-Hearing Association, 1998; Audiology Australia, 2013), studies investigating management skills suggest that current training is insufficient (Bertoli et al., 2009; El-Molla, Smith, Henshaw, & Ferguson, 2012; Ferrari, Jokura, Silvestre, Campos, & Paiva, 2015; Reese & Hnath-Chisolm, 2005; Upfold, May, & Battaglia, 1990; West & Smith, 2007). The high incidence of hearing aid management difficulty reported is of concern as poor handling skills are associated with low hearing aid use (Kumar, Hickey, & Shaw, 2000; Mulrow, Tuley, & Aguilar, 1992; Popelka et al., 1998), benefit (Campos, Bozza, & Ferrari, 2014) and satisfaction (Bennett, Taljaard, Meyer, & Eikelboom, 2017a; Kumar et al., 2000). As such, there are distinct patient benefits to ensuring hearing aid management skills are acquired at the time of receiving the hearing aid.

The low level of hearing aid knowledge and management skill observed in hearing aid owners is likely influenced by the irregularity in training provided, specifically the varied content and modes of delivery used by clinicians and clinics (Kochkin, 2012). Although studies have demonstrated that hearing aid owners are unable to recall between 25-65% of information provided during the consultations four weeks later (El-Molla et al., 2012; Reese & Hnath-Chisolm, 2005), one study demonstrated that targeted one-on-one training can result in improved device management skills immediately and two to three weeks following the retraining session (Bennett, Jayakody, Eikelboom, Taljaard & Atlas, 2015a). However, the surveys used to measure hearing aid handling skills have only included a portion of the skills needed for hearing aid use (Bennett, Taljaard, Brennan-Jones, Tegg-Quinn, & Eikelboom, 2015b). To date, the number of tasks and the detailed level of knowledge and training required for optimal hearing aid management has not been defined. Availability of a complete list of the knowledge, skills and tasks required for hearing aid management would

benefit both clinicians and hearing aid owners as it could be used as: (1) a training guide to be followed during initial hearing aid management training sessions, (2) a checklist to review at the end of the training program to ensure all necessary information and training was provided, and (3) an assessment tool to evaluate whether the knowledge and skills were adequately learned and retained.

Qualitative research can provide insight into how both clients and clinicians view the range of tasks required for hearing aid management by recording their experiences and perspectives (Knudsen, Laplante-Lévesque, Jones, Preminger et al., 2012). There is a growing body of literature utilising qualitative techniques in audiological research to increase our understanding of patient driven concepts and improve clinical processes (Grenness, Hickson, Laplante-Lévesque, & Davidson, 2014; Knudsen et al., 2012; Laplante-Lévesque, Hickson, & Worrall, 2010; Laplante-Lévesque, Knudsen, et al., 2012; Laplante-Lévesque, Pichora-Fuller, & Gagné, 2006; Linssen, Joore, Minten, van Leeuwen, & Anteunis, 2013). Whereas the majority of these studies have used semi-structured interview or focus group techniques, this study used a mixed methods approach, concept mapping. Concept mapping combines qualitative approaches to data collection with quantitative data analyses to produce visual maps of how participants view a particular topic. Participants put forward statements describing their experiences, perceptions, thoughts or ideas about a specific topic, and then give meaning to these statements through grouping and ranking activities (Trochim, 1989). Concept mapping has been used to understand the context surrounding health related outcomes (Burke, O'Campo, Peak, Gielen, McDonnell & Trochim, 2005) and in audiology research to understand factors involved in the client-clinician interaction that affect hearing aid adoption (Poost-Foroosh, Jennings, & Cheesman, 2015; Poost-Foroosh,

Jennings, Shaw, Meston, & Cheesman, 2011), as well as to investigate problems associated with hearing aid use (Bennett et al., 2017b).

The purpose of this study was to generate a conceptual framework for understanding perceived skill required to optimally manage hearing aids and how these skills are acquired; in doing so, identifying key aspects of the hearing aid fitting process that could be improved. To undertake this, concept mapping techniques were employed to describe 1) the knowledge, skills and tasks required for hearing aid management and the importance of each of these to overall success with hearing aids, and 2) how these skills are acquired; from the perspectives of both hearing aid owners and clinicians. The knowledge gained will inform the development of clinical training and evaluation tools to improve hearing aid management skills, which may subsequently improve hearing aid use, benefit and satisfaction. Although participants in this study generated the data for the two research questions (identification of the skills required for hearing aid use, and how these skills are acquired), only the first will be presented here with the latter to be published in a subsequent paper.

METHODS

Concept mapping techniques were used to generate and analyze the data, and include: a) brainstorming, b) grouping and rating, c) data analysis, and d) interpretation (Burke et al., 2005; Trochim & Kane 2005). The methods used in this study followed those described in Bennett et al. (2017b) and are summarized below.

Participants

The beliefs and behaviors of both hearing aid owners and clinicians with experience in fitting and adjusting hearing aids were sought in this study. Hearing aid owners were recruited via email or post through two participating clinics in Perth and Brisbane, Australia, and via the Communication Research Registry (a database of volunteers in Australia who have consented to being contacted about research projects related to communication disability, including adults with hearing loss). All adult hearing aid owners were invited to participate. Clinicians were recruited via email through a hearing aid manufacturers' database of Australian clientele. All of the clinicians on this database were invited to participate.

The literature describing Concept Mapping processes does not specify a minimum number of participants for the brainstorming activity, although Trochim (1989) describe preferring groups of 10 to 20 people to insure a variety of opinions and still enable group discussion. Participants should be diverse and represent all stakeholders involved in a topic, in this case, both hearing aid owners and clinicians. The minimum number of participants recommended for the grouping activity is 15, as studies with fewer than 15 participants are more likely to generate less reliable concept maps (indicated by the stress value; described in detail below) (Rosas & Kane, 2012). There is no recommendation for a minimum number of participants for the rating activity; however, large numbers are required for generalizability to the wider population.

The hearing aid owner group (n=24) included persons between 56 and 91 years of age and the clinician group (n=22) included persons between 32 and 69 years of age. Both groups were heterogeneous in age, gender, and experience with hearing aids as described

in Table 1. Hearing aid owners were based in the Australian states of Western Australia (n=17) and Queensland (n=7), and reported owning hearing aids from seven different manufacturers. Participating clinicians were based in Queensland (n=3), Victoria (n=1), Tasmania (n=1) and Western Australia (n=17), and worked in a range of different clinical environments. Only one of the participants worked for a clinic aligned with the hearing aid manufacturer through which clinicians were recruited.

Table 1. Descriptive statistics for participant demographics.

Cohort Description	Hearing aid owners (n = 24)	Clinicians (n = 22)
Age (mean \pm SD) (years)	78.46 \pm 8.93	42.95 \pm 9.64
Gender		
Male: n (%)	15 (68.18)	2 (9.09)
Female: n (%)	9 (31.82)	20 (90.91)
Self-reported severity of hearing loss (when not wearing hearing aids)		
Mild: n (%)	1 (4.17)	
Moderate: n (%)	13 (54.17)	
Severe: n (%)	5 (20.83)	
Profound: n (%)	1 (4.17)	
Number of years wearing hearing aids		
<1 year: n (%)	2 (8.33)	
1-5 years: n (%)	7 (29.17)	
5-10 years: n (%)	8 (33.33)	
>10 years: n (%)	3 (12.50)	
Style of hearing aids worn		
ITE: n (%)	2 (8.33)	
BTE: n (%)	14 (58.33)	
Satisfaction with hearing aids		
Highly satisfied: n (%)	3 (12.50)	
Satisfied: n (%)	13 (54.17)	
Neutral: n (%)	2 (8.33)	
Dissatisfied: n (%)	1 (4.17)	
Highly dissatisfied: n (%)	0	
Daily hearing Aid use		
None: n (%)	2 (8.33)	
<1 hour per day: n (%)	0	
1-4 hours per day: n (%)	0	
4-8 hours per day: n (%)	3 (12.50)	
>8 hours per day: n (%)	14 (58.33)	

Years of experience dispensing hearing aids	
<5 years: n (%)	3 (13.64)
5-10 years: n (%)	2 (9.09)
10-20 years: n (%)	16 (72.73)
>20 years: n (%)	1 (4.55)
Highest level of audiological qualifications completed	
Certificate 5 in audiometry: n (%)	
Graduate diploma in audiology: n (%)	3 (13.64)
Masters in audiology: n (%)	2 (9.09)
Clinical Doctorate in audiology: n (%)	16 (72.73)
	1 (4.55)
Predominant type of employment	
Government funded chain: n (%)	1 (4.55)
Independent private clinic: n (%)	10 (45.45)
Private chain of clinics: n (%)	2 (9.09)
Not-for-profit organization: n (%)	6 (27.27)
Hospital: n (%)	1 (4.55)
University: n (%)	2 (9.09)

Notes: ITE: in-the-ear hearing aid; BTE: behind-the-ear hearing aid

Procedures

Ethical approval for this study was granted by the Human Research Ethics Office of The University of Western Australia and The University of Queensland's Behavioural and Social Sciences Ethical Review Committee. All participants provided written consent to participate.

