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Faculty of Humanities
Department of Speech-Language Pathology and Audiology

CONSUMER PERSPECTIVES ON IMPROVING HEARING AIDS: A QUALITATIVE STUDY

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A dissertation in fulfilment of the requirements for the degree MA AUDIOLOGY in the Department of Speech Language Pathology and Audiology, Faculty of Humanities, University of Pretoria

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Note: This dissertation is written in English (U.K.). However, due to this work being based on written data collected from research participants in the United States (U.S.), and submission to the American Journal of Audiology for publication (see chapter 3), some parts such as the research article and direct quotations, may be presented in English (U.S.).

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This dissertation is dedicated to independent audiologists everywhere. May you continue to honour your passion for empowering people with the gift of communication in our ever-evolving industry.

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RESEARCH OUTPUT AND PUBLICATION

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PLAGIARISM DECLARATION

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Declaration

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LIST OF ABBREVIATIONS

App	Application (i.e. mobile application)
BOD	Burden of disease
CES	Customer effort score
CBPR	Community-based participatory research
DTC	Direct to consumer
ENT	Ear, nose and throat specialist
FDA	U.S. food and drug administration
GBD	Global burden of disease
HA	Hearing aid
HHP	Hearing healthcare professional
HL	Hearing loss
HPCSA	Health professions council of South Africa
ICF	International classification framework
ICOPE	Integrated care for older people
IP rating	Ingress Protection rating
ISO	International Organization for Standardization
NIDCD	National Institute on Deafness and Other Communication Disorders
OTC	Over the counter
PCC	Person-centred care
REM	Real ear measurement
U.S.	United States of America
WHO	World Health Organisation

KEY WORDS

Hearing aid accessibility

Hearing aid benefit

Hearing aid improvements

Hearing aid fitting outcomes

Hearing aid service delivery

Industry transparency

Sound clarity

User perspectives

User autonomy

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ABSTRACT

Optimal hearing aid fittings are central to the management of hearing loss. While research studies using quantitative scales typically report high hearing aid user satisfaction rates, other studies show poor uptake and sustained usage of hearing aids. While quantitative research is valuable, nuanced factors influencing hearing aid user experiences can be minimised. This underscores a need for the qualitative exploration of holistic hearing aid experiences, to promote successful outcomes. In light of this, the present study aimed to describe user perspectives on desired changes to hearing aids, in order to make them more useful. An open-ended question from a cross-sectional online survey was retrospectively analysed using inductive, qualitative content analysis. Participants were adult hearing aid users in the United States (U.S.), who had obtained their hearing aids either through the traditional hearing healthcare professional (HHP) mediated prescription route, or through the OTC service delivery model. The survey was disseminated over email through the Hearing Tracker forum database and through Lexie Hearing, an OTC hearing aid company. Results showcased a rich variety of information and highlighted diverse viewpoints. 628 participant responses were manually coded and categorised to form domains. The mean age of the surveyed population was 66 years old (13. 4 SD). The majority were bilateral, behind-the-ear hearing aid users. Three domains illustrating desired hearing aid changes emerged from the data. The **(i) hearing aid features domain (n= 635 responses)** illustrated challenges surrounding hearing aid usability (appearance and comfort), durability (Ingress Protection (IP) ratings) and digital functionality (Bluetooth connectivity). The **(ii) sound quality domain (n=282 responses)** described challenges surrounding sound recognition and clarity (as an independent concept from volume) as well as the performance of noise reduction technology. The **(iii) service-delivery domain (n=378 responses)** described user concerns about affordability, audiologist

credibility and overall hearing aid industry market transparency. Participants expressed satisfaction with hearing aid technological developments, similar to previous studies indicating high satisfaction rates, but expressed a strong desire for further improvements, to better align hearing aids and services with their needs. Key areas for improvement include cost accessibility, physical device aesthetics and comfort, technical functioning, user autonomy, sound clarity and collaboration and trust between patients and HHPs. While some participant suggestions such as those surrounding aesthetics are known, novel information regarding features enhancing user autonomy and promoting industry transparency, were highlighted. Against the backdrop of an evolving hearing aid industry, the findings of this study can assist HHPs in being informed facilitators for both, health consumers and their patients. Consideration should be given to intervention solutions which promote principles of Person-Centred Care (PCC), enhance patient self-efficacy and maintain transparency.

CHAPTER ONE: INTRODUCTION

1.1. STUDY BACKGROUND

The Global Burden of Disease (GBD) associated with hearing loss is increasing, with the economic costs being estimated to be in excess of $981billion (GBD 2019 Hearing Loss Collaborators, 2021; McDaid, Park, & Chadha, 2021). Indeed, the World Health Organisation (WHO) projects that in 2050, one in every ten people will require hearing rehabilitation (World Health Organisation, 2021). The impacts of disabling hearing loss are significant, spanning communication difficulties, cognitive decline, decreased education and employment opportunities and social isolation (Singh & Jha, 2020; McDaid, Park, & Chadha, 2021).

Favourable hearing aid outcomes have proven to be instrumental in mitigating these negative effects of hearing loss (Picou, 2020; Ritter, Barker, & Scharp, 2020). However, despite growth in the hearing aid industry to cater for evident intervention needs, hearing aid uptake and sustained usage remains low in both, hearing aid owners and non-owners (McCormack & Fortnum, 2013; Dillon, Day, Bant, & Munro, 2021; Jorgensen & Novak, 2020). In 2021, the National Institute on Deafness and Other Communication Disorders (NIDCD) reported that only 16-30% of adults in the United States (U.S.), who require hearing aids, actually use them. Factors influencing use are widespread, including the significant issue of cost-accessibility, as well as other factors such as stigmatisation, perceived non-necessity, dissatisfaction with hearing aids and professional distrust (Pouyandeh & Hoseinabadi, 2019; Ritter, Barker, & Scharp, 2020; Solheim, Gay, & Hickson, 2017; Desjardins & Sotelo, 2021). This implies the complexity of the hearing healthcare journey, and contextualises the challenges of individuals with hearing loss.

The hearing aid industry has attempted to alleviate some of these challenges with technological innovation, producing hearing aids which boast digital signal processing and, more recently, artificial intelligence, to optimize hearing aids to their full potential (Valentinuzzi, 2020; Wolfgang, 2019). Innovation, while lauded, has come with an increase in hearing aid cost and digital complexity (Orji , et al., 2020). The hearing aid industry has been plagued by what is known as the five-firm oligopoly. This oligopoly implies market domination by five large hearing aid firms which both limits, and controls market share (Amlani, 2023). The result of this is standardised pricing which is exclusionary, particularly for a population that can be predisposed to hearing loss comorbidities, resulting in competing health needs (Planey, 2020; Waterworth, et al., 2022). In addition to cost-accessibility concerns, the availability of hearing healthcare services is insufficient in developed and developing countries alike, with a lack of sufficient hearing healthcare professionals (HHPs), and significant geographical distance between patients and HHPs (World Health Organization, 2023). In essence, an underwhelming contraction exists: a high socio-economic impact of hearing loss demanding management, but underutilised innovation due to impaired accessibility.

In October 2022, the U.S. Food and Drug Administration (FDA) took a step forward in solving the issue of accessibility, by sanctioning the marketing of over-the-counter (OTC) hearing aids. These devices capitalise on contemporary technology which has made self-fitting hearing aids a reality (Blustein, Weinstein, & Chodosh, 2022). OTC hearing aids have become available on the open market across the U.S., allowing adults with perceived mild to moderate hearing loss access, without requiring a prescription from a HHP (The Food and Drug Administration, 2023). It is noteworthy that these OTC devices have replaced Direct to Consumer (DTC) hearing aids, which were sold online previous to the FDA ruling (Manchaiah, et al., 2023). The traditional, HHP-mediated, prescription model of hearing aid service provision, is still

available for those who require or prefer it. This includes individuals with complex hearing-related disorders, those with degrees of hearing loss exceeding the moderate range covered by OTC devices, and those under the age of eighteen.

1.2. MEANINGFUL HEARING AID USAGE AND STUDY RATIONALE

While increasing access to hearing aids is a crucial factor affecting usage, owning a hearing aid is not a guarantee of successful use (Blustein, Weinstein, & Chodosh, 2022). Saunders, Dillard, Zobay, Cannon and Naylor (2021) examined persistent hearing aid usage in U.S. veterans who had free access to hearing aids. They reported that only 63% of individuals who were fitted, continued using their hearing aids after 24 months. One aspect that affected use, was the presence of co- and multimorbidity, which decreased the likelihood of persistent hearing aid use. The International Classification of Functioning, Disability and Health (ICF), developed by the World Health Organization (WHO), emphasises the importance of interpreting hearing loss within a biopsychosocial framework, in recognition of its multifarious effects and comorbidities (Meyer, Grenness, Scarinci, & Hickson, 2016). The ICF considers environmental factors (such as technology, health systems and attitudes) and body functions (such as intellect, temperament, emotions and motivation), to be the far-reaching effects of hearing loss. These effects are further confounding, in the context of the factors influencing hearing aid use already mentioned, such as device dissatisfaction and perceived non-necessity.

Another important factor affecting hearing aid usage is a lack of trust in HHPs. This has been shown to negatively impact hearing aid use, with individuals mistrusting diagnoses or the need for intervention, when their expectations do not align with those of the HHP (Ritter, Barker, & Scharp, 2020). Contemporary research advocates for Person-Centred Care (PCC), with a focus

on patient involvement in decision-making. This departure from the traditional biomedical model prioritises patient expectations and goals, paving the way for patient-professional collaboration, to facilitate meaningful intervention (Scarinci, Tulloch, Meyer, Ekberg, & Lind, 2022).

Exploring the meaningfulness of intervention itself is common in audiology research, to predict success and facilitate evidence-based intervention. In this regard, many previous studies have examined hearing aid satisfaction. The majority of these have reported high satisfaction rates among hearing aid users (Kozlowski, Ribas, Almeida, & Luz, 2017; Davidson, Marrone, Wong, & Musiek, 2021; Heselton, Bennett, Manchaiah, & Swanepoel, 2022). Indeed, data from MarkeTrak reflect a continued increase in hearing aid satisfaction since 1989, in line with technological advancements (Powers & Carr 2022). While this reflects positively, differentiating between satisfaction and benefit is key in interpreting hearing aid outcomes. It is also necessary when exploring device rejection in hearing aid owners. Picou (2022) differentiates between benefit and satisfaction with hearing aids as two distinct concepts. Hearing aid benefit is determined by improvements perceived with device use, while satisfaction is determined by individual perception of overall hearing aid performance (Picou, 2022). While overall satisfaction with hearing aids appears high, key concerns hindering benefit, such as poor speech perception in noise, and a lack of physical comfort, have been reported in previous studies (Davidson, Marrone, Wong, & Musiek, 2021; Bennett et al., 2021).

It is noteworthy that the majority of studies on hearing aid satisfaction is quantitative in nature, showcasing results which can minimise the significant nuances of user experience. The dichotomy of high hearing aid satisfaction rates, but conversely low uptake and sustained usage

rates, is an example of this. Against this backdrop, the present study sought to qualitatively explore key issues hindering hearing aid usefulness (or benefit), by platforming hearing aid user experiences. These deeper insights into hearing aid use can facilitate enhancements in service delivery, to promote meaningful benefit and satisfaction, and overall favourable hearing aid outcomes. In order to source qualitative data which showcased authentic experiences, the researcher carefully considered the population to be surveyed. The contemporary individual with hearing loss in the U.S. is profiled as an active health consumer, with access to platforms that encourage open dialogue. An example of this is Hearing Tracker (https://www.hearingtracker.com), an online forum which connects individuals with hearing loss to HHPs, and displays online reviews of hearing aids. The present study capitalised on this consumer dialogue, by surveying individuals belonging to the Hearing Tracker database. Furthermore, users of Lexie Hearing branded OTC hearing aids (https://lexiehearing.com/us) were also surveyed, providing insights into this relatively novel market, which aims to overcome the significant factor of cost-accessibility. The study aimed to explore changes that hearing aid users would like to see in their devices, in order to make them more useful.

CHAPTER TWO: METHODOLOGY

2.1. RESEARCH AIM

The study aimed to describe user perspectives on desired changes to hearing aids, in order to make them more useful.

2.2. RESEARCH DESIGN

The study employed a retrospective qualitative research design. Retrospective research is conducted on data which is available as a result of previous collation (Junod, 2010). Data collection for the study had ceased before analysis began, allowing for time-efficient analysis. Qualitative research examines an individual's personal experience and can provide deeper insight into a subject's perception, as opposed to a quantitative design which often captures less descriptive data (Hammond, Malec, Nick, & Buschbacher, 2015). This design proved valuable in understanding individuals' experiences with hearing aids and their perceived needs. Phenomenology was used as a research tradition to guide the study. Phenomenology is concerned with exploring participant experiences, to be able to describe their perceptions of a specific object (Manchaiah, Beukes, & Roeser, 2022). This was implemented by suspending researcher perceptions during the data analysis process (no hypotheses were generated). Participant responses led to the organic emergence of categories to represent the data (described in more detail later in this chapter), without researcher presuppositions. Participant experiences and perceptions which shaped their suggestions, were the focal point of the study.

A cross-sectional survey question was analysed using content analysis and an inductive approach. The content analysis method allowed for categories to emerge from the data organically, providing a comprehensive overview that linked common concerns detailed in

participant responses (Manchaiah, Beukes, & Roeser, 2022; Hsieh & Shannon, 2005). The inductive approach to data analysis allowed for the generation of new information from the data, with no pre-existing hypothesis for the study (Manchaiah, Beukes, & Roeser, 2022). In a cross-sectional study, data is collected from various age groups and can then be compared. These studies are advantageous in terms of timing, as the data is collected at a single point in time, as opposed to longitudinal studies which can be lengthy. This allowed inferences to be made about the selected population, to generate new information in a convenient, timely manner (Leedy & Ormrod, 2021).

2.3. STUDY SETTING

The study was based on a survey conducted in 2021, on U.S. based hearing aid users who were either members of the Hearing Tracker online community, or Lexie hearing aid users. Hearing Tracker is an independent consumer resource in the form of a website, which has been developed by hearing professionals to provide individuals with evidence-based information regarding hearing healthcare. The website includes consumer reviews on hearing aids and links individuals to hearing healthcare professionals in the United States. Individuals surveyed on this platform obtained their hearing aids through the traditional HHP-mediated prescription route. Lexie Hearing is a company founded by the HearX Group which markets OTC self-fitting hearing aids. Individuals who purchase these devices sign up for access to remote support services in line with tele-audiology practice.

2.4. MATERIAL AND APPARATUS

An online, cross-sectional survey, which took approximately 15 minutes to complete, was emailed to individuals through the above-mentioned databases (Hearing Tracker and Lexie

Hearing). The data was collected in October and November 2021. The survey was developed by Prof. Vinaya Manchaiah (formerly based at the University of Lamar, currently based at the University of Colorado and Extraordinary Professor at the University of Pretoria) and Prof. De Wet Swanepoel (UP) in collaboration with social psychologists Prof. Jamie Pennebaker (University of Texas at Austin) and Prof. Ryan Boyd (University of Lancaster). While Prof. Manchaiah and Prof. Swanepoel provided the audiology context for the survey, the collaboration with social psychologists lent depth to the structure of the survey's open-ended questions (discussed more below). These questions were structured to pique participant interest and encourage open, meaningful responses that could generate a dialogue surrounding hearing aid user experience.

The survey comprised four open-ended questions relating to hearing aid use. It also included questions related to basic demographic information (Appendix A). Each open-ended question was analysed and discussed as a stand-alone study. The question relevant to the current study at hand is as follows:

"We talk to audiologists and hearing aid companies. Tell us how you would like hearing aids to change to be more useful for you and the people around you. Please be honest. We really would like your thoughts and feelings about this. Your comments will help us when we talk to people in the industry."

2.5. RESEARCH PARTICIPANTS

The study made use of purposive sampling. This type of sampling is often used in qualitative research as participants are chosen for their capability to provide information relating to a specific topic, and allows for the generation of new theory related to the topic (Manchaiah,

Beukes, & Roeser, 2022). Participants were selected based on specific inclusion and exclusion criteria which was shaped by the research aim. Included participants originated from the Hearing Tracker and Lexie Hearing databases, as all individuals utilising these platforms were known hearing aid users and were therefore able to share their experiences and provide relevant data for the study. Individuals utilising the Hearing Tracker and Lexie Hearing services had previously indicated to the respective companies that they were willing to participate in research. These individuals were therefore contacted over email with the survey for completion. Seven hundred and twenty-seven (727) responses were received. From these, a total of 628 responses were analysed after exclusions (399 from Hearing Tracker and 229 from Lexie Hearing). In addition to the exclusion criteria below, responses that did not answer the survey's open-ended question (for example participant answers which were completely irrelevant to the question) were also excluded.

The study excluded individuals who utilised Personal Sound Amplification Products (PSAPs). PSAPS are devices intended for individuals with normal hearing, to amplify sounds for recreational activities, such as birdwatching (U.S. Food and Drug Administration, 2021). PSAPS are classified as consumer electronics and not medical devices (U.S. Food and Drug Administration, 2021), and were therefore not considered in the present study which focused on hearing aids specifically. The study also excluded individuals who were fitted with hearing aids during childhood, the result of which could have an effect on their perceptions surrounding hearing aids and their usefulness, which was not the focus of this study. Participants that met the criteria outlined in the table below were included in the study.

Table 4. Participant Inclusion Criteria

Inclusion Criteria	Rationale
Adults (18 years old and older)	This population was most likely to provide informed and comprehensive perspectives.
Varying degrees of self-reported hearing loss	User perspectives regardless of degree of hearing loss was considered valuable to add to the diversity of data.
Based in the United States (U.S.)	This was due to participants being accessed through Hearing Tracker and Lexie Hearing which both operate in the U.S.
Current or previous hearing aid users	All perspectives relating to hearing aid usefulness was considered valuable, varying experiences were welcomed to gain more insights.
Had obtained hearing aids through the HHP mediated prescription model or the OTC model	Varying experiences were considered valuable to gain more insights. OTC hearing aids are relatively novel and added a new dimension to the study. Individuals surveyed from the Hearing Tracker database utilised prescription hearing aids of varying models. Individuals surveyed from the OTC company, Lexie Hearing, utilised the Lexie Lumen hearing aid model (the only model available through Lexie Hearing at the time of the survey).

