Influential Factors in Driving Confidence among Hearing-Impaired Older Adults in Cape Town

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Glossary of Terms

Hearing loss and hearing assessment terms

Disabling hearing loss: Among adults, hearing thresholds worse than 40dB HL in the better-hearing ear (World Health Organisation [WHO], n.d.).

Hearing Handicap Inventory for the Elderly: A 25-question instrument used to assess the level of self-perceived handicap caused by hearing loss among older adults (Sogebi & Mabifah, 2015). The questions relate to how the individual perceives the social and emotional effects of their hearing loss (McCabe, 2019).

Hearing Handicap Inventory for the Elderly Screening Version: A 10-question version of the Hearing Handicap Inventory for the Elderly, also focusing on the social and emotional effects of hearing loss (McCabe, 2019).

Mild hearing loss: Among adults, hearing thresholds between 26 and 40dB HL (Clarke, 1981; WHO, n.d.). Individuals with mild hearing loss may have difficulty hearing whispered speech, birds chirping and speech in the presence of background noise (Hearing Health Foundation, n.d.; Quadio, 2016).

Moderate hearing loss: Among adults, hearing thresholds between 41 and 55dB HL (Clarke, 1981; WHO, n.d.). Individuals with moderate hearing loss may have difficulty hearing sounds such as running water from several meters away, as well as hearing and understanding speech in both quiet and noisy environments (Hearing Health Foundation, n.d.; Quadio, 2016).

Moderately-severe hearing loss: Among adults, hearing thresholds between 56 and 70dB HL (Clarke, 1981). Individuals with moderately-severe hearing loss may have difficulty hearing and understanding conversations in any environment without a hearing aid, as well as sounds such as the shower and air conditioner (Hearing Health Foundation, n.d.; Quadio, 2016).

Non-disabling hearing loss: Among adults, hearing thresholds better than or equal to 40dB HL in the better-hearing ear (WHO, n.d.). Individuals with non-disabling hearing loss may have difficulty hearing whispered speech, birds chirping and speech in the presence of background noise (Hearing Health Foundation, n.d.; Quadio, 2016).

Presbycusis: A progressive, symmetrical, sensorineural, age-related hearing loss (Fetoni, Picciotti, Paludetti, & Troiani, 2010).

Presbyvestibulopathy: Typical age-related decline in vestibular functioning characterised by postural imbalance, dizziness, abnormal gait and falls (Agrawal et al., 2019).

Profound hearing loss: Among adults, hearing thresholds worse than 91dB HL (Clarke, 1981; WHO, n.d.). Individuals with profound hearing loss may have difficulty hearing speech without a hearing aid, even at shouting level (Hearing Health Foundation, n.d.; Quadio, 2016). These individuals may not be able to hear even extremely loud noises, such as the sound of a motorcycle or airplane (Hearing Health Foundation, n.d.; Quadio, 2016).

Pure-tone audiometry: A type of hearing test used in a typical hearing assessment battery, to determine the softest sounds that a patient is able to hear fifty percent of the time (Walker, 2013). Typically, frequencies of 250Hz, 500Hz, 1000Hz, 2000Hz, 4000Hz and 8000Hz are tested (Walker, 2013).

Severe hearing loss: Among adults, hearing thresholds between 71 and 90dB HL (Clarke, 1981). Individuals with severe hearing loss may have difficulty hearing conversation without a hearing aid, even at shouting level. (Hearing Health Foundation, n.d.; Quadio, 2016).

Sound-attenuating booth: A room that has been specially designed and constructed to reduce noise for testing hearing (Maclennan-Smith, Swanepoel, & Hall, 2013).

Speech banana: A banana-shaped plot showing the frequency and intensity of speech sounds (Klangpornkun, 2013). The speech banana and its contents can be seen in Figure 1.

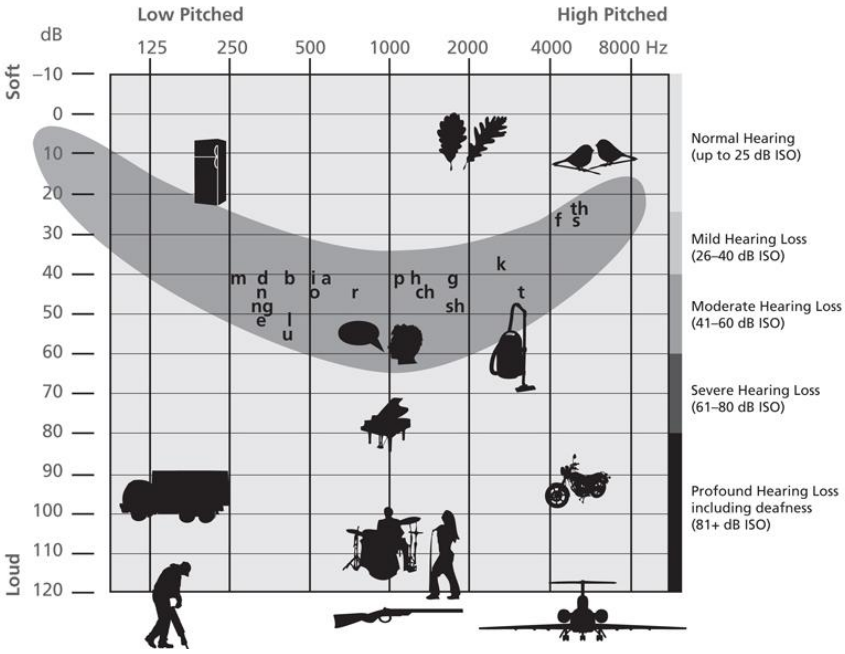

Figure 1. The speech banana, showing the intensity and frequency of speech sounds with levels of hearing loss.

Speech recognition testing: A common test in the typical hearing assessment battery, in which words are read to the patient for the patient to repeat (Francart, van Wieringen, & Wouters, 2010). The aim is to determine the patient's ability to hear and interpret words, which helps to determine the patient's functional hearing ability and their potential hearing aid success (Ng, Rudner, Lunner, & Ronnberg, 2013). Speech recognition testing may include the presence of background noise to help simulate a more realistic listening environment (Francart et al., 2010).

Other terms

Arrive Alive: An online road safety information platform which aims to enhance road safety awareness and save lives (Arrive Alive, n.d. a).

Autonomy: A person’s right to make decisions independently and with full understanding (Jahn, 2011).

Beneficence: Ensuring maximum benefit for individuals partaking in a study (Jahn, 2011).

Benign Paroxysmal Positional Vertigo: An inner ear disorder in which changes in head position cause the inner ear to send error signals to the brain, leading to a feeling of vertigo (Palmeri & Kumar, 2019; von Brevern et al., 2015).

Better-than-average effect: Also known as the illusory superiority phenomenon, it is the tendency of people to consider themselves more proficient at a particular task than others (Kim, Kwon, & Chiu, 2017).

Bilateral vestibular hypofunction: A chronic balance disorder characterised by reduced bilateral vestibular function (Fawzy & Khater, 2016; Hermann et al., 2018). Individuals with bilateral vestibular hypofunction may experience poor balance, difficulty walking and blurred vision, especially during head or body movement (Fawzy & Khater, 2016; Hermann et al., 2018).

Central tendency bias: The tendency of an individual to select an answer closer to the middle of the scale (Malone, Nicholl, & Tracey, 2014).

Cognitive load: The demand placed on working memory while performing a task (Kalyuga, 2011).

Cognitive processing speed: The ability to quickly process information, which is required for cognitive tasks (Ebaid, Crewther, MacCalman, Brown, & Crewther, 2017).

Content validity: Ensuring that all aspects of a construct are assessed by a measure (Heale & Twycross, 2015; Johnson & Danhauer, 2002).

Criterion validity: The extent to which different instruments measure the same variable (Heale & Twycross, 2015).

Delphi technique: An anonymous process whereby a panel of experts provides feedback over multiple rounds until consensus is reached (Bishop, Snowling, Thompson, Greenhalgh, & CATALISE consortium, 2015; Boulkedid, Abdoul, Loustau, Sibony, & Alberti, 2011).

Dementia: A clinical syndrome of cognitive decline which impairs social or occupational abilities (Chertkow, Feldman, Jacova, & Massoud, 2013).

Driving confidence: An individual's perception of their ability to effectively perform aspects of driving (Conlon, Rahaley, & Davis, 2017).

Driving performance: The level of ability in performing tasks involved in driving, such as brake reaction time, driving speed and steering wheel control (Jin et al., 2012).

Driving self-regulation: The practice of avoiding driving in certain situations which the driver deems unsafe due to self-perceived physical limitations (Wong, Smith, & Sullivan, 2015).

Duty of care: The duty of a health care professional to provide their patients with advice, care and treatment of a professional standard (Eagle & Ryan, 2014).

Executive function: The top-down cognitive processes involved in decision-making, problem-solving, concentration and attention (Diamond, 2013; Kearney, Harwood, Gladman, Lincoln, & Madus, 2013).

Hawthorne effect: A change in a person's behaviour as a result of being observed (Johnson & Danhauer, 2002).

High-income country: Gross national income per capita of more than $12 056, using the World Bank Atlas method (The World Bank, 2019).

Incident cognitive impairment: The change from not presenting with cognitive impairment to presenting with cognitive impairment over a period of time, typically one year (Stanford School of Medicine, 2004).

Incident dementia: The change from not presenting with dementia to presenting with dementia over a specific time period (Alexander, Lopes, Ricchetti-Masterson, & Yeatts, 2015).

Internal consistency: The extent to which all the items on a scale measure one construct (Heale & Twycross, 2015).

Justice: Fairness and equity across all research stages, including benefits, risks, resources and distribution of findings (Jahn, 2011).

Long-term memory: Unlimited-capacity storage of information which can be stored for long periods of time, including for life (Camina & Guell, 2017).

Low-income country: Gross national income per capita of $995 or less, using the World Bank Atlas method (The World Bank, 2019).

Lower-middle-income country: Gross national income per capita of between $996 and $3 895, using the World Bank Atlas method (The World Bank, 2019). It is similar to a low-income country in terms of health and healthcare (Druetz, 2018; Mills, 2014).

Ménière's disease: An inner ear disorder characterised by recurrent attacks of vertigo as well as hearing loss, tinnitus and aural fullness in the affected ear (Goebel, 2015).

Motor vehicle crash: One or more vehicles colliding with each other or with objects, people or animals (Stewart & Lord, 2002). The term "motor vehicle crash" will be used in this study in place of the more common term "motor vehicle accident", as the word "accident" may imply a lack of fault on the part of the person responsible for the crash (Stewart & Lord, 2002). The word “crash” is more comprehensive as it includes incidents that are accidental, negligent and intentional (Stewart & Lord, 2002). The use of the term “accident” to describe crashes has been discouraged in the last few decades and the term has been banned by the British Medical Journal due to the implications of the word “accident” (British Medical Journal, 2001; Stewart & Lord, 2002).

Non-maleficence: Ensuring that no harm comes to an individual as a result of participating in a research study (Jahn, 2011).

Older adult: A person with the chronological age of 65 years or older (World Health Organisation, 2010). Similar yet ageist terms include “senior”, “old” and “elderly”, and the use of such terms will be avoided in this work (Avers, Brown, Chui, Wong, & Lusardi, 2011).

Parkinson’s disease: A common, progressive neurodegenerative disease often characterised by the following motor symptoms: a resting tremor, rigidity in the hands and face, and reduced motor activity (Corti, Lesage, & Brice, 2011; DeMaagd & Philip, 2015). Non-motor symptoms and signs may also be present, such as cognitive and psychiatric issues (Corti et al., 2011).

Reference bias: The effect that different standards of comparison have on participants’ responses to survey questions (West, 2014).

Reliability: The general term for the consistency of an instrument in measuring a concept (Heale & Twycross, 2015).

Response bias: The general term for the tendency of a person to provide inaccurate or untruthful answers to survey questions (Lavrakas, 2008).

Short-term memory: Limited-capacity storage, able to hold a small amount of information for a short amount of time (Camina & Guell, 2017).

Social desirability bias: A person responding in a way that they deem to be more socially acceptable, either by overstating socially desirable behaviours or understating socially undesirable behaviours (Lavrakas, 2008).

Standardised Mini-Mental State Examination: A widely-used screening assessment for dementia and cognitive decline (Riendeau, Maxwell, Patterson, Weaver, & Bedard, 2016). The SMMSE was developed with clearer guidelines for scoring and administration than the Mini-Mental State Examination, which helped reduce administration time and inter-rater variance (Independent Hospital Pricing Authority, 2014).

Upper-middle-income country: Gross national income per capita of between $3 896 and $12 056, using the World Bank Atlas method (The World Bank, 2019).

Validity: The general term for the accuracy of an instrument in measuring a concept (Heale & Twycross, 2015).

Visual acuity: The sharpness or clarity of vision (Chou, Dana, Bougatsos, Grusing, & Blazina, 2016).

Glossary of Abbreviations

AA: Arrive Alive

ADSES: Adelaide Driving Self-Efficacy Scale

BPPV: Benign Paroxysmal Positional Vertigo

BVH: Bilateral Vestibular Hypofunction

DCS-D: Driving Comfort Scale (Day)

DCS-N: Driving Comfort Scale (Night)

HHIE: Hearing Handicap Inventory for the Elderly

HHIE-S: Hearing Handicap Inventory for the Elderly Screening Version

MVC: Motor Vehicle Crash

SMMSE: Standardised Mini-Mental State Examination

WHO: World Health Organisation

Abstract

Research has shown that age-related hearing loss may have profound implications on all aspects of an individual's life, including cognitive abilities. The relationship between hearing loss and cognition has led to research which indicates an association between objective hearing loss and reduced driving performance in older adults. However, little research exists on the relationship between self-perceived hearing loss and driving confidence, particularly in the South African context. The current study aimed to identify possible associations between driving confidence and hearing loss, age, sex and driving safety among older adults. Data analysis indicated a significant increase in driving confidence after one month of first-time hearing aid use. An insignificant or weak relationship was found between self-perceived hearing loss and level of driving confidence. Age, sex and a combination of both were significantly associated with level of driving confidence. No association was found between pure-tone average and level of driving confidence or between pure-tone average and driving safety. Further research in this area could assist in advising legislation relating to licensing and road safety campaigns targeted at older adults, as well as expanding audiologists' duty of care to include counselling on the potential positive effects of hearing aid use on driving confidence.

Key words: Audiology, older adults, hearing loss, driving confidence.

Chapter 1: Literature Review

Introduction

Research has shown that age-related hearing loss may have profound implications on all aspects of an individual's life, including cognitive abilities. The relationship between hearing loss and cognition has led to research which indicates an association between objective hearing loss and reduced driving performance in older adults. However, little research exists on the relationship between self-perceived hearing loss and driving confidence, particularly in the South African context. Therefore, the primary focus of this study was to examine the relationship between hearing loss and driving confidence[1] among older adults. The literature review opens with a discussion on hearing loss in older adults, followed by the association between hearing loss and cognitive decline in older adults. Next, possible factors contributing to driving performance, restriction and cessation are discussed, with a focus on hearing loss and driving performance. Driving confidence is then explored, highlighting the relationship between driving confidence and observed driving ability and between driving confidence and degree of hearing loss. The chapter concludes by highlighting the contribution that the current study makes to the existing body of research.