All participants were required to attend two data collection sessions; the first consisted of a brainstorming activity and the second included completing grouping and rating tasks. Sessions were held separately for hearing aid owners and clinicians to allow them to speak freely about their experiences without having to consider the other party in a client-clinician relationship. For participating hearing aid owners, data collection was conducted through face-to-face group sessions (between 1 and 19 in each group) across two sites (Perth and in Brisbane) to increase transferability (Guba, 1981). For participating

clinicians, data collection was conducted via an online portal (version 4, Ithica, NY: Concept Systems Incorporated). The benefit afforded to hearing aid owners from the face-to-face brainstorming activity included the ability to interact with each other and build on the statements put forward by other participants. Participating clinicians were not able to interact with each other in the same manner, although they were able to view each other's statements. While participating clinicians had the opportunity to log into the system multiple times and submit additional statements, clinicians only logged into the brainstorming session once. As such, the first few clinicians to log into the brainstorming session missed the opportunity to build on the statements put forward by subsequent entries. The sessions were conducted in October and November 2015 and were not recorded.

Brainstorming

For hearing aid owners, this first session was split into two 45 minute periods with a 15 minute break in-between. Participants were first asked to generate statements that described "What hearing aid owners must do in order to use, handle, manage, maintain and care for their hearing aids appropriately, for example, turn it on or change the battery." Participating hearing aid owners were prompted to include statements regarding their personal experiences as well as things that they have heard from other people, such as family or friends with hearing aids. During the second period participants were asked to generate statements that described "How hearing aid owners learn the skills required to use, handle, manage, maintain and care for their hearing aids". Data from this second period will be presented in a subsequent manuscript. Statements put forward by participants were entered into a Microsoft Excel spreadsheet and projected on a screen as

they were generated for all to see. In this way, participants could build on each other's statements. Participant instructions were delivered in a neutral tone and participants were not prompted beyond asking for clarification if the participants' statement was not clear or re-asking the research question using the same wording when there was a lull in contributions. The research team accepted all statements during the brainstorming activity so as not to deter contributions. The individual statements put forward by participants were not discussed, and only new ones added. All members of the group were given equal opportunity to provide input.

For the clinician group, the brainstorming session took place via the online portal available in the concept mapping software Concept Systems (version 4, Ithica, NY: Concept Systems Incorporated). Clinicians were asked to generate statements in response to the same two research questions, and were provided using the exact same wording as the hearing aid owner group. Participating clinicians were able to enter statements into the system, which were then available for the other clinicians to see; in this way clinicians could enter new statements that built on existing statements or enter completely new concepts. The clinicians were not able to change or comment directly on each other's statements, only add new statements to the list. Clinicians were not able to see the statements put forward by the hearing aid owners' at this stage, or vice versa. The clinicians were not identifiable to each other.

Following the brainstorming session, members of the research team (RB, CM and RE) pooled and refined all of the statements from both cohorts (all hearing aid owners and clinicians). The statements were edited for clarity to ensure that participants had a clear, understandable and relevant list of statements for the grouping and rating tasks.

Statements that were identical to each other were eliminated (Poost-Foroosh et al., 2011), as well as statements that did not directly relate to the brainstorming question (for example, “pressure from grandchildren if still not hearing well”) or were considered inaccurate so as not to confuse or mislead participants (for example, “rechargeable batteries are cheaper”). Furthermore, some sentences were split into single concept phrases (for example, the following statement was split into its six components “understand how the hearing aid battery works, i.e. learn how to tell the positive side from the negative side of the hearing aid battery, how to insert the battery, not to be afraid of touching the hearing aid batteries with their fingers, know that the battery will go flat after the sticker is removed regardless of hours of use, and how to dispose of hearing aid batteries”) (Jackson & Trochim, 2002). All statements were reworded with a neutral tone and to be in the third person (for example “I was never shown how to change the wax filter”, “I don’t know how to change the wax protector”, “they don’t bother learning how to change the wax filter” were combined and reworded to be statement 74. *know when to change the wax filter/protector*). The resulting set of statements served as the core content for the grouping and rating tasks.

Grouping and rating of the statements

During the second session participants grouped the brainstormed statements to identify common themes. For the rating task, participants were given the list of all the statements and asked to rate the *importance* of each statement to a hearing aid owner’s overall success with hearing aids, using a 5-point Likert scale (1 = minimally important to 5 = extremely important).

For the hearing aid owners, the grouping and rating tasks took place via face-to-face group sessions (Brisbane and Perth). Two hours was allocated for the session, although many finished the task early and were free to leave. Statements were printed on individual cards. Participants were asked to sort the cards into groups based on how similar in meaning they were to one another, and to provide a title for each group. For the rating task, hearing aid owners were provided with a list of the statements and asked to rate them as described above (paper based survey). Although hearing aid owners attended this session as a group, participants were instructed to work independently. Most participants completed the tasks alone; a few discussed the task with other participants during the grouping task, but mainly to clarify a statement rather than discuss which group it belonged to.

For the clinicians, grouping and rating tasks took place via the online portal (version 4, Ithica, NY: Concept Systems Incorporated), wherein clinicians logged in and completed the tasks at any time within a six week period. For the online grouping task, the software displayed all of the statements on one side of the screen and instructed the clinicians to move the statements across to the other side of the screen into folders, as many folders as required, and then to name the folders accordingly. Participants were unable to see each other's' grouping and rating tasks. See Bennett et al. (2017b) for further details on how grouping and rating tasks were conducted.

All participants attended the brainstorming sessions and contributed to the generation of statements for both research questions 1) identification of what needs to be learned for successful hearing aid use and 2) how this knowledge and skill is acquired. Participants were then randomly allocated into two groups using a random number generator in Microsoft Excel. Each group was randomly assigned to one of the two research

questions for the Session 2 grouping and rating tasks. All participants were invited to complete grouping and rating for both research questions and directed to start with the question for which they were randomly allocated to. Of the 24 hearing aid owners who participated in the brainstorming session, 16 (including the 12 allocated to this research question; 100% retention rate) completed the rating activity for the first research question (identification of what needs to be learned for successful hearing aid use) and nine completed the grouping activity (75% retention rate). Twenty-two clinicians participated in the brainstorming session, 17 of which (including the 11 allocated to this research question; 100% retention rate) completed the rating activity for the first research question (identification of what needs to be learned for successful hearing aid use) and nine completed the grouping activity (82% retention rate).

Data analysis and interpretation

Data generated by the hearing aid owners were entered into the Concept Systems software (version 4, Ithica, NY: Concept Systems Incorporated). The data from participating clinicians was captured as they performed their tasks within the Concept Systems software.