2.6. ETHICAL CONSIDERATIONS

The survey was conducted in the U.S., with the collaboration of the Universities of Lamar and Colorado. The study's survey received ethical clearance from Lamar University (IRB-FY21-248) (Appendix B). The memorandum of understanding between the University of Pretoria and Lamar University has been included in this work (Appendix D). The memorandum of understanding between the University of Pretoria and the University of Colorado has also been included in this work (Appendix E). Data analysis commenced once ethical clearance was obtained from the Research and Ethics committee, Faculty of Humanities, at the University of Pretoria (HUM033/0822) (Appendix C). The ethical considerations for this study are divided into those related to the researcher and those related to the participants (Kumar, 2011; Leedy & Ormrod, 2021).

Researcher-related ethics

Bias was avoided by independent review of the data analysis by research supervisors. The appropriate choice of methodology was also controlled by rigorous appraisal from research supervisors. This ensured that information was accurately reported and remained relevant to the study aim. In an effort to use information from the study appropriately, and facilitate meaningful dissemination of information, a journal article manuscript was submitted to the American Journal of Audiology. In addition to this, plagiarism was avoided by constant monitoring of written material (see also plagiarism declaration). Furthermore, participant responses were included as direct quotations in the research, without revealing participant identities or using responses as the researcher's text.

Participant-related ethics

Informed consent for participation in the study was obtained from each survey participant. Participants were emailed the survey, accompanied by information about the study and a consent tick box (Appendix A). Anonymity was upheld by assigning numerical codes to participant responses, thereby ensuring identities were kept anonymous before the dataset was shared and analysis commenced. The deidentified dataset was provided to the researcher by Prof. Vinaya Manchaiah (Extraordinary professor, University of Pretoria). This deidentified dataset was used for analysis purposes and participant personal identifying details were never shared.

2.7. TRUSTWORTHINESS

Trustworthiness of the research was ensured by considering the aspects of reliability and validity. Reliability refers to the consistency, clarity and replicability of a research study's

methodology (Rose & Johnson, 2020). The inductive, content analysis approach used to analyse the survey responses was extensively documented at each stage, to ensure clear and replicable analysis. This documentation included original survey responses and all code books leading to the final presentation of the data. Multiple expert researchers (Prof. Vinaya Manchaiah, Dr Eldré Beukes, Anglia Ruskin University, and Dr Ilze Oosthiuzen, UP) cross-checked this analysis to ensure consistency of the approach, by checking the primary researcher's code books, discussing the coding approach and by independent coding. Validity refers to the accuracy of the findings of a research study (Rose & Johnson, 2020). Findings were measured against the research aim and critically compared to current research, to ensure accuracy. Inconsistencies, such as duplicate categories, were discussed and appraised by supervisors until discrepancies were resolved.

2.8. DATA ANALYSIS

The Statistical Package for the Social Sciences (SPSS) version 28 was used to analyse the demographic survey data, in order to obtain descriptive statistics. Responses to the open-ended question was analysed using the content analysis method as described by Graneheim & Lundman (2004). Content analysis was deemed appropriate for the study, as it allows for the description of various data aspects. As the survey question was open-ended, responses obtained were multifaceted and composed of various data aspects. Content analysis allowed inferences to be made and formatted in a way which provided a detailed overview, linking to the research aim (Manchaiah, Beukes, & Roeser, 2022).

Survey responses were consolidated on a Microsoft Excel spreadsheet and allocated a numerical participant identity (displayed as a participant number (P) in direct quotes in this

work), to form a de-identified dataset. The data was first examined through data immersion. Thereafter, each participant response was divided into meaning units, depending on the length and number of aspects (or topics of discussion) in the response. Individually assigned corresponding codes were then generated per response (one or more codes per response, depending on the number of aspects presented). As a result, the Microsoft Excel spreadsheet containing the participant responses was developed into a code book. Common codes across responses began to emerge. These codes formed sub-categories. Eventually, these sub-categories were grouped with similar counterparts to form larger categories and thereafter domains. The frequency of each sub-category was also recorded, with examples of meaning units, to aid in data interpretation. Finally, the categories and patterns identified were linked to the research aim, to draw conclusions. While patterns were observed for meaningful interpretation, each response was scrutinised individually in order to develop insightful conclusions, influenced by the nuance of hearing aid users' diverse experiences and desires. To this point, while the frequency of sub-categories was reported in the results to display popular opinions, sub-categories with smaller frequencies and conflicting opinions were also discussed.

The Hearing Tracker survey included a minimum word count of 20 words, while the Lexie Hearing survey did not include a minimum word count. As a result, some responses from Lexie Hearing users were shorter. Despite this, all responses which sufficiently answered the open-ended question, regardless of length, were included in the analysis. For example, a participant answering the survey question with the word "rechargeable" was deemed as them preferring a rechargeable device, in the context of the question. The researcher has acknowledged this limited context as a limitation later in this work.

CHAPTER THREE: RESEARCH ARTICLE

Title: Consumer Perspectives on Improving Hearing Aids: A Qualitative Study

Journal: American Journal of Audiology

Authors: Nabeelah Desai; Eldré W. Beukes; Vinaya Manchaiah; Faheema Mahomed-Asmail; De Wet Swanepoel

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3.1. ABSTRACT

Purpose:

Hearing aids play a pivotal role in mitigating the impact of hearing loss, yet their adoption and consistent usage remains suboptimal. Understanding the hearing aid needs of individuals with hearing loss is important to support uptake, use, and outcomes. The current study describes users' perspectives on how hearing aids can be improved.

Method:

A cross-sectional, qualitative, content analysis design was used for an open-ended question from an online survey, exploring user perspectives on hearing aid improvements. Participants were adult hearing aid users in the United States, surveyed from the HearingTracker and Lexie Hearing user database.

Results:

A total of 628 participants (M_{age} = 66 years) were surveyed. The majority of participants used

bilateral, behind-the-ear hearing aids that were obtained either through a hearing health care professional or online. Three domains, highlighting areas for hearing aid improvement, were identified. (a) The hearing aid features domain described user issues surrounding physical appearance and fit, general features, streaming, battery functionality, adjustments, smartphone applications, and hearing aid–related accessories. There was dissatisfaction with aesthetics and functionality, with a notable desire for improvements in physical appearance and fit (n = 161), and features to improve self-efficacy. (b) The sound quality domain described user issues surrounding sound perception and difficult situations. Participants highlighted unmet needs for clarity, especially in noisy environments (n = 143). (c) The service-delivery domain described user issues surrounding audiology services and general satisfaction, with criticisms centered on the high cost of hearing aids (n = 193) and the credibility of hearing health care professionals.

Conclusions:

Hearing aid users appreciated current technological advances but expressed a need for improvements, to better align devices with their requirements. Key areas included physical aesthetics, user control over device adjustments, sound clarity, cost accessibility, and trust between the user and hearing health care professional. Future designs should focus on features enhancing user autonomy and self-efficacy.

3.2. INTRODUCTION

Hearing health care has advanced rapidly in line with technological improvements. This growth aligns with an expanding need for its services, as the World Health Organization (WHO) projects that more than 700 million individuals will require hearing rehabilitation by 2050 (WHO, 2021). The effectiveness of hearing aids as an intervention for hearing loss is well documented and widely accepted (Picou, 2020; Ritter et al., 2020). Nevertheless, a significant proportion of individuals with disabling hearing loss remain without these devices (Dillon et al., 2021; McCormack & Fortnum, 2013). The utilization of hearing aids is influenced by multiple factors, including accessibility, individual perception of hearing loss and satisfaction with devices (Pouyandeh & Hoseinabadi, 2019). The present study aimed to describe user perspectives on hearing aids, with a focus on desired improvements, in order to enhance hearing aid use and improve hearing aid fitting outcomes.

Recent changes in hearing aid regulations in the United States have aimed to improve

accessibility and affordability. In 2022, the U.S. Food and Drug Administration (FDA) sanctioned the sale of over-the-counter (OTC) hearing aids, despite some concerns regarding the quality and efficacy of this delivery model (Almufarrij et al., 2019; Manchaiah et al., 2023; Sheffield et al., 2022). Consequently, individuals are no longer confined to acquiring hearing aids exclusively through hearing health care providers; they can now purchase OTC hearing aids without an audiologist consultation. These hearing aids typically present a more affordable and accessible option and are available online or at retail outlets. The FDA specifies that OTC devices cater to individuals aged 18 years or older, with perceived mild to moderate hearing loss (FDA, 2023). Such industry changes signify a shift in hearing health care from a traditional paternalistic approach, to one which encourages individuals to be active participants in their hearing rehabilitation (Taylor, 2016). This open market approach might have positive, yet to be observed, long-term implications for hearing aid adoption (Parmar et al., 2022).

In addition to issues surrounding accessibility and recent market changes, the hearing aid industry has continued to focus on advancements in technology, including design, sound quality, and user-friendly features such as phone call streaming (Hesse & Hoppe, 2017). Despite these enhancements, rates of hearing aid nonuse among both owners and nonowners remain relatively high (Dillon et al., 2021; McCormack & Fortnum, 2013; Oosthuizen et al., 2022). This is evident in the United States, where estimates suggest that only 30% of adults aged 70 years or older, with disabling hearing loss, actually use hearing aids (National Institute on Deafness and Other Communication Disorders, 2021). Factors for nonuse extend beyond accessibility and include internally motivated aspects such as perceived nonnecessity, stigmatization, lack of integration into daily living and deficient education, and externally motivated aspects such as discomfort, financial burden, professional distrust, and prioritization of other needs (Desjardins & Sotelo, 2021; Ritter et al., 2020; Solheim et al., 2017). These findings highlight the complexity of hearing aid provision and the necessity to scrutinize factors influencing both dispensing and user satisfaction, to optimize service delivery (Hesse & Hoppe, 2017). Understanding the heterogenous needs of individuals with hearing loss is key to improving hearing aid uptake and outcomes.

Contrary to low usage rates, several studies note high satisfaction rates among hearing aid users (Davidson et al., 2021; Heselton et al., 2022; Kozlowski et al., 2017). Hearing aid satisfaction has reportedly escalated from 58% in 1989 to 83% in 2022, based on consolidated data from the MarkeTrak survey (Powers & Carr, 2022). Key factors influencing satisfaction include improved communication ability and sound quality (Kozlowski et al., 2017) and speech perception in noise

(Davidson et al., 2021). Recently, Bennett et al. (2021) examined online reviews from hearing aid users and found that, while hearing aid benefit was perceived as high from users answering multiple-choice questions, there were key factors in reviews, which indicated barriers to success. These included factors such as cost, physical fit, hearing in noisy environments and technical difficulties. Using the same data set, Manchaiah et al. (2021) conducted a linguistic analysis of online reviews from hearing aid users and reported that, while hearing aid benefit and satisfaction was high, clinic visits and cost of hearing aids often negatively offset this positive impact. A key takeaway from these studies is that, while hearing aid user benefit and satisfaction is high in terms of overall improved communication and sound detection, they report dissatisfaction on specific issues such as cost and speech clarity in the presence of background noise. This identifies the need for potential changes to hearing aids, as well as service delivery models.

Studies on hearing aid benefit and satisfaction are generally measured using quantitative patient-reported outcome measures, leading to a scarcity of qualitative research exploring hearing aid use and associated satisfaction. Qualitative research has become increasingly important in audiology, with these types of studies providing valuable insights into user perspectives and needs. Oosthuizen et al. (2022) conducted a systematic review of qualitative studies exploring hearing aid user experiences. Their review included 25 studies, which discussed factors surrounding adoption, use, and suboptimal use of hearing aids. The study highlighted the complexity of multiple factors affecting hearing aid use and the significance of qualitative data in understanding the user experience holistically. In contrast to previous studies, which quantified hearing aid use and satisfaction, the present study's qualitative analyses exposed common details in hearing aid user experiences and their impact, revealing areas of concern and insight into user expectations. User-reported insights into hearing aid experiences are available on various online platforms such as HearingTracker (https://www.hearingtracker.com) and Soundly (https://www.soundly.com). These types of platforms serve to facilitate open, unbiased consumer dialog and connect individuals with products and services. Exploring unmet needs of hearing aid users across these platforms may provide insights that could help mitigate high rates of nonuse, while fostering meaningful improvements in satisfaction and benefit rates. The present study therefore utilized responses from users of the online HearingTracker database and an OTC provider, Lexie Hearing, to gather data on hearing aid user perspectives. This study specifically explored user perspectives on improving hearing aids, using qualitative methodology.

3.3. METHOD

The study used a cross-sectional survey design. Qualitative content analysis was used to analyze

responses to an open-ended question from a survey sent to U.S. hearing aid users who were part of the HearingTracker database or had purchased Lexie Hearing aids. An inductive approach was used for data analysis. Due to the qualitative nature of the study and its large data set, no preexisting hypotheses were developed. Content analysis was used for its structured approach, to explore all aspects of the data and identify recurring concepts in responses, thereby informing systematic categorization and conclusions (Manchaiah et al., 2022). Relevant institutional clearances were obtained from Lamar University's institutional review board (IRB-FY21–248) and the University of Pretoria's Research Ethics Committee (HUM033/0822) prior to data collection and analysis. Two reporting guidelines were used when describing the methodology and results of the study: the equator network checklist for reporting results of Internet e-surveys (Eysenbach, 2004), and Domain 3 of the consolidated criteria for reporting qualitative research (Tong et al., 2007).

3.4. PARTICIPANTS

Purposive sampling was used to recruit participants who were users of the HearingTracker database (http://www.hearingtracker.com) and users of the Lexie hearing aids (http://www.lexiehear ing.com). HearingTracker is an online consumer forum that showcases user reviews and experiences with hearing aids. Individuals surveyed from this forum obtained their hearing aids from a health care professional (HCP) at a clinic or hearing center, through the conventional, in-person service delivery model. The Lexie Hearing OTC model provides self-fitting hearing aids to individuals online, or in store, with exclusively online support.

Participants that were included in the study were adults (> 18 years old), presenting with varying degrees of hearing loss. Individuals who utilized Personal Sound Amplification Products (PSAPs) and those fitted with hearing aids during early childhood were excluded. According to the FDA, PSAPs are consumer electronics intended for individuals with normal hearing, to amplify sounds for recreational activities (FDA, 2021). Responses that did not answer, or were irrevelant to, the survey's open-ended question that formed the basis of this study, were also excluded. Seven hundred twenty-seven (727) responses were captured. A total of 628 responses were analyzed after exclusions (399 from HearingTracker and 229 from Lexie Hearing).

3.5. SURVEY

The current study was nested in a larger online survey that focused on hearing aid user

experiences. The survey was conducted in October and November 2021. The researchers developed and shared the survey with HearingTracker and Lexie Hearing who emailed it to their respective users. The survey comprised of an introductory page describing the study and requesting informed consent from the participants (a tick box was used), 33 closed-ended questions and four open-ended questions. There were five sections: (a) demographic and hearing aid–related information (structured questions); (b) hearing aid experiences (four open-ended questions); (c) International Outcomes Inventory for Hearing Aids (Cox & Alexander, 2002); (d) general health, well-being, and social network information; and (e) further demographic information. The open-ended questions in Section 2 were developed by two audiologists (D.S. and V.M.) and social psychologists (Jamie Pennebaker and Ryan Boyd). The HearingTracker survey included a minimum word count of 20 words, whereas the Lexie Hearing survey did not include a minimum word count. However, all responses that sufficiently answered the open-ended question, irrespective of length, were included in the analysis. As an example, some participants answered the question with one word: "rechargeable." This was deemed to indicate their preference for a rechargeable device, since the question posed to them requested information on their desired changes to hearing aids, to improve usefulness. However, the authors recognize that some responses such as these had limited contextual information which is highlighted as a key limitation of the study.

The survey was initially piloted by four audiologists. After revisions, it was imported to Qualtrics and further reviewed. Item randomization was not used, and respondents were not given the opportunity to edit submitted responses. No data that were personally identifiable were collected.

For the purpose of this study, data from Section 1 in the survey (demographic and hearing aid–related information) and from Section 2 (one specific open-ended question on hearing aid experiences) was used. The open-ended question from the survey, which was analyzed in the current study, was, "We talk to audiologists and hearing aid companies. Tell us how you would like hearing aids to change to be more useful for you and the people around you. Please be honest. We really would like your thoughts and feelings about this. Your comments will help us when we talk to people in the industry."

3.6. DATA ANALYSIS

The Statistical Package for the Social Sciences (SPSS) Version 28 was used to analyze the demographic survey data, in order to obtain descriptive statistics. Participant responses to the

open-ended question were analyzed using inductive content analysis as described by Graneheim and Lundman (2004). Survey responses were consolidated on a Microsoft Excel spreadsheet and allocated a numerical participant identity (ID), to form a de-identified data set. The data was first examined through data immersion. Each response was divided into meaning units and corresponding codes were generated. The Microsoft Excel spreadsheet containing the participant responses was developed into a code book. Codes were grouped into different categories and subcategories to identify patterns for meaningful interpretation.

For the purpose of trustworthiness, data analysis was extensively documented at each stage, ensuring clear and replicable results as recommended by Manchaiah et al. (2022). Documentation included original survey responses and all code books leading to the final presentation of the data. Initial coding and categorization was performed by the primary author (N.D.) and was cross-checked by two researchers (E.W.B. and V.M.) to ensure consistency during coding and category development.

3.7. RESULTS

Participant ages ranged from 24 to 93 years, with an average age of 66 years (13. 4 *SD*). Participants comprised 62% (*n* = 386) men, 38% (*n* = 239) women and 0.5% (*n* = 3) either nonbinary or preferring not to answer. Hearing aids were obtained from a private or university hearing clinic by 36% (*n* = 225) of participants, a discount warehouse by 12% (*n* = 74), internet or online store by 42% (*n* = 264), from a pharmacy or hearing center by 0.5% (*n* = 3) and from a hearing professional visiting the participant's home by 0.3% (*n* = 2). Additionally, 10% (*n* = 60) of participants obtained their hearing aids from other sources, such as the U.S. veterans administration. Almost all participants were bilateral (93%, *n* = 582), behind-the-ear (93%, *n* = 586) hearing aid users. Participants were asked to provide a self-report on their unaided hearing status: 1% (*n* = 4) felt that they could hear everything without hearing aids, 27% (*n* = 168) felt that they sometimes did not hear speech, 52% (*n* = 329) felt that they regularly did not hear speech and 20% (*n* = 127) of participants felt that they could almost never hear speech without hearing aids.