[1] Refer to glossary

Hearing Loss in Older Adults

Presbycusis, an age-related progressive, sensorineural hearing loss, is becoming increasingly recognised as a significant global health issue and is regarded as the most common sensory disorder in older adults[2] (Someya & Prolla, 2010). The severity of such age-related hearing loss varies; however, worldwide approximately 33% of adults over the age of 65 years have a disabling hearing loss (Chien & Lin, 2012; WHO, 2012)[3]. In adults aged 85 years and older, the percentage of hearing-impaired individuals increases to 80%, highlighting the progressive nature of presbycusis (Fetoni et al., 2010; Walling & Dickson, 2012). Typically, presbycusis is refractory to medical or surgical interventions, leaving amplification in the form of hearing aids and audiological rehabilitation as management strategies (Parham, Lin, Coelho, Sataloff, & Gates, 2013). Hearing aid use forms part of an overall aural rehabilitation programme managed by an audiologist (Makhoba & Joseph, 2016). Despite the large number of individuals with presbycusis, one of the main treatments for it is under-utilised, with only one in seven individuals experiencing presbycusis wearing a hearing aid (Chien & Lin, 2012; McCormack & Fortnum, 2013; WHO, 2012). Key factors contributing to poor uptake of amplification include the stigma of wearing hearing aids, lack of benefit from hearing aids, financial constraints and not understanding key aspects of hearing aid use, such as correct insertion (Kochkin, 2012; McCormack & Fortnum, 2013). McCormack and Fortnum (2013) therefore recommended increased counselling on hearing aid use and more regular rehabilitation sessions to improve hearing aid usage.

Most hearing-impaired individuals reside in low-income[4] and middle-income countries[5], specifically those in Sub-Saharan Africa (including South Africa), South Asia and Asia Pacific (Stevens et al., 2013; WHO, 2012). South Africa is not immune to the global ageing phenomenon and prevalence of age-related hearing loss. A population survey of 2494 individuals in Cape Town found that 29.8% of individuals over the age of 40 years and 68.9% of individuals over the age of 60 years had some degree of hearing loss (Ramma & Sebothoma, 2016). Furthermore, Louw, Swanepoel, Eikelboom and Hugo (2018), who aimed to determine hearing loss prevalence at primary health care clinics in Tshwane, found the prevalence of

[2] See Glossary.
[3] See Glossary.
[4] See Glossary.
[5] See Glossary.

hearing loss to be 44.3% among 548 individuals over the age of 40 years. Having established that hearing loss associated with ageing is a pervasive problem globally, the following section will highlight the ways in which hearing loss impacts on an individual's life, with cognitive impact being the primary focus.

Impact of hearing loss acquired in adulthood. A major concern of untreated hearing loss is that it impairs interpersonal communication, which has profound implications for all realms of life (social, emotional, cognitive and vocational) (Lin, Thorpe, Gordon-Salant, & Ferrucci, 2011). Studies have shown that hearing loss among adults is associated not only with communication difficulties, but also has negative psychological, physiological and functional implications (Amieva et al., 2015; Harada, Natelson Love, & Triebel, 2013; Lin, Thorpe, et al., 2011; Tremblay & Backer, 2016). Hearing loss has been independently associated with cognitive and functional decline, social isolation, slower gait and increased risk of falls (Amieva et al., 2015; Harada et al., 2013; Lin, Thorpe, et al., 2011; Tremblay & Backer, 2016). Social isolation linked to hearing loss may be worsened by factors which may further isolate an individual. An example of these isolating factors is lack of independent mobility, which may result from an individual's lack of driving confidence. This increased isolation may result in depression, which in turn may lead to increased cognitive decline (Lin, Thorpe, et al., 2011; Tremblay & Backer, 2016; Wayne & Johnsrude, 2015). Studies from the past decade have explored the association between hearing loss and cognitive decline (Amieva et al., 2015; Deal et al., 2016; Lin, 2011; Lin, Metter, et al., 2011; Lin et al., 2013; Wayne & Johnsrude, 2015), the findings of which are described in the following section.

The association between cognitive decline and hearing loss in older adults. Cognitive decline, including disorders such as dementia[6] and Alzheimer's disease, is prominent among older adults' health concerns, due to the increase in life expectancy (Bishop, Lu, & Yanker, 2010; Luchetti, Terracciano, Stephan, & Sutin, 2016). For example, cognitive impairments such as dementia are expected to double every 20 years, placing an immense burden on society and the health care system (Lin, Thorpe, et al., 2011). Although cognitive decline is part of the

[6] See Glossary.

normal aging process (Harada et al., 2013), it is crucial to be able to distinguish between normal and pathologic cognitive decline (Bishop et al., 2010; Harada et al., 2013).

In the last decade, the significant relationship between hearing loss and cognitive decline has gained much attention, as both are associated with communication difficulties, depression and isolation (Lin, 2011; Lin, Thorpe, et al., 2011; Tremblay & Backer, 2016; Wayne & Johnsrude, 2015). There are several methodological issues inherent in research surrounding the aging brain, such as selection bias, in which individuals with functional limitations and who are in poor health may be less likely to participate in research (Harada et al., 2013). It is likely that only healthier individuals would participate, limiting the generalisability of results (Harada et al., 2013). Participants may be misdiagnosed as cognitively normal due to the slow onset nature of dementia and Alzheimer's disease (Harada et al., 2013).

Several longitudinal studies have demonstrated the link between hearing loss and cognitive impairment (Amieva et al., 2015; Deal et al., 2016; Lin, Metter, et al., 2011; Lin et al., 2013). In two of the four studies discussed, hearing loss appeared to be significantly associated with accelerated cognitive decline in older adults (Amieva et al., 2015; Lin et al., 2013). A 55% increase in risk for dementia was noted by Deal et al. (2016) when the degree of hearing loss was moderate or severe, compared to lesser degrees of hearing loss. Adding to Deal et al.'s (2016) findings, Lin, Metter, et al. (2011) found that participants who later developed dementia had a pure-tone average decline of 0.52dB per year, compared to a 0.27dB decline in individuals who did not develop dementia. Participants with mild hearing loss[7] were significantly more likely to develop incident dementia[8] ($p=0.049$) than their normal-hearing counterparts, as well as those with moderate hearing loss[9] ($p=0.004$) and severe hearing loss[10] ($p=0.04$) (Lin, Metter, et al., 2011). The above-mentioned studies have several methodological similarities, including repeated follow-ups, long follow-up periods, the use of a sound-attenuating booth[11] for audiometric testing and the use of the WHO's definition of hearing loss (Deal et al., 2016; Lin et al., 2013). The studies' main strengths are their longitudinal design, enabling the researchers to investigate changes in hearing and cognition over an extended

[7] See Glossary.
[8] See Glossary.
[9] See Glossary.
[10] See Glossary.
[11] See Glossary.

timeframe, and the use of random sampling from the population. Despite their merits, the studies have several limitations. Lin, Metter, et al. (2011) utilised a sample comprising only volunteer participants, raising concerns regarding a possible healthy volunteer bias, in which healthier individuals from the population are more likely to participate in research (Foy, Chen, Kimmel, & Gorlova, 2011); a community-based sample would have increased the generalisability of the results. A very small number of participants were included in some of the sub-groups, such as the "severe hearing loss" group comprising only six participants, limiting generalisability (Lin, Metter, et al., 2011). Furthermore, Lin, Metter, et al. (2011) also relied on self-reported hearing aid use which may have been inaccurate, as opposed to obtaining hours of use from the hearing aid software. Similarly, Amieva et al. (2015) relied on self-reported hearing impairment rather than objectively-measured hearing abilities, the latter utilised by Lin et al. (2013) and Lin, Metter, et al. (2011).

In addition to longitudinal studies, a systematic review of the literature and subsequent meta-analyses of the study findings by Taljaard, Olaithe, Brennan-Jones, Eikelboom and Bucks (2015) examined the association between hearing impairment, hearing aids and cognition. Taljaard et al. conducted a systematic database search using PsycINFO, CINAHL, the Cochrane Library and hand-searching for unpublished studies to avoid publication bias. Thirty-three studies with a total of 4 260 participants were included. Among adults aged 37 to 78 years, normal-hearing individuals had lower rates of cognitive decline than hearing-impaired individuals, both hearing aid users and non-hearing aid users (Taljaard et al., 2015). Taljaard et al. found that hearing aid use was significantly related to reduced cognitive decline, adding to the findings that individuals with hearing aids have slower rates of cognitive decline than those with untreated hearing loss (Amieva et al., 2015). Better hearing was also associated with better cognitive processing speed, short-term and long-term memory and executive function, all of which are crucial for everyday tasks such as driving (Taljaard et al., 2015).

However, the number of studies included in some of the analyses was small, with only three studies indicating a significant difference in cognition between hearing-impaired individuals with and without hearing aids (Taljaard et al., 2015). However, there were over 200 participants between these three studies. A major limitation is that none of the studies in the systematic review were blinded, randomised control trials, which would have provided the most accurate assessment of whether hearing intervention does improve cognition (Taljaard et al., 2015). Taljaard et al. also failed to mention if any of the studies included were longitudinal or cohort studies. Overall, much of the research indicates a significant association between degree of hearing loss, decreased cognitive abilities and more rapid cognitive decline, but should be interpreted with caution due to the studies' limitations (Amieva et al., 2015; Deal et al., 2016; Lin, Metter, et al., 2011; Lin et al., 2013; Taljaard et al., 2015). Having established the relationship between age-related hearing loss and cognitive decline, it is crucial to consider the ways in which cognitive and other types of age-related decline may impact older adults' everyday functioning. Therefore, the following section will discuss the association between age-related vestibular decline, age-related hearing loss and driving.

Possible Factors Contributing to Driving Performance[12] in Older Adults

The association between age-related vestibular decline and driving. It is likely that discussing hearing loss alone in terms of its possible contribution to decreased driving performance and confidence would be an incomplete representation of the current state of knowledge. Dizziness and balance impairments are among the most common chronic issues experienced by older adults (Fernandez, Breinbauer, & Delano, 2015; Iwasaki & Yamasoba, 2015). Despite the visuo-spatial issues associated with vestibular impairments in the older population, their association with driving is typically overlooked (Bigelow & Agrawal, 2015; MacDougall, Moore, Black, Jolly, & Curthoys, 2009; Wei & Agrawal, 2009). This lack of research may be due to the intimate relationship between cochlear decline and likely vestibular decline, as it is difficult to isolate the contributions of each. As the vestibular system undergoes age-related changes, investigating the association between vestibular disorders and driving is of high importance, given our increasingly aging population and the increasing number of older drivers on the road (Fernandez et al., 2015; Iwasaki & Yamasoba, 2015; Lin & Bhattacharyya, 2012; Sivak & Schoettle, 2012). The ability to orientate oneself in space and perceive movements is essential in daily tasks such as driving, therefore damage to the vestibular system and the possibility of vertigo attacks could pose serious driving issues (von Brevern, von Stuckrad-Barre, & Fetter, 2014). Theoretically, age-related vestibular decline should not be ignored in the current, as vestibular decline may affect driving ability and safety (Dawson, Uc, Anderson, Johnson, & Rizzo, 2010). However, vestibular disorders are difficult to assess in research without sophisticated equipment, therefore such assessments have not been included in this work. This section will briefly discuss age-related vestibular decline in the context of driving while noting that vestibular decline is not the primary focus of this study.

[12] See Glossary.

In the last decade, three national surveys among thousands of older adults in the United States of America examined the relationship between vestibular disorders and driving (Lin & Bhattacharyya, 2012; Ward, Agrawal, Hoffman, Carey, & Della Santina, 2013; Wei & Agrawal, 2017). In the National Health and Nutrition Examination Surveys, Wei and Agrawal (2017) found that participants were four times more likely to report driving difficulties if they had a symptomatic vestibular disorder, such as Ménière's disease or bilateral vestibular hypofunction, compared to individuals without a vestibular disorder. Similarly, Lin and Bhattacharyya (2012) found that almost half (47.1%) of older adults aged 65 years and older who experienced dizziness in the past year reported that their balance problems prevented them from driving. The above findings indicate that vestibular disorders have functional implications, restricting affected individuals from participating in important activities such as driving, thereby affecting their quality of life (Lin & Bhattacharyya, 2012; Wei & Agrawal, 2017). These restrictions in driving have been mirrored by the opinions of some medical experts, who have recommended that individuals suffering from peripheral vestibular disorders should not be driving, either at all or only after successful rehabilitation therapy in the cases of bilateral vestibulopathy, Ménière's disease and Benign Paroxysmal Positional Vertigo (BPPV)[13] (von Brevern et al., 2014). The main weakness of the studies explored thus far is their failure to assess observed driving performance and whether observed performance may be influenced by vestibular impairment, therefore, their findings should be interpreted with caution.

The link between observed driving performance and vestibular impairment has been the focus of several research projects, with contrasting findings to the above studies on self-reported driving. MacDougall et al. (2009) conducted a cross-sectional study assessing on-road driving performance of older drivers with diagnosed bilateral vestibular loss, using the subjective evaluations of experienced specialists as well as an objective, custom-made eye movement video system. They found no significant differences in eye-head coordination, dynamic visual acuity, proficiency in lane changing, merging with traffic, parking or overall driver performance when compared with an age-matched control group (MacDougall et al., 2009). However, a considerable limitation to the study is the exceedingly small sample size of three participants in the vestibular impairment group and three participants in the control group

[13] See Glossary.

(MacDougall et al., 2009), thus restricting generalisability. Another major consideration is the recent revision of the diagnostic criteria for presbyvestibulopathy[14] and altering the definition to include mild vestibular losses typical of the normal aging process (Agrawal et al., 2019). At the time of MacDougall et al.'s study, it is possible that only more moderate or severe vestibular losses were considered, thus skewing the data.

The association between hearing loss and driving performance. Driving is considered an integral part of maintaining independence, mobility and social connections (Gabaude, Marquié, & Obriot-Claudel, 2010; MacLeod, Satariano, & Ragland, 2014). As such, driving in older age is becoming increasingly important as the proportion of older adults in society is on the rise (Gabaude et al., 2010). Sivak and Schoettle (2012) found a significant increase in the percentage of licensed older drivers in all 15 of the high-income countries[15] included in their study, including Canada, Spain, Finland and Japan. A similar trend has also been seen in low-income countries such as China (Zhao, Popovic, Ferreira, & Lu, 2007). It is vital that all drivers are aware of any factors which may impact on their driving safety and potentially pose a danger to others.

In what appears to be a novel study, Horswill et al. (2009) investigated differences in driving hazard perception time among mid-aged (35-55 years), older (65-74 years) and oldest old (75-84 years) drivers. The 140 participants were required to watch 20 minutes of video footage of driving and press a button when they saw a potential motor vehicle crash (MVC) about to occur. Horswill et al. (2009) found no difference in response time between the mid-aged and older group but found that the oldest group of drivers had significantly slower response times (Horswill et al., 2009). Slower response times would indicate that the driver is more likely to cause a MVC (Horswill et al., 2009).