Multidimensional scaling was used to generate a point map to graphically display the relationship between statements as indicated by the grouping task. In Concept Mapping, each point on the map represents one brainstormed statement. The proximity of two points indicates how often these statements were grouped together by participants; the smaller the distance between two points, the more often participants grouped the two statements together. The position of each point on the map (i.e. top or bottom, left or right) is not important, only the distance between each point. The reliability of the multidimensional scaling analysis was tested by computing a stress index, indicating the goodness of fit of the

two dimensional configuration to the sort data. A stress value between 0.205 and 0.365 was considered acceptable (Kane & Trochim, 2007).

Hierarchical cluster analysis performed within the Concept Systems software used the participant grouping data to generate cluster maps. The cluster map graphically depicts clusters of points (statements) based on a consensus of how the participants grouped the individual statements. Selecting the appropriate number of clusters was achieved primarily through reviewing the statements within each cluster and discussing whether the merging or splitting of clusters is appropriate; that is, it has to make sense that the statement is allocated to a particular cluster (Jackson & Trochim, 2002). These decisions were also informed using bridging scores (Jackson & Trochim, 2002), indicating whether the statements contained within a cluster were more often grouped together by participants (lower bridging score), or less likely to be grouped together (higher bridging score). Bridging scores can be used to indicate whether the cluster may be improved if separated into two clusters. It is important to note here that only the number of clusters is being influenced by the researchers. Researcher judgment is required with cluster analysis as there is no sensible mathematical criterion available to select the number of clusters because the “best” number of clusters depends on the level of specificity desired and the context at hand, factors that can only be judged subjectively (Jackson & Trochim, 2002). See Bennett et al. (2017b) for details on how the bridging score and cluster content are used to determine the number of clusters.

After examining 14 different possible cluster solutions, two of the authors (RB & CM) reached a consensus about the best number of clusters to represent the data. Each cluster represents a concept. Concept names were based on the grouping labels put forward by the

participants during data collection. The resulting map is the concept map. The research team generated a description of each concept identified by the concept map based on the statements it contains and the labels indicated by the participants. For example, the names put forward by participants for the concept “Working with Your Clinician” included “clinician”, “communication with the clinician”, “find a good clinician”, “clinician-related”, “comfort and confidence in service provider”, “clinician assistance”, “quality of clinician”, and “working with your clinician”.

A concept map was generated for each cohort (clinicians and hearing aid owners). To determine whether the cohort concept maps differed significantly a split-half reliability measure (comparing the data from each cohort) was conducted using the concept mapping software (version 4, Ithica, NY: Concept Systems Incorporated) and Spearman-Brown Prophecy Formula correction applied using SPSS Statistics (version 21.0, Armonk, NY: IBM Corp). A correlation above 0.70 was considered high (Hinkle, Wiersma, & Jurs, 2003) and indicated sufficient consensus between the clinicians’ and hearing aid owners’ data and that they could be combined to create one concept map for further analyses.

A similar reliability analysis was conducted for this final concept map (clinician and hearing aid owner data combined). The participant cohort was randomly split into two sub-cohorts, and then separate similarity matrices and cluster maps were generated for each (based on the number of clusters selected for the final map) (Trochim, 1993). Correlation between the two maps was evaluated by applying the Spearman-Brown correction correlation to the split half correlation (Trochim, 1993) using SPSS Statistics (version 21.0, Armonk, NY: IBM Corp). A correlation above 0.70 was considered high (Hinkle et al., 2003) and indicated that the two cohort maps were similar, i.e. that the concept maps accurately

represented the participants' grouping activity data and thus that the data was reliable (Trochim, 1993).

To validate the interpretation of the data, the final concept map generated was sent to all participants (hearing aid owners and clinicians) via post for feedback. Participants were asked to reflect on whether they felt 1) the concept map accurately represented the concepts informed by the statements, 2) the name of each of the concepts accurately represented the statements it contained, and 3) the description of each of the concepts accurately represented the statements it contained. Participant feedback informed whether the concept map(s) needed to be redefined or labelled and described differently.

Participants' rating scores were used to identify the *importance* of each concept to overall success with hearing aids. Internal consistency of the ratings data were calculated using Cronbach's alpha for each concept to determine reliability of the concept map (Rosas & Kane, 2012). Welch's *t* test was used to compare the mean importance ratings for the same cluster across two groups (hearing aid owners and clinicians), and between two clusters for the same participant group.

RESULTS

Brainstorming sessions yielded a total of 208 statements across all three sessions describing what hearing aid owners must do to use, handle, manage, maintain and care for their hearing aid. Reducing and editing the statements resulted in a final list of 111 statements used for the grouping and rating tasks (see Appendix A). The statements generated by the participants varied in nature; some were knowledge based (for example, 32. *know where to buy puffers or vacuum for cleaning wax*), some were tasks (for example,

41. *practice using the phone with the hearing aid*), and others were psychosocial in nature (for example, 33. *be motivated to wear the hearing aids* and 29. *be happy with the little achievements, e.g. being pleased with hearing and localizing the rustling of the leaves when bush walking*).

The concepts identified through concept map generation for the hearing aid owners group and the clinician group did not differ greatly (split-half correlation for the grouping task was 0.75 and application of the Spearman-Brown correction resulted in a reliability of 0.86), and as such a combined concept map was generated and used for the remainder of the analyses. The final concept map selected (cohorts combined) had a stress index of 0.24, suggesting a very good fit of the concept map to the similarity matrix (Trochim, 1993). Reliability testing of the grouping tasks suggested high consistency between how participants sorted the data; split-half correlation of 0.75 and 0.86 following Spearman-Brown correction (Trochim, 1993).

The concept map generated revealed two overarching themes: the *device* and the *person*. The *device* theme contained 65 of the 111 statements and described knowledge or practical skills specifically related to the hearing aid. The *person* theme contained 46 of the 111 statements and described knowledge, skills or personal attributes relating to the individual obtaining hearing aids. Six concepts were identified: (1) "Daily Hearing Aid Use", (2) "Hearing Aid Maintenance and Repairs", (3) "Learning to Come to Terms with Hearing Aids", (4) "Communication Strategies", (5) "Working with Your Clinician", and (6) "Advanced Hearing Aid Knowledge" (Figure 1). Descriptions of the six concepts generated by the researchers reflected the statements contained within each concept and the group names put forward by participants during the grouping activity (Table 2). The example statements

included in Table 2 are those with the smaller bridging scores, that is, those statements that were most often placed in each concept group by the participants, thus best representing the core meaning of the concept.