Qualitative analysis identified three domains, composed of 12 categories and 57 subcategories. No considerable differences were observed between responses from individuals with HCP-prescribed hearing aids and OTC hearing aids.

Domain 1: Hearing Aid Feature Suggestions

Domain 1 included seven categories and 30 subcategories (see Table 1) relating to the physical appearance and fit (161), general features (143), streaming (133), battery functionality (103), adjustments (40), user-centric app (47) and accessories (8) of hearing aids. This domain described a generally negative user experience with hearing aids. The majority of responses in this domain related to the category regarding the physical appearance and fit of hearing aids. A minority of participants felt that hearing aids should be more visible. For this minority specifically, stigma associated with hearing aids did not appear to be a concern. However, the majority of participants felt that hearing aids should be less visible and more aesthetically pleasing. The category regarding general features was also prominent, with some participants asking for hearing aids to be simpler to use, and others favoring technological advancements, even suggesting features, which they would like to see developed (further detail is provided in the Discussion section). For example, “I want aids to be helpful, useful and functional. I don’t really need all of the bells and whistles that come with some aids, but prefer an app that works all of the time, not just occasionally” (P309, male, 74). This category also featured a majority request for waterproof hearing aids. For example, “More comfortable and waterproof. I got caught in the rain the other day and I was worried about them!” (P110, female, 67).

Table 1. Domain 1—hearing aid feature suggestions (*n* = 628 participants).

Category	Sub-category	Meaning unit examples (participant ID, age in years, gender)
Physical appearance and fit (161)	Less visible (77)	*"As small as possible, it is best to make invisible" (P468, 25, female)*
	Improve comfort (48)	*"The area between my ear and my head becomes sore, raw. The aids cause my ears to itch" (P312, 63, female)*
	More secure fitting (22)	*"Make the design more secure in the ear so they don't fall out" (P687, 75, male)*
	More colours and aesthetic options (11)	*"I've always wanted one that looks good" (P396, 33, male)*
	More visible (3)	*"I can see the 'shame' being replaced by 'this is cool' to enabling hearing devices to be worn, colourful too." (P354, 72, female)*
General features (143)	Waterproof (40)	*"I wish they could be made water-resistant/waterproof the way smartwatches and fitness bands are made." (P630, 74, female)*
	Improve ease of use (32)	*"Hearing aid battery drawers need to be easier to open." (P127,61, female)*
	More system design improvements (24)	*"Keep bolstering their capabilities to monitor health - as a solo senior I'll need as much support as possible to remain independent." (P460, 68, female)*
	Less maintenance (12)	*"If cleaning them could be made easier, I would like that." (P31, 74, male)*
	More technological advances (11)	*"Electronic processing development should continue." (P304, 85, male)*
	Improve durability (10)	*"They need to have a longer lifespan." (P295, 70, male)*
	Include telecoil (8)	*"I'm VERY upset when I learn that T-coils aren't going to be included in various hearing aid models. I can't do that WITHOUT T-coils." (364, 76, female)*
	Include tinnitus masking (6)	*"Tinnitus improvements would definitely help me." (P260, 76, male)*
Streaming (133)	Improve connectivity issues (106)	*"All hearing aids in today's day and age really should have Bluetooth connectivity without the need for a necklace or other type of adapter" (P30, 44, female)*
	Ability to connect to more than one device (17)	*"I can only connect my aids to one phone via Bluetooth- so I chose my work cell phone. That means I can't talk to people from home, socially, or for personal reasons." (P311, 59, male)*
	More Android and iOS compatibility (10)	*"I feel all hearing aids should be compatible with all cell phones not just iPhones for example." (P455, 55, female)*
Battery functionality (103)	Prefer rechargeability (50)	*"I will also ONLY purchase rechargeable aids." (P79, 77, male)*
	Improve battery life (38)	*"The biggest issue, truly, is battery life." (P73, 54, female)*
	Improve charger options (5)	*"A charging case that had a battery INSIDE so that I could charge them on the go." (P437, 77, male)*
	Prefer rechargeability with disposable or spare batteries (4)	*"Even for traveling just for a weekend good to know if you had a problem with your charger; you had batteries as a backup" (P333, 71, female)*

	Improve access to batteries (4)	*"The chargeable hearing aids eventually will have to have the batteries replaced and some brands can't have this done in the doctor's office!" (P428, 74, male)*
	Prefer disposable batteries (2)	*"Keep offering aids with replaceable batteries rather than going rechargeable. I've heard too many stories of people not getting a successful charge" (P106, 64, male)*
User-centric App (47)	Improve feature range (21)	*"Quality of the hearing aid apps I've used is shockingly marginal. I would like much finer control over such things as volume and filter settings." (P98, 75, male)*
	Improve connectivity and interface (18)	*"My hearing aid app is basically useless. It doesn't allow me to properly adjust the volume, pitch, and tone." (P202, 69, female)*
	Improve usability (8)	*"The phone app is hard to understand. Especially with older people" (P265, 59, male)*
Adjustments (40)	More self-adjustment options (22)	*"Give wearers more ability to fine tune their own hearing aids without the need to always go to an audiologist." (P150, 66, male)*
	More remote adjustments and programming (11)	*"Requiring you to go back to the person you bought it from - which could be thousands of miles away after you move is horrible." (P285, 82, male)*
	More succinct adjustments (7)	*"The ability for the Audiologist to adjust each frequency independently without affecting the frequency right next to it!" (P272, 65, male)*
Accessories (8)	Wider range (6)	*"More gizmos like the Roger on and the Resound Multi Mic. These are game changers for me." (P95, 47, female)*
	More improvements (2)	*"Probably my major complaint is with the remote, the remotes need to be improved for Oticon anyway." (P270, 78, female)*

Bluetooth streaming was identified as an essential feature that required further development as illustrated here, “Have a big issue with audiologists that don’t think that connectivity (phone app/ TV streamer/remote mic) is part of fitting the hearing aids and vendors don’t want customers to call them when the add-on don’t work” (P359, male, 69). Participants also emphasized a need to have more control over fine-tuning their devices, and for remote assistance from professionals to avoid travelling.

Domain 2: Hearing Aid Sound Quality Suggestions

Domain 2 included two categories and 14 subcategories (see Table 2) relating to sound perception (143) and difficult situations (139). Responses in this domain indicated that user sound quality needs were yet to be met. The sound perception category featured a majority of participants who felt that sound clarity needed to be improved. They described sound clarity as independent from sound volume as illustrated here, “Hearing aids always make conversation loud enough—they fail in fulfilling complete clarity in the conversations.” (P622, male, 73). Participants also wanted hearing aids to produce output that sounded more “natural.”

Table 2. Domain 2—hearing aid sound quality suggestions (*n* = 628 participants).

Category	Sub-category	Meaning unit examples (participant ID, age in years, gender)
Sound perception (143)	Improve sound recognition and clarity (70)	*"I would like to be able to better understand actual words spoken - not just the volume - particularly when watching a movie or TV program. Sound can be muddled." (P48, 73, female)*
	More natural sound (17)	*"A hearing aid that would be much like natural hearing without all the adjustments rather than fancy microphones." (P168, 62, female)*
	Improve severe-profound hearing loss options (12)	*"Platform rollouts for profound, at launch, not 2-3 years later, I know the market and demographics play to that, but always annoys me when profound get last dibs." (P193, 40, male)*
	Improve music perception (12)	*"Most hearing aids are not designed to replicate music accurately. The music ear buds that are evolving into hearing aids are a good direction." (P209, 64, male)*
	Improve television, phone and media perception (11)	*"And tv commercials are the worst...everything is in one volume...LOUD. You can't hear the speaker because the music drowns them out! (P339, 84, female)*
	Improve directionality and localisation (10)	*"Hearing aids are still limited directionally - i.e., need to face people to hear, cannot hear as well when people are behind me, sit next to me, lower their heads, etc." (P38, 77, female)*
	Eliminate feedback (8)	*"The squeaking drives me so insane I just want to throw the thing on the floor and stamp on it!!" (P226, 83, female)*
	Improve CROS HA options (3)	*"My question is: why can't the transmitter side of the CROS system also contain the ability to cancel out the irritating frequencies and amplify the frequencies that are mostly gone to give me some hearing boost in my bad ear, along with transmitting to the other ear?" (P281, 72, male)*
Difficult situations (139)	Improve noise reduction (57)	*"I can't believe with the technology available today that a hearing aid can't be design to work better in noisy place" (P384, 76, male)*
	Improve speech in noise perception (40)	*"I would like hearing aids to emphasize the voices close to me...not the whole restaurant. Why can't I introduce the aids to the voices at the table and hear those folks?" (P17, 68, female)*
	Improve adaptation to environment (17)	*"I would like them to adapt automatically or naturally to noisy restaurants or events" (P48, 73, female)*
	Improve real world performance (13)	*"Fitting in a business office does not provide an accurate measure for a person's life experiences. In office fitting settings, a recording of different voices at different sound levels (and background noises) would be very helpful for making adjustments. Just speaking to the fitter is not that helpful." (P336, 75, female)*
	Eliminate wind noise (7)	*"Get rid of wind noise. I have seen a lot of advertising over the years that states a significant reduction in wind noise...to my thinking it's false advertising" (P75, 83, male)*
	Improve hearing from a distance (5)	*"They should have a close and distant focus mode, that I can control manually, so I can hear from farther away when I want to." (P294, 59, female)*

Note. CROS HA = contralateral routing of signals hearing aid

The difficult situations category emphasized issues with hearing in the presence of background noise, for example, “I can’t believe with the technology available today that a hearing aid can’t be designed to work better in noisy places” (P384, 76, male). Participants wanted to see improvements in noise reduction technology as well as speech in noise perception. Some participants felt that hearing aid fittings did not prepare users for hearing sound in the real world, which presents various sound environments.

Domain 3: Hearing Aid Service-Delivery Suggestions

Domain 3 included three categories and 13 subcategories (see Table 3) relating to the cost (193), audiology services (93) and general satisfaction (90) with hearing aids. Responses in this domain conveyed an undertone of criticism and concern with regards to consumer access to hearing aids, credible information, and person-centered care. The category regarding cost was most prominent. Participants suggested that the cost of hearing aids and services be more affordable, and that audiologists present as more transparent and credible when communicating charges, for example, “There is NO transparency regarding prices. When I was diagnosed with hearing loss the sales person came rushing in to sell me a hearing aid. I regret signing a lease! While researching brands and prices I became aware of the lack of transparency for pricing, it appears this lack of transparency is throughout this industry. How will I know if I am getting a discount if the price is not obvious?” (P247, female, 67).

Table 3. Domain 3—hearing aid service-delivery suggestions (*n* = 628 participants).

Category	Sub-category	Meaning unit examples (participant ID, age in years, gender)
Cost (193)	Reduce cost for devices and services (139)	*"The cost for so many is prohibitive." (P158, 79, female)*
	Enable insurance and corporate funding (32)	*"I think that should be a priority to get insurance companies to cover/assistance in hearing aids. Hearing NEEDS to be categorized as a DISABILITY, as it is a DISABILITY." (P268, 68, female)*
	Reduce cost of high-tech features (13)	*"There are many options like background noise, volume, directionality etc but each adds a big cost to final product and have to make choices." (P71, 74, male)*
	Reduce cost of repairs, guarantees and upgrades (9)	*"If they need repair don't make it so expensive" (P90, 67, male)*
Audiology services (95)	Access to reliable information (25)	*"The industry is plagued by the "100th innovation that you don't really need but we are going to convince you that you need it" mentality. This interferes with good information being easily available to solve a social connectedness problem for people." (P326, 64, male)*
	Improve audiologist competency (20)	*"I feel that when I go to have my hearing aids adjusted that the provider isn't really listening to what I am complaining about (or doesn't know what to do to help me). They seem to want to adjust the hearing aids to a formula (this was especially true at a clinic that didn't normally work on Phonak)." (P47, 80, male)*
	Prefer audiologist support (16)	*"I think it is very important to go to a real audiologist and get a good hearing test before fitting a hearing aid." (P304, 85, male)*
	Improve accessibility of devices and services (13)	*"Easier access at retail locations or online" (P26, 57, male)*
	Improve credibility and transparency (10)	*"More transparency on what you are getting for dollars paid." (P89, 73, male)*
	Provide trial before purchase (6)	*"There should be at least a 3-month free trial available. Short-wearing trials are inadequate to assess how the aids are helping or not." (P336, 75, female)*
	Increase public awareness (5)	*"I think that awareness of hearing loss and the impact on social interactions, quality of life needs to be improved." (P199, 62, male)*
General satisfaction (90)	Satisfied with technology (86)	*"Just between my first set of hearing aids and my second set five years later, I have seen a leap in technological advances that give me great hope for the future." (P24, 64, male)*

	Dissatisfied with technology (4)	*"it's kind of unbelievable I pay $6500 and still can't hear very well in many situations. I have heard better using a Personal Listening Device like Pocket Talker, which is kind of a joke." (P433, 23, male)*

The category regarding audiology services emphasized a desire for access to reliable information and improved audiologist competency. Participants wanted audiologists to understand their needs better, include them in decision making and employ best practices during clinic visits. Some participants also stated their general satisfaction with hearing aids, noting current innovations in technology to be favorable. A minority stated a general dissatisfaction, having had disappointing experiences with previous hearing aids not meeting their expectations.

3.8. DISCUSSION

The study explored potential improvements in hearing aids from users' perspectives, revealing valuable insights on both hearing devices and service delivery. Despite general satisfaction with hearing aids, as noted in the current study and previous studies (Davidson et al., 2021; Kozlowski et al., 2017; Powers & Carr, 2022), there was a pervasive desire for technological and service delivery enhancements. In this study, hearing aids were described in three domains focusing on (a) general features and functionalities, (b) sound quality, and (c) service delivery. Similarly, Bennett et al. (2021) identified high user satisfaction and benefit from hearings aids among users, but with specific needs toward improved hearing aid experiences.

Hearing Aid Features

Participants displayed divergent preferences toward advanced features. Some favored simplicity, while others appreciated new technologies, as also reported by Gomez et al. (2022). Their study noted digital literacy as a significant factor in successful hearing aid use but found that users, despite sufficient digital literacy, struggled with hearing aid application (app) technology due to manual dexterity issues. In the present study, participants highlighted a need for hearing aids themselves and associated apps to be more user-friendly to improve ease of use. Notably, some participants desired additional features signaling hearing difficulty to others (such as a blinking light controlled via an app) and built-in mechanisms aiding acclimatization (such as indicators for correct insertion and auditory fatigue). Self-adjustment opportunities for sound quality were also desired to improve user experience. Participants specifically asked for more control to fine-tune their own hearing aids. This preference indicated a significant shift from clinician-driven prescriptive measures, toward user-centered options, reflecting a broader desire for autonomy and self-efficacy in hearing health care.

This theme of user empowerment was further echoed in participants' calls for remote consultations and a more collaborative approach from audiologists. The concept of user control and empowerment was also reported by Gomez et al. (2022) in their user narrative, where individuals preferred using hearing aid apps to make real-time adjustments to facilitate communication. Supporting this trend toward self-management, Ross (2020) reported that hearing aid consumers often respond positively to marketing strategies that promote user autonomy. Furthermore, Gomez and Ferguson (2020) highlighted the importance of empowering individuals with knowledge for self-management even before the fitting of hearing aids, finding this approach central to improving user outcomes. Last, Fuentes-López et al. (2019) also established a positive correlation between hearing aid adherence and self-efficacy, noting that higher levels of education were associated with increased self-efficacy. It is necessary to highlight the use of a personalized approach that takes into account individual users' educational backgrounds, socio-economic status, geographical region, and access to resources (e.g., Wi-Fi) and other unique needs to ensure favorable outcomes.

Although technological advancements pose great user advantages, they can be accompanied by technical challenges. In the present study, participants identified Bluetooth connectivity as critical yet problematic, a finding consistent with prior studies (Bennett et al., 2021; Murdin et al., 2022; Vercammen et al., 2023). The issue was twofold: first, pairing to apps and devices presented technical difficulties and, second, once paired for streaming specifically, the streamed signal was perceived as poor in quality. Participants felt that audiologists neglected connectivity issues by not addressing them. Previous research (e.g., Murdin et al., 2022), similarly found Bluetooth functionality to be a common source of dissatisfaction among hearing aid users. Bennett et al. (2021) also found that users enjoyed streaming functionality as a feature but expressed negative opinions regarding technical difficulties. Vercammen et al. (2023) cited Bluetooth connectivity issues being a cause of frustration when discussing the real-life experiences of hearing aids users. This highlights both the need for reviewing digital literacy requirements during service delivery and the need for hearing professionals to provide support for technical issues.

Beyond software feature improvements, hearing aid hardware suggestions centered around the need for moisture resistance, improved physical comfort and aesthetic appeal. Previous research has shown that moisture damage is one of the most common reasons for hearing aid repairs (Hay & Zielinski, 2022). The issues of comfort and aesthetic appeal is also not new, with previous studies citing this as a significant factor for user satisfaction (Chundu et al., 2021; Bennett et al., 2021).

Participant responses in the present study emphasized the need for hearing aids to be more closely aligned with active lifestyles. It is essential that hardware technology is long-wearing and comfortable, as hearing aid users become more reliant on their devices as wearable technology. Holt (2023) described wearable technology, such as Bluetooth streaming, as being central to hearing devices and improving communication. As the narrative surrounding hearing loss-related stigma progresses, evidenced by previous studies such as Scharp and Barker (2021), there appears to be a generational movement away from the traditional mindset of hearing aids being simply a medical device, to being considered more as a wearable technology. This is particularly true in the consumer sphere of OTC hearing aids. In the present study, participants drew parallels between hearing aids and earbuds in terms of aesthetics and function. The majority of participants wanted hearing aids to be less visible, with one participant requesting them to look more "humanized," and others preferring the aesthetics to be more in line with a sophisticated gadget. This illuminates the profile of the contemporary hearing aid consumer, who views hearing loss less as a "personal shortcoming," and more as a "relational reality" (Scharp and Barker, 2021). It is noteworthy that issues surrounding hearing loss-related stigma and digital literacy still remain relevant despite not being a focus of this study.