Adding to the above findings, an Australian study examined the relationship between hearing loss and driving performance in 107 older drivers (Hickson, Wood, Chaparro, Lacherez, & Marszalek, 2010). Hearing loss was determined by means of objective and

[14] See Glossary.
[15] See Glossary.

subjective measures, namely pure-tone audiometry[16], speech recognition testing[17] and the Hearing Handicap Inventory for the Elderly (HHIE)[18] (Hickson et al., 2010). Driving performance was assessed by two instructors along a 5km route, assessing participants' ability to correctly identify and react to road signs and road hazards, as well as drive through pairs of cones without knocking the cones over (Hickson et al., 2010). Participants drove the route three times: once without any distractors, once with auditory distractors and once with visual distractors (Hickson et al., 2010). It was found that when driving in the presence of auditory or visual distracters, older adults with a moderate to severe hearing impairment had significantly reduced driving performance ($p=0.01$) compared to their normal-hearing and mildly hearing-impaired counterparts (Hickson et al., 2010). This reduction in driving performance would make the driver more likely to cause a MVC (Hickson et al., 2010). An advantage of the study is that it introduced the novel finding that hearing loss negatively impacts on certain aspects of driving performance (Hickson et al., 2010). Similarly, a more recent study of 500 older adults also found that adults with moderate to severe hearing impairment performed significantly worse on a driving assessment and were more at risk for a MVC than their mildly-impaired ($p<0.002$) and normal-hearing (p,0.001) counterparts (Edwards et al., 2016). The study by Edwards et al. had several advantages, such as the longitudinal study design and three-year follow up period. They used objectively-measured hearing loss and made use of the Useful Field of View test, a well-validated and reliable measure of predicting MVC risk (Edwards et al., 2016).

Due to the relationship between hearing impairment and reduced driving performance, several countries and states have placed driving restrictions on hearing-impaired drivers. For example, Spain requires drivers with a moderate or worse hearing loss to modify their vehicle to include a panoramic rear-view mirror and a lateral exterior rear-view mirror, thereby increasing visual stimuli (Ruiz, 2015). Similarly, the state of New York requires hearing-impaired drivers to modify their vehicle with full-view mirrors and/or wear a hearing aid while driving (New York State Department of Motor Vehicles, n.d.). While Australia places no restrictions on hearing-impaired private vehicle drivers, commercial drivers with a disabling hearing loss may need to wear a hearing aid while driving, renew their licenses more often and be subject to a periodic license review (Austroads, 2019). However, many hearing-impaired

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[16] See Glossary.
[17] See Glossary.
[18] See Glossary.

drivers are indirectly restricted through licensing age restrictions. While there is currently no legislation in South Africa preventing older adults or hearing-impaired adults from driving, Arrive Alive (AA) recommends that education and road safety programmes be put in place for older drivers (AA, n.d. a) and the use of hearing aids if required (AA, n.d. b). Countries such as Sweden and Norway require than drivers aged 70 and older prove their driving fitness every three years (Mitchell, 2008). In the USA, the legislation differs in each state (Claims Journal, 2012). Delaware and Connecticut place no restrictions on older drivers, Alaska requires drivers aged 70 and older to renew their license in person, and California and Arizona require regular eye examinations and written driving assessments (Claims Journal, 2012). Given the association between hearing impairment and increased risk of MVCs, it is necessary to investigate whether older drivers are aware of the factors which may impact on their driving abilities, and whether their perceptions of their driving abilities are accurate. The relationship between self-perceived and actual driving abilities will be discussed in the following section.

The association between self-perceived and observed driving performance. In an Australian study, Wood, Lacherez and Anstey (2013) compared self-reported driving ability with observed driving performance in 278 adults aged 70 to 88 years. Conditions such as driving at night, in the rain, on a highway and in unfamiliar areas were evaluated (Wood et al., 2013). Forty-seven (17.4%) participants made critical driving errors during the on-road assessment; however, none of the participants rated themselves as poor drivers (Wood et al., 2013). Notably, 98% of participants rated themselves as between “average” and “excellent”, with only 2% rating themselves as “fair” (Wood et al., 2013). Even participants who made such critical errors that the instructor had to take control of the vehicle to avoid a MVC rated their driving abilities as highly as the rest of the participants (Wood et al., 2013). These results indicate a large discrepancy between self-rated ability and observed driving ability and highlight a serious lack of insight into participants’ own driving abilities and performance (Wood et al., 2013). This mismatch between self-perceived and observed abilities is a potential hazard to safe driving, as drivers may be overconfident in their abilities (Horrey, Lesch, Mitsopoulos-Rubens, & Lee, 2015). A criticism of the study is that it failed to mention the name of the validated questionnaire used in the study. However, the on-road assessment was well-validated, and participants were marked at 148 locations along the 19.4km route (Wood et al., 2013). It is also unlikely that recall bias affected the results, as those who scored poorly on the observed assessment but rated themselves highly, were more rather than less likely to report an accident (Wood et al., 2013).

It is crucial that more research be devoted to the relationship between self-perceived and observed driving ability, as this relationship plays a role in safe driving (Horrey et al., 2015). It is also important that the situations in which older drivers lack confidence be identified so that targeted driving advice can be given. Despite the overestimation of driving abilities noted in the above study, studies have shown that older adults are more likely to restrict the amount of driving they do and the situations in which they drive as they age (Conlon et al., 2017; MacLeod et al., 2014; Siren & Meng, 2012). Therefore, the following section will explore the factors potentially leading to driving restriction and cessation among older drivers.

Possible Factors Contributing to Driving Restriction and Cessation

In general, as a person ages, they reduce their distance and speed of driving and tend to avoid certain driving situations (Conlon et al., 2017; Siren & Meng, 2012). These changes in driving behaviour may be due to the sensory and cognitive changes occurring during the aging process, as driving is a complex task involving numerous functions such as decision-making, attention, quick reaction time and visual acuity (Albert, Lotan, Weiss, & Shiftan, 2018; Dit Asse, Fabrigoule, Helmer, Laumon & Lafont, 2014). These age-related changes in driving habits are referred to as self-regulation of driving (Conlon et al., 2017; Siren & Meng, 2012; Wong et al., 2015). The factors contributing to driving self-regulation[19] and cessation have been the focus of several studies (Conlon et al., 2017; Dit Asse et al, 2014; Donorfio, D'Ambrosio, Coughlin, & Mohyde, 2008; MacLeod et al., 2014) as appropriate self-regulation may assist older drivers in driving safely for more years, thereby maintaining their independence and reducing their accident risk (Conlon et al., 2017; Wong et al., 2015). The safety of older drivers has received significant attention due to the increased number of older drivers on the road and the disproportionate fatality rate of older drivers in MVCs (AA, n.d. a; Sivak & Schoettle, 2012). South African traffic law enforcement survey results in 2018 indicated that 57 percent of motorists felt that their own and other motorists' compliance towards traffic laws and regulations was very poor or poor, increasing the risk for MVCs (AA, 2018). Bribery of authority figures is also a significant issue in South Africa; in 2017, 39% of bribes were to avoid traffic offenses (The Ethics Institute, 2017). Between January and March 2019, more than fifty drivers were arrested for attempting to bribe a police officer (Phakgadi,

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[19] See Glossary.

2019) Furthermore, recent surveys indicate that the City of Cape Town has a population of approximately 4.5 million people (World Population Review, 2019), with approximately 1.2 million registered vehicles between them (The National Traffic Information System [eNaTiS], 2019). However, there are only approximately 430 traffic officers serving the City of Cape Town, with only one-third of them (143) on duty at any one time (Sesant, 2016). This indicates that there is only one traffic officer per 31 637 Cape Town residents and 9005 vehicles at any time, which may be inadequate to ensure the safety of older drivers (eNaTiS, 2019; Sesant, 2016; Wold Population Review, 2019). Consistent with the above numbers, a recent news article indicated that the City of Cape Town is understaffed in terms of traffic officers and is aiming to increase their number of officers on the road in an effort to reduce traffic violations (Charles, 2019).

To investigate the factors contributing to driving self-regulation and cessation, Conlon et al. (2017) conducted a study among 399 Australian adults who drove at least once per week, using the Situational Avoidance Questionnaire to assess self-regulation (Conlon et al., 2017). Their findings indicated that older age, poorer general health and vision, reduced strength and flexibility, more cognitive difficulties, more negative attitudes toward driving and poorer driving confidence were associated with increased driving self-regulation (Conlon et al., 2017). Since participants were physically and cognitively high-functioning and reported few driving difficulties, it was recommended that further investigations be conducted into the factors influencing driving cessation, but with a sample of adults who self-regulate their driving to a much greater extent (Conlon et al., 2017). Similar associations were found in a longitudinal study of 1200 older adults in California (MacLeod et al., 2014). MacLeod et al. found that individuals with functional limitations such as difficulty bathing ($p=<0.05$) or walking a flight of stairs ($p=<0.01$), cognitive difficulties ($p=<0.01$), and poorer vision due to issues such as cataracts ($p=<0.1$) were at increased risk for driving cessation. The study by MacLeod et al. (2014) was one of the few studies to examine the association between physical and cognitive limitations and driving cessation longitudinally.

An association between cognitive factors and driving reduction was also found in a study conducted in France among 523 older drivers (Dit Asse et al., 2014). They found that dementia and Parkinson’s disease[20], poor visual working memory, slow cognitive processing

[20] See Glossary.

speed and severe decline in general cognitive performance played a significant role in driving restriction (Dit Asse et al., 2014). A major drawback of the study is that it only examined reductions in the number of kilometres driven and no other types of driving self-regulation, such as situational avoidance or decrease in driving frequency (Dit Asse et al., 2014). Furthermore, the study did not examine the effect of age on driving self-regulation (Dit Asse et al., 2014).

The above-mentioned studies found many differences between the driving habits of men and women (Conlon et al., 2017; Dit Asse et al., 2014; Donorfio et al., 2008). Regardless of age, men were more likely to drive more kilometres per week and drive in difficult driving situations, where women were more likely to reduce and cease driving, particularly at a younger age, and report more difficulty driving (Conlon et al., 2017; Dit Asse et al., 2014; Donorfio et al., 2008). Furthermore, Dit Asse et al. (2014) found that fear of falling and physical limitations were associated with driving restriction in women only. It is important to consider that the driving discomfort experienced by older drivers, particularly women, may not be as a result of actual poorer driving ability (Siren & Meng, 2013). Rather, it may be due to lower levels of driving confidence, as found by Meng and Siren (2015), which may lead male partners to do more driving than their female partners. If this is the case, it may lead to unnecessary and premature driving self-regulation and cessation among women, with adverse consequences such as limited independence and social isolation (Siren & Meng, 2013).

One possible explanation for reduced driving confidence among women may be sex-role stereotypes (Granié & Papafava, 2011). Among 599 pre-adolescents and adolescents, Granié and Papafava (2011) found that, even from childhood, driving is viewed as a masculine activity and men are perceived as having innate driving abilities. In contrast, women were seen as being less naturally competent at driving than men, which requires women to drive with more caution (Granié & Papafava, 2011). Therefore, driving confidence and the fundamental role it plays in appropriate or premature driving self-regulation requires further investigation, which will be reviewed in the following section.

Driving Confidence

Following on from the previous sections on driving performance and ability as well as driving restriction and cessation, this section reviews the available literature on driving confidence. First, studies examining the relationship between driving confidence and driving performance, both self-rated and observed, are discussed. Next, research which explores the relationship between degree of hearing loss and driving confidence is reviewed.

The association between driving confidence and observed driving ability. A Canadian study explored the relationship between driving confidence and observed driving performance among drivers aged 65 years and older (Riendeau et al., 2016). In part one of the study, 74 participants completed the Older and Wiser Driver Questionnaire, a 20-item self-report questionnaire focusing on health status and driving habits and underwent a 12.1km on-road driving assessment (Riendeau et al., 2016). In part two, 29 participants completed the Day and Night Driving Comfort Scales (DCS-D and DCS-N) and the Driving Habits and Intentions Questionnaire and completed a 12.1km on-road driving assessment. Both parts of the study found no relationship between levels of driving confidence and on-road driving performance (Riendeau et al., 2016). Furthermore, the results indicated a mismatch between perceived and observed driving abilities, as none of the participants rated themselves as more likely to be at risk of an MVC than others their age, despite 38 of the 74 participants (51.4%) failing the on-road assessment (Riendeau et al., 2016).

While Riendeau et al.'s (2016) study reported results consistent with previous studies, there are several methodological limitations. The sample sizes for both phases were small and convenience sampling was used, limiting the generalisability of the results (Riendeau et al., 2016). Furthermore, limited psychometric information is available for the measures used in this study, other than the DCS (Riendeau et al., 2016). However, a strength of this study is that similar results were obtained with several different driving confidence questionnaires (Riendeau et al., 2016). Other strengths include the use of a standardised, observed on-road driving assessment and the use of Standardised Mini-Mental State Examination (SMMSE)[21] to screen for cognitive impairment (Riendeau et al., 2016), which has a sensitivity of 87% and a specificity of 82% (Malloy et al., 1997).

In another investigation of the relationship between driving confidence and observed driving performance, Sullivan, Smith, Lurie-Beck and Horswill (2015) found similar results to Riendeau et al. (2016) in an Australian population. Among the 98 older adults in the study,

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[21] See Glossary.

participants generally rated themselves as better drivers than their fellow participants and also rated themselves as better drivers than the average Brisbane driver (Sullivan et al., 2015), an example of the better-than-average effect[22] (Kim et al., 2017). Furthermore, age was strongly correlated to reaction time ($p=<0.001$), indicating that hazard perception abilities decline with age (Sullivan et al., 2015). Weak correlations were found between perceptions of driving ability and observed driving performance, adding to the findings that older adults may have inaccurate perceptions of their own abilities (Sullivan et al., 2015).

Furthermore, research examining the relationships between driving confidence, self-perceived ability, observed ability and driving cessation indicates that older drivers restrict or cease driving based largely on their self-perceived ability and confidence, rather than their true driving ability (Sullivan et al., 2015; Wood et al., 2013). However, multiple studies have shown weak relationships between observed and perceived driving abilities, between confidence and observed abilities, and between ability and likelihood of driving restriction (Riendeau et al., 2016; Sullivan et al., 2015; Wood et al., 2013). These results indicate that older drivers' perceptions of their driving abilities are inaccurate and suggest that a lack of confidence is an inadequate reason to restrict driving, as lack of confidence may not stem from lack of true ability (Sullivan et al., 2015). Alternatively, as previously mentioned, an overestimation of one's driving abilities may also lead to unsafe driving behaviour (Horrey et al., 2015).

The association between driving confidence and degree of hearing loss. At present, extremely limited research exists on the potential influence of degree of hearing loss on driving confidence. A recent Swedish study among 109 drivers aged 60 years and older introduced some novel findings (Thorslund et al., 2019). Hearing loss was determined according to a 4-frequency PTA and according to performance on a Speech in Noise test with the use of bilateral hearing aids (Thorslund et al., 2019). Driving confidence was assessed using a Likert scale to rate driving confidence in fourteen driving scenarios (Thorslund et al., 2019). Thorslund et al. (2019) found a strong association between objective and subjective measures of hearing loss, indicating that older adults are aware of their hearing abilities to an extent. Better aided performance on the Speech in Noise test was significantly associated with higher levels of driving comfort in several situations, including at intersections with no traffic lights, driving alone, in rush-hour traffic and with an emergency vehicle present on the road (Thorslund et al.,

[22] See Glossary.