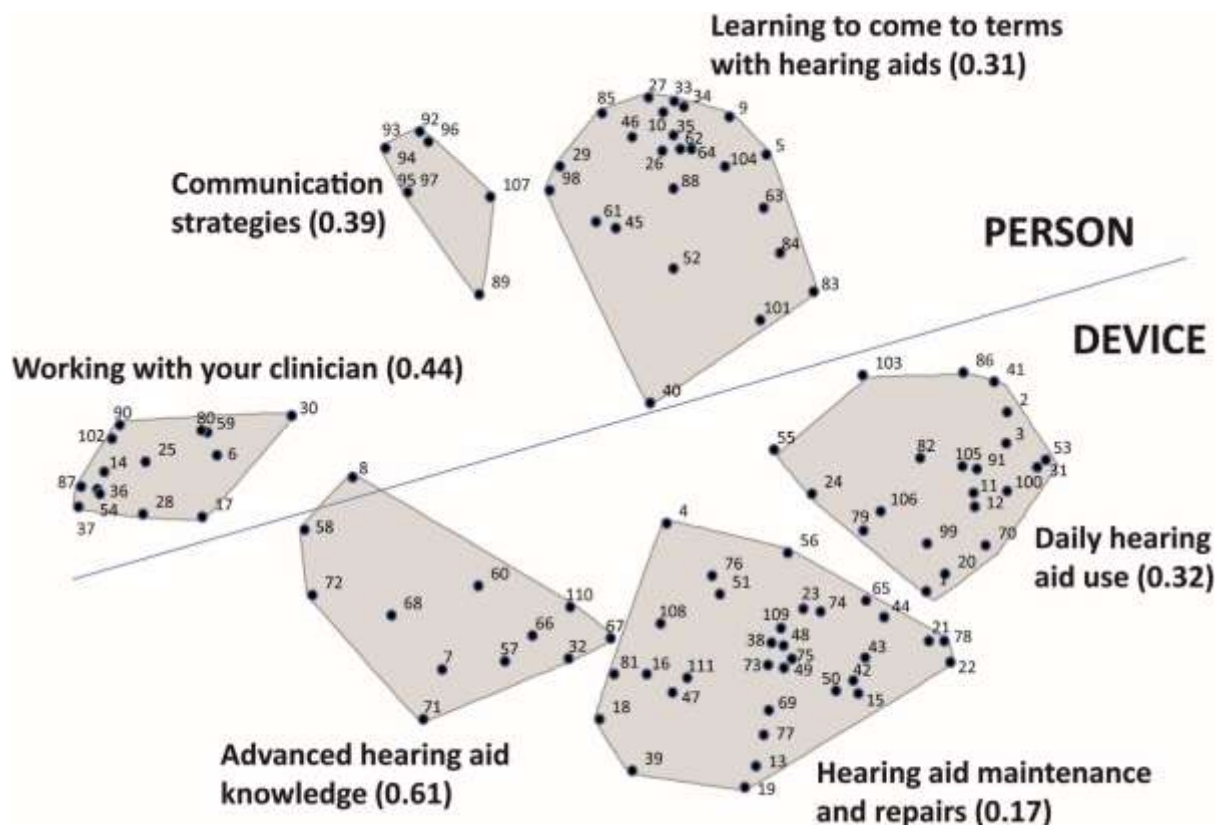


Figure 1. Concept map with bridging scores illustrating how related statements were to each other within clusters.

Eighteen ($n = 12$ hearing aid owners and $n = 6$ clinicians) of the 46 participants (39% response rate) provided feedback on the final concept map generated from the data. All respondents indicated that they agreed with the concepts, the concept names and descriptions. Until this point the concept “Hearing Aid Maintenance and Repairs” had been called “Hearing Aid Care and Maintenance”. However, two respondents commented that although tasks associated with hearing aid handling, damages and repairs were included in this concept, the title did not provide sufficient emphasis and they suggested that these

Table 2. Six concepts describing what hearing aid owners must do in order to use, handle, manage, maintain and care for their hearing aid(s).

Theme	Concepts (bridging score; mean importance rating)	Concept description	Representative statements (bridging score; mean importance rating)
Device	Hearing Aid Maintenance and Repairs (0.17; 3.83)	Knowledge and skills required for ongoing hearing aid maintenance and care, including preventing and troubleshooting common problems experienced with hearing aids.	73. Know when and how hearing aid tubing should be replaced (0.00; 3.85) 42. Know how and when to clean the hearing aid moulds, including the vents (0.02; 4.32) 109. Know when to use a dry aid kit, such as when it is humid, after sweating/exercising, wet ears from showering/swimming (0.02; 4.00) 50. Clean microphones ports and/or replace microphone covers (0.02; 3.68) 15. Know how to remove the wax from the hearing aid (different for different types of hearing aids) (0.08; 4.44) 23. Know how to troubleshoot for causes of feedback e.g. wax/moisture in the ear/speaker, cracked tubing, inaccurate insertion (0.10; 3.88)
	Daily Hearing Aid Use (0.32; 3.79)	Knowledge and skills required for daily hearing aid handling and use.	1. Learn how and when to change (or charge) the battery (0.18; 4.68) 99. Check that the hearing aids are working by cupping it in the hand and listening to whether it whistles/feedback (0.19; 3.65) 12. Know which program to use for which situation (0.24; 3.76) 105. Learn how to use the volume control (0.25; 3.64)
	Advanced Hearing Aid Knowledge (0.61; 3.50)	Knowledge and understanding required for optimal hearing aid use and management, beyond that required for daily hearing aid handling and maintenance.	67. Know that it is ok to collect extra batteries before going away, rather than running out or having to find a place to buy batteries while away (0.34; 3.91) 32. Know where to buy puffers or vacuums for cleaning wax (0.36; 3.18) 110. Understand how ear wax in the ear canal can cause problems with the hearing aids (0.39; 4.15) 60. Know to ask for a dry box (dry aid kit) as clinicians don't always give them out or mention them (0.56; 3.26)

Person	Learning to Come to Terms with Hearing Aids (0.31; 3.97)	Acceptance and understanding of the personal journey one has to take after obtaining a hearing aid.	<p>46. Use hearing aids on a regular basis in order to ‘retrain’ the brain and to accept amplified sounds as ‘normal’ (0.10; 4.56)</p> <p>35. Set up a reminder to encourage daily hearing aid use (0.10; 2.19)</p> <p>33. Be motivated to wear the hearing aids (0.12; 4.58)</p> <p>64. Understand that getting used to hearing aids can be emotional to start with (0.12; 3.97)</p> <p>62. Understand that it takes a long time to get used to sounds – it can be scary at first, there is so much noise in the world (0.13; 3.94)</p>
	Communication Strategies (0.39; 3.91)	Strategies for hearing aid owners and their communication partners to improve communication when wearing or not wearing hearing aids.	<p>92. Teach family/friends to look at you when they speak (0.23; 3.94)</p> <p>96. Learn not to be afraid to ask people to repeat themselves if you don’t hear them the first time (0.26; 4.18)</p> <p>95. Try to speak one-on-one when talking with people in a noisy place (0.29; 4.06)</p> <p>94. Know to speak face-to-face when talking with people, to watch their lips (0.29; 3.94)</p>
	Working with Your Clinician (0.44; 3.93)	Clinician skills and clinic procedures that facilitate an optimal client-clinician relationship, wherein the client can receive the information and training required for hearing aid use and management.	<p>37. Find a clinician who is aware of the impact of different health problems on hearing aid use (0.17; 3.55)</p> <p>36. Ask to see the same clinician so that they can get to know you (0.20; 3.48)</p> <p>87. Find a clinician who is always willing to discuss and fix problems (0.21; 4.50)</p> <p>14. Know what questions to ask their clinician to get all of the information (0.26; 3.65)</p>

tasks be separated into a category of its own. Due to the nature of concept mapping, researchers are not able to influence which statements are contained within each concept, only the concept's name and description. Therefore the concept was renamed to "Hearing Aid Maintenance and Repairs".

Reliability estimates of the rating data, evaluated with the cohorts combined, demonstrated high internal consistency for all six concepts: "Daily Hearing Aid Use" ($\alpha = 0.91$), "Hearing Aid Maintenance and Repairs" ($\alpha = 0.95$), "Learning to Come to Terms with Hearing Aids" ($\alpha = 0.93$), "Communication Strategies" ($\alpha = 0.94$), "Working with Your Clinician" ($\alpha = 0.90$), and "Advanced Hearing Aid Knowledge" ($\alpha = 0.91$).

Participants' mean ratings for the importance of each individual statement ranged from 2.55 to 4.74; thus none of the statements were deemed unimportant. The importance of each concept, as indicated by the participant rating scores, is reported in Table 3. It should be noted that the items contributing to the six concepts were generated by both hearing aid owner and clinician groups and were not adjusted for any expected directionality of importance weightings. Thus, it is possible that the importance of individual statements may differ to the importance indicated for the concept. There were no significant between-cohort differences for the mean ratings for each of the concepts, with the exception of the concept "Learning to Come to Terms with Hearing Aids" (Table 3), which was deemed more important by the clinician group. There was a difference in the order in which the concepts were rated between the two cohorts. The hearing aid owner group indicated all six concepts to be of similar importance, that is, the mean ratings for each concept did not differ significantly. In contrast, the clinician group indicated five of the six concepts to be of similar importance, but the concept "Advanced Hearing Aid

Knowledge” was deemed to be significantly less important than the other five concepts (Table 4).

Table 3. Mean importance ratings for each of the six concepts as rated by the hearing aid owner and clinician groups, and the between cohort differences.