It should also be noted that modern hearing aids have already included a large number of suggestions made by participants. These observations highlighted the need for audiologists to assist patients to find the right product that fits their personal preferences and needs. Using decision aids (Taylor & Weinstein, 2015), and providing trial periods may help resolve some of the issues mentioned by study participants.

Hearing Aid Sound Quality

In the second domain on hearing aid sound quality suggestions, participants highlighted the intrinsic auditory processing challenges that they expected hearing aids to mitigate. Despite recent technological advancements, participants reported persistent difficulties with understanding speech in noisy environments, revealing a notable gap between audibility and comprehension. This aligns with findings from Bennett et al. (2021), who discussed similar unmet user needs in relation to challenging listening situations. These findings underscore the need for enhanced real-world simulations in clinical settings to better prepare users for diverse listening environments, and emphasize the importance of aural rehabilitation as a part of best practices (Oeding, 2022). Despite the significant efforts from the industry to improve hearing aid signal processing algorithims and associated sound quality, anecdotal reports as well as research studies have demonstrated that hearing aid sound quality is still a major

issue for many users (Bennett et al., 2021; Heselton et al., 2022; Oeding, 2022). However, it is hoped that the use of Artificial Intelligence/Machine Learning algorithms will help improve this in the coming years (Lesica et al., 2021).

Hearing Aid Service Delivery

In the third domain, participant attitudes toward service delivery by audiologists varied widely, reflecting concerns about costs, professional competency and about professionals truly understanding their needs. Participants noted a lack of transparency in the industry, particularly surrounding the cost of hearing aids, and called for more inclusivity in decision-making processes regarding intervention. This perspective aligns with the current broader transition in health care, moving from paternalistic approaches to more person-centered care (Bundesen, 2019). This emerging model prioritizes partnerships between patients and professionals, emphasizing collaborative strategies to meet individual needs more effectively (Delaney, 2018). Mahomed-Asmail et al. (2023) found that audiologists are receptive to this person-centered approach, which has been associated with improved patient satisfaction when care is delivered from a holistic perspective. Individualized care and prioritization of patient goals was highlighted as a key element for enhancing treatment outcomes in their study. This individualized approach was also cited by Bennett et al. (2021) as being central to addressing patient needs, when they explored online consumer hearing aid reviews. Participants in the present study expressed the need for reliable information to inform decision making, and voiced concerns that audiologists were not transparent due to financial affiliations with hearing aid sales. They also questioned the use of best practices from their audiologists. Participant responses revolved around a common theme of impaired trust with audiologists, which is central to patient outcomes (Oosthuizen et al., 2022). Preminger et al. (2015) found that displaying professional competency, encouraging joint decision making and abstaining from an emphasis on hearing aid sales helps foster trust between audiologists and patients. The responses from participants in the present study painted a picture of a contemporary consumer who desires hearing aids to function as a tool for user autonomy, self-efficacy, and consumer empowerment. The position of the audiologist, from the perspective of the hearing aid user, manifests as a facilitator in the hearing health care journey.

Study Limitations

Our study had some limitations. First, due to self-selected users completing the survey there was

a high likelihood of sampling bias. The survey was conducted online and also included participants who had obtained their hearing aids through the online OTC service delivery model. It is possible that these individuals were more likely to present with higher levels of digital literacy and a preference for advanced hearing aid features. The results could underrepresent individuals with a lack of access to technology or a certain level of digital literacy. Second, the responses from Lexie Hearing users were generally shorter due to the absence of a minimum word limit, in contrast to the HearingTracker database that required at least 20 words. This limited context, as discussed earlier. Third, the open-ended survey question was multifaceted to motivate participants to write more detailed notes. The wordy question could have proven complex to some participants. Fourth, the study reported on a large amount of information, from a large data set, with a focus on describing prevalent hearing aid user desires. Adding an additional layer of complexity through subgroup analyses was beyond the scope of this article. Future consideration could be given to differences in responses according to subgroups (e.g., differences in responses between individuals with various levels of hearing difficulty, age, or place of hearing aid purchase). Last, participants were only based in the United States, which could mean that findings have limited generalizability to other populations.

3.9. CONCLUSIONS

Hearing aid users highlighted several areas for device and service-delivery improvements. Their suggestions underscored the need for greater user autonomy, reduced device moisture damage, minimized Bluetooth connectivity issues, improved sound clarity and more effective service delivery. Although some challenges, such as device appearance, comfort, cost, and sound quality resonate with previous research, others such as features fostering user autonomy are relatively novel, particularly among individuals with a higher level of digital literacy and self-efficacy for hearing aid technology. Moreover, the suggestions about service delivery have implications for policy making and building patient trust, by using person-centered strategies during hearing aid consultation sessions. This study, thus, contributes to the growing evidence base on hearing aid user satisfaction and highlights user-centered suggestions for improving experiences and satisfaction with hearing aids.

3.10. DATA AVAILABILITY STATEMENT

Data are not publicly available due to institutional regulations, but access may be granted upon request from the corresponding author, De Wet Swanepoel, in compliance with the specific data

access policies of the institution (https://www.up.ac.za/media/shared/12/ZP_Files/research-data-ma nagement-policy_august-2018.zp161094.pdf).

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3.12. REFERENCES

Almufarrij, I., Munro, K. J., Dawes, P., Stone, M. A., & Dillon, H. (2019). Direct-to-Consumer Hearing Devices: Capabilities, Costs, and Cosmetics. *Trends in Hearing, 23*. doi:https://doi.org/10.1177/2331216519858301

Barker, B. A., & Scharp, K. M. (2021). “I Have to Social Norm This”: Making Meaning of Hearing Loss from the Perspective of Adults Who Use Hearing Aids. *Health Communication, 36*(6), 774-781. doi: https://doi.org/10.1080/10410236.2020.1712523

Bennett, R. J., Swanepoel, D., Ratinaud, P., Bailey, A., Pennebaker, J. W., & Manchaiah, V. (2021). Hearing aid acquisition and ownership: what can we learn from online consumer reviews? *International Journal of Audiology, 60*(11), 917-926. doi: https://doi.org/10.1080/14992027.2021.1931487

Bundesen, L. L. (2019). *PCC 2.0: From Awareness to Action!* Retrieved from The Hearing Review: https://hearingreview.com/hearing-loss/patient-care/pcc-2-0-from-awareness-to-action

Chundu, S., Allen, P. M., Han, W., Ratinaud, P., Krishna, R., & Manchaiah, V. (2021). Social representation of hearing aids among people with hearing loss: an exploratory study. *International Journal of Audiology, 60*(12), 964-978.

Cox, R. M., & Alexander, G. C. (2002). The International Outcome Inventory for Hearing Aids (IOI-HA): psychometric properties of the English version: El Inventario International de Resultados para Auxiliares Auditivos (IOI-HA): propiedades psicometricas de la version en ingles. *International Journal of Audiology, 41*(1), 30-35. doi: https://doi.org/10.3109/14992020209101309

Davidson, A., Marrone, N., Wong, B., & Musiek, F. (2021). Predicting Hearing Aid Satisfaction in Adults: A Systematic Review of Speech-in-noise Tests and Other Behavioral Measures. *Ear and Hearing, 42*(6), 1485–1498. Retrieved July 19, 2022

Delaney, L. J. (2018). Patient-centred care as an approach to improving health care in Australia. *Collegian, 25*(1), 119-123. Retrieved May 17, 2023, from https://doi.org/10.1016/j.colegn.2017.02.005

Desjardins, J. L., & Sotelo, L. R. (2021). Self-Reported Reasons for the Non-Use of Hearing Aids Among Hispanic Adults With Hearing Loss. *American Journal of Audiology, 30*(3), 709-716. doi: https://doi.org/10.1044/2021_AJA-21-00043

Dillon, H., Day, J., Bant, S., & Munro, K. J. (2021). Adoption, use and non-use of hearing aids: a robust estimate based on Welsh national survey statistics. *International Journal of Audiology, 59*(8), 567-573. doi: https://doi.org/10.1080/14992027.2020.1773550

Eysenbach, G. (2004). Improving the Quality of Web Surveys: The Checklist for Reporting Results of Internet E-Surveys (CHERRIES). *Journal of Medical Internet Research, 6*(3). doi: https://doi.org/10.2196/jmir.6.3.e34

Fuentes-López, E., Fuente, A., Valdivia, G., & Luna-Monsalve, M. (2019). Does educational level predict hearing aid self-efficacy in experienced older adult hearing aid users from Latin America? Validation process of the Spanish version of the MARS-HA questionnaire. *PLoS One, 14*(12). Retrieved from https://doi.org/10.1371/journal.pone.0226085

Gomez , R., & Ferguson, M. (2020). Improving self-efficacy for hearing aid self-management: the early delivery of a multimedia-based education programme in first-time hearing aid users. *International Journal of Audiology, 59*(4), 272-281.

Gomez, R., Habib, A., Maidment, D. W., & Ferguson, M. A. (2022). Smartphone-Connected Hearing Aids Enable and Empower Self-Management of Hearing Loss: A Qualitative Interview Study Underpinned by the Behavior Change Wheel. *Ear and Hearing, 43*(3), 921-932. doi: https://doi.org/10.1097/AUD.0000000000001143

Graneheim, U. H., & Lundman, B. (2004). Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness. *Nurse Education Today, 24*(2), 105-112. doi: https://doi.org/10.1016/j.nedt.2003.10.001

Hay, M. E., & Zielinski, R. Q. (2022). Moisture in Hearing Instruments: Problematic, Prevalent, and Professionally Preventable. *The Hearing Journal, 75*(3), 20-24. doi: https://doi.org/10.1097/01.HJ.0000823376.60686.5d

Heselton, T., Bennett,, R. J., Manchaiah, V., & Swanepoel, D. (2022). Online Reviews of Hearing Aid Acquisition and Use: A Qualitative Thematic Analysis. *American Journal of Audiology*, 1-15. doi: https://doi.org/10.1044/2021_AJA-21-00172

Hesse, G., & Hoppe, U. (2017). Hearing aids: indications, technology, adaptation, and quality control. *GMS Current Topics Otorhinolaryngol Head Neck Surgery, 16*, 1-24. doi: https://doi.org/10.3205/cto000147

Holt, C. (2023). Wearable Technologies in Hearing Aids Ring True with Consumers, Providers. *The Hearing Journal, 76*(02), 28-29. doi: https://doi.org/10.1097/01.HJ.0000919788.69576.f3

Kozlowski, L., Ribas, A., Almeida, G., & Luz, I. (2017). Satisfaction of Elderly Hearing Aid Users. *International Archives of Otorhinolaryngology, 21*(01), 92-96. doi:https://doi.org/10.1055/s-0036-1579744

Lesica, N. A., Mehta, N., Manjaly, J. G., Deng, L., Wilson, B. S., & Zeng, F.-G. (2021). Harnessing the power of artificial intelligence to transform hearing healthcare and research. *Nature Machine Intelligence, 3*, 840–849. doi:https://doi.org/10.1038/s42256-021-00394-z

Mahomed-Asmail, F., Hlayisi, V.-G., Joubert, K., Metcalfe, L., Graham, M. A., & Swanepoel, D. (2023). Person-centered care: preferences and predictors in speech-language pathology and audiology practitioners. *Frontiers in Psychology, 14*. Retrieved from https://doi.org/10.3389/fpsyg.2023.1162588

Manchaiah, V., Beukes, E., & Roeser, R. J. (2022). *Evaluating and Conducting Research in Audiology.* San Diego: Plural Publishing Incorporated. Retrieved March 13, 2022, from https://ebookcentral-proquest-com.uplib.idm.oclc.org/lib/pretoria-ebooks/reader.action?docID=6499979

Manchaiah, V., Sharma, A., Rodrigo, H., Bailey, A., De Sousa, K. C., & Swanepoel, D. (2023). Hearing Healthcare Professionals' Views about Over-The-Counter (OTC) Hearing Aids: Analysis of Retrospective Survey Data. *Audiology Research, 13*(2), 185–195. Retrieved from https://doi.org/10.3390/audiolres13020018

Manchaiah, V., Swanepoel, D., Bailey, A., Pennebaker, J. W., & Bennett, R. J. (2021). Hearing Aid Consumer Reviews: A Linguistic Analysis in Relation to Benefit and Satisfaction Ratings. *American Journal of Audiology, 30*(3), 761-768. Retrieved from https://doi-org.uplib.idm.oclc.org/10.1044/2021_AJA-21-00061

McCormack, A., & Fortnum, H. (2013). Why do people fitted with hearing aids not wear them? *International Journal of Audiology, 52*(5), 360-368. Retrieved July 18, 2022, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3665209/

Murdin, L., Sladen, M., Williams, H., Bamiou, D.-E., Bibas, A., Kikidis, D., . . . Pontoppidan, N. H. (2022). EHealth and Its Role in Supporting Audiological Rehabilitation: Patient Perspectives on Barriers and Facilitators of Using a Personal Hearing Support System With Mobile Application as Part of the EVOTION Study. *Frontiers, 9*. doi:https://doi.org/10.3389/fpubh.2021.669727

Oeding, K. (2022). Improving hearing aid outcomes in background noise: An investigation of outcome measures and patient factors. *Doctoral thesis*. University of Minnesota's Digital Conservancy.

Oosthuizen, I., Manchaiah, V., Launer, S., & Swanepoel, D. (2022). Hearing aid Experiences of Adult Hearing aid Owners During and After Fitting: A Systematic Review of Qualitative Studies. *Trends in Hearing, 26*. doi:https://doi.org/10.1177/23312165221130584

Parmar, B. J., Mehta, K., Vickers, D. A., & Bizley, J. K. (2022). Experienced hearing aid users' perspectives of assessment and communication within audiology: a qualitative study using digital methods. *International Journal of Audiology, 61*(11), 956-964. doi:https://doi.org/10.1080/14992027.2021.1998839

Picou, E. M. (2020). MarkeTrak 10 (MT10) Survey Results Demonstrate High Satisfaction with and Benefits from Hearing Aids. *Seminars in Hearing, 41*(1), 21–36. doi:https://doi.org/10.1055/s-0040-1701243

Pouyandeh, M. H., & Hoseinabadi, R. (2019, July). Factors Influencing the Hearing Aids Use and Satisfaction: A Review Study. *Journal of Modern Rehabilitation, 13*(3), 137-146. doi: http://dx.doi.org/10.32598/JMR.13.3.137

Powers, T. A., & Carr, K. (2022). MarkeTrak 2022: Navigating the Changing Landscape of Hearing Healthcare. *The Hearing Review, 29*(5), 12-17. Retrieved July 24, 2022, from https://hearingreview.com/inside-hearing/research/marketrak-2022-navigating-the-changing-landscape-hearing-healthcare

Preminger, J. E., Oxenbøll, M., Barnett, M. B., Jensen, L. D., & Laplante-Lévesque, A. (2015). Perceptions of adults with hearing impairment regarding the promotion of trust in hearing healthcare service delivery. *International journal of audiology, 54*(1), 20–28. doi: https://doi.org/10.3109/14992027.2014.939776

Ritter, C. R., Barker, B. A., & Scharp, K. M. (2020). Using attribution theory to explore the reasons adults with hearing loss do not use their hearing aids. *PLOS One, 15*(9). doi: https://doi.org/10.1371/journal.pone.0238468

Ross, F. (2020). A Perspective on the Application of Kapferer's Brand Identity Prism in the Branding Process of Hearing Aid Retail Companies. *Journal of Management and Marketing Review, 5*(3), 141 – 146 . Retrieved May 31, 2023, from http://gatrenterprise.com/GATRJournals/JMMR/pdf_files/JMMRVol5%283%292020/2.Florian%20Ross-Edited.pdf

Sheffield, S. W., Jacobs, M., & Ellis Jr., C. (2022). Considerations for the Over-the-Counter Hearing Aid Delivery Model. *Perspectives of the ASHA Special Interest Groups, 7*(6), 1802–1805. Retrieved from https://doi.org/10.1044/2022_PERSP-22-00058

Solheim, J., Gay, C., & Hickson, L. (2017). Older adults' experiences and issues with hearing aids in the first six months after hearing aid fitting. *International Journal of Audiology, 57*(1), 31-39. doi:https://doi.org/10.1080/14992027.2017.1380849

Taylor, B. (2016). *20Q: Interventional Audiology - Changing the Way We Deliver Care*. Retrieved May 17, 2022, from Audiology Online: https://www.audiologyonline.com/articles/20q-interventional-audiology-17080?_ga=2.97239583.168148_1

Taylor, B., & Weinstein, B. (2015). *Moving from Product-Centered to Patient-Centric Care: Expanding Treatment Options Using Decision Aids*. Retrieved from Audiology Online: https://www.audiologyonline.com/articles/moving-from-product-centered-to-14473

The Food and Drug Administration. (2023). *Hearing Aids*. Retrieved January 16, 2023, from US Food and Drug Administration: https://www.fda.gov/medical-devices/consumer-products/hearing-aids

The National Institute on Deafness and Other Communication Disorders (NIDCD). (2021). *Quick Statistics About Hearing*. Retrieved February 13, 2022, from The National Institute on Deafness and Other Communication Disorders: https://www.nidcd.nih.gov/health/statistics/quick-statistics-hearing#9

Tong, A., Sainsbury, P., & Craig, J. (2007). Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care, 19*(6), 349 –357.

U.S. Food and Drug Administration. (2021). *Hearing Aids and Personal Sound Amplification Products: What to Know*. Retrieved August 11, 2022, from U.S. Food and Drug Administration: https://www.fda.gov/consumers/consumer-updates/hearing-aids-and-personal-sound-amplification-products-what-know

Vercammen, C., Oosthuizen, I., Manchaiah, V., Ratinaud, P., Launer, S., & Swanepoel, D. (2023). Real-life and real-time hearing aid experiences: Insights from self-initiated ecological momentary assessments and natural language analysis. *Frontiers in Digital Health, 5*. doi: https://doi.org/10.3389/fdgth.2023.1104308

World Health Organisation (WHO). (2021). *Deafness and hearing loss*. Retrieved February 13, 2022, from World Health Organisation: https://www.who.int/news-room/fact-sheets/detail/deafness-and-hearing-loss

CHAPTER FOUR: DISCUSSION, CLINICAL IMPLICATIONS AND CONCLUSION

Previous research has shown high hearing aid satisfaction rates, with some user difficulties in terms of benefit, but overall low usage rates considering hearing loss prevalence (McCormack & Fortnum, 2013; Dillon, Day, Bant, & Munro, 2021; Davidson, Marrone, Wong, & Musiek, 2021). The current study posed an open-ended question to prescription and OTC hearing aid users, to identify how to make hearing aids more useful. The question encouraged open discourse and made mention of audiologists, hearing aid companies and the overall industry. Participant responses provided valuable insight into the technical aspects surrounding hearing aid use, and into perceptions surrounding audiologist and industry practices.