2019). Interestingly, pure-tone average (PTA) was not significantly related to driving confidence (Thorslund et al., 2019). Thorslund et al. (2019) also found a significant correlation between hearing aid use while driving and self-reported hearing aid benefit, indicating that those who reported the most benefit from their hearing aids used them the most for driving. Despite this correlation, only 49% of the study's participants wore hearing aids, and only 57% of the hearing aid users wore them while driving (Thorslund et al., 2019). However, these results must be interpreted with caution due to the small sample size and the use of unknown questionnaire, possibly created by the researchers. Another limitation is the fact that the study did not compare driving confidence scores with and without the use of a hearing aid. Given the limited research, it is vital that further investigations into the relationship between degree of hearing loss and driving confidence be conducted.

Conclusion

Recent research has shown that age-related hearing loss has profound implications on all aspects of an individual's life, including cognitive abilities (Deal et al., 2016; Lin, Thorpe, et al., 2011; Lin, Metter, et al., 2011). Numerous studies over the past decade have indicated an association between poorer hearing, increased prevalence of cognitive impairment and a higher rate of cognitive decline (Amieva et al., 2015; Deal et al., 2016; Lin, 2011; Lin et al., 2013). However, the above studies had several limitations between them. Limitations included small sample sizes (Lin, Metter, et al., 2011; Taljaard et al., 2015), lack of objective hearing assessments (Amieva et al., 2015) and lack of blinded, randomised control trials (Taljaard et al., 2015). With the relationship between hearing loss and cognitive abilities in mind, several studies have found associations between hearing loss and reduced driving performance and confidence (Hickson et al., 2010; Riendeau et al., 2016; Thorslund et al., 2019; Tremblay & Backer, 2016; Wood et al., 2013). Limitations of these studies include small sample sizes (Riendeau et al., 2016; Thorslund et al., 2019) and the use of unnamed or uncommon tools to measure self-rated confidence and driving abilities (Riendeau et al., 2016; Wood et al., 2013). Furthermore, some research has pointed to a mismatch between perceived and observed driving performance, with older drivers feeling disproportionately confident about their driving abilities when compared to their actual driving performance (Sullivan et al., 2011; Wood et al., 2013). In contrast, some older drivers, particularly women, lack confidence to the point where they prematurely cease driving, despite being capable of driving safely (Conlon et al., 2017; MacLeod et al., 2014). Despite all these associations, limited research exists on the relationship between age-related hearing loss in older adults and levels of driving confidence, particularly in the South African context. As there appears to be an association between hearing impairment and driving confidence (Thorslund et al., 2019), it is crucial that further research be conducted on this topic as the findings may have important implications for safe driving behaviour among older adults. Further research could advise legislation relating to licensing and driving for older adults. For the above reasons, the current study will aim to fill the gap in the literature by examining the influential factors in driving confidence among hearing-impaired older adults in a South African context.

Chapter 2: Methodology

Introduction

This chapter begins with a brief overview of the study's aims and objectives. Next, each aim and its objectives are described in more detail, including the research design and procedure. The chapter concludes with a discussion of the data management, data analysis, reliability, validity and ethical considerations relating to the study.

Aims and Objectives

The aim of the study is two-fold, as described below:

Aim 1: To adapt two existing driving confidence scales for use in the South African context.

Objective 1: To subject two existing driving confidence scales, the Adelaide Driving Self-Efficacy Scale (ADSES [Appendix A]) and the Day scale of the Driving Comfort Scales (DCS-D [Appendix B]), for review and collation using the e-Delphi consensus technique.

Aim 2: To determine possible associations between driving confidence and hearing loss, age, sex and driving safety among adults aged 65 to 85 years in Cape Town.

In a population of older adults presenting for evaluation of possible hearing loss, the objectives were:

Objective 1: To evaluate the potential influence of hearing loss on driving confidence.
Objective 2: To explore possible correlations between age, sex, and a combination of age plus sex and level of driving confidence.
Objective 3: To examine potential relationships between level of hearing impairment and driving safety as defined by number of MVCs and traffic violations.
Objective 4: Using pre-test and post-test measures, to evaluate for any change in driving confidence after the use of a hearing aid/s for a period of one month, in individuals fitted with amplification for the first time.

Different designs were used to answer the study's aims and thus will be described separately.

Aim 1: To adapt two existing driving confidence scales for use in the South African context.

Research design. A quantitative approach was employed for Aim 1. This aim's purpose was to collate the opinions of panel members by assessing how many panel members gave similar feedback and opinions about each question (Pathak, Jena, & Kalra, 2013; Yilmaz, 2013). Therefore, a descriptive approach was most appropriate. More specifically, the e-Delphi

Consensus technique (Avella, 2016) was used to evaluate and adapt the clarity, relevance and completeness of the ADSES and the DCS-D for the South African context. The e-Delphi technique makes use of a panel of experts who provide feedback on a topic over a series of rounds, with the aim of reaching consensus (Avella, 2016). The e-Delphi technique does not require the panel to meet face-to-face, eliminating travel time and travel costs and allowing participation of individuals who do not reside in the same city as the researcher (Avella, 2016; Donohoe, Stellefson, & Tennant, 2013). Furthermore, participants can share their opinions without the effects of group dynamics, reducing potential inaccuracy caused by manipulation (Donohoe et al., 2013; Yousuf, 2007). Another advantage is flexibility, as participants can work on and submit their responses at a place and time that is convenient for them (Avella, 2016; Donohoe et al., 2013). A potential disadvantage is the need for internet access; however, all panel members had internet access either at home or at work (Donohoe et al., 2013).

Participants. The panel consisted of lay and expert individuals working in the fields of audiology, older adults, driving instruction or road traffic safety. Included in the panel were:

- A representative from PROBUS (Professional and Business), an association for retired individuals.
- An audiologist who works with adults ≥65 years.
- A physiotherapist whose expertise includes rehabilitating adults back into driving.
- A geriatrician who works with adults ≥65 years.
- A driving instructor.

Sampling strategy. A non-probability, purposive sampling method was used to select the panel, as has been done in similar studies (Barker, Munro, & de Lusignan, 2015; Hogan, Scialfa, & Caird, 2014; Mahoney et al., 2017). Purposive sampling was appropriate as panel members had to be knowledgeable in their field. Potential participants were contacted via email (Appendix C) to request participation in the study.

Sample size. The panel consisted of five participants. There is no agreement regarding an optimal sample size when using the Delphi technique (Akins, Tolson, & Cole, 2005). As the purpose of this panel was to contextualise and combine two already validated questionnaires rather than develop new knowledge, a small sample size was selected.

Selection criteria.

Inclusion criteria

- Participants needed to be working and have at least 10 years' experience in their field, as this is considered highly experienced (Barker et al., 2015; Horswill, Taylor, Newnam, Wetton, & Hill, 2013; Wallis, Burns, & Capdevilla, 2009).
- Participants needed to work regularly with individuals over the age of 65 years, as this age group was the focus of the study.
- Participants needed to be proficient in English, as the driving confidence scales that they analysed were in English. This was assessed by asking participants if English was their home language, and if not, if they felt that they were fluent in English.
- Participants needed to have internet access, as the survey was distributed via email.

Participant recruitment.

- Potential participants were found in several different ways. The PROBUS representative was recommended by PROBUS Western Cape, after the researcher contacted them. The geriatrician, audiologist and driving instructor were found after an online search for individuals in those professions in Cape Town. The physiotherapist was recommended to the researcher by her co-supervisor.
- Potential participants were contacted via email to request participation.
- The researcher briefly outlined the study and asked whether they would be interested in participating or would like to know more about the study.
- If the person declined, they were thanked for their time.
- If they were interested in participating, the researcher sent them the information sheet (Appendix D) and the informed consent sheet (Appendix E) via email to sign. They then became a participant.

Data collection procedure. The Delphi survey took place online to ensure that participants participated anonymously to other panel members (Barker et al., 2015; Bishop et al., 2015). The convenience of online participation may have helped improve recruitment and retention rates (Barker et al., 2015; Bishop et al, 2015). The procedure summarised in Figure 2 is based on the procedures described by Avella (2016), Bishop et al. (2015), Hsu and Sandford (2007), and Mahoney et al. (2017).

Round 1
Participants reviewed each question on the ADSES and DCS-D by answering several questions:

1. Is this question relevant to driving in South Africa?
2. Could this question be more appropriately phrased for the South African context? If so, please rephrase the question.
3. Is this question clear? If not, please rephrase the question.
4. Are there any other questions that should be added into this questionnaire? If so, please list the additional question/s below.

↓

Researcher reviewed feedback and made changes to questions

↓

Round 2
Participants stated whether they agreed with each change and why

↓

If 80% agreement was reached, the change was made

↓

Round 3
Participants reviewed questions on which consensus could not be reached previously and stated whether the change should be made

↓

If 80% agreement was reached, the change was made

Figure 2. Procedure for the Delphi Consensus Panel

Round 1

Participants were given the ADSES (George, Clark, & Crotty, 2007) and DCS-D (Myers, Paradis, & Blanchard, 2008). They were asked to review each question on the questionnaire by answering several questions on a form created by the researcher (Appendix F). Participants were asked whether they thought each question was clear, appropriately phrased for the South African context and relevant to driving in South Africa, and to expand on their answers where appropriate. The researcher reviewed all the participants' feedback and made the changes recommended by the panel.

Round 2

Participants were presented with the questionnaire with the changes made apparent. Participants were required to state whether they agreed with the changes posed by other individuals (Avella, 2016; Hsu & Sandford, 2007; Mahoney et al., 2017). Changes to the questionnaire were only made in cases where 80% consensus was reached (Barker et al., 2015; Bishop et al., 2015; Hogan et al., 2014; Mahoney et al., 2017).

Round 3

In the final round, items on which agreement could not be reached previously were returned to the panel (Avella, 2016; Hsu & Sandford, 2007; Mahoney et al., 2017). Only if 80% consensus was achieved was the relevant change made to the questionnaire (Barker et al., 2015; Bishop et al., 2015; Hogan et al., 2014; Mahoney et al., 2017). Participants had two weeks to submit their responses after each round (Barker et al., 2015).

Data collection materials.

Adelaide Driving Self-Efficacy Scale. The ADSES consists of 12 questions relating to driving in different scenarios (George et al., 2007). Driving confidence in each scenario is rated on a Likert scale from 1 to 10, where 1 is not confident at all and 10 is completely confident (George et al., 2007).

Day Driving Comfort Scale. The DCS-D also makes use of a Likert scale (Myers et al., 2008). It consists of 17 questions and likely takes only a few minutes to complete, as it takes approximately 6 minutes to complete both the DCS-D and DCS-N (Myers et al., 2008).

Participant question form. This form was created by the researcher to gain an understanding of each panel member's opinion on each of the questions in the ADSES and DCS-D. The form consisted of four "yes/no" questions, with space for participants to expand on each of their answers by rephrasing or adding additional questions.

Aim 2: To evaluate predetermined factors which could potentially influence driving confidence among adults aged 65 to 85 years in Cape Town.

Research design. A quantitative, descriptive, cross-sectional survey design was used for objectives one to three, and a repeated measures design after one month for objective four. The study aimed to show trends and correlations between variables without establishing causal relationships. Therefore, a quantitative, descriptive design was most suitable (Babbie, 2016). Cross-sectional studies have the benefit of typically being inexpensive, and multiple outcomes and factors can be assessed in one study (Levin, 2006; Sedgwick, 2014). Limitations include the fact that cross-sectional studies are conducted at only one point in time and therefore cannot indicate a sequence of events (Levin, 2006). Therefore, only associations can be made, and causality cannot be inferred (Levin, 2006; Sedgwick, 2014). Disadvantages include the lack of contextual information to help interpret the findings, which is compounded by the often inflexible tools or assessments used in studies (Denscombe, 2010). Small sample sizes may compromise the reliability and accuracy of findings; therefore a disadvantage may be the requirement of a large sample (Denscombe, 2010).

Surveys have many benefits, with the main advantages being time-efficiency and cost-efficiency (Denscombe, 2010; Rice, Winter, Doherty, & Milner, 2017). Large amounts of data can be easily obtained with limited time, materials and money (Denscombe, 2010). Limitations include typically low response rates, as surveys are often ignored if not presented face-to-face (Denscombe, 2010; Rice et al., 2017). Data obtained from surveys often lack depth, particularly when a quantitative design is used (Denscombe, 2010). Furthermore, participants may forget or choose not to answer every question on the survey, rendering it incomplete and potentially not usable for data analysis.

Participants.

Study setting. The settings were the Gardens, Century City and Sea Point branches of Cape Hearing Aids and the Cape Gate branch of Kind2Hearing. All are audiology private practice facilities in Cape Town which focus on providing hearing aids to hearing-impaired adults.

Sampling strategy. A non-probability, purposive sampling method was used, as the target sample was clearly defined and participants shared several common factors (Etikan, Musa, & Elkassim, 2016).

Recruitment. When booking an appointment, the receptionist informed the patient of the audiologist's study and that they may be asked to participate. Patients were informed that participation is optional and that the study is not linked to the practice or their appointment. Interested individuals were given the option to provide their email address. Information letters (Appendix G) were emailed or, more commonly, provided at the practice. A poster advertising the study was displayed in the waiting room of the practices (Appendix H), allowing interested individuals to approach staff for more information.

Sample size. Using the recommended confidence interval of 95% and a margin of error of 5% (Wilson van Voorhis & Morgan, 2007), online calculators suggested a sample size of 377 participants (FluidSurveys Team, 2014; Qualtrics, 2010; Raosoft, n.d.). However, given the time limitations of this study, a sample size of 377 participants was not realistically achievable. When the margin of error was increased from 5% to 7%, the required sample size decreased to 195 (Raosoft, n.d.), which is comparable to the relatively small sample sizes of 154, 119 and 107 participants used in similar studies (Freund, Gravenstein, Ferris, Burke, & Shaheen, 2005; Hickson et al., 2010; McNamara, Ratcliffe, & George, 2014). Therefore, the sample size for this study was 195. The increased margin of error was noted as a limitation to this study as it reduces the validity of the results (Faber & Fonseca, 2014).

Selection criteria.

Inclusion criteria.

- Individuals between the ages of 65 and 85 years, as 65 years is typically when people are classified as "older adults" and this age group has been used in similar studies (Freund et al., 2005; Hickson et al., 2010; Ji et al., 2011). The age of 85 years was selected as the upper age limit for two reasons. Firstly, very few patients seen at the private practices were over the age of 85 years. Secondly, there may be a vast difference in terms of physical health and cognition between an 85-year-old individual and a 95-year-old individual (Boscoe, 2008). Therefore, an upper age limit was included as opposed to having an "80 years and older" category.

- Individuals with a bilateral hearing loss acquired in adulthood, as is typical of presbyacusis (Fetoni et al., 2010).
- Individuals who drove at least once per week, as this criterion was used for similar studies (Conlon et al., 2017; Hickson et al., 2010).
- Individuals who were proficient in English, as determined by the patient's ability to understand and carry out the instructions for the hearing assessment as well as their self-rated English proficiency on the demographics questionnaire (Appendix I).
- Individuals who could self-administer the questionnaire.
- Individuals who had not previously worn a hearing aid/s.
- For the one-month post-test measure, participants who were first-time hearing aid users who had been fitted with amplification devices since first completing the questionnaires, needed to have worn their hearing aid/s for at least eight hours per day, as this was deemed to be a reasonably good amount of use (Iwahashi, Jardim, & Bento, 2013; Perez & Edmonds, 2012; Smith, Mack, & Davis, 2008). Hours of use were checked on the usage log on the hearing aid software.