Cluster	Hearing aid owner’s mean rating Mean (SD)	Clinician’s mean rating Mean (SD)	Between cohort differences		
			<i>t</i>	Degrees of Freedom	<i>p</i> -value
Daily Hearing Aid Use	3.64 (1.21)	3.94 (1.08)	1.7837	40	>0.05
Hearing Aid Maintenance and Repairs	3.76 (1.09)	3.89 (1.12)	1.0135	62	>0.05
Learning to Come to Terms with Hearing Aids	3.77 (1.16)	4.17 (1.03)	2.6965*	46	<0.01
Communication Strategies	3.74 (1.27)	4.06 (1.15)	2.0269	14	>0.05
Working with Your Clinician	3.91 (1.13)	3.96 (1.25)	0.2107	26	>0.05
Advanced Hearing Aid Knowledge	3.64 (1.18)	3.37 (1.28)	-1.2253	22	>0.05

* Correlation is significant at the 0.05 level

Table 4. Welch's t-test was used to determine significant differences between the mean ratings for the importance of each concept. This was performed separately for each cohort. It can be seen that the hearing aid owners did not indicate any of the concepts to be of significantly different importance than any others. While the clinicians agreed for four of the five concepts, they indicated that the concept Advanced Hearing Aid Knowledge was significantly less important than the other four concepts identified.

Concept	Hearing aid owners [Welch's t (Degrees of freedom)]					Clinicians [Welch's t (Degrees of freedom)]				
	1. Daily Hearing Aid Use	2. Hearing Aid Maintenance and Repairs	3. Learning to Come to Terms with Hearing Aids	4. Communication Strategies	5. Working with Your Clinician	1. Daily Hearing Aid Use	2. Hearing Aid Maintenance and Repairs	3. Learning to Come to Terms with Hearing Aids	4. Communication Strategies	5. Working with Your Clinician
2. Hearing Aid Maintenance and Repairs	-0.8495 (51)					0.3011 (51)				
3. Learning to Come to Terms with Hearing Aids	-0.8929 (43)	-0.0556 (54)				-1.3641 (43)	-1.8595 (54)			
4. Communication Strategies	-0.6499 (27)	0.1305 (38)	0.1785 (30)			-0.7530 (27)	-1.1880 (38)	0.6728 (30)		
5. Working with Your Clinician	-1.4636 (33)	-0.8709 (44)	-0.8265 (36)	-0.9095 (20)		-0.1050 (33)	-0.3459 (44)	0.9899 (36)	0.4888 (20)	
6. Advanced Hearing Aid Knowledge	0.0006 (31)	-0.7388 (42)	-0.777 (34)	-0.5785 (18)	-1.3394 (24)	2.7291 (31)*	-2.7236 (42)**	-3.8976 (34)**	-3.4492 (18)**	-2.4244 (24)

* Correlation is significant at the 0.05 level

** Correlation is significant at the 0.01 level

DISCUSSION

The challenges associated with getting used to hearing aids have been described as multi-factorial, and include adjustment to altered sensory input, learning the practical skills associated with hearing aid use, and managing the psychosocial impact of hearing loss (Boothroyd, 2007; Dawes, Maslin, & Munro, 2014; Hogan, 2001; Knudsen, Oberg, Nielsen, Naylor, & Kramer, 2010). Typically, the hearing health professional provides informational- and emotion-based counselling in these areas throughout the hearing rehabilitation program. However, the quality, mode of delivery and extent of counselling required for being able to manage hearing aids adequately has not fully been examined. The amount of time spent on hearing aid management during clinical consultations is limited, with hearing aid owners reporting having received less than one hour of hearing aid-related counselling during their entire rehabilitation program (Kochkin et al., 2012), but the relationship with hearing aid management skills were not reported. Furthermore, much of the hearing aid information is delivered verbally (Ferguson et al., 2015), with hearing aid owners unable to recall between 25-65% of information provided during the consultation four weeks later (El-Molla et al., 2012; Reese & Hnath-Chisolm, 2005). It is therefore not surprising that up to 90% of hearing aid owners demonstrate difficulty with basic hearing aid management tasks (Ferrari et al., 2015; Bennett et al., 2017a) and almost 50% of hearing aid owners report not receiving enough practical help regarding hearing aid use (Kelly et al., 2013). The informational and training needs of hearing aid owners appear not to be met by current clinical practices.

Focused on providing evidence to improve clinical practices, this study generated an itemized list of the knowledge, skills and tasks required for hearing aid management

through engaging both hearing aid owners and clinicians. Participants identified six concepts required for hearing aid management, with two overarching themes: the *device* and the *person*. Delineating the device from the person is an important construct often overlooked by clinicians (Boothroyd, 2007; Erdman, Wark, & Montano, 1994; Sweetow, 2007; Sweetow & Sabes, 2007), but continually emphasized by hearing aid owners in qualitative studies (Grenness et al., 2014; Kelly et al., 2013; Knudsen, Nielsen, Kramer, Jones, & Laplante-Lévesque, 2013; Laplante-Lévesque et al., 2010; Laplante-Lévesque, Jensen, Dawes, & Nielsen, 2012; Laplante-Lévesque, Knudsen, et al., 2012; Lockett, Jennings, & Shaw, 2010; Poost-Foroosh et al., 2011). Some argue that the focus on hearing aids over rehabilitation of the person may be due to the increased promotion and marketing of hearing aids by the manufacturers and the misplaced belief that hearing aids alone could overcome hearing loss concerns (Sweetow, 2007; Sweetow & Sabes, 2007).

The majority of the statements generated in this study were associated with the device rather than the person. This may be due to the wording of the question specifying requirements for hearing aid management, but may also echo the historical dominance of the biomedical model of service delivery in audiology practices, focusing on pathology, impairment and treatment (Erdman et al., 1994), described as a deficit-based, device-centric model with little emphasis on the role of the person with hearing impairment (Hogan, 2015). Device related items described by participants in this study included practical tasks as well as knowledge items describing the process of learning how and when to use different hearing aid features, across three key concepts: “Daily Hearing Aid Use”, “Hearing Aid Maintenance and Repairs” and “Advanced Hearing Aid Knowledge”. It is interesting to note that when generating the statements, participants delineated the physical ability to

manipulate the hearing aid from the cognitive understanding of how, where and when to use the hearing aid feature. These results are interesting in light of the findings of Bennett et al. (2017a) which demonstrated that hearing aid owners were significantly better at self-reporting practical tasks (e.g. physical manipulation of the volume control) than understanding-based tasks (e.g. knowing when to adjust the volume and by how much). Bennett et al. (2017a) also found that participants demonstrated fewer difficulties for basic and frequently performed tasks (e.g. hearing aid removal/ insertion and changing the battery), than more complex and infrequently performed tasks (e.g. volume control and telephone use). Thus, the role of the clinician should not be to simply provide instructions for hearing aid handling, but to establish whether hearing aid owners have learned the skills necessary, with special attention to understanding based tasks and those more complex or less frequently performed. Surveys provide a medium for clinicians to ensure they have provided all the necessary information and training, and also to systematically evaluate whether the hearing aid owner has in fact learned what was taught (Bennett et al., 2015b).

Although hearing aids have been demonstrated to improve hearing sensitivity and subsequently quality of life (Chisolm et al., 2007; Kochkin & Rogin, 2000; McArdle, Chisolm, Abrams, Wilson, & Doyle, 2005), hearing aids alone are often not enough to overcome the disability imposed by hearing impairment (Sweetow & Sabes, 2007). The psychosocial consequences of untreated hearing loss are widely recognized in both research and clinical practices, and include distress, anxiety, depression, loneliness and smaller social network size (Arlinger, 2003; Kramer, Kapteyn, Kuik, & Deeg, 2002; Mener, Betz, Genther, Chen, & Lin, 2013; Nachtegaal et al., 2009; Pronk et al., 2014; Tambs, 2004). Due to the impact of hearing loss on communication, both the person with hearing loss and the significant other

will experience effects as a result of the hearing loss and subsequent rehabilitation (Kamil & Lin, 2015; Stark & Hickson, 2004; Wallhagen, Strawbridge, Shema, & Kaplan, 2004).