4.1. OVERVIEW OF RESEARCH FINDINGS

The results of the study were categorised into three domains, namely: (i) hearing aid feature suggestions, (ii) hearing aid sound quality suggestions and (iii) hearing aid service-delivery suggestions.

The largest domain, in terms of the number of suggestions, related to hearing aid features (n= 635 responses). The physical appearance, comfort, waterproof capability (known as the Ingress Protection (IP) rating), rechargeability options and technical aspects (such as Bluetooth connectivity issues) were the most mentioned aspects in this domain. These responses called for functional improvements to make hearing aids more conducive to convenient use.

The second most prominent domain, in terms of the number of suggestions, related to hearing aid service-delivery (n= 378 responses), and specifically cost (n= 193 responses). Indeed, the

cost of hearing aids and related services was overall the most discussed category by participants in the study. Responses extended beyond actual cost, to include discourse surrounding a lack of funding options (including medical insurance), and ancillary costs, such as repairs. These remarks imbued a sense of cynicism (consumer versus industry) and distrust (patient versus audiologist), with participants calling for more affordable devices and industry transparency, as well as improved audiologist competency and credibility.

The domain with the least number of suggestions related to hearing aid sound quality (n= 282 responses). Despite this domain containing only two categories, a noteworthy factor was the repeated mention of inadequate sound recognition and clarity when wearing hearing aids. Participants also voiced a need for improved noise reduction technology. Sound clarity was separated from the concept of volume, the latter of which was not considered to be an issue by the majority. These responses called for improvements in technology and audiology practice - with some participants mentioning Real Ear Measurements (REMs) - to enhance user benefit.

Overall, participant suggestions appeared nuanced by negative user experiences. However, the open-ended question posed to participants capitalised on suggestions for improvements, which supersedes the impression of overall dissatisfaction. In fact, while participants were not directly asked to comment on their satisfaction with hearing aids, a significant number of them chose to. The majority indicated high levels of satisfaction with industry progression, in terms of technological advancement and innovation. The overall sentiment of participant suggestions therefore, was an appreciation of current technology, with a hopeful outlook for future advancements, while balancing the basic needs for easy functionality, access (in terms of cost), audiologist credibility and industry transparency.

Differentiating between the perspectives of prescription and OTC hearing aid users (i.e. subgroup analyses) was not deemed necessary to fulfil the aim of this study, and was therefore not a focus. However, both types of users were included, offering a unique perspective. During the process of data analysis, specifically coding and category formation, no significant differences in suggestions were observed between these users. It is noteworthy that the survey was conducted in 2021 (prior to the FDA's favourable ruling on OTC hearing aids in October 2022), at which stage Lexie Hearing was marketing only one DTC hearing aid that was subsequently classified as an OTC-self fitting hearing aid. Future research may therefore benefit more from differentiating between prescription and OTC users. Furthermore, the hearing aid users surveyed from Hearing Tracker used various hearing aid models, at varying levels of technology. While the survey did question participants about their current device, it was possible for them to have had a history of device use which shaped their opinions.

Taking the above into consideration, the overall sentiments and suggestions of participants which led to category formation, prevailed, regardless of where or how their hearing aids were accessed. OTC and prescription hearing aid users presented with common desires for meaningful changes to hearing aids. They both also expressed satisfaction with their hearing aids. Despite initial reluctance amongst HHPs to accept the implementation of the OTC model of service delivery (Manchaiah, et al., 2023), emerging research forecasts the potential for cost-effectiveness and increased uptake of hearing aids as a result (Borre, et al., 2023). Furthermore, there is a likelihood that OTC hearing aids can complement the existing HHP-mediated prescription service delivery model, achieving the goal of greater access to evidence-based intervention (Swanepoel, Oosthuizen, Graham, & Manchaiah, 2023). The present study adds to the emerging literature on OTC hearing aids, by providing insights into OTC user perspectives, alongside those of prescription hearing aid users. From this viewpoint, the OTC

hearing aid industry neither supersedes nor precludes prescription hearing aid industry promotion. These service delivery models are seen as complementary, as opposed to mutually exclusive, and encourages an audiologist led, person-centred approach, to ensure that patients and hearing aid consumers alike, benefit from enhanced access to evidence-based hearing solutions.

4.2. CLINICAL IMPLICATIONS

The motivation behind the study's survey was to gain insight into hearing aid users' everyday experiences with their hearing aids. The qualitative methodology was deliberately selected to distinguish the study from previous quantitative research in this area. The distinguishing factor was the use of open-ended questions to elicit hearing aid user perspectives in their own words, as opposed to traditional, standardised questionnaires, which are often less comprehensive due to the use of multiple-choice questions with predefined answers. The core findings from the study gave rise to detailed clinical implications, which have been outlined in figure one below.

Figure 1. Key components, core study findings and possible clinical implications

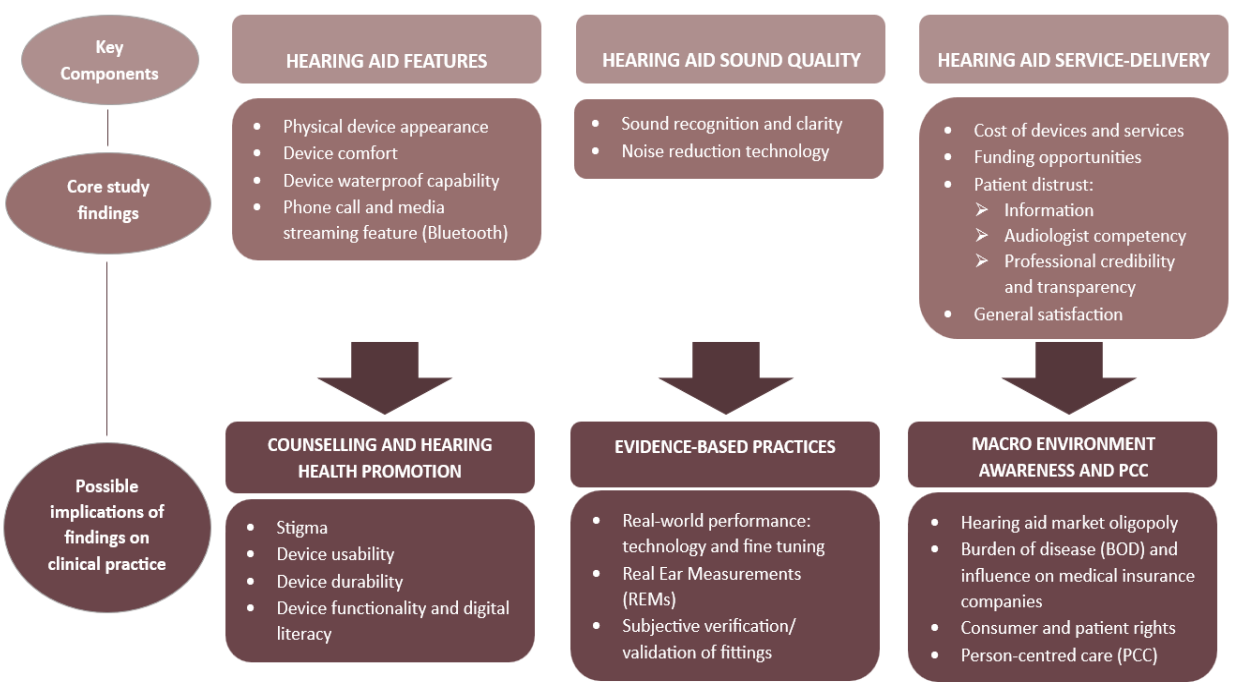

Figure one above highlights the three key components of the study (hearing aid features, hearing aid sound quality and hearing aid service-delivery) which are applicable to the clinical setting. These components are in reference to the three domains which emerged during data analysis (see results section in chapter three). The purpose of the figure is to summarise the core findings of the study in each component, and propose functional clinical applications in relation to these findings.

Key Component: Hearing Aid Features

Participants seeking intervention for hearing loss were mindful of the socio-cultural undertones of disability and related stigma. Many responses called for hearing aids to be less visible, more aesthetically pleasing and, even for hearing aids to look more like Bluetooth earbuds. It becomes important for the clinical audiologist to counsel patients at risk of hearing aid rejection due to stigma-related challenges. This consideration also involves assisting patients to choose devices which are in line with their style preferences. Additionally, facilitating involvement of support structures (such as family and community) in aural rehabilitation and hearing health promotion programmes can help reduce the burden of stigma.

Participants also desired improved usability (more physically comfortable hearing aids), durability (higher IP ratings) and functionality (fewer Bluetooth connectivity issues) of hearing aids. One example of a participant's opinion highlights the challenges surrounding usability and appropriate device selection: *"The industry also pushes things that add cost to hearing instruments. Bluetooth, rechargeable devices, etc. While these things can be wonderful to some, they are highly complex to others… I watch my good friend struggle with his tiny hearing aids. Trying to get the BT feature to work to hear on a cell phone, etc. Watch the frustration he*

goes through when it doesn't work. Screaming 'HELLO HELLO' to an incoming call that isn't coming in, etc. Just saying. keeping it simple might be a good answer for many new hearing aid users." (participant 158, age 79, female).

Clinicians are tasked with ensuring optimal device selection for patients, by conducting a detailed needs analysis (including the factor of digital literacy) before dispensing hearing aids. This is imperative in order to recommend devices to patients which fit their individual needs. Selection can be optimised by employing the use of decision aids to engage patients during the decision-making process (Taylor & Weinstein, 2015). Audiologists should present device options to patients which already fit their needs, and allow them to choose one based on their preference. Involving patients in the decision-making process capitalises on their self-efficacy and enhances the likelihood of hearing aid adherence (Fuentes-López et al., 2019). Furthermore, OTC and prescription hearing aid companies are tasked with achieving low Customer Effort Scores (CES) (Clark & Bryan, 2013). This essentially means that hearing aid users are provided with resources to both, facilitate ease of use (such as mobile apps or manuals), and to mitigate inevitable technical challenges (such as phone or text support lines). Hearing aid companies can encourage continuous user feedback throughout the product lifecycle to inform future development and improve product offerings, by utilising existing hearing aid mobile applications. One example of this is gamification. Bitrián, Buil and Catalán (2021) found that gamification in mobile applications had the potential to increase user engagement. The applicability of gamification in the healthcare context is still being explored in current research, and this could have potential benefits for hearing aid users.

Key Component: Hearing Aid Sound Quality

Participant responses highlighted the need for improved sound recognition, clarity and noise reduction. It is relevant for the clinical audiologist to consider the potential real-world performance of hearing aids by simulating different listening environments during fittings, where possible. More so, employing evidence-based practices and adhering to gold standards, in terms of settings selection and fine tuning, will facilitate optimal fittings. It is noteworthy to include the use of subjective verification (or validation) using free-field speakers, but more importantly, REMs. It is relevant to note that previous research has shown that while REMs increase hearing aid user satisfaction, most audiologists do not do them (Jorgensen & Novak, 2020). One example of a participant's experience highlights this: *"I have been asking for environmental sound rooms where you can test your HAs on site in different situations with the HA provider before going out there to test the HAs in real word. Those rooms used to test HL, could be used to simulate different environments with patient wearing new HAs. It would be a start. It is brain frying to test HAs in the real world. REM is the best way to program the HAs for the real world. I know from experience. Now, which HA providers take the time to do REM?"* (participant 245, age 60, female).

Key Component: Hearing Aid Service-Delivery

The aspect of hearing aid cost and a lack of funding permeated opinions regarding professional distrust. It is the responsibility of the clinical audiologist to become aware of the macro - environmental factors surrounding hearing aid service delivery. Globally, the nature of the hearing aid industry oligopoly, and associated limited market competition, has influenced hearing aid consumers by diminishing access with high device price points. This eventually led to the OTC hearing aid movement (Blustein, Weinstein, & Chodosh, 2022). Indeed, data from MarkeTrak shows that some of the highest hearing aid adoption rates are represented

specifically by individuals who present with high incomes (specifically $100K and above), demonstrating the prohibitive factor that cost can play (Carr & Kihm, 2022).

Despite the significant Burden of Disease (BOD) and economic cost of hearing loss (McDaid, Park, & Chadha, 2021), medical insurance coverage for hearing aids is low (Assi, Reed, Nieman, & Willink, 2021), limiting options for individuals with hearing loss. In clinical settings, individuals may be able to afford the cost of a diagnosis but unable to fund the cost of a hearing aid. This could impair the patient-professional relationship with the audiologist, as the patient begins to view the audiologist as a salesperson, with a personal investment in hearing aid sales. One example of a participant's experience highlights this issue of professional distrust: *"I know people must make a living, but I need them to try and duplicate what is my normal sound qualities, instead I am an opportunity for them to make a sale. I don't have a sense that they are trying to truly serve my needs…They just want to make a sale and hope they don't see you again. I don't envy the aging person who must look into hearing aids. They really are at the mercy of hearing dispensers… People see an aging population and they think opportunities to make money."* (participant 289, age 72, female). Another participant echoed this sentiment with the following statement: *"audiologists usually push one brand over another. It screams of kickbacks."* (participant 253, age 52, female).

The clinical audiologist should acknowledge the burden of cost placed on their patients and engage them as health or medical consumers, who are entitled to play a role in their own intervention. This can be achieved with a PCC approach, professional-led information sharing and informed decision-making. Promoting transparency can allow patients to access more affordable technologies. Indeed, present hearing aid technologies, such as hearing aid apps and OTC devices, encourage consumer engagement, empowerment and accessibility by enabling

patients as health consumers (LeRouge, Durneva, Lyon, & Thompson, 2022). The twentieth century was marked by socio-cultural changes and political transition, giving rise to the Consumer Health Information (CHI) movement (Huber & Gillaspy, 2011). This movement can be associated with the more recent focus on PCC which is recognised as significant in the field of audiology (Mahomed-Asmail, et al., 2023). Amidst these macro - environmental changes, it is critical for clinical audiologists to recognise their role as the facilitator in the hearing healthcare journey. This is true not only for individuals who purchase hearing aids directly through them, but also for those who seek a diagnosis and thereafter consultation regarding OTC hearing aids, or an individualised intervention plan.

In other low to middle income countries like South Africa, where a two-tiered healthcare system (the private and public sectors) exists, there are similar concerns. The demand for hearing aids exceeds supply in the public sector, and medical aid coverage for these devices are low in the private sector (Hlayisi & Ramma, 2018). This service-delivery gap demands further exploration of alternative models of hearing aid accessibility, that appropriately contextualizes trends and recommendations. In 2022, Bhamjee, le Roux, Schlemmer, Graham, and Mahomed-Asmail reported that 82% of South African audiologists believed that the hospitals they were based at, presented with inadequate resources to fulfil in-person screening and diagnostic needs. While remaining cognisant of cost implications, geographical distance to intervention sites and the large number of patients per audiologist, it becomes relevant to attempt innovative practice.

The WHO’s recently published guidelines on hearing aid service delivery for low- and middle-income settings may provide valuable assistance for this innovative practice (World Health

Organization, 2023). These guidelines advocate for the provision of preprogrammed or self-fitting hearing aids facilitated by trained non-specialists, positioned geographically close to communities, who are supervised by specialists (such as audiologists and ear, nose and throat (ENT) specialists). These supervising specialists can be consulted when required using mobile health services, overcoming geographical barriers to access. The guidelines highlight the need for hearing aid provision to form a part of integrated services, involving primary healthcare. Similarly, Khoza-Shangase (2022) proposed the consideration of an asynchronous tele-audiology model in South Africa, which is led by audiologists who interpret diagnostic data that is collected by patient site facilitators. While the Health Professions Council of South Africa (HPCSA) is yet to release guidelines on the above, another example of relevant recent guidelines is the WHO's Integrated Care for Older People (ICOPE) framework. This advocates for a PCC approach where health and social care workers identify the needs of patients at a primary care level, before referring to relevant professionals, to ensure holistic care and better access to services (World Health Organisation, 2019).

On a broader scale, learning from the accessibility debate in the U.S. and associated FDA regulations on OTC, hearing healthcare promotion can be done twofold: by educating the public to drive consumer -and eventually corporate- engagement, and by educating fellow healthcare professionals, and associated management structures, to integrate them into hearing rehabilitation practices. It is particularly important to encourage corporate and management involvement, to promote more accessible and affordable audiology services and hearing aids. An example of such engagement would be audiologist transparency regarding the adherence to the International Organization for Standardization's (ISO) requirements for PCC (Young & Smith, 2022), at an institutional level. While the economically diverse and lower resourced setting of the South African healthcare system poses challenges for individuals with hearing

loss, the costs associated with this BOD is sufficient to encourage mitigation attempts at all levels, to improve quality of life.

4.3. STRENGTHS AND LIMITATIONS

The study presented with a number of strengths which facilitated meaningful results. Furthermore, study limitations were carefully identified and considered to ensure trustworthiness of the results and conclusion.

Study Strengths

- The study dataset was significantly larger as compared to previous studies on hearing aid satisfaction (n = 628, after exclusions) which contributed to data diversity and generalisability.
- Participants presented with varying degrees of self-reported hearing difficulty, and had obtained their hearing aids through both, the traditional HHP-mediated prescription route, as well as through the OTC model. These factors allowed for further diversity and applicability to the contemporary hearing aid industry.
- The qualitative methodology and open-ended nature of the question posed to participants was instrumental in encouraging open discourse, and uncovering deeper insights into the everyday needs of hearing aid users.
- The manual content analysis approach used to analyse the data allowed for granularity, and uncovered novel as well as popular suggestions from participants.
- Rigor was observed during the analysis process with one primary coder and two supervisors checking codes and categories individually. This, in combination with the initial pilot study for the survey, ensured that the study results were relevant,

trustworthy and replicable.