Exclusion Criteria.

- Individuals with a potential cognitive impairment as they were considered a vulnerable group (Prusaczyk, Cherney, Carpenter, & DuBois, 2017), as determined by a score of <3 out of 5 on the Mini-Cog (Appendix J).

Data collection procedure.

- Once ethical approval was granted by the Faculty of Health Sciences Human Research Ethics Committee (Reference HREC 497/2018, see Appendix K), permission to request patients' participation in the study was obtained from the respective owners of Cape Hearing Aids and Kind2Hearing (Appendix L).
- The patient arrived for their appointment having already been informed of the study by the receptionist.
- They were asked by the receptionist if they would like to participate in the study.
- If they did not receive the information sheet electronically after booking their appointment, they were given a hard copy.
- The patient attended their appointment with the audiologist.

- At the end of the appointment, the audiologist thanked the patient and the appointment was terminated.
- The audiologist then asked the patient if they received the information sheet and whether they would like to participate in the study.
- If the patient chose not to participate, they were thanked and the session was terminated as per normal practice procedures.
- If they chose to participate, they were given an informed consent sheet (Appendix M) to sign and they were given the opportunity to ask questions about the study. Once they gave informed consent, they became a participant.
- The participant completed the Mini-Cog.
- If they failed the Mini-Cog, they were told that they did not pass a memory test, which is not something to be concerned about due to the screening nature of the instrument but should be mentioned to their doctor. They were given a referral letter (Appendix N) and excluded from further participation. If the participant expressed concern about failing the Mini-Cog and had further questions about it, the researcher explained that the Mini-Cog is only a screening test and that it is best that a doctor provides further information and possible further testing.
- If the participant passed the Mini-Cog, they completed the demographics questionnaire and the Hearing Handicap Inventory for the Elderly Screening Version (HHIE-S [Appendix O]) and the driving confidence questionnaire (Appendix P).
- If the patient was fitted with a hearing aid/s during the study, they were asked to repeat the driving confidence questionnaire in one month, either at their follow-up appointment or via email.
- Questionnaires in which one or more questions were not answered were deemed incomplete and that participant was excluded from the study.

Data collection materials.

HHIE-S. The HHIE-S is a widely accepted screening tool for recognising hearing handicap among older adults (Weinstein, 1989, as cited in Gates, Murphy, Rees, & Fraher, 2003). It consists of 10 items which must each be answered as “yes”, “sometimes” or “no” (Gates et al., 2003). While some studies have shown a correlation between objective and subjective hearing loss, including the HHIE-S (Arnold et al., 2018; Pierre, Johnson, & Fridberger, 2015; Thorslund et al., 2019), others have indicated that HHIE-S scores do not always correlate with PTAs due to denial or too much concern about their hearing loss (Gates et al, 2003). Therefore it was important that a patient-orientated outcome measure be included to assess participants' self-perceived hearing handicap.

Self-assessment of driving confidence scale. The scale used in this study was a combination of the ADSES (George et al., 2007) and DCS-D (Myers et al., 2008). Some items on the ADSES are not included in the DCS-D and vice versa, therefore a combination of both scales was used according to the expert panel's recommendations in Aim 1.

Mini-Cog. The Mini-Cog is a widely used screening tool for cognitive impairment (Doerflinger, 2013; Ismail, Rajji, & Shulman, 2010). It consists of a 3-word recall task and a clock drawing task, and takes 3-4 minutes to complete (Ismail et al., 2010; Li, Dai, Zhao, Liu, & Li, 2018; Milian et al., 2012). Given its short completion time and superior characteristics compared to other tools, the Mini-Cog is considered a highly useful tool in screening for cognitive impairment (Li et al., 2018; Yang et al., 2016). The Mini-Cog was used in the study to exclude potentially cognitively impaired individuals, who are regarded as a vulnerable group (Prusaczyk et al., 2017).

Demographics questionnaire. Participants were asked to rate their English proficiency, provide their age and sex, and answer several questions relating to their recent history MVCs and traffic violations. These questions asked participants how many times they had been pulled over by a traffic officer, been in a collision or near-collision involving another vehicle, bumped or dented their own or someone else's car, or received a parking or speeding ticket in the last year.

Data Management.

All data were stored in password-protected files on an external hard-drive and a copy of the data was stored on Dropbox, a secure online storage system. Windows Defender and McAfee Live Safe antivirus systems were installed on the researcher's laptop. The hard-drive was kept in a locked drawer at the researcher's residence. Data were entered into an Excel spreadsheet. To ensure accuracy of data capturing, 10% of the data was randomly selected and re-entered. Double entry of data has been found to be superior to other data checking methods, namely reading aloud and visual checking (Barchard & Verenikina, 2013). According to

Macdonald (2018), data entered must be at least 99.7% accurate to ensure that accurate conclusions are drawn from the data. If there was less than 99.7% accuracy in the randomly selected data, all data would have needed to be re-entered and checked. Hard copies of completed questionnaires as well as electronic data will be kept for 5 years after the completion of this study, as recommended by the University of Cape Town's Human Research Ethics Committee.

No person outside of this study has had or will have access to the raw data or participants' particulars. Each participant was assigned a participant code according to their sex and which Cape Hearing Aids or Kind2Hearing branch they attended, e.g. the first male participant at the Gardens branch was coded as MG001. Coded patient identities ensured that patient information and responses remained confidential. Names and participant codes of participants who were fitted with hearing aids were entered into a separate register that only the researcher may access, as those participants were asked to fill in the driving confidence questionnaire again after a month.

Participants were classified into two main categories according to their PTA, namely "non-disabling hearing loss" and "disabling hearing loss". This method was chosen because it was difficult to find many participants over the age of 65 with normal hearing. Moreover, participants likely requested an audiologic assessment as hearing loss was been suspected or perceived. The "disabling hearing loss" group was further split into "moderate loss", "moderately-severe loss", "severe loss" and "profound loss". The right and left ears' PTAs were averaged, as this study was interested in each participant's overall hearing acuity rather than ear-specific hearing loss. In terms of audiological management, i.e. hearing aid selection and programming, each ear is treated separately. Using an average of both ears may have obscured the impact of several asymmetrical hearing loss included in the study; however, given the symmetrical nature of presbycusis, the vast majority of participants' hearing losses were symmetrical.

PTAs were calculated using a four-frequency PTA which includes 4KHz rather than the traditional three-frequency PTA of 500Hz, 1000Hz and 2000Hz, as 4KHz was included in a similar study (Thorslund et al., 2019). High-frequency hearing loss is also a marker of presbyacusis and therefore excluding 4KHz may lead to an inaccurate PTA (Arvin, Prepageran, & Raman, 2013). Participants were also classified according to the HHIE-S into the category "no handicap", mild-moderate handicap" or "severe handicap" (Gates et al., 2003). Participants were also split into age groups of 65-69 years, 70-74 years, 75-79 years and 80-85 years, as these groupings have been used in other studies focusing on older drivers (Braitman & McCartt, 2008; Dit Asse et al., 2014).

Data Analysis.

Microsoft Excel was used to analyse the data. First, normal quantile plots were used to determine whether the data were normally distributed. All data were found to be normally distributed, therefore parametric statistics were selected. Descriptive statistics were used to determine measures of central tendency (mean, median and mode) of participants' age, objective hearing loss, self-perceived hearing handicap, MVCs and traffic violations, and level of driving confidence. Intraclass Correlation Coefficient (ICC) indicated moderate reliability (Koo & Li, 2016 [ICC=0.52]). Measures of statistical dispersion were used to determine the range, standard deviation and variance of participants' age, objective hearing loss, self-perceived hearing handicap, MVCs and traffic violations, and level of driving confidence. Finally, linear regression analysis was used to analyse relationships between variables. Regression analysis was also used to analyse the relationship between level of driving confidence and self-perceived hearing handicap, as well as the relationship between level of driving confidence and severity of hearing loss according to the PTA. In the following chapter, data will be represented in tables and/or graph format where applicable.

Reliability and validity

Previous research has found the ADSES to have a high degree of internal consistency, as Cronbach's Alpha coefficient was α=.098 and remained the same even when items were removed from the questionnaire (George et al., 2007). Criterion validity was also found to be high (George et al., 2007). The same research found a significant correlation between participants who scored high on the ADSES and who passed an on-road driving test, and those who scored lower on the ADSES and failed the driving test (George et al., 2007).

Rasch analysis in a previous study found the DCS-D to have good item reliability (0.98) and good internal consistency, with Cronbach's Alpha coefficient being α=0.92 (Myers et al., 2008). Test-retest reliability was adequate for the DCS-D (ICC=0.7) and there was a significant association between scores on the scale and self-reported abilities, driving frequency and situational avoidance (Myers et al., 2008). Content validity for the current study was ensured by having an expert panel assess and improve the clarity, relevance and completeness of the ADSES (George et al., 2007) and DCS-D (Myers et al., 2008) as a combined questionnaire. The HHIE has been found to have high reliability in assessing the impact of hearing loss on quality of life (Cronbach's alpha coefficient being α=0.91, Spearman-Brown coefficient=0.90 and intra-class correlation coefficient [ICC]=0.85) (Tomioka et al., 2013).

A main threat to the reliability of this study is bias. In the first part of the study, researcher bias may have occurred, as the way the questions were phrased and who was invited to participate in the panel may have led to bias (Avella, 2016). Potential biases may have existed in the second part of the study as well. To appear more competent as a driver, participants may have under-reported driving difficulties. The researcher attempted to combat social desirability bias[23] and the Hawthorne effect[24] by assuring participants that there were no correct or incorrect answers to the questions, and that they should try to answer as honestly as possible. The researcher attempted to combat central tendency bias[25] by encouraging participants to think carefully before responding and not withhold information, while reassuring them that their answers were anonymous and could not be used to their detriment. Healthy volunteer bias may have also been operant in the study. This means that only a subset of the population was sampled, limiting the generalisability of results (Salkind, 2010). The better-than-average effect[26] (Kim et al., 2017) may have also skewed the data, possibly leading to participants rating their hearing and driving confidence more highly than what it is. The above-mentioned biases may all lead to inaccurate data and limited generalisability of results.

Ethical Considerations

The researcher ensured that the ethical considerations of autonomy, beneficence, non-maleficence and justice were honoured in each stage of this study. Confidentiality is of utmost importance and was ensured across all stages of research. The study was designed and executed in accordance with the Declaration of Helsinki (World Medical Association, 2013), the Global Code of Conduct for Research in Resource-Poor Settings (TRUST project, 2018) and the Singapore Statement on Research Integrity (Stenek & Meyer, 2010; Appendix Q).

Autonomy

Individuals must have a comprehensive understanding of what is expected of them if

[23] See Glossary.
[24] See Glossary.
[25] See Glossary.
[26] See Glossary.

they choose to participate in research in order to give voluntary informed consent (Jahn, 2011). To ensure autonomy, an information letter detailing the study's purpose was given to all patients at the private practices who were potential participants. This letter included that patients from the private practices may withdraw from the study at any time with no repercussions. Only patients who passed the Mini-Cog became participants, ensuring that all the potentially hearing-impaired participants had the cognitive capacity to fully consent. The Mini-Cog was used due to many of the participants being of older age and therefore at risk of cognitive impairment (Prusaczyk et al., 2017).

To ensure that patients were not being coerced and were consenting freely, a poster outlining the study was displayed in the waiting rooms of the practices. The receptionist alerted the patients to the poster and if they wanted more information, the receptionist provided them with the information sheet. The receptionist informed the patients that the study was not linked to the practice or to the patient's appointment. Once the consultation had been terminated and the patient thanked, the researcher reminded them about the study and asked if they would like to participate. This way, the patient was not unduly pressured. The researcher made the roles of the audiologist and researcher clear to potential participants to avoid confusion and reiterated to participants that the study was not linked to their appointment.

Beneficence

Participants received a token of appreciation for their participation, namely a R100 Woolworths voucher for panel participants and a pen and notepad for all other participants. These tokens are well within the good practice guidelines for participation in research studies in South Africa (Department of Health, 2019). The socio-economic status of all participants was such that these gifts would not induce participation. There were no other direct benefits to participants in this study. Indirect benefits included the opportunity to contribute data to an area of research that is particularly limited in South Africa. This research could potentially help inform the counselling audiologists give to hearing-impaired individuals regarding the ways in which hearing loss impacts one's life.

Non-maleficence

The details of participation were made clear in the information sheet given to participants, thereby ruling out any deception. Participant responses were kept confidential and their personal information not divulged to anyone outside of the study. There were no appreciable risks to participants in this study and the risk/benefit ratio was favourable.

Justice

To ensure that justice was upheld, study participants were selected fairly. No potential participant was excluded on the grounds of gender, ethnicity or religious convictions. However, due to the driving confidence questionnaire being in English, only individuals who are proficient in English were included. The majority of patients who attended appointments at Cape Hearing Aids were first language English speakers. The researcher changed employment to another private practice, Kind2Hearing, only after starting data collection. Although most of the patients attending Kind2Hearing were first language Afrikaans speakers, most were proficient and easily able to converse in English. The questionnaire being in English was noted by the researcher as not being a barrier, therefore the questionnaire was not translated into Afrikaans.

Confidentiality

Procedures to ensure confidentiality are outlined under the data management section (pp. 31-32).

Chapter 3: Results

Overview of the Chapter

In this chapter, the results will be described in correspondence with the aims and objectives of this study.

Aim 1: The adaption of two existing driving confidence scales for use in the South African context.

Objective 1: To subject two existing driving confidence scales, the ADSES and the DCS-D, for review and collation using the e-Delphi consensus technique. All the potential panel members approached, as laid out in the methodology section, agreed to be panel members. Panel members' suggestions of alternative phrasing and additional questions can be seen in Table 1. The panellists collectively suggested changes to 24 of the 29 original questions (83%) from the ADSES and DCS-D.

Table 1. Original and alternative question phrasings in round one.