Participants in this study recognized the personal experiences and personal investment required by the hearing aid owner when acquiring hearing aids through the theme Person; this theme included the three concepts: "Learning to Come to Terms with Hearing Aids", "Communication Strategies" and "Working with Your Clinician".

For the most part, statements included in the concept "Learning to Come to Terms with Hearing Aids" described the acceptance and determination required to get used to hearing aids. The importance of hearing aid owners expectations, attitudes and adjustment to hearing aids is evidenced in their relationship to hearing aid outcomes (Jerram & Purdy, 2001; Saunders, Frederick, Silverman, & Papesh, 2013; Saunders, Lewis, & Forsline, 2009). However, opportunities for hearing aid owners to discuss their personal experiences with the clinician may be limited in the clinical setting. A recent study by Ekberg et al. (2014) investigated the way in which clinicians currently address hearing aid owners' psychosocial concerns during clinical appointments by recording 63 patient-clinician interactions live in the clinical setting. Analyzing the discourse between audiologists and patients revealed that audiologists frequently disregard emotional content in the patients talk. Audiologists did not easily engage in discussions with ambiguous or negative themes and hearing aids were quickly presented following a diagnosis of hearing impairment as a problem-solving attempt. It appears that audiologists may require further training in discussing the thoughts feelings and behaviors associated with hearing loss and hearing aid use. The IDA institute (idainstitute.com) provide clinical tools to help audiologists address the psychological and social challenges of hearing loss. The psychological and psychosocial aspects of hearing aid

use identified by participants in this study could be used to inform application of such tools in the clinical setting, and to inform development of clinician training programs.

Participants in this study noted the importance of the working relationship between the hearing aid owner and the clinician through the concept “Working with Your Clinician”. This concept included statements that described both clinician and hearing aid owner traits and actions required for hearing aid management skills training, such as *87. Find a clinician who is always willing to discuss and fix problems* and *90. Be comfortable admitting to the clinician how little you have used the hearing aid*. Clinician traits included awareness, willingness, knowledge, and understanding. These traits are in line with facilitators of a good therapeutic relationship as outlined by Grenness et al. (2014). Hearing aid owner traits included proactive behavior (finding, seeking, asking and attending), knowledge (knowing what questions to ask), and being comfortable with the clinician (divulging information and asking for help). These traits are in line with studies describing aspects of personality found to be associated with successful hearing aid use (Cox, Alexander, & Gray, 2007; Jerram & Purdy, 2001). Participants (hearing aid owners and clinicians) in this study generated statements that described building a long term relationship between the hearing aid owner and the clinician, specifically returning to the clinic for help and attending ongoing appointments. In contrast, other qualitative studies involving hearing aid owners have described the client-clinician interaction in the early stages of hearing aid acquisition only, rather than as an ongoing relationship (Dawes et al., 2014; Laplante-Lévesque, Jensen, Dawes, & Nielsen, 2013; Laplante-Lévesque, Knudsen, et al., 2012). Given the chronic nature of hearing loss and that treatment with hearing aids must be sustained over a lifetime, there

is clear benefit to actively engaging the patient in their rehabilitation program and forging a long term relationship.

There is growing evidence that aural rehabilitation services beyond the fitting of hearing aids result in better outcomes, such as “Communication Strategies” training (Hickson, Worrall, & Scarinci, 2007b). Although the research question employed in this study asked what is required for hearing aid management, participants put forward statements that described how to be a better communicator and the importance of teaching others how to be better communicators (primarily family members). The inclusion of “Communication Strategies” as a concept highlights the importance of communication training to the participants involved in this study.

Clinical considerations

Participants identified 111 individual statements describing the knowledge, skills or tasks required for hearing aid management, highlighting the magnitude of information that clinicians are required to impart, and the overwhelming amount of information that hearing aid owners are expected to learn when obtaining hearing aids. The itemized list of hearing aid management tasks identified in this study could assist clinicians in realizing the large amount of information that must be transferred from clinician to hearing aid owner, and may prompt clinicians to change their clinical protocols to include checklists, alternative training methods, supplemental materials, and modes of skill evaluation to address the hearing aid management deficits that are currently observed.

The concept “Hearing Aid Maintenance and Repairs” included tasks that may be considered more complex than the tasks included in the “Daily Hearing Aid Use” concept

(Goggins & Day, 2009; West & Smith, 2007). The complexity may be due to the physical requirements of the task, for example, microphone covers can be small and fiddly to manage (Bennett et al, 2015a). Additionally, tasks may be considered complex due to how infrequently they are performed, thus increasing the chance that hearing aid owners may forget how to perform the task or forget that the task is even necessary. To address this, clinicians should ensure that hearing aid owners have sufficient training and support at initial hearing aid fitting appointments and at intervals thereafter. For example, given that several maintenance tasks are required to be performed for the first time approximately three months after the initial hearing aid fitting appointment (such as wax protector/ microphone cover/ slim tube and dome replacement) it may be beneficial for clinicians to make contact with hearing aid owners at this time to remind them about these maintenance tasks and offer additional training and support. These sorts of additional services may be more necessary in older populations, as older adults have been found to be less knowledgeable about the complex features on their hearing devices than the basic features (Dullard & Cienkowski, 2014).

Whereas the concepts “Daily Hearing Aid Use” and “Hearing Aid Maintenance and Repairs” included the majority of the device related tasks, participants indicated a related but separate category named “Advanced Hearing Aid Knowledge”. This concept demonstrated the highest bridging score of all concepts, suggesting that some participants placed the included statements in other groups, or in some cases, statements were placed in a group of their own. For example, such was often the case for *7. know about insurance for hearing aids* and *72. know to still use protection to prevent further hearing loss*. It could be argued that some of the statements contained within the “Advanced Hearing Aid

Knowledge” concept may fit in the other two device related concepts, being either daily tasks or ongoing maintenance tasks. Ultimately, however, through the concept mapping process participants’ grouped these statements together, generating a specific category named “Advanced Hearing Aid Knowledge”. Initially it was unclear why these items were grouped together; however, the rating data shed some light. Where hearing aid owners rated the concept “Advanced Hearing Aid Knowledge” as similarly important to the other five concepts, the clinicians rated it as significantly less important than the other five concepts. It is possible that due to the large amount of information and training that audiologists are currently expected to administer in a very small time period, clinicians make a judgement call as to those hearing aid owners who require certain items of information or training and those who do not. It is possible then that the category “Advanced Hearing Aid Knowledge” reflects the ‘additional’ information that some hearing aid owners do not receive, but would like to. As previously reported by other studies involving hearing aid owners (Kelly et al., 2013; Laplante-Lévesque et al., 2013), participants in this study highlighted their desire for greater access to information.

Limitations

One of the limitations of this study was that participants self-selected to volunteer for the study which may have biased the content and the rating scales. Although clinicians were recruited from the database of a hearing aid manufacturer, it is unlikely that this would have biased the findings as participating clinicians worked in a variety of organizations, only one of whom was from a clinic aligned with that particular manufacturer. Sample sizes were small which may have influenced the contents of the statements provided; other hearing aid owners and clinicians may have generated

additional statements not included in this study. Nevertheless, the number of statements generated was large and this is the most comprehensive study to date looking at hearing aid management. Additionally, given the small sample size, the rating scale results should not be assumed representative of the population. Only 35% of participants provided feedback on the final concept map generated from the data. None the less, findings are informative and provide a framework for development of clinical tools for training and evaluation of hearing aid management skills.

CONCLUSION

Over 111 unique statements describing the knowledge, skills or tasks required for hearing aid management were identified, highlighting the magnitude of information and training required to optimally manage hearing aids. The six concepts identified by participants provide a framework for future clinical tools for training and evaluation of hearing aid management skills. Clinicians and hearing aid owners generally agreed on the importance of concepts, with the exception of one, “Advanced Hearing Aid Knowledge”, indicating that statements in this category require closer consideration.