- Analysing one open-ended question from the survey as a stand-alone study, proved fruitful in making the abovementioned manual coding methodology possible.

Study Limitations

- There was a possibility of sampling bias as participants were self-selected. The survey was conducted over email with individuals who used the online Hearing Tracker forum or had purchased OTC hearing aids. Their suggestions could under-represent those with a lack of access to technology or lower levels of digital literacy.
- The responses from Lexie Hearing participants were shorter due to the absence of a minimum word count. The Hearing Tracker participant responses were required to be at least 20 words, and were therefore often longer than the former. As a result, some Lexie participants provided limited text that did not provide much context to what they were saying. This could have been confounded by the fact that the present study analysed only one open-ended question from the survey, in isolation from the other three. Additionally, some Hearing Tracker participants expressed disdain for the minimum word count, using filler words to reach the minimum word count to progress to the next survey question. Fortunately, responses with minimum context could still be judged as suggestive (as discussed previously in the methodology section). This limitation is therefore unlikely to have had an exceedingly negative impact.
- The open-ended survey question was multifaceted, in order to motivate participants to provide more detail. The wording could have proven complex to some respondents who may have provided less context to their responses as a result. Future studies could consider shorter open-ended questions and focus group discussions to mitigate this.
- The analysed dataset was large and the chosen methodology involved manual coding

and categorisation. While this achieved the aimed-for granularity, the time-consuming process meant that subgroup analyses, based on degree of self-reported hearing difficulty and route of hearing aid acquisition, was beyond the scope of this study. While no significant differences in participant suggestions relevant to the above was noted (as discussed previously), future research should include subgroup analyses for more detail.

- Lastly, participants were only based in the United States, which could limit generalisability to other populations.

4.4. FUTURE RESEARCH

It would be relevant for future research to examine perspectives of hearing aid users and compare them across context. For example, perspectives from individuals with advanced access versus disparity populations. Qualitative research in audiology should be prioritised to drive contextual understanding of individuals. Community-Based Participatory Research (CBPR) (Marrone, Nieman, & Coco, 2022) should be considered a benchmark, to facilitate research with high applicability to real-life situations, while remaining meaningful to academia, where ideologies must be nurtured in their infancy to inform future breakthroughs.

Considering the recent implementation of the OTC model of hearing aid service delivery (on 17 October 2022), future studies should focus on comparisons between the HHP-mediated prescription model and the OTC model. Specific topics to examine include the effectiveness of the new model in increasing access to hearing aids, and comparisons of long-term positive fitting outcomes per model. Future studies should also examine user perspectives on OTC versus prescription hearing aid features, considering cost differences, for more insight on model

effectiveness.

Due to the number of participant responses indicating difficulty with sound clarity despite adequate volume, even with hearing aids, this has been identified as an area for more research. Specifically, future studies should focus on the effects of varying degrees of hearing loss onauditory processing, the limitations of even advanced hearing aid technology in this regard, and the clinical application of aural rehabilitation programs to improve sound clarity with and without the presence of background noise.

4.5. CONCLUSION

Qualitative content analysis revealed valuable insights into hearing aid user perspectives on how to improve hearing aids, which are highly applicable to the clinical setting. Perceptions on hearing aid usefulness are impacted by physical and technical device features, as well as associated service provision. While the majority of study participants were satisfied with their devices, they also desired improvements to enhance usefulness. Notable areas of improvement included: decreasing the cost of hearing aids and associated services, improving sound clarity, enhancing speech perception in background noise, improving the general physical features of hearing aids such as aesthetics and IP ratings, and lastly, enhancing hearing aid service delivery with a PCC approach. Amidst an evolving audiology landscape, led by the introduction of OTC regulations in the U.S., and the WHO's guidelines on self-fitting hearing aids to enhance access, the role of the audiologist is indispensable to facilitate meaningful hearing healthcare.

REFERENCES

Almufarrij, I., Munro, K. J., Dawes, P., Stone, M. A., & Dillon, H. (2019, July 8). Direct-to-Consumer Hearing Devices: Capabilities, Costs, and Cosmetics. *Trends in Hearing, 23*, 1–18. doi: https://doi.org/10.1177/2331216519858301

Amlani, A. M. (2023, May 8). *20Q: Audiology Economics*. Retrieved from Audiology Online: https://www.audiologyonline.com/articles/20q-audiology-economics-28543

Assi, L., Reed, N. S., Nieman, C. L., & Willink, A. (2021). Factors Associated With Hearing Aid Use Among Medicare Beneficiaries. *Innovation in Aging, 5*(3). doi:https://doi.org/10.1093/geroni/igab021

Barker, B. A., & Scharp, K. M. (2021). "I Have to Social Norm This": Making Meaning of Hearing Loss from the Perspective of Adults Who Use Hearing Aids. *Health Communication, 36*(6), 774-781. doi: https://doi.org/10.1080/10410236.2020.1712523

Bennett, R. J., Swanepoel, D., Ratinaud, P., Bailey, A., Pennebaker, J. W., & Manchaiah, V. (2021). Hearing aid acquisition and ownership: what can we learn from online consumer reviews? *International Journal of Audiology, 60*(11), 917-926. doi: https://doi.org/10.1080/14992027.2021.1931487

Bhamjee, A., le Roux, T., Schlemmer, K., Graham, M. A., & Mahomed-Asmail, F. (2022). Audiologists' Perceptions of Hearing Healthcare Resources and Services in South Africa's Public Healthcare System. *Health Services Insights, 15*, 1–11. doi:https://doi.org/10.1177/1178632922113542

Bitrián, P., Buil, I., & Catalán, S. (2021). Enhancing user engagement: The role of gamification in mobile apps. *Journal of Business Research, 132*, 170-185. doi:https://doi.org/10.1016/j.jbusres.2021.04.028

Blustein, J., Weinstein, B. E., & Chodosh, J. (2022). Over-the-counter hearing aids: What will it mean for older Americans? *Journal of the American Geriatrics Society, 70*(7), 2115-2120. Retrieved from https://doi-org.uplib.idm.oclc.org/10.1111/jgs.17781

Borre, E. D., Johri, M., Dubno, J. R., Myers, E. R., Emmett, S. D., Pavon, J. M., . . . Sanders Schmidler, G. D. (2023). Potential Clinical and Economic Outcomes of Over-the-Counter Hearing Aids in the US. *JAMA Otolaryngology – Head & Neck Surgery*. doi:https://doi.org/doi:10.1001/jamaoto.2023.0949

Bundesen, L. L. (2019, October 14). *PCC 2.0: From Awareness to Action!* Retrieved from The Hearing Review: https://hearingreview.com/hearing-loss/patient-care/pcc-2-0-from-awareness-to-action

Carr, K., & Kihm, J. (2022). MarkeTrak—Tracking the Pulse of the Hearing Aid Market. *Seminars in Hearing, 43*(04), 277-288. doi:https://doi.org/10.1055/s-0042-1758380

Chundu, S., Allen, P. M., Han, W., Ratinaud, P., Krishna, R., & Manchaiah, V. (2021). Social representation of hearing aids among people with hearing loss: an exploratory study. *International Journal of Audiology, 60*(12), 964-978.

Clark, M., & Bryan, A. (2013). *Customer Effort: Help or hype?* The Henley Centre for Customer Management. Retrieved from chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://assets.henley.ac.uk.s3.amazonaws.com/legacyUploads/8.1-Customer-Effort-Clark-and-Bryan-2013.pdf

Cox, R. M., & Alexander, G. C. (2002). The International Outcome Inventory for Hearing Aids (IOI-HA): psychometric properties of the English version: El Inventario International de Resultados para Auxiliares Auditivos (IOI-HA): propiedades psicometricas de la version en ingles. *International Journal of Audiology, 41*(1), 30-35. doi:10.3109/14992020209101309

Davidson, A., Marrone, N., Wong, B., & Musiek, F. (2021). Predicting Hearing Aid Satisfaction in Adults: A Systematic Review of Speech-in-noise Tests and Other Behavioral Measures. *Ear and Hearing, 42*(6), 1485–1498. doi:doi.org/10.1097/AUD.0000000000001051

Delaney, L. J. (2018). Patient-centred care as an approach to improving health care in Australia. *Collegian, 25*(1), 119-123. Retrieved May 17, 2023, from https://doi.org/10.1016/j.colegn.2017.02.005

Desjardins, J. L., & Sotelo, L. R. (2021, September 10). Self-Reported Reasons for the Non-Use of Hearing Aids Among Hispanic Adults With Hearing Loss. *American Journal of Audiology, 30*(3), 709-716. doi: https://doi.org/doi.org/10.1044/2021_AJA-21-00043

Dillon, H., Day, J., Bant, S., & Munro, K. J. (2021, June). Adoption, use and non-use of hearing aids: a robust estimate based on Welsh national survey statistics. *International Journal of Audiology, 59*(8), 567-573 . doi: https://doi.org/10.1080/14992027.2020.1773550

Eysenbach, G. (2004). Improving the Quality of Web Surveys: The Checklist for Reporting Results of Internet E-Surveys (CHERRIES). *Journal of Medical Internet Research, 6*(3). doi:10.2196/jmir.6.3.e34

Fuentes-López, E., Fuente, A., Valdivia, G., & Luna-Monsalve, M. (2019). Does educational level predict hearing aid self-efficacy in experienced older adult hearing aid users from Latin America? Validation process of the Spanish version of the MARS-HA questionnaire. *PLoS One, 14*(12). Retrieved from https://doi.org/10.1371/journal.pone.0226085

GBD 2019 Hearing Loss Collaborators. (2021). Hearing loss prevalence and years lived with disability, 1990–2019: findings from the Global Burden of Disease Study 2019. *The Lancet, 397*(10278), 996-1009. Retrieved from https://doi.org/10.1016/S0140-6736(21)00516-X

Gomez , R., & Ferguson, M. (2020). Improving self-efficacy for hearing aid self-management: the early delivery of a multimedia-based education programme in first-time hearing aid users. *International Journal of Audiology, 59*(4), 272-281.

Gomez, R., Habib, A., Maidment, D. W., & Ferguson, M. A. (2022). Smartphone-Connected Hearing Aids Enable and Empower Self-Management of Hearing Loss: A Qualitative

Interview Study Underpinned by the Behavior Change Wheel. *Ear and Hearing, 43*(3), 921-932. doi: https://doi.org/10.1097/AUD.0000000000001143

Graneheim, U. H., & Lundman, B. (2004). Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness. *Nurse Education Today, 24*(2), 105-112. doi: https://doi.org/10.1016/j.nedt.2003.10.001

Hammond, F., Malec, J., Nick, T., & Buschbacher, R. (2015). *Handbook for Clinical Research : Design, Statistics, and Implementation.* New York: Demos Medical Publishing . Retrieved March 13, 2022, from https://ebookcentral-proquest-com.uplib.idm.oclc.org/lib/pretoria-ebooks/reader.action?docID=3007787&ppg=25

Hay, M. E., & Zielinski, R. Q. (2022, March). Moisture in Hearing Instruments: Problematic, Prevalent, and Professionally Preventable. *The Hearing Journal, 75*(3), 20-24. doi:10.1097/01.HJ.0000823376.60686.5d

Heselton, T., Bennett,, R. J., Manchaiah, V., & Swanepoel, D. (2022, March 14). Online Reviews of Hearing Aid Acquisition and Use: A Qualitative Thematic Analysis. *American Journal of Audiology*, 1-15. doi:10.1044/2021_AJA-21-00172

Hesse, G., & Hoppe, U. (2017). Hearing aids: indications, technology, adaptation, and quality control. *GMS Current Topics Otorhinolaryngol Head Neck Surgery, 16*, 1-24. doi: https://doi.org/10.3205/cto000147

Hlayisi, V.-G., & Ramma, L. (2018). Rehabilitation for disabling hearing loss: evaluating the need relative to provision of hearing aids in the public health care system. *Disability and Rehabilitation , 41*(22), 2704-2707. doi:https://doi-org.uplib.idm.oclc.org/10.1080/09638288.2018.1473507

Holt, C. (2023). Wearable Technologies in Hearing Aids Ring True with Consumers, Providers. *The Hearing Journal, 76*(02), 28-29. doi: https://doi.org/10.1097/01.HJ.0000919788.69576.f3

Hsieh, H.-F., & Shannon, S. E. (2005). Three Approaches to Qualitative Content Analysis. *Qualitative Health Research, 15*(9), 1277-88. doi:10.1177/1049732305276687

Huber , J. T., & Gillaspy, M. L. (2011). Knowledge/Power Transforming the Social Landscape: The Case of the Consumer Health Information Movement. *The Library Quarterly: Information, Community, Policy, 81*(4), 405-430. doi:https://doi.org/10.1086/661657

Jorgensen, L., & Novak, M. (2020). Factors Influencing Hearing Aid Adoption. *Seminars in Hearing, 41*(1), 6-20. doi:doi: 10.1055/s-0040-1701242

Junod, V. (2010). Retrospective research: what are the ethical and legal requirements? *Swiss Medical Weekly* . doi:https://doi.org/10.4414/smw.2010.13041

Khoza-Shangase, K. (2022). In pursuit of increasing the application of tele-audiology in South Africa: COVID-19 puts on the alert for patient site facilitator training. *South African Journal of Communication Disorders, 69*(2). doi:https://doi.org/10.4102/sajcd.v69i2.900

Kozlowski, L., Ribas, A., Almeida, G., & Luz, I. (2017). Satisfaction of Elderly Hearing Aid Users. *International Archives of Otorhinolaryngology, 21*(01), 92-96. doi:https://doi.org/10.1055/s-0036-1579744

Kumar, R. (2011). *Research Methodology A Step-By-Step Guide For Beginners* (3 ed.). New Delhi: Sage Publications.

Leedy , P., & Ormrod, J. (2021). *Practical Research: Planning and Design* (Twelfth ed.). Harlow, Essex, United Kingdom: Pearson Education Limited . Retrieved March 13, 2022, from https://ebookcentral-proquest-com.uplib.idm.oclc.org/lib/pretoria-ebooks/reader.action?docID=6142159

LeRouge, C., Durneva, P., Lyon, V., & Thompson, M. (2022). Health Consumer Engagement, Enablement, and Empowerment in Smartphone-Enabled Home-Based Diagnostic Testing for Viral Infections: Mixed Methods Study. *JMIR Mhealth Uhealth, 10*(6). doi: https://doi.org/10.2196/34685

Lesica, N. A., Mehta, N., Manjaly, J. G., Deng, L., Wilson, B. S., & Zeng, F.-G. (2021). Harnessing the power of artificial intelligence to transform hearing healthcare and research. *Nature Machine Intelligence, 3*, 840–849. Retrieved from https://doi.org/10.1038/s42256-021-00394-z

Mahomed-Asmail, F., Hlayisi, V.-G., Joubert, K., Metcalfe, L., Graham, M. A., & Swanepoel, D. (2023). Person-centered care: preferences and predictors in speech-language pathology and audiology practitioners. *Frontiers in Psychology, 14*. Retrieved from https://doi.org/10.3389/fpsyg.2023.1162588

Manchaiah, V., Beukes, E., & Roeser, R. J. (2022). *Evaluating and Conducting Research in Audiology.* San Diego: Plural Publishing Incorporated. Retrieved March 13, 2022, from https://ebookcentral-proquest-com.uplib.idm.oclc.org/lib/pretoria-ebooks/reader.action?docID=6499979

Manchaiah, V., Sharma, A., Rodrigo, H., Bailey, A., De Sousa, K. C., & Swanepoel, D. (2023). Hearing Healthcare Professionals' Views about Over-The-Counter (OTC) Hearing Aids: Analysis of Retrospective Survey Data. *Audiology Research, 13*(2), 185-195. doi:https://doi.org/10.3390/audiolres13020018

Manchaiah, V., Swanepoel, D., Bailey, A., Pennebaker, J. W., & Bennett, R. J. (2021). Hearing Aid Consumer Reviews: A Linguistic Analysis in Relation to Benefit and Satisfaction Ratings. *American Journal of Audiology, 30*(3), 761-768. Retrieved from https://doi-org.uplib.idm.oclc.org/10.1044/2021_AJA-21-00061

Marrone, N., Nieman, C., & Coco, L. (2022). Community-Based Participatory Research and Human-Centered Design Principles to Advance Hearing Health Equity. *Ear Hear, 43*(Suppl 1). doi:https://doi.org/10.1097/AUD.0000000000001183

McCormack, A., & Fortnum, H. (2013, May). Why do people fitted with hearing aids not wear them? *International Journal of Audiology, 52*(5), 360-368. Retrieved July 18, 2022, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3665209/

McDaid, D., Park, A.-L., & Chadha, S. (2021). Estimating the global costs of hearing loss. *International Journal of Audiology, 60*(3), 162–170. Retrieved from https://doi.org/10.1080/14992027.2021.1883197

Meyer, C., Grenness, C., Scarinci, N., & Hickson, L. (2016). What Is the International Classification of Functioning, Disability and Health and Why Is It Relevant to Audiology? *Seminars in Hearing, 37*(3), 163–186. doi:10.1055/s-0036-1584412

Murdin, L., Sladen, M., Williams, H., Bamiou, D.-E., Bibas, A., Kikidis, D., . . . Pontoppidan, N. H. (2022). EHealth and Its Role in Supporting Audiological Rehabilitation: Patient Perspectives on Barriers and Facilitators of Using a Personal Hearing Support System With Mobile Application as Part of the EVOTION Study. *Frontiers, 9*. doi:https://doi.org/10.3389/fpubh.2021.669727

Oeding, K. (2022). Improving hearing aid outcomes in background noise: An investigation of outcome measures and patient factors. *Doctoral thesis*. University of Minnesota's Digital Conservancy.