Original questions from ADSES and DCS-D	**Alternative question phrasings/ recommendations for changes**	**Rationale given for phrasing change**
1. Driving in your local area?	None	None
2. Driving in heavy traffic?	One panellist suggested: Driving in rush-hour traffic?	None
3. Driving in unfamiliar areas?	One panellist suggested: Driving in new or unfamiliar areas?	None
4. Driving at night?	None	None
5. Driving with people in the car?	Four panellists suggested: Driving with passengers in the car?	"Driving with people in the car" may be ambiguous, therefore using the term "passengers" instead of "people" would be clearer.
6. Responding to road signs/traffic signals?	One panellist suggested: Understanding and reacting to road signs/traffic signals?	None
7. Driving around a roundabout?	Three panellists suggested: Driving around a traffic circle?	In South Africa we use the term "traffic circle" instead of "roundabout".
8. Attempting to merge with traffic?	One panellist suggested: Attempting to merge into traffic?	None
9. Turning right across oncoming traffic?	One panellist suggested: Turning right into a busy intersection?	None
10. Planning travel to a new destination?	One panellist suggested: Planning a road trip to a new place? One panellist suggested: Planning a route to a new destination?	None

11. Driving in high speed areas?	Two panellists suggested: Driving on the freeway at the national speed limit (120 km/h)? One panellist suggested: Driving in a 120km/h zone?	In South Africa, the national speed limit is 120km/h.
12. Parallel parking?	One panellist suggested: Doing parallel parking?	None
13. Driving in light rain?	One panellist suggested: Driving when it is drizzling?	None
14. Driving in heavy rain?	None	None
15. Driving in winter conditions (snow, ice)?	One panellist suggested: Driving in severe winter conditions such as snow – if this is applicable to the area where you reside? One panellist suggested: Driving in extreme weather conditions (snow, ice, fog or mist)? One panellist suggested: Remove this question altogether.	This question is not relevant to driving in Cape Town as we don't experience snow and ice.
16. Driving when there is glare or reflection from the sun?	None	None
17. Driving when caught in an unexpected or sudden storm?	Remove this question altogether.	This question is much the same as driving in heavy rain.
18. Driving in unfamiliar routes (different areas), detours or sign changes?	Driving in unfamiliar routes where road signs or traffic signals have been damaged or stolen? One panellist suggested: Driving on unfamiliar routes with detours or sign changes or in new areas?	None
19. Making a left hand turn with no lights or stop signs?	Two panellists suggested: Making a right-hand turn with no lights or stop signs?	In South Africa we drive on the left side of the road, therefore to cross an intersection we make a right-hand turn, not a left-hand turn. In South Africa, we use the term "robot" instead of "light".
20. Completing a left hand turn on a yellow or red light when already mid-intersection?	Two panellists suggested: Completing a right hand turn on a yellow or red robot when already mid-intersection?	

	One panellist suggested: Completing a right-hand turn when the robot turns yellow or red?	
21. Pulling in or backing up from tight spots in parking lots with large vehicles on either side?	One panellist suggested: Pulling in or reversing out of tight spots in parking lots with large vehicles on either side? One panellist suggested: Pulling in or reversing from tight parking spaces in parking lots with large vehicles on either side?	In South Africa, we use the term "reversing", not "backing up".
22. Seeing street or exit signs with little warning?	One panellist suggested: When you suddenly see and need to react to off-ramp signs and street signs unexpectedly?	None
23. Driving on 2-lane highways?	One panellist suggested: Driving on 2-lane highways/freeways?	None
24. Keeping up with the flow of highway traffic when the flow is over the posted speed limit of 100km/h?	Two panellists suggested: Keeping up with the flow of highway/freeway traffic when the flow is over the speed limit of 120km/h?	In South Africa, our national speed limit is 120km/h, therefore "100km/h" should be changed to "120km/h".
25. Driving with multiple transport trucks around you?	Driving with multiple taxis around you? One panellist suggested: Driving with many large trucks near you on the road?	Taxis are more specific to South Africa/Cape Town.
26. Merging with traffic and changing lanes?	One panellist suggested: Merging into traffic and changing lanes?	None
27. Driving when other drivers tailgate or drive too close behind you?	One panellist suggested: Driving when other drivers drive too close behind you?	None
28. Driving when other drivers pass on a non-passing lane?	One panellist suggested: Driving when other drivers pass on the emergency lane?	In South Africa, we use the term "solid line" instead of "non-passing lane".

	Three panellists suggested: Driving when other drivers overtake you on a solid line?	
29. Driving when other drivers do not signal or seem distracted?	One panellist suggested: Driving when other drivers do not indicate or seem distracted?	None
Additional questions suggested:	One panellist suggested: Driving on a mountain pass? One panellist suggested: Driving on a road with no yellow line/shoulder to pull into? One panellist suggested: Driving on a road with livestock or pedestrians walking nearby?	In South Africa, seeing livestock on the side of the road is quite common in certain areas.

The questionnaire, with both original and alternative phrasings for each question, was returned to each participant to begin round two (as seen above in Table 1). Through rounds two and three, panel members were presented with each question in its original and alternative phrasing. Panel members then selected whether they preferred the original or alternative phrasings for each question until 80% consensus was reached. For questions 9, 10, 17, 18 and 24, 60% consensus was accepted as 80% consensus could not be reached after three rounds. Given that the deliberations between the original questions and alternatives were only minor differences in phrasing, e.g. "planning travel to a new destination" versus "planning a road trip to a new place", a 60% consensus was accepted for the above questions. The original questions, as well as the phrasing for which consensus was reached in rounds two and three, can be seen in Table 2.

Table 2. Original and consensus question phrasings in rounds two and three

Original	**Round 2 consensus**	**Round 3 consensus**
1. Driving in your local area?	Driving in your local area?	Driving in your local area?
2. Driving in heavy traffic?		Driving in heavy traffic?
3. Driving in unfamiliar areas?	Driving in new or unfamiliar areas?	Driving in new or unfamiliar areas?
4. Driving at night?	Driving at night?	Driving at night?
5. Driving with people in the car?		Driving with passengers in the car?
6. Responding to road signs/traffic signals?		Understanding and reacting to road signs/traffic signals?
7. Driving around a roundabout?	Driving around a traffic circle?	Driving around a traffic circle?
8. Attempting to merge with traffic?		Attempting to merge with traffic?
9. Turning right across oncoming traffic?		*Turning right across oncoming traffic?
10. Planning travel to a new destination?		*How confident do you feel planning a road trip to a new place?
11. Driving in high speed areas?		Driving on the freeway at the national speed limit (120km/h)?
12. Parallel parking?	Parallel parking?	Parallel parking?
13. Driving in light rain?		Driving in light rain?
14. Driving in heavy rain?	Driving in heavy rain?	Driving in heavy rain?
15. Driving in winter conditions (snow, ice)?	Driving in extreme weather conditions (snow, ice, fog or mist)?	Driving in extreme weather conditions (snow, ice, fog or mist)?

16. Driving when there is glare or reflection from the sun?	Driving when there is glare or reflection from the sun?	Driving when there is glare or reflection from the sun?
17. Driving when caught in an unexpected or sudden storm?		*Driving when caught in an unexpected or sudden storm?
18. Driving in unfamiliar routes (different areas), detours or sign changes?		*Driving in unfamiliar routes (different areas), detours or sign changes?
19. Making a left hand turn with no lights or stop signs?		Making a right-hand turn with no lights or stop signs?
20. Completing a left hand turn on a yellow or red light when already mid-intersection?		Completing a right-hand turn on a yellow or red light when already mid-intersection?
21. Pulling in or backing up from tight spots in parking lots with large vehicles on either side?	Pulling in or reversing out of tight spots in parking lots with large vehicles on either side?	Pulling in or reversing out of tight spots in parking lots with large vehicles on either side?
22. Seeing street or exit signs with little warning?		When you suddenly see and need to react to off-ramp signs and street signs unexpectedly?
23. Driving on 2-lane highways?	Driving on 2-lane highways/freeways?	Driving on 2-lane highways/freeways?
24. Keeping up with the flow of highway traffic when the flow is over the posted speed limit of 100km/h?		*Keeping up with the flow of highway/freeway traffic when the flow is over the speed limit of 120km/h?
25. Driving with multiple transport trucks around you?	Driving with many large trucks near you on the road?	Driving with many large trucks near you on the road?
26. Merging with traffic and changing lanes?		Merging into traffic and changing lanes?
27. Driving when other drivers tailgate or drive too close behind you?	Driving when other drivers drive too close behind you?	Driving when other drivers drive too close behind you?
28. Driving when other drivers pass on a non-passing lane?	Driving when other drivers overtake you on a solid line?	Driving when other drivers overtake you on a solid line?
29. Driving when other drivers do not signal or seem distracted?	Driving when other drivers do not indicate or seem distracted?	Driving when other drivers do not indicate or seem distracted?
30. Driving on a mountain pass?	Driving on a mountain pass?	Driving on a mountain pass?
31. Driving on a road with no yellow line/shoulder to pull into?		Driving on a road with no yellow line/shoulder to pull into?
32. Driving on a road with livestock or pedestrians walking nearby?	Driving on a road with livestock or pedestrians walking nearby?	Driving on a road with livestock or pedestrians walking nearby?

*Questions for which 60% consensus was accepted after three rounds.

Of the 29 questions included in the initial combination of the ADSES and DCS-D, 12 of the original question phrasings and 17 of the alternative phrasings were chosen. The three additional questions suggested by panel members, namely questions 31, 32 and 33, were all included through consensus. The final questionnaire, according to the panel recommendations, was used for data collection in Aim 2, which will be discussed in the following section.

Aim 2: To determine possible associations between driving confidence and hearing loss, age, sex and driving safety among adults aged 65 to 85 years in Cape Town.

Objective 1: To Evaluate the Potential Influence of Hearing Loss on Driving Confidence. The mean, mode and median four-frequency PTAs were 38.4dB, 32.5dB and 36.6dB respectively, all falling within the "mild hearing loss" category. The PTAs ranged from 11.3dB to 72.5dB, with a standard deviation (SD) of 14.3dB. The mean, mode and median self-perceived hearing handicap scores were 15.7, 24.0 and 14.0 out of a possible score of 40, all falling within the "mild-moderate' category of self-perceived hearing handicap. The HHIE-S scores ranged from 0 (no handicap) to 40 (severe handicap), with a standard deviation of 9.9 on the total scores. The mean, mode and median scores for level of driving confidence were 244.5, 272.0 and 252.0 respectively, out of a possible score of 320. The total scores ranged from 79 to 320, both of which were outliers, with a standard deviation of 97.3 on the total scores.

The relationship between PTA and driving confidence was examined first using regression analysis. Two analyses were performed, one using the PTA average and the other using the categories of "normal hearing" (0), "mild loss" (1), "moderate loss" (2) and "moderately-severe loss" (4). Regression analysis revealed no significant relationship between PTA and level of driving confidence using PTA average (p=0.31) or hearing loss category (p=0.31). Next, regression analysis was used to examine the relationship between HHIE-S scores and driving confidence. Two analyses were performed, one using the total HHIE-S score and the other using the categories of "no handicap" (0), "mild-moderate handicap" (1) and "severe handicap" (2). Regression analysis revealed no significant relationship between HHIE-S scores and driving confidence when using the categories (p=0.06) and a significant but weak relationship when using the total HHIE-S scores (p=0.04*). The average driving confidence scores in the "no handicap", "mild-moderate handicap" and "severe handicap" groups were 254.86 (p=0.74), 236.21 (p=0.78) and 233.03 (p=0.61) respectively, indicating decreasing driving confidence with increasing self-perceived hearing handicap. The relationship between HHIE-S scores and level of driving confidence is displayed in the scatterplot in Figure 3, indicating no significant relationship between HHIE-S scored and driving confidence scores. Finally, regression analysis indicated a significant relationship between PTA and HHIE-S scores ($p<0.05$).

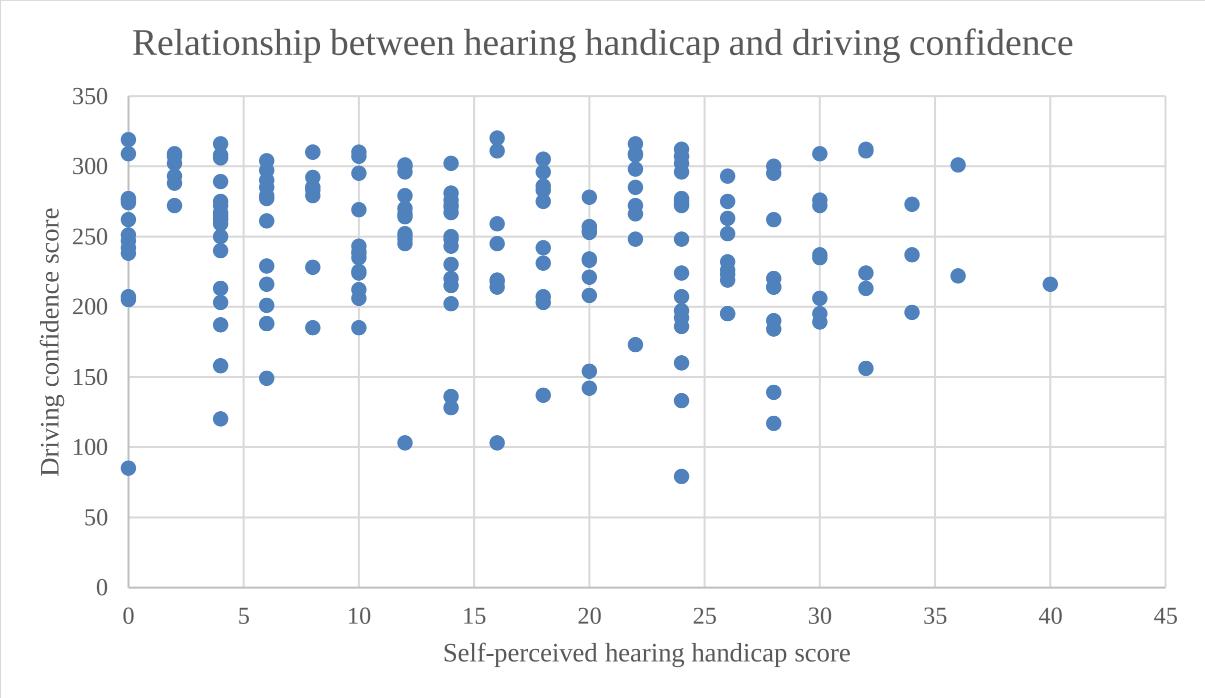

Figure 3. Scatterplot Showing the Relationship Between Self-Perceived Hearing Handicap and Driving Confidence

Objective 2: To explore possible correlations between age, sex, and a combination of age plus sex and level of driving confidence. To evaluate objective 2, Quantile-Quantile plots were used to determine whether the data were normally distributed. Age was found to be normally distributed, therefore parametric statistics were selected. The histogram in Figure 4 indicates the distribution of participants' ages in the study.

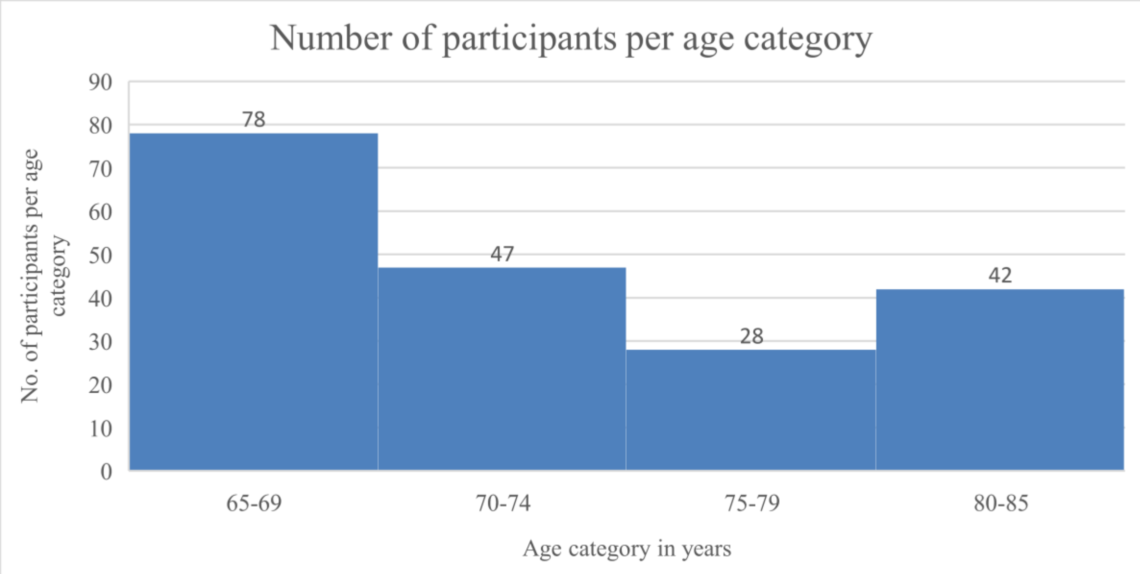

Figure 4. Distribution of participants' ages.