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REFERENCES

- Arlinger, S. (2003). Negative consequences of uncorrected hearing loss-a review. *International Journal of Audiology, 42*, 2S17-12S20.
- Bennett, R. J., Jayakody, D., Eikelboom, R. H., Taljaard, D. S., & Atlas, M. D. (2015a). A prospective study evaluating cochlear implant management skills. Development and validation of the Cochlear Implant Management Skills (CIMS) survey. *Clinical Otolaryngology, 41*(1), 51.
- Bennett, R. J., Taljaard, D. S., Brennan-Jones, C. G., Tegg-Quinn, S., & Eikelboom, R. H. (2015b). Evaluating hearing aid handling skills: A systematic and descriptive review. *International Journal of Audiology, 54*(11), 765-776.
- Bennett, R. J., Taljaard, D. S., Meyer, C., & Eikelboom, R. H. (2017a). Are hearing aid owners able to identify and self-report handling difficulties? *International Journal of Audiology, 1-7*. (accepted for publication July 2017)
- Bennett, R. J., Laplante-Lévesque, A., Meyer, C. J., & Eikelboom, R. H. (2017b). Exploring hearing aid problems: Perspectives of hearing aid owners and clinicians. *Ear and Hearing, 1-16*. (accepted for publication July 2017)
- Bertoli, S., Staehelin, K., Zemp, E., Schindler, C., Bodmer, D., & Probst, R. (2009). Survey on hearing aid use and satisfaction in Switzerland and their determinants. *International Journal of Audiology, 48*(4), 183-195.
- Boothroyd, A. (2007). Adult aural rehabilitation: what is it and does it work? *Trends in Amplification, 11*(2), 63-71.
- Burke, J. G., O'Campo, P., Peak, G. L., Gielen, A. C., McDonnell, K. A., & Trochim, W. M. (2005). An introduction to concept mapping as a participatory public health research method. *Qualitative Health Research, 15*(10), 1392-1410.
- Campos, P. D., Bozza, A., & Ferrari, D. V. (2014). *Hearing aid handling skills: relationship with satisfaction and benefit*. Paper presented at the CoDAS.
- Carson, A. J. (2005). "What brings you here today?" The role of self-assessment in help-seeking for age-related hearing loss. *Journal of Aging Studies, 19*(2), 185-200.
- Chisolm, T. H., Johnson, C. E., Danhauer, J. L., Portz, L. J., Abrams, H. B., Lesner, S., . . . Newman, C. W. (2007). A systematic review of health-related quality of life and hearing aids: final report of the American Academy of Audiology Task Force On the Health-Related Quality of Life Benefits of Amplification in Adults. *Journal of the American Academy of Audiology, 18*(2), 151-183.
- Concept Systems Incorporated. (2011). The Concept System [computer software], version 4, Ithaca, NY. <http://www.conceptsystems.com>

- Cox, R. M., Alexander, G. C., & Gray, G. A. (2007). Personality, hearing problems, and amplification characteristics: Contributions to self-report hearing aid outcomes. *Ear and Hearing, 28*(2), 141-162.
- Dawes, P., Maslin, M., & Munro, K. J. (2014). 'Getting used to' hearing aids from the perspective of adult hearing-aid users. *International Journal of Audiology, 53*(12), 861-870.
- 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*(2), 56-62.
- Ekberg, K., Grenness, C., & Hickson, L. (2014). Addressing patients' psychosocial concerns regarding hearing aids within audiology appointments for older adults. *American Journal of Audiology, 23*(3), 337-350.
- El-Molla, F., Smith, Z., Henshaw, H., & Ferguson, M. (2012). *Retention of rehabilitation information by first-time hearing aid users with and without interactive patient information*. Paper presented at the meeting of the British Academy of Audiology, Manchester, United Kingdom.
- Erdman, S. A., Wark, D. J., & Montano, J. J. (1994). Implications of service delivery models in audiology. *Journal of the Academy of Rehabilitative Audiology, 27*, 45-60.
- Ferguson, M., Brandreth, M., Brassington, W., & Wharrad, H. (2015). Information Retention and Overload in First-Time Hearing Aid Users: An Interactive Multimedia Educational Solution. *American Journal of Audiology, 24*(3), 329-332.
- Ferrari, D. V., Jokura, P. R., Silvestre, N. A., Campos, P. D., & Paiva, P. M. P. (2015). Practical hearing aid skills test: results at the time of fitting and comparison of inter-rater reliability. *Audiology-Communication Research, 20*(2), 110-115.
- Goggins, S., & Day, J. (2009). Pilot study: Efficacy of recalling adult hearing-aid users for reassessment after three years within a publicly-funded audiology service. *International Journal of Audiology, 48*(4), 204-210.
- Grenness, Hickson, Laplante-Lévesque, & Davidson. (2014). Patient-centred audiological rehabilitation: perspectives of older adults who own hearing aids. *International Journal of Audiology, 53 Suppl 1*, S68-75.
- Grenness, C., Hickson, L., Laplante-Lévesque, A., & Davidson, B. (2014). Patient-centred care: A review for rehabilitative audiologists. *International Journal of Audiology, 53*(S1), S60-S67.
- Guba, E. G. (1981). Criteria for assessing the trustworthiness of naturalistic inquiries. *Educational Communication and Technology Journal, 29*(2), 75-91.
- Hickson, Worrall, & Scarinci. (2007a). *Active Communication Education (ACE): A program for older people with hearing impairment*: Speechmark.
- Hickson, Worrall, & Scarinci. (2007b). A randomized controlled trial evaluating the active communication education program for older people with hearing impairment. *Ear and Hearing, 28*(2), 212-230.
- Hinkle, D. E., Wiersma, W., & Jurs, S. G. (2003). Applied statistics for the behavioral sciences. *Journal of Educational Statistics, 15*(1), 84-87.
- Hogan, A. (2001). *Hearing rehabilitation for deafened adults: A psychosocial approach*. London. John Wiley & Sons.

- Hogan, A. (2015). Societal Change: Towards a More Comprehensive Re-structuring of Hearing Services. *Hearing Impairment and Hearing Disability: Towards a Paradigm Change in Hearing Services*. New York. Routledge, 105.
- Jackson, K. M., & Trochim, W. M. (2002). Concept mapping as an alternative approach for the analysis of open-ended survey responses. *Organizational Research Methods*, 5(4), 307-336.
- Jerram, J., & Purdy, S. C. (2001). Technology, expectations, and adjustment to hearing loss: predictors of hearing aid outcome. *Journal of the American Academy of Audiology*, 12(2), 64-79.
- Kamil, R. J., & Lin, F. R. (2015). The effects of hearing impairment in older adults on communication partners: a systematic review. *Journal of the American Academy of Audiology*, 26(2), 155-182.
- Kane, M., & Trochim, W. M. (2007). *Concept mapping for planning and evaluation* (Vol. 50): Sage.
- Kelly, T. B., Tolson, D., Day, T., McColgan, G., Kroll, T., & Maclaren, W. (2013). Older people's views on what they need to successfully adjust to life with a hearing aid. *Health and Social Care in the Community*, 21(3), 293-302.
- Knudsen, L. V., Laplante-Lévesque, A., Jones, L., Preminger, J. E., Nielsen, C., Lunner, T., . . . Kramer, S. E. (2012). Conducting qualitative research in audiology: a tutorial. *International Journal of Audiology*, 51(2), 83-92.
- Knudsen, L. V., Nielsen, C., Kramer, S. E., Jones, L., & Laplante-Lévesque, A. (2013). Client labor: adults with hearing impairment describing their participation in their hearing help-seeking and rehabilitation. *Journal of the American Academy of Audiology*, 24(3), 192-204.
- Knudsen, L. V., Oberg, M., Nielsen, C., Naylor, G., & Kramer, S. E. (2010). Factors influencing help seeking, hearing aid uptake, hearing aid use and satisfaction with hearing aids: a review of the literature. *Trends in Amplification*, 14(3), 127-154.
- Kochkin, Beck, Christensen, Compton-Conley, Fligor, Kricos, & Turner. (2010). MarkeTrak VIII: The impact of the hearing healthcare professional on hearing aid user success. *The Hearing Review*, 17(4), 12-34.
- Kochkin, S., Beck, D., Christensen, L., Compton-Conley, C., Fligor, B., Kricos, P., . . . Turner, R. (2012). MarkeTrak VIII: The impact of the hearing healthcare professional on hearing aid user success. *The Hearing Review*, 17(4), 12-34.
- Kochkin, S., & Rogin, C. (2000). Quantifying the obvious: The impact of hearing instruments on quality of life. *The Hearing Review*, 7(1), 6-34.
- Kramer, S. E., Kapteyn, T. S., Kuik, D. J., & Deeg, D. J. (2002). The association of hearing impairment and chronic diseases with psychosocial health status in older age. *Journal of Aging and Health*, 14(1), 122-137.
- Kumar, M., Hickey, S., & Shaw, S. (2000). Manual dexterity and successful hearing aid use. *Journal of Laryngology and Otolaryngology*, 114(8), 593-597.
- Laplante-Lévesque, A., Hickson, L., & Worrall, L. (2010). A qualitative study of shared decision making in rehabilitative audiology. *Journal of the Academy of Rehabilitative Audiology*, 43, 27-43.