Oosthuizen, I., Manchaiah, V., Launer, S., & Swanepoel, D. (2022). Hearing aid Experiences of Adult Hearing aid Owners During and After Fitting: A Systematic Review of Qualitative Studies. *Trends in Hearing, 26*. doi:10.1177/23312165221130584

Orji , A., Kamenov, K., Dirac, M., Davis, A., Chadha, S., & Vos, T. (2020). Global and regional needs, unmet needs and access to hearing aids. *International Journal of Audiology, 59*(3), 166-172. doi:10.1080/14992027.2020.1721577

Parmar, B. J., Mehta, K., Vickers, D. A., & Bizley, J. K. (2022). Experienced hearing aid users' perspectives of assessment and communication within audiology: a qualitative study using digital methods. *International Journal of Audiology, 61*(11), 956-964. doi:https://doi.org/10.1080/14992027.2021.1998839

Picou, E. M. (2022). Hearing Aid Benefit and Satisfaction Results from the MarkeTrak 2022 Survey: Importance of Features and Hearing Care Professionals. *Seminars in Hearing, 43*(4), 301-316. doi:10.1055/s-0042-1758375

Planey, A. M. (2020). Hearing Health Care In The United States: A Multi-Scale Spatial & Political Economic Analysis Of Health Care Policy And Access To Audiology Services. University of Illinois.

Pouyandeh, M. H., & Hoseinabadi, R. (2019, July). Factors Influencing the Hearing Aids Use and Satisfaction: A Review Study. *Journal of Modern Rehabilitation, 13*(3), 137-146. doi: http://dx.doi.org/10.32598/JMR.13.3.137

Powers, T. A., & Carr, K. (2022, May 3). MarkeTrak 2022: Navigating the Changing Landscape of Hearing Healthcare. *The Hearing Review, 29*(5), 12-17. Retrieved July 24, 2022, from https://hearingreview.com/inside-hearing/research/marketrak-2022-navigating-the-changing-landscape-hearing-healthcare

Preminger, J. E., Oxenbøll, M., Barnett, M. B., Jensen, L. D., & Laplante-Lévesque, A. (2015). Perceptions of adults with hearing impairment regarding the promotion of trust in hearing healthcare service delivery. *International journal of audiology, 54*(1), 20–28. doi: https://doi.org/10.3109/14992027.2014.939776

Ritter, C. R., Barker, B. A., & Scharp, K. M. (2020, September 4). Using attribution theory to explore the reasons adults with hearing loss do not use their hearing aids. *PLOS One, 15*(9). doi: 10.1371/journal.pone.0238468

Rose, J., & Johnson, C. W. (2020, February 10). Contextualizing reliability and validity in qualitative research: toward more rigorous and trustworthy qualitative social science in leisure research. *Journal of Leisure Research, 51*(4), 432-451. doi: DOI: 10.1080/00222216.2020.1722042

Ross, F. (2020). A Perspective on the Application of Kapferer's Brand Identity Prism in the Branding Process of Hearing Aid Retail Companies. *Journal of Management and Marketing Review, 5*(3), 141 – 146 . Retrieved May 31, 2023, from http://gatrenterprise.com/GATRJournals/JMMR/pdf_files/JMMRVol5%283%292020/2.Florian%20Ross-Edited.pdf

Saunders, G. H., Dillard, L. K., Zobay, O., Cannon, J. B., & Naylor, G. (2021). Electronic Health Records As a Platform for Audiological Research: Data Validity, Patient Characteristics, and Hearing-Aid Use Persistence Among 731,213 U.S. Veterans. *Ear and Hearing, 42*(4), 927-940. doi:10.1097/AUD.0000000000000980

Scarinci, N., Tulloch, K., Meyer, C., Ekberg, K., & Lind, C. (2022). Using an Online Tool to Apply a Person-Centred Approach in Audiological Rehabilitation: A Pilot Study. *Audiology Research, 12*(6), 620–634. Retrieved from https://doi.org/10.3390/audiolres12060060

Sheffield, S. W., Jacobs, M., & Ellis Jr., C. (2022). Considerations for the Over-the-Counter Hearing Aid Delivery Model. *Perspectives of the ASHA Special Interest Groups, 7*(6), 1802–1805. Retrieved from https://doi.org/10.1044/2022_PERSP-22-00058

Singh, R., & Jha, V. K. (2020). International Journal of Life science and Pharma Research Impact of Hearing Loss on Quality of Life in Adults. ResearchGate. doi: https://doi.org/10.22376/ijpbs/lpr.2020.10.5.L221-225

Solheim, J., Gay, C., & Hickson, L. (2017). Older adults' experiences and issues with hearing aids in the first six months after hearing aid fitting. *International Journal of Audiology, 57*(1), 31-39. doi:10.1080/14992027.2017.1380849

Swanepoel, D., Oosthuizen, I., Graham, M. A., & Manchaiah, V. (2023). Comparing Hearing Aid Outcomes in Adults Using Over-the-Counter and Hearing Care Professional Service Delivery Models. *American Journal of Audiology, 32*(2), 314–322. doi:https://doi.org/10.1044/2022_AJA-22-00130

Taylor, B. (2016). *20Q: Interventional Audiology - Changing the Way We Deliver Care*. Retrieved May 17, 2022, from Audiology Online: https://www.audiologyonline.com/articles/20q-interventional-audiology-17080?_ga=2.97239583.168148_1

Taylor, B., & Weinstein, B. (2015, July 20). *Moving from Product-Centered to Patient-Centric Care: Expanding Treatment Options Using Decision Aids*. Retrieved from Audiology Online: https://www.audiologyonline.com/articles/moving-from-product-centered-to-14473

The Food and Drug Administration. (2023). *Hearing Aids*. Retrieved January 16, 2023, from US Food and Drug Administration: https://www.fda.gov/medical-devices/consumer-products/hearing-aids

The National Institute on Deafness and Other Communication Disorders (NIDCD). (2021). *Quick Statistics About Hearing*. Retrieved February 13, 2022, from The National Institute on Deafness and Other Communication Disorders: https://www.nidcd.nih.gov/health/statistics/quick-statistics-hearing#9

Tong, A., Sainsbury, P., & Craig, J. (2007). Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care, 19*(6), 349 –357.

U.S. Food and Drug Administration. (2021, October 19). *Hearing Aids and Personal Sound Amplification Products: What to Know*. Retrieved 08 11, 2022, from U.S. Food and Drug Administration: https://www.fda.gov/consumers/consumer-updates/hearing-aids-and-personal-sound-amplification-products-what-know

Valentinuzzi, M. E. (2020). Hearing Aid History: From Ear Trumpets to Digital Technology. *IEEE Pulse, 11*(5), 33-36. doi:10.1109/MPULS.2020.3023833

Vercammen, C., Oosthuizen, I., Manchaiah, V., Ratinaud, P., Launer, S., & Swanepoel, D. (2023). Real-life and real-time hearing aid experiences: Insights from self-initiated ecological momentary assessments and natural language analysis. *Frontiers in Digital Health, 5*. doi: https://doi.org/10.3389/fdgth.2023.1104308

Waterworth, C. J., Marella, M., O'Donovan, J., Bright, T., Dowell, R., & Bhutta, M. F. (2022). Barriers to access to ear and hearing care services in low- and middle- income countries: A scoping review. *Global Public Health*. doi:https://doi.org/10.1080/17441692.2022.2053734

Wolfgang, K. (2019, March). Artificial Intelligence and Machine Learning: Pushing New Boundaries in Hearing Technology. *The Hearing Journal, 72*(3), 26-30. doi:10.1097/01.HJ.0000554346.30951.8d

World Health Organisation (WHO). (2019). Integrated care for older people (ICOPE): Guidance for person-centred assessment and pathways in primary care.

World Health Organisation. (2021, April 1). *Deafness and hearing loss*. Retrieved February 13, 2022, from World Health Organisation: https://www.who.int/news-room/fact-sheets/detail/deafness-and-hearing-loss

World Health Organization . (2023). *Hearing aid service delivery approaches for low- and middle-income settings.* Geneva: WHO. Retrieved from https://www.who.int/publications/i/item/9789240087927

Young, M., & Smith, M. A. (2022). *Standards and Evaluation of Healthcare Quality, Safety, and Person-Centered Care.* StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing. Retrieved from https://www.ncbi.nlm.nih.gov/books/NBK576432/

APPENDICES

THE FOLLOWING APPENDICES ARE INCLUDED BELOW:

Intro

Hearing Aid Experiences

Dear Sir/Madam,

Hearing aid benefit and satisfaction as reported by its users are generally measured using standardized questionnaires. However, not all the items within these questionnaires are applicable and/or considered important by all hearing aid users. For this reason, using open-ended questions may have some value in gathering deeper insights into real-world and everyday life of hearing aid users. In this study, we aim to examine perspectives of hearing aid users from their own words. We hope that the knowledge generated from this study will help facilitate hearing aid journey as well as in designing the future generation hearing aids.

The study has been approved by the Lamar University's Institutional Review Board (IRB-FY21-248). All the information recorded will be kept confidential and stored in an encrypted manner. Participation in this study is voluntary. Estimated time of survey is 15 minutes. The attached document has some additional information. However, we are happy to answer any questions you may have before the start of this study.

To view additional study information and procedures, please click on the file below.

Additional Study Information

By clicking below, I consent electronically to participate in this study.

○ Yes, I consent

- ◯ No, I do not consent

Demographic and hearing aid related information

How old are you (in years)?

[ ]

Please indicate your gender:

- ◯ Female
- ◯ Male
- ◯ Non-binary (or gender neutral)

Do you have any difficulty with your hearing (without hearing aids)?

- ◯ No, I always hear everything
- ◯ Yes, sometimes I do not hear what is being said
- ◯ Yes, I regularly do not hear what is being said
- ◯ Yes, I almost never hear what is being said

How long have you had hearing loss? Provide your answer in years.

[ ]

Do you own a hearing aid for your:

- ○ Right ear
- ○ Left ear
- ○ Both ears

From the time you first learned you had a hearing problem how long did you wait before purchasing your first hearing aids? Please provide your answer as a numerical value (e.g., 1, 3, 15).

Year(s) _____

Month(s) _____

What type of hearing aid do you use?

- ○ In-the-ear (ITE) hearing aids (Hearing aid sits completely/entirely in the ear)

- ◯ Behind-the-ear (BTE) hearing aids (Hearing aid has 2 parts: One part, the mold, sits in the ear and the other part, the hearing aid, sits behind the ear)

Which brand hearing aid do you currently use?

- ◯ Kirkland
- ◯ Oticon
- ◯ Phonak
- ◯ ReSound
- ◯ Signia / Siemens
- ◯ Starkey
- ◯ Unitron
- ◯ Widex
- ◯ [ ] Other, please specify

How did you purchase your current hearing aids?

- ◯ From a hearing clinic (private or university)
- ◯ Discount Warehouse (Costco, Sams, etc.)
- ◯ Internet / Online
- ◯ Pharmacy Hearing Center (CVS)

- ○ A hearing professional came to my residence
- ○ [ ] Other, please specify:

Open-ended questions

For many people, getting and wearing a hearing aid is a major life decision. They often say that getting a hearing aid is embarrassing and makes them feel or look old. Others worry about the cost or what others will say. How did you deal with these issues when you decided to buy a hearing aid? What motivated you to get hearing aids? Was there a single reason or event that convinced you or were there many reasons? Please provide as much detail as possible about the reason or reasons why you decided to get hearing aids. What would you recommend to others who are starting to have hearing problems?

Have hearing aids changed your life in a meaningful way? Why or why not? We would really like to know your experience with your hearing aids and how you think and feel about your hearing aids.

We are trying to understand when people do and do not wear their hearing aids. Other than when you are alone, when do you avoid wearing hearing aids? Why? Why do you think people often avoid wearing hearing aids in situations that they really should?

We talk to audiologists and hearing aid companies. Tell us how you would like hearing aids to change to be more useful for you and the people around you. Please be honest. We really would like your thoughts and feelings about this. Your comments will help us when we talk to people in the industry.

Hearing aid benefit/satisfaction

Think about how much you used your present hearing aid(s) over the past two weeks. On an average day, how many hours did you use the hearing aid(s)?

- ○ None
- ○ Less than 1 hour a day
- ○ 1 to 4 hours a day
- ○ 4 to 8 hours a day
- ○ More than 8 hours a day

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

- ○ Helped not at all
- ○ Helped slightly
- ○ Helped moderately
- ○ Helped quite a lot
- ○ Helped very much

Think again about the situation where you most wanted to hear better. When you use your present hearing aid(s), how much difficulty do you STILL have in that situation?

- ○ Very much difficulty
- ○ Quite a lot of difficulty
- ○ Moderate difficulty
- ○ Slight difficulty

- ◯ No difficulty

Considering everything, do you think your present hearing aid(s) is worth the trouble?

- ◯ Not at all worth it
- ◯ Slightly worth it
- ◯ Moderately worth it
- ◯ Quite a lot worth it
- ◯ Very much worth it

Over the past two weeks, with your present hearing aid(s), how much have your hearing difficulties affected the things you can do?

- ◯ Affected very much
- ◯ Affected quite a lot
- ◯ Affected moderately
- ◯ Affected slightly
- ◯ Affected not at all

Over the past two weeks, with your present hearing aid(s), how much do you think other people were bothered by your hearing difficulties?

- ◯ Bothered very much
- ◯ Bothered quite a lot
- ◯ Bothered moderately
- ◯ Bothered slightly

- ○ Bothered not at all

Considering everything, how much has your present hearing aid(s) changed your enjoyment of life?

- ○ Worse
- ○ No change
- ○ Slightly better
- ○ Quite a lot better
- ○ Very much better

General health and well-being & social network

In general, would you say your health is:

- ○ Excellent
- ○ Very good
- ○ Good
- ○ Fair
- ○ Poor

In general, would you say your mental health is:

- ○ Excellent
- ○ Very good
- ○ Good
- ○ Fair
- ○ Poor

How would you rate your quality of life?

- ○ Very poor
- ○ Poor
- ○ Neither poor nor good
- ○ Good
- ○ Very good

In a typical week, how much time do you spend in total on moderate and vigorous physical activities where your heartbeat increases and you breathe faster (e.g., brisk walking, cycling, heavy gardening, running, recreational sport):

- ○ Less than ½ an hour (30 minutes)
- ○ ½ an hour to 1½ hour (30-90 minutes)
- ○ 1½ - 2½ hours (90-150 minutes)
- ○ 2½ - 5 hours (150-300 minutes)
- ○ More than 5 hours (more than 300 minutes)

For the following questions (questions 5 to 10), please provide your answer as a numerical value (e.g., 1, 3, 15).

How many people live in your household?

How many children do you have?

How many grandchildren do you have?

How many people do you know that you would call a close friend?

How many people do you know that have hearing loss but who do not have hearing aids?

How many people do you know that have hearing loss and have/wear hearing aids?

Additional demographic information

Which of the following options best describe your work situation?

- ○ Employed or homemaker
- ○ Out of work or looking for work
- ○ Student

- ◯ Unable to work
- ◯ Retired

What is the highest level of schooling (education) you have completed?

- ◯ Less than high school
- ◯ High school
- ◯ Some college but not degree
- ◯ A university degree

Please select one of the following options that describes your living arrangement/ situation:

- ◯ I live with my family
- ◯ I live with my spouse/partner
- ◯ I live with a friend
- ◯ I live on my own

What is your ethnicity?

- ◯ Hispanic or Latino
- ◯ Non-Hispanic or Latino

What is your race?

- ◯ American Indian

- ◯ Alaska Native, Asian
- ◯ Black or African American
- ◯ Native Hawaiian
- ◯ Other Pacific Islander
- ◯ White
- ◯ More than One Race

What is your pretax household income, approximately?

- ◯ Under $25,000
- ◯ $25,000 to $49,999
- ◯ $50,000 to $99,999
- ◯ $100,000 to $149,000
- ◯ $150,000 or more

Block 5

We are inviting a few people who completed the questionnaire to participate in a virtual interview (Zoom). Are you interested in participating in this interview study?

- ◯ Yes. If yes, please share your email address.
  [ ]
- ◯ No

APPENDIX B

[EXTERNAL] IRB-FY21-248 - Initial: Initial - Exempt - Approved

do-not-reply@cayuse.com <do-not-reply@cayuse.com>
Fri 7/23/2021 3:40 PM
To: Vinaya Manchaiah <vmanchaiah@lamar.edu>

RESEARCH & SPONSORED PROGRAMS ADMINISTRATION LAMAR UNIVERSITY

Jul 23, 2021 3:40:40 PM CDT

Vinaya Channapatna Manchaiah

Re: Exempt - Initial - IRB-FY21-248 Hearing aid experiances

Dear Dr. Vinaya Channapatna Manchaiah

Lamar University's Institutional Review Board (IRB) for Human Research Participants Protection has completed its review of your submission and has deemed your study to be exempt from further IRB review.

Category 2.(i). Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording).
The information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subjects.

As a research investigator, please be aware of the following:

- You will immediately report to the IRB via LU Cayuse any injuries or other unanticipated problems involving risks.
- You acknowledge and accept your responsibility for protecting the rights and welfare of human research participants and for complying with all parts of 45 CFR Part 46, the LU IRB Policy and Procedures.
- You will ensure that legally effective informed consent is obtained and documented if necessary. If written consent is required, the consent form must be signed by the participant or the participant's legally authorized representative. A copy is to be given to the person signing the form and a copy is to be kept for your file.
- Any proposed changes, including changes to your survey, hard copy or in Qualtrics, from previously approved IRB applications must be submitted to the Office of Research and Sponsored Programs via LU Cayuse. The proposed changes cannot be initiated without IRB review and approval.

Once your study is complete, please login to Cayuse and close your study.

Good luck with your research endeavors.

Sincerely,
Lamar University Human Subjects Review Board

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Humanities
Fakulteit Geesteswetenskappe
Lefapha la Bomotho

05 December 2022

Dear Miss N Desai

Project Title:	Hearing aid changes for improved use: User perspectives
Researcher:	Miss N Desai
Supervisor(s):	Prof F Mahomed Asmail
Department:	Speech Language Pathology and Audiology
Reference number:	22959191 (HUM033/0822)
Degree:	Masters

Thank you for the application that was submitted for ethical consideration.

The Research Ethics Committee notes that this is a literature-based study and no human subjects are involved. The application has been **approved** on 5 December 2022 with the assumption that the document(s) are in the public domain. Data collection may therefore commence, along these guidelines.

Please note that this approval is based on the assumption that the research will be carried out along the lines laid out in the proposal. However, should the actual research depart significantly from the proposed research, a new research proposal and application for ethical clearance will have to be submitted for approval.

We wish you success with the project.

Sincerely,

Prof Karen Harris
Chair: Research Ethics Committee
Faculty of Humanities
UNIVERSITY OF PRETORIA
e-mail: tracey.andrew@up.ac.za

Appendix A: Memorandum of Understanding between the University of Pretoria and Lamar University.