Measures of central tendency, namely mean, mode and median, were conducted for age. The mean, mode and median ages were 72.7 years, 65 years and 72 years respectively. The average driving confidence scores per age category, as seen in Figure 5, indicate a decline in average driving confidence scores as age increases.

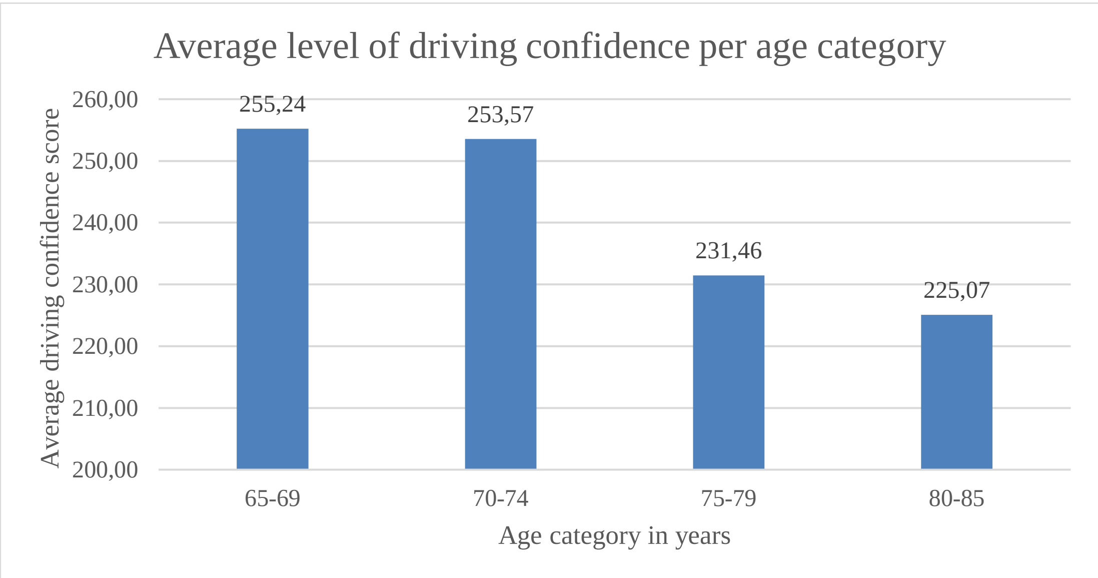

Figure 5. Average Level of Driving Confidence by Age Category

T-tests were used to compare levels of driving confidence between age categories. T-tests indicated a significant difference in driving confidence between the 70-74 years and 75-79 years categories (p=<0.05**) and between the 65-74 years and 75-85 years categories (p=<0.05**). No significant difference was found between the 65-69 years and 70-74 years categories (p=0.43) or between the 75-79 years and 80-85 years categories (p=0.05*). While it was not a main objective of the study, the researcher also investigated which driving confidence questions indicated the lowest and highest average confidence levels. The overall lowest-scoring questions all enquired about driving at night, driving when visibility is compromised and driving in poor weather conditions. The overall highest-scoring questions enquired about driving locally and performing actions crucial or common to driving, such as reacting to road signs and driving around a circle. The lowest-scoring and highest-scoring questions can be seen in Tables 3 and 4 respectively.

Table 3. Overall lowest-scoring questions on the driving confidence questionnaire

Average score out of 10	**Question number**	**Question**
5.88	15	Driving in extreme weather conditions (snow, ice, fog or mist)
6.34	4	Driving at night
6.42	17	Driving when caught in a sudden or unexpected storm
6.47	16	Driving when there is glare or reflection from the sun
6.66	14	Driving in heavy rain

Table 4. Overall highest-scoring questions on the driving confidence questionnaire

Average score out of 10	**Question number**	**Question**
9.47	1	Driving in your local area
8.97	6	Understanding and reacting to road signs/traffic signals
8.85	7	Driving around a traffic circle
8.67	5	Driving with passengers in the car
8.54	23	Driving on 2-lane highways/freeways

The second comparison in objective two examined the relationship between sex and level of driving confidence. Of the 195 participants, 99 were male and 96 were female. Among male participants, the mean, mode and median driving confidence scores were 260.3, 209 and

272 respectively, out of a possible 320. Among female participants, the mean, mode and median driving confidence scores were 229.1, 248 and 233.5 respectively. Male participants scored higher in all three aspects of central tendency than their female counterparts. Regression analysis also indicated a significant difference in levels of driving confidence between males and females ($p=0.0003$***), with males rating themselves as more confident. The difference in driving confidence scores between females and males can be seen in Figure 6.

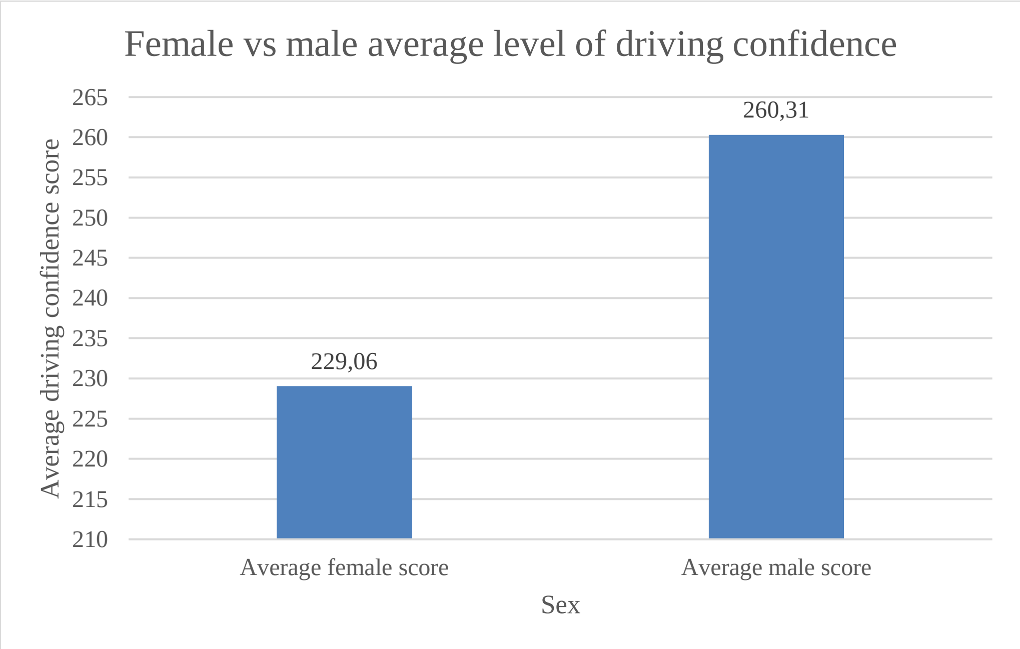

Figure 6. Female vs Male Average Level of Driving Confidence

The third and final comparison in objective 2 examined the relationship between a combination of age plus sex and level of driving confidence. Regression analysis revealed a significant association between a combination of age plus sex and level of driving confidence ($p<0.05$**). The differences in average driving confidence scores among younger females, younger males, older females and older males are noted in Figure 7.

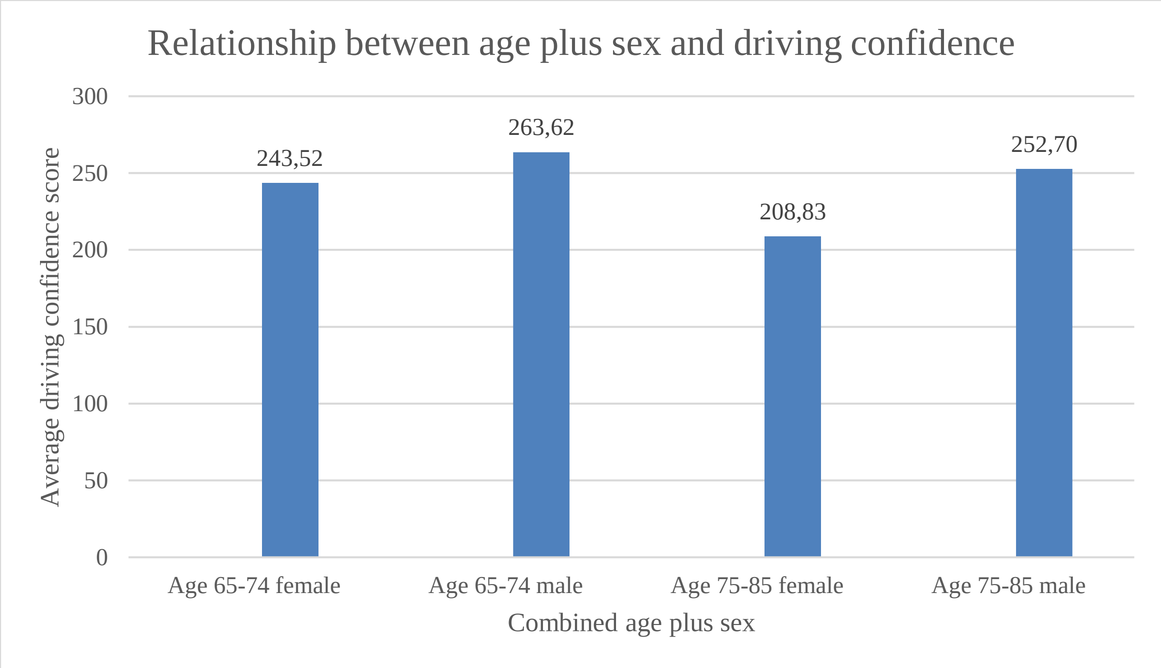

Figure 7. Relationship Between Age Plus Sex and Average Level of Driving Confidence

Objective 3: To examine potential relationships between level of hearing impairment and driving safety as defined by number of MVCs and traffic violations. To evaluate objective three, a comparison was made between participants' PTAs and number of self-reported MVCs and traffic violations. Number of self-reported MVCs and traffic violations were used as a proxy for driving safety. The average number of MVCs and traffic violations among normal-hearing individuals was 1.42, 1.92 among mildly-impaired individuals, 1.60 among moderately- impaired individuals and 1.00 among moderately-severely impaired individuals. Regression analysis indicated no significant association between level of hearing impairment and driving safety ($p=0.96$). The average number of MVCs and traffic violations per hearing loss category is displayed in Figure 8.

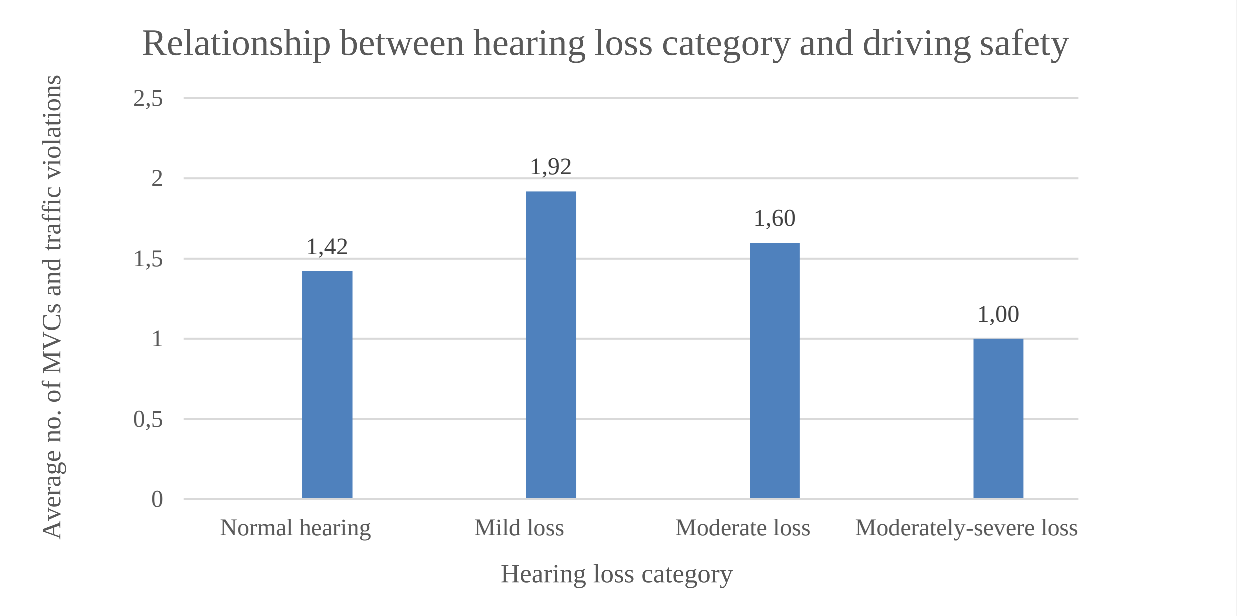

Figure 8. Average number of traffic violations per hearing loss category

Objective 4: Using pre-test and post-test measures, to evaluate for any change in driving confidence after the use of a hearing aid/s for a period of one month, in individuals fitted with amplification for the first time. To examine objective 4, pre-test and post-test measures were used to evaluate for any change in driving confidence after the use of a hearing aid/s for a period of one month, in individuals fitted with amplification for the first time. Nineteen participants were measured both pre-test and post-test, with fifteen participants showing an increase in driving confidence, three participants showing a decrease in driving confidence and one participant showing no change. Among the nineteen pre-test participants, the average level of driving confidence 225.7 out of 320. The post-test measure indicated an average level of driving confidence of 245.0 out of 320. A t-test revealed a significant increase in driving confidence after one month of hearing aid use (p=<0.05*). The differences in driving confidence scores in the pre-test and post-test measures are noted in Figure 9.