- Laplante-Lévesque, A., Jensen, L. D., Dawes, P., & Nielsen, C. (2012). Optimal Hearing Aid Use: Focus Groups With Hearing Aid Clients and Audiologists. *Ear and Hearing, 34*(2), 193-202.
- Laplante-Lévesque, A., Jensen, L. D., Dawes, P., & Nielsen, C. (2013). Optimal hearing aid use: focus groups with hearing aid clients and audiologists. *Ear and Hearing, 34*(2), 193-202.
- Laplante-Lévesque, A., Knudsen, L. V., Preminger, J. E., Jones, L., Nielsen, C., Oberg, M., . . . Kramer, S. E. (2012). Hearing help-seeking and rehabilitation: perspectives of adults with hearing impairment. *International Journal of Audiology, 51*(2), 93-102.
- Laplante-Lévesque, A., Pichora-Fuller, M. K., & Gagné, J. P. (2006). Providing an internet-based audiological counselling programme to new hearing aid users: a qualitative study. *International Journal of Audiology, 45*(12), 697-706.
- Linssen, A. M., Joore, M. A., Minten, R. K., van Leeuwen, Y. D., & Anteunis, L. J. (2013). Qualitative interviews on the beliefs and feelings of adults towards their ownership, but non-use of hearing aids. *International Journal of Audiology, 52*(10), 670-677.
- Lockey, K., Jennings, M. B., & Shaw, L. (2010). Exploring hearing aid use in older women through narratives. *International Journal of Audiology, 49*(8), 542-549.
- McArdle, R., Chisolm, T. H., Abrams, H. B., Wilson, R. H., & Doyle, P. J. (2005). The WHO-DAS II: measuring outcomes of hearing aid intervention for adults. *Trends in Amplification, 9*(3), 127-143.
- Meister, H., Lausberg, I., Kiessling, J., von Wedel, H., & Walger, M. (2002). Identifying the needs of elderly, hearing-impaired persons: the importance and utility of hearing aid attributes. *European Archives of Oto-rhino-laryngology, 259*(10), 531-534.
- Mener, D. J., Betz, J., Genter, D. J., Chen, D., & Lin, F. R. (2013). Hearing loss and depression in older adults. *Journal of the American Geriatrics Society, 61*(9), 1627.
- Mulrow, C. D., Tuley, M. R., & Aguilar, C. (1992). Correlates of successful hearing aid use in older adults. *Ear and Hearing, 13*(2), 108-113.
- Nachtegaal, J., Smit, J. H., Smits, C., Bezemer, P. D., van Beek, J. H., Festen, J. M., & Kramer, S. E. (2009). The association between hearing status and psychosocial health before the age of 70 years: results from an internet-based national survey on hearing. *Ear and Hearing, 30*(3), 302-312.
- Poost-Foroosh, L., Jennings, M. B., & Cheesman, M. F. (2015). Comparisons of client and clinician views of the importance of factors in client-clinician interaction in hearing aid purchase decisions. *Journal of the American Academy of Audiology, 26*(3), 247-259.
- Poost-Foroosh, L., Jennings, M. B., Shaw, L., Meston, C. N., & Cheesman, M. F. (2011). Factors in client-clinician interaction that influence hearing aid adoption. *Trends in Amplification, 15*(3), 127-139.
- Popelka, M. M., Cruickshanks, K. J., Wiley, T. L., Tweed, T. S., Klein, B. E., & Klein, R. (1998). Low prevalence of hearing aid use among older adults with hearing loss: the Epidemiology of Hearing Loss Study. *Journal of the American Geriatrics Society.*
- Pronk, M., Deeg, D. J., Smits, C., Twisk, J. W., van Tilburg, T. G., Festen, J. M., & Kramer, S. E. (2014). Hearing Loss in Older Persons Does the Rate of Decline Affect Psychosocial Health? *Journal of Aging and Health, 25*(5), 703-723.

- Reese, J. L., & Hnath-Chisolm, T. (2005). Recognition of hearing aid orientation content by first-time users. *American Journal of Audiology*, *14*(1), 94-104.
- Rosas, S. R., & Kane, M. (2012). Quality and rigor of the concept mapping methodology: a pooled study analysis. *Evaluation and Program Planning*, *35*(2), 236-245.
- Saunders, Frederick, Silverman, & Papesh. (2013). Application of the health belief model: development of the hearing beliefs questionnaire (HBQ) and its associations with hearing health behaviors. *International Journal of Audiology*, *52*(8), 558-567.
- Saunders, Lewis, & Forsline. (2009). Expectations, prefitting counseling, and hearing aid outcome. *Journal of the American Academy of Audiology*, *20*(5), 320-334.
- Solheim, J., Kværner, K. J., Sandvik, L., & Falkenberg, E.-S. (2012). Factors affecting older adults' hearing-aid use. *Scandinavian Journal of Disability Research*, *14*(4), 300-312.
- SPSS Inc. (2014). IBM © SPSS Statistics (Version V21). Chicago, IL.
- Stark, P., & Hickson, L. (2004). Outcomes of hearing aid fitting for older people with hearing impairment and their significant others. *International Journal of Audiology*, *43*(7), 390-398.
- Sweetow, R. (2007). Instead of a hearing aid evaluation, let's assess functional communication ability. *The Hearing Journal*, *60*(9), 26-31.
- Sweetow, R., & Sabes, J. (2007). Technologic advances in aural rehabilitation: applications and innovative methods of service delivery. *Trends in Amplification*, *11*(2), 101-111.
- Tambs, K. (2004). Moderate effects of hearing loss on mental health and subjective well-being: results from the Nord-Trøndelag Hearing Loss Study. *Psychosomatic Medicine*, *66*(5), 776-782.
- Trochim. (1993). *The reliability of concept mapping*. Paper presented at the Annual Conference of the American Evaluation Association, Dallas, Texas.
- Trochim, W., & Kane, M. (2005). Concept mapping: an introduction to structured conceptualization in health care. *International Journal for Quality in Health Care*, *17*(3), 187-191.
- Trochim, W. M. (1989). An introduction to concept mapping for planning and evaluation. *Evaluation and Program Planning*, *12*(1), 1-16.
- Upfold, L., May, A., & Battaglia, J. (1990). Hearing aid manipulation skills in an elderly population: a comparison of ITE, BTE, and ITC aids. *British Journal of Audiology*, *24*(5), 311-318.
- Wallhagen, M. I., Strawbridge, W. J., Shema, S. J., & Kaplan, G. A. (2004). Impact of self-assessed hearing loss on a spouse: A longitudinal analysis of couples. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *59*(3), S190-S196.
- West, R. L., & Smith, S. L. (2007). Development of a hearing aid self-efficacy questionnaire. *International Journal of Audiology*, *46*(12), 759-771.
- WHO. (2014). Deafness and hearing loss. Retrieved 20/08/2014, from <http://www.who.int/mediacentre/factsheets/fs300/en>