LAMAR UNIVERSITY
MEMBER THE TEXAS STATE UNIVERSITY SYSTEM™

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Memorandum of Understanding

This Memorandum of Understanding ("MOU") is made and entered into on August 01, 2021 (the "Effective Date"), between Lamar University, an institution of higher education in the State of Texas and a component of The Texas State University System, ("University'), which is located at 4400 MLK Parkway, Beaumont, Texas 77710, United States of America (USA) and University of Pretoria, Faculty of Humanities, an institution of higher education in the Gauteng Province, which is located at corner Roper Street and Lynwood Road, Hatfield, 0028, Pretoria, Republic of South Africa (SA)("Partner "), University and Partner shall be known collectively as "the Parties" and singularly as "a Party" or "the Party."

Recitals

Whereas, cordial relations exist between Lamar University and University of Pretoria, Faculty of Humanities,

Whereas, Lamar University and University of Pretoria, Faculty of Humanities have discussed mutual goals regarding academic opportunities for students and faculty; and

Whereas, Lamar University and University of Pretoria, Faculty of Humanities desire to establish a program to be formalized at a later date (the "Program") for the benefit of students and faculty of their respective educational institutions;

Now, therefore, the Parties enter into this MOU, in order to memorialize fundamental concepts regarding the Program, which includes supporting collaborative research projects, international experience for faculty/staff and students and academic teaching.

Understanding of the Parties

In contemplation of the establishment of the Program, the Parties agree as follows:

Article 1 (Objectives)

A. To contribute further to the original understanding between both countries (the United States of America and the Republic of South Africa), both cities (Beaumont and Pretoria), and both institutions (Lamar University and University of Pretoria, through mutual cooperation programs.

B. To further collaborations between Lamar University and University of Pretoria through academic programs in instruction, research and faculty/staff development among the faculty/staff and students of both institutions.

C. To enhance the international experience of faculty/staff and students in the area of:
    1. Research
    2. Joint Programs and Collaboration
    3. Exchange of Faculty/Staff and Students

Article 2 (Responsibilities of Parties)

A. Both institutions commit themselves to identify concrete areas of academic collaboration and to explore the means to achieve a successful collaboration.
B. The officials who will have the responsibility in coordinating the Program for the Parties are: Dr. Vinaya Manchaiah, Department of Speech and Hearing Sciences, Lamar University, USA; and Prof De Wet Swanepoel, Department of Speech-Language Pathology and Audiology, Faculty of Humanities, University of Pretoria, SA.

Article 3 (Understanding of Parties)

A. The Parties understand and acknowledge that they are making a significant commitment to this collaborative effort Accordingly, the Parties agree to expendtheir best efforts on the design, implementation, and successful continuation of the Program.

8. This MOU shall remaineffective from the effective date listed above untiltheend of the term of three (3) years.

C. The Parties understand and acknowledge that this MOU will provide the foundation for a more comprehensive agreement concerning the details of the Program; and that this MOU does not commit the Parties regarding the Program. This MOU is gratuitous for the parties and no payment or remuneration may be required by virtue of its execution as the Parties will absorb inherent costs to comply withthis MOU at this time.

D. The Parties understand that this Program must support through its activities the mission of Lamar University and the University of Pretoria, Faculty of Humanities; that the Programs may not use the name and official seal of the other Party or any of its components without the written consent of the senior management of the other Party or her/his designee; that the Program issubject to all policies and procedures of the Boardof Regents and Administrationof the Texas State University System and those of the University of Pretoria, and must submit to reporting and auditing requirements as established by both Parties,.

E. Any intellectual property matters that arise from the Program shall be addressed pursuant to applicable policy, law and mutual written agreements among the Parties.

F. This MOU contains the entire understanding of Parties at this time. If either Party is unwilling or unable to continue with plans for the Program, that Party may do so by sending thirty (30) days written notice to the other Party.

G. This MOU may not be amended or otherwise modified except by the written agreement of both Parties. Neither Party may assign this MOU without the other Party's prior written consent. The invalidity or unenforceability of any provision(s) of this MOU will not impair the validity and enforceabilityof the remainingprovisions.

H. In their execution of this agreement, allcontractors, subcontractors,their respective employees, and other acting by or through them shallcomply withall federal and state policies andlaws that prohibit discrimination,harassment, and sexual misconduct. Any breach of this covenant may result in termination of this agreement.

In witness whereof, the Parties have caused their fully authorized representativesto execute this MOU effective as of the date written above.

P:intedNam2.7:.gilliam
Signature:
Title: Chair, Speech and Hearing Sciences

Printed Name: Prof. Herina Holtzhausen
Signature: _____
Title: Dean, Fine Arts and Communication

Printed Name: Prof.Jerry Lin
Signature: _____
Title: Associate Provost for Research and Sponsored Program, Lamar University

Printed Name: W Swanepoel
Signature: A.
Title: Professor, Dept of Speech-LanguagePathology and Audiology

Printed Name: Prof. Vasu Reddy
Signature: _____
Title: Dean of the Facu of Humanities, University of Pretoria

Note: Modification of thisform requires approval of OGC

Standard Form Approved by the Lamar University Office of General Counsel

Appendix B: Memorandum of Understanding between the University of Pretoria and the University of Colorado.

NON-MONETARY COLLABORATION AGREEMENT

This Agreement is made by and between The Regents of the University of Colorado, a body corporate, for and on behalf of the University of Colorado Denver ("University"), and University of Pretoria, Faculty of Humanities, an institution of higher education in the Gauteng Province, Pretoria, Republic of South Africa (“Collaborator”).

WHEREAS, it is in the mutual interest of University and Collaborator to participate in a study entitled: Supporting collaborative research projects, international experience for faculty/staff and students, and academic teaching. ("Project");

WHEREAS, Dr. Vinaya Manchaiah at the University, and Professor De Wet Swanepoel at the Collaborator ("Principal Investigators") are designated to coordinate the Project for University and Collaborator respectively;
Whereas, cordial relations exist between University of Colorado and University of Pretoria, Faculty of Humanities,

WHEREAS, Principal Investigators have discussed mutual goals regarding academic opportunities for students and faculty; and

WHEREAS, Principal Investigators desire to establish a program to be formalized at a later date (the “Program”) for the benefit of students and faculty of their respective educational institutions;

WHEREAS, Collaborator and University shall conduct the Project in accordance with the Scope of Work (“SOW”) attached as **Exhibit A**;

NOW, THEREFORE, the parties agree as follows:
1. SCOPE OF WORK. The Project shall be conducted in accord with the SOW attached

hereto as Exhibit A and incorporated into this Agreement by this reference solely for the purpose WT_Coll_09.14.10

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of describing the work to be performed under this Agreement. The research shall be carried out during the project period (“Project Period”), which shall be the date of this fully executed agreement and shall remain effective until the end of the term of three years**.** The Project may be extended by mutual written agreement; however, the Project may also be terminated early as provided in Article 15 below.

2. PRINCIPAL INVESTIGATORS. The research is to be conducted under the direction of the Principal Investigators. It will be the responsibility of each Principal Investigator to

transmit to and receive information from the other party, to coordinate visits and arrange all other matters pertinent to the Project.

3. PROTECTION OF HUMAN SUBJECTS. If applicable, Collaborator and University shall comply with Department of Health and Human Services ("DHHS") policies and regulations on the Protection of Human Subjects (45 CFR 46 as amended). Collaborator shall provide to University evidence of approval by Collaborator's Institutional Review Board. No work involving human subjects shall commence without prior approval by the Office for Human Research Protections ("OHRP") of an assurance to comply with the requirements of 45 CFR 46 to protect human research subjects.

Collaborator shall submit to the University an approved assurance, reviewed and approved by the appropriate Collaborator Institutional Review Board, that the rights and welfare of any human subjects involved in this project are adequately protected in accordance with DHHS policies and regulations on the Protection of Human Subjects.

4. RIGHTS IN DATA AND SPECIMENS. Both parties shall keep complete and accurate records of the work performed under this Agreement. Collaborator shall provide University with specimens, if applicable, along with the related reports and forms, as provided for in the Protocol. ("Study Reports"). The Parties shall own copyright relating to all Study Reports in proportion to each Party's intellectual contribution to such copyright , provided that the Party that generated such intellectual contribution to such copyright shall retain full ownership with

respect to applicable Study Reports. The Parties shall have right to use such Reports for

academic and research purposes. The Parties will not use any Protected Health Information ("PHI") or Personal Information or Confidential Information as defined by Health Insurance Portability and Accountability Act of 1996 ("HIPAA") and the Protection of Personal Information Act 4 of 2013 unless the Study subject has consented thereto in writing. Specimens will be utilized in accordance with the Exhibit A. Future use of data and specimens will be done in accordance with the study Protocol.

5. CONFIDENTIALITY. The parties may wish, from time to time, in connection with work contemplated under this Agreement, to disclose confidential information to each other related to the Project ("Confidential Information"). For purposes of this Agreement, the term "Confidential Information" shall mean any and all information, know-how, data, technical and non-technical materials, designs, concepts, processes, innovations, product samples and specifications, financial or business information, and other expertise, whether or not patentable, furnished by a disclosing party to recipient. Confidential Information shall be clearly marked by the disclosing party with the legend, "CONFIDENTIAL INFORMATION" or another appropriate proprietary legend. If disclosed orally or visually,

the employee(s) making the disclosure shall be responsible for clearly informing the recipient's employee(s), in writing within thirty (30) days, of the confidentiality of the information disclosed. Each party will use reasonable efforts to prevent the disclosure of the other party's Confidential Information to third parties for a period of five (5) years after termination or expiration of the Agreement, provided that the recipient party's obligation hereunder shall not apply to information that:

a) is not disclosed in writing or reduced to writing and so marked with an appropriate confidentiality legend within thirty (30) days of disclosure;
b) is already in recipient party's possession at the time of disclosure thereof;
c) is or later becomes part of the public domain through no fault of recipient party;
d) is received from a third party having no obligations of confidentiality to disclosing party;
e) is independently developed by the recipient party; or
f) is required by law, regulation, or court order to be disclosed.

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In the event that information is required to be disclosed pursuant to subsection 6.1(f), the party required to make disclosure shall notify the other to allow that party to assert whatever exclusions or exemptions may be available to it under such law or regulation.

6. COLORADO OPEN RECORDS ACT. Collaborator acknowledges that University is subject to the Colorado Public Records Act (C.R.S. §§ 24-72-201 et seq.). All Confidential Information of Collaborator shall be treated by University as confidential, as set forth in this Article 6, to the extent permitted under §§ 24-72-204. If University is required by Colorado Public Records Act to disclose any of Collaborator's Confidential Information, University shall: (i) use reasonable efforts to notify Collaborator in advance of such disclosure, and Collaborator shall be given the opportunity to oppose such disclosure by University by seeking a protective order or other appropriate remedy; (ii) disclose only that portion of Confidential Information which is legally required to be disclosed; and (iii) exercise all reasonable efforts to have confidential treatment accorded to the disclosed Confidential Information.

7. PUBLICATION. It is anticipated that the results of the work will be published jointly. Both parties will acknowledge the other party in any publication or presentation in accordance with academic standards.

8. USE OF NAME. Each party agrees not to include the name or any logotypes or symbols of the other party or the names of any researchers at such institutions in any advertising, sales promotion or other publicity matter without the prior written approval of the other party. However, nothing in this Article or elsewhere in this Agreement is intended to restrict either party from disclosing the existence, nature, Project, name of Collaborator or University, and

any additional matters required by law to be disclosed, or from including those items of information in the routine reporting of its activities.

9. INVENTIONS.
9.1 SOLE INVENTIONS. All Inventions conceived and first actually reduced to

practice solely by University shall be owned solely by University and shall be disposed of in

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accordance with University Policy, and all Inventions conceived and first actually reduced to practice solely by Collaborator shall be owned solely by Collaborator and shall be disposed of by Collaborator ("Sole Inventions"). The party who is the sole owner of such Invention shall, at its option, prepare, file, prosecute, and maintain applications throughout the world in countries of its choice.

9.2 JOINT INVENTIONS. All Inventions conceived and first actually reduced to practice by University and Collaborator as recognized under the U.S. law of inventorship shall be the mutual property of both to the extent of coinventorship, which shall, to the extent permitted by law, jointly hold all rights, title, and interest in proportion to each party's contribution to such inventions provided that the Party that generated such contributions to such inventions shall retain full ownership with respect to such inventions. The parties agree, to the extent they are legally able to do so, to negotiate in good faith the disposition of Joint Inventions.

9.3 DISCLOSURE (AND PREVIOUSLY EXISTING INVENTIONS). Each party shall promptly disclose to the other party in writing and on a confidential basis any Sole Invention or Joint Invention ("Invention Disclosure"). Notwithstanding the foregoing, it is recognized and understood that this Agreement does not affect any rights to any inventions of either party in existence prior to the Effective Date of this Agreement or those developed outside the course of the Project ("Prior Inventions"). Prior Inventions are and will remain the separate property of University or Collaborator, as applicable, and are not affected by this Agreement, and neither party shall have any claims to or rights in such separate Prior Inventions of the other.

10. LIABILITY. Each party shall be responsible for its own negligent acts or omissions or those of its officers or employees while performing their professional duties as set forth in this Agreement and the SOW, to the full extent allowed by law. Notwithstanding the foregoing, nothing in this Agreement is a limitation or waiver of the application of the Colorado Governmental Immunity Act set forth in C.R.S. §24-10-101 to §24-10-120 to any claims resulting from the performance of the University or its employees under this Agreement.

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11. INSURANCE. University and Collaborator certify that they maintain adequate levels of insurance or self-insurance to meet their obligations under this Agreement.

12. NOTICE. Whenever any notice is to be given hereunder, it shall be in writing and sent to the following address:

University:

University of Colorado Denver
Office of Grants and Contracts, Mail Stop F428 Anschutz Medical Campus, Bldg. 500, W1124 13001 E. 17th Place
Aurora, CO 80045
Phone: (303) 724-0090
Fax: (303) 724-0814 OGC.Contracts@ucdenver.edu

Collaborator: University of Pretoria, Humanities Cnr Lynwood Road and Roper Street

Hatfield, 0028 Pretoria Republic of South Africa

13. TERMINATION. This Agreement may be terminated by either party at any time upon thirty (30) days prior written notice to the other party. Written notice of termination shall be directed to the appropriate individual named in this Agreement.

14. GOVERNING LAW. The parties will remain silent to governing law. Regardless of venue or jurisdiction of any dispute between the parties resulting from the performance of this agreement, the parties agree that the terms of the Colorado Governmental Immunity Act, CRS §§ 24-10-101 et seq. shall apply to such dispute.

15. EXPORT CONTROL. Notwithstanding any other provision of this Agreement, the parties understand and agree that they are subject to, and agree to abide by, any and all

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applicable United States laws and regulations controlling the export of technical data, computer software, laboratory prototypes and other commodities. It is the expectation of the parties that the work done pursuant to this Agreement will constitute fundamental research and be exempt from export control licensing requirements under the applicable export control laws and regulations. The parties do not wish to take receipt of Export-Controlled

Information except as may be knowingly and expressly agreed to in writing signed by an authorized representative of the parties and for which the parties have made specific arrangements. “Export Controlled Information” includes without limitation information subject to U.S. export control laws and regulations the requirements of the Arms Export Control Act, 22 U.S.C. 2751-2794, the International Traffic in Arms Regulation, 22 C.F.R. 120 et seq., the Export Administration Act, 50 U.S.C. app. 240l-2420, the Export Administration Regulations, 15 C.F.R. 730-77, Nuclear Regulatory Commission, 10 C.F.R. 110 and Department of Energy, 10 C.F.R 810. The parties agree to work together to ensure that, with regard to this Agreement, both are in compliance with any and all applicable U.S. export control laws and regulations, as well any and all embargoes and/or other restrictions imposed by the Treasury Department’s Office of Foreign Asset Controls.

16. INDEPENDENT CONTRACTORS. The parties shall perform their obligations under this Agreement as independent contractors and nothing contained in this Agreement shall be construed to be inconsistent with such relationship or status.

17. ENTIRE AGREEMENT. This Agreement, together with any attachments hereto, represents the entire understanding of the Parties and supersedes any prior or contemporaneous agreements or understandings between Investigators and/or University with Collaborator with respect to the subject matter hereof. Furthermore, no modification, supplement, or new agreement may be executed, prior to the expiration of this Agreement, between Investigator and/or University with Collaborator with respect to the subject matter hereof, without formal written amendment to this Agreement, signed by all Parties. In the event of any inconsistency between this Agreement and any other attachments or documents, this Agreement shall control.

COLLABORATOR

UNIVERSITY

7

By:

Name:

Prof V. Reddy
Dean: Faculty of Humanities

By: Name: Title: Date:

Liz Causey
Manager of Contracts

Liz Causey 4/13/22

Title:
Date: 6 May 2022

8

EXHIBIT A STATEMENT OF WORK

1. To contribute further to the original understanding between both countries (the United States of America and the Republic of South Africa), and both institutions (University and Collaborator, through mutual cooperation programs.
2. To further collaborations between University and Collaborator through academic programs in instruction, research and faculty/staff development among the faculty/staff and students of both institutions.

3. To enhance the international experience of faculty/staff and students in the area of:

a. Research
b. Joint Programs and Collaboration
c. Exchange of Faculty/Staff and Students

APPENDIX F

From: **AJA** <em@editorialmanager.com>
Date: Wed, Mar 20, 2024 at 5:43 PM
Subject: AJA Manuscript Decision - [EMID:3481ba0db35f917c]
To: De Wet Swanepoel <dewet.swanepoel@up.ac.za>

CC: "Nabeelah Desai" desainabeelah@gmail.com, "Eldré W. Beukes" eldre.beukes@aru.ac.uk, "Vinaya Manchaiah" vinaya.manchaiah@cuanschutz.edu, "Faheema Mahomed-Asmail" faheema.mahomed@up.ac.za

AJA-23-00245R2
Consumer Perspectives on Improving Hearing Aids: A Qualitative Study
American Journal of Audiology

Dear Dr. De Swanepoel,

I am pleased to accept your manuscript for publication in American Journal of Audiology.

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Marc Brennan
Editor
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