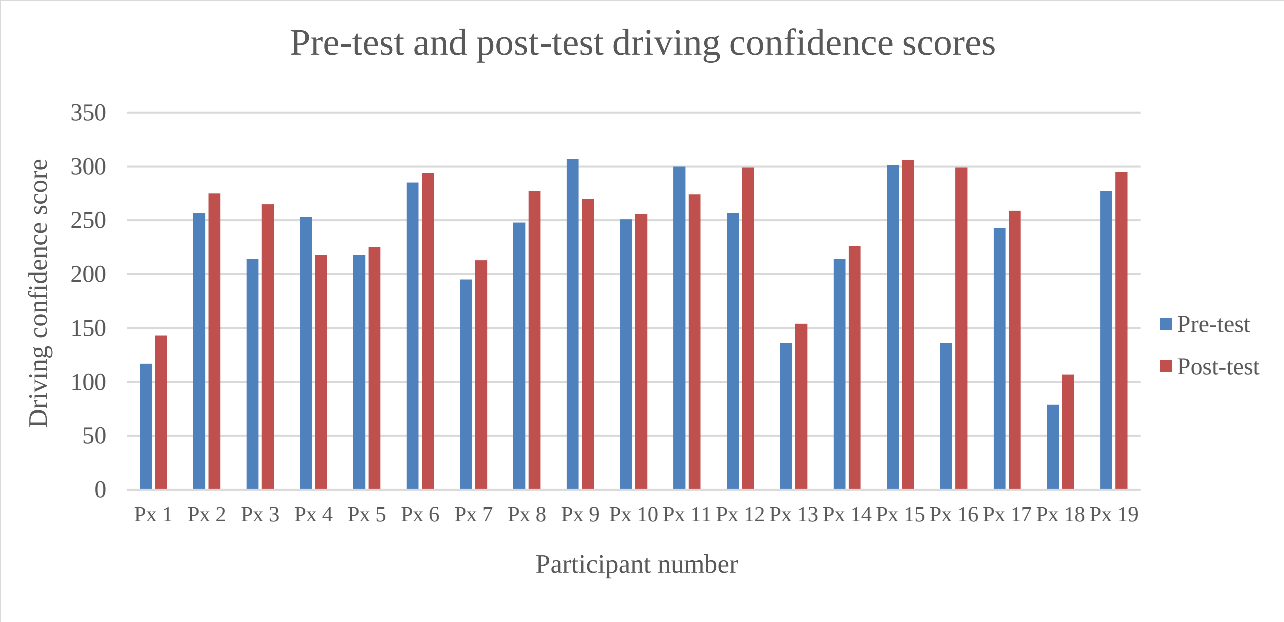

Figure 9. Pre-Test and Post-Test Driving Confidence After One Month of Hearing Aid Use

Summary

Overall, data analysis indicated an insignificant or weak relationship between self-perceived hearing handicap and level of driving confidence. A significant increase in driving confidence was found after one month of first-time hearing aid use. Age, sex, and a combination of both were found to be significantly associated with level of driving confidence. No association was found between PTA and level of driving confidence or between PTA and driving safety. The results will be discussed further in the following chapter.

Chapter 4: Discussion

Overview of the Chapter

The primary focus of this study was to examine the relationship between hearing loss and driving confidence among older adults, as very limited research exists on this topic. The current study aimed to fill the gap in the literature by examining the influential factors in driving confidence among hearing-impaired older adults in the South African context. Aim one focused on adapting two existing driving confidence scales for use in the South African context. Aim two explored possible associations between driving confidence and hearing loss, age, sex and driving safety among adults aged 65 to 85 years in Cape Town. This chapter will consider the results and their application in the context of the existing research on hearing loss and driving confidence. Thereafter, limitations of this study and recommendations for future research will be discussed.

Adapting Driving Confidence Scales

At present, no validated questionnaire exists for assessing driving confidence among South African drivers. This study combined two existing, validated questionnaires from other countries and sought to make them more appropriate for the South African context through the use of a panel. The panel was small yet diverse, as each panellist had a different occupational background and/or area of expertise. The Delphi panel questionnaire included the option for panellists to give reasons for their answers, which helped provide additional insight into their perspectives. Panel members suggested changes in phrasing for the majority of the original questions from the ADSES and DCS-D, indicating that many of the original questions' phrasings were not ideal or appropriate for the South African context. Having clear, context-appropriate questions in the final questionnaire was vital, as participants' understanding of each question impacted their answers. Several suggestions were related to specific vocabulary used in South Africa, such as "robot" instead of "traffic light" and "traffic circle" instead of "roundabout". Other suggestions included changes related to South African traffic and weather, such as including "fog and mist" as extreme weather conditions rather than "snow and ice" and driving in the presence of taxis. The above types of changes highlight the importance of including terms and situations more commonly used or encountered in South Africa to ensure that the final questionnaire was as clear and context-appropriate as possible. Consensus of 80%

was reached for 26 of the 32 questions after three rounds. Consensus of 60% was accepted for remaining six questions, as the nature of the changes suggested was minor, i.e. “merging with traffic” vs “merging into traffic”. It was decided by the researcher that such discrepancies in phrasing were unlikely to have a significant effect on the way participants rated their driving confidence. Therefore, although a reduced level of consensus was not ideal, 60% consensus was accepted.

Factors Influencing Driving Confidence

Objective hearing loss and driving confidence. The literature, although limited, suggests that the severity of hearing loss based on PTA is not significantly associated with driving confidence among older adults (Thorslund et al., 2019). The current study’s findings were consistent with the literature and indicated no significant relationship between severity of PTA and driving confidence. One possible explanation for the lack of relationship between PTA severity and driving confidence may be the use of coping strategies, which older adults may utilise when driving with reduced hearing (Thorslund et al., 2019). As Thorslund et al. (2019) appears to be the only study to investigate the relationship between PTA and driving confidence, there is no other research with which to compare the results of the current study. Thorslund et al. (2019) indicated that the Speech in Noise test, a more complex and functional audiological assessment, was significantly related to driving confidence in certain driving situations, such as driving in rush hour traffic and driving on a highway. Therefore, the Speech in Noise Test results may be a better determinant of driving confidence than PTA severity.

While it was not one of the main focuses of the study, it is interesting to note the significant relationship found between PTA and HHIE-S scores, indicating that participants with poorer PTA averages rated their hearing abilities as worse. The significant relationship between PTA and HHIE-S scores is supported by two recent studies among older adults, which both found a significant association between PTA and self-reported hearing loss, as well as Speech in Noise scores (Arnold et al., 2018; Thorslund et al., 2019). This relationship may indicate that older adults do have some insight into their hearing abilities and feel appropriately limited by their level of hearing impairment.

Effect of self-perceived hearing handicap on driving confidence. At present, no other study has directly investigated the relationship between self-perceived hearing loss and driving confidence. The current study found that total HHIE-S scores were not significantly associated with driving confidence scores, but that being in one of the three HHIE-S categories was significantly yet weakly associated with driving confidence. Although weak, it is important to note the association between HHIE-S categories and driving confidence, as this novel finding may contribute pioneering information to the existing research on driving confidence. However, based on the weakness of the association, audiologists should not yet be providing counselling to their patients on the relationship between self-perceived hearing loss and driving confidence as part of their duty of care[27].

Effect of age on driving confidence. A notable finding in this study was that driving confidence levels decline with increasing age. This finding is supported by the decline in cognitive and physical abilities associated with the ageing process, such as visual acuity, reaction times, hazard perception, multitasking and physical strength, all of which are crucial for driving (Albert et al., 2018; Dit Asse et al., 2014; Sullivan et al., 2015). The decline in confidence with age mirrors the decline in reaction time with age, found by Horswill et al. (2009). If older adults are in fact aware of these age-related declines in physical and cognitive abilities, this may be a reason for their decline in driving confidence levels. The driving situations which had the overall lowest and highest confidence scores were also noted. The overall lowest-scoring questions were related to driving at night, driving when visibility is compromised and driving in poor weather conditions. The overall highest-scoring questions referred to driving locally and performing actions crucial or common to driving, such as reacting to road signs and driving around a traffic circle (roundabout). The lowest-scoring questions relate to driving situations which may be considered highly demanding, both cognitively and visually, while the highest-scoring questions may be less demanding (Albert et al., 2018). The reduced confidence in more visually and cognitively demanding situations is supported by Thorslund et al. (2019), who found reduced driving confidence in similarly challenging driving situations. Given the decline in visual acuity and cognition with age, it is possible that these declining functions contribute to the reduced confidence in the above driving

[27] See Glossary.

situations (Albert et al., 2018; Dit Asse et al., 2014). While some countries around the world place certain licensing or driving restrictions on older drivers, there is currently no legislation in South Africa preventing individuals over a certain age from driving (AA, n.d. a; Claims Journal, 2012; Mitchell, 2008). The current study only examined confidence, rather than driving abilities, therefore the findings cannot determine whether older drivers should stop or limit their driving at a particular age. However, given the decline in driving confidence with age, older drivers could be encouraged by their audiologist or general practitioner to consider whether they still feel safe driving in situations in which they are particularly unconfident, in order to maintain optimal driving safety.

Effect of sex on driving confidence. Consistent with previous research, male participants were found to be significantly more confident than their female counterparts. This finding is supported by previous studies which indicated that men drive more kilometres per week and drive in more difficult driving situations than women, who in contrast are more likely to reduce or cease driving at a younger age. (Conlon et al., 2017; Dit Asse et al., 2014; Donorfio et al., 2008). The driving self-restriction noted by Conlon et al. (2017), Dit Asse et al. (2014) and Donorfio et al. (2008) is consistent with the lower levels of driving confidence found among women in the current study. Reduced driving confidence among women is supported by the findings in Siren and Meng (2013), who hypothesised that driving discomfort among older women may be due to reduced confidence rather than poorer driving ability. Siren and Meng (2013) further speculated that reduced confidence may lead to unnecessary and premature driving self-regulation. Reduced confidence among female drivers is also supported by the findings of Granié and Papafova (2011), who found that social stigma and stereotyping may lead to women feeling less confident and less capable as drivers.

Hearing impairment and driving safety. Overall, participants reported low numbers of traffic violations and MVCs, with a mean of 0.32 violations per participant. Contrary to the available literature (Edwards et al, 2016; Hickson et al., 2010; Horswill et al., 2009), no association was found between objective hearing loss and MVCs and traffic violations. It is plausible that participants may have felt uncomfortable giving their truthful number of traffic violations, underreporting due to social desirability bias. Furthermore, societal behaviour and opinions towards traffic legislation must be considered. Bribery of authority figures is a significant issue in South Africa; in 2017, 39% of bribes were to avoid traffic offenses (The Ethics Institute, 2017). Between January and March 2019, more than fifty drivers were arrested for attempting to bribe a police officer (Phakgadi, 2019). Furthermore, the South African traffic law enforcement survey results in 2018 indicated that 57% of motorists felt that their own and other motorists' compliance towards traffic laws and regulations was very poor or poor (AA, 2018). Therefore, it is possible that South African drivers regularly disregard the speed limit and do not check whether they have outstanding traffic fines. This is supported by a recent article which indicated that Capetonian residents owe the City of Cape Town over R324 million ($22 million) in outstanding traffic fines (Charles, 2019). The article also states that the City of Cape Town is intending to increase its number of traffic officers in an effort to reduce traffic violations (Charles, 2019). Furthermore, recent surveys indicate that, at any one time, there is only one traffic officer on duty for every 31 637 Cape Town residents and 9005 vehicles (eNaTiS, 2019; Sesant, 2016; Wold Population Review, 2019). Therefore, it may be inferred that the current level of traffic enforcement in Cape Town may not be high enough. As a result, participants' self-reported number of speeding tickets and number of times pulled over by a traffic officer may not be a true indication of whether they practice unsafe driving, as there are potentially too few traffic officers on the road to apprehend offending drivers. Furthermore, the lack of traffic enforcement means that drivers have a worse frame of reference to go by in terms of rating their own driving ability, as the above numbers indicate that unlawful driving is extremely common and can go unpunished in Cape Town.

Change in driving confidence with amplification. One of the most interesting and clinically relevant findings was a significant increase in driving confidence after one month of first-time hearing aid use. However, these results should be interpreted with caution due to the small sample size of only nineteen participants. The significant overall increase in driving confidence builds on the existing evidence of improved cognition noted among hearing aid wearers by Taljaard et al. (2015). Taljaard et al. (2015) found that hearing aid wearers had improved cognition and better cognitive processing speed, memory and executive function than hearing-impaired individuals who did not wear hearing aids. The above functions play a crucial role in complex tasks such as driving (Albert et al., 2018; Dit Asse et al., 2014; Sullivan et al., 2015; Taljaard et al., 2015). While Taljaard et al. (2015) focused on the impact of hearing aids on cognition, the current study adds to these findings with evidence of improved confidence. Improvement in driving confidence may also be attributed to less effort being expended on auditory processing when a hearing aid is worn, leaving more cognitive resources available for the task of driving, as suggested by Hickson et al. (2010). This improvement in confidence may have implications in terms of road safety campaigns targeted at older adults. Road safety campaigns and associations such as the AA should encourage older drivers to have their hearing tested and to wear their hearing aids when driving. Audiologists could also include counselling on the potential positive effects of hearing aid use on driving confidence, as part of their duty of care.

The current study investigated influential factors in driving confidence among older adults. The factors studied were objective hearing loss, self-perceived hearing handicap, age and sex. The study found age, sex and a combination of age plus sex to be the most influential factors in determining level of driving confidence. One month of first-time hearing aid use was also a significant influential factor, while self-perceived hearing handicap was noted as a significant but weak influential factor. Objective hearing loss was not found to be influential in driving confidence among older adults. Therefore age, sex, first-time hearing aid use and perceived hearing handicap appear to be influential factors in hearing loss among older adults.

Limitations

There are several methodological and patient-based factors inherent in the study that may have influenced participants' responses and the results, therefore the findings must be interpreted with caution. Selection bias may have been operant, as seen by the large number of participants aged 65 years, which is likely due to the "free screening" offer advertised by Cape Hearing Aids for individuals age 65 years and older. It should be noted that the mode age of 65 years was significantly below the mean and median ages of 72.7 years and 72 years respectively. This may be due to the special "free hearing screening" offer advertised by Cape Hearing Aids, applicable to individuals aged 65 years and older. Possibly due to advertising and word of mouth, many patients at Cape Hearing Aids and therefore participants in this study were aged 65 years, many of whom had normal hearing or mild hearing loss. Normal quantile plots indicated the distribution of age and hearing loss to be normal. However, the high number of 65-year-olds may have skewed the results, as more younger participants potentially meant fewer older participants were included, limiting the generalisability of results (Harada et al., 2013). The resultant younger sample could have therefore raised the average level of driving confidence inaccurately, skewing the data.

Patient responses may have been affected by central tendency bias, whereby individuals tend to choose answers closer to the middle of the scale (Malone et al., 2014). Social desirability bias may have also played a role, leading to participants responding in a way that they deem more socially acceptable, likely by understating their MVCs and traffic violations and possibly overstating or understating their confidence levels. Social desirability bias could further be linked to sex-role stereotypes, possibly leading to male participants rating their confidence levels as higher and female participants rating their confidence as lower (Granié & Papafava, 2011).

Healthy volunteer bias may have also been operant, meaning that only a subset of the population was sampled (Salkind, 2010). The better-than-average effect (Kim et al., 2017) may have skewed the data, possibly leading to participants rating their driving confidence more highly than what it is. Common in cross-sectional self-report studies is recall bias, in which participants incorrectly recall information about their past (Catalogue of Bias Collaboration, Spencer, Brassey, & Mahtani, 2017; Sedgwick, 2012). As a result, participants may have incorrectly remembered events relating to driving, which may have been exacerbated by memory difficulties associated with ageing (Catalogue of Bias Collaboration et al., 2017; Sedgwick, 2012). Finally, reference bias may have been a factor influencing responses, as each participant may have a different idea of what being confident in driving means. The researcher did not provide a definition of confidence to the participants. Reference bias is often a problem in self-report measures, potentially leading to inaccurate results as each participant's idea of confidence is influenced by their honesty, introspection and self-perception (Demetriou, Ozer, & Essau, 2015). These factors and biases can lead to inaccurate findings, thereby limiting the generalisability of results. The researcher attempted to combat the above biases by assuring participants that there were no correct or incorrect answers to the questions, that their answers were completely anonymous and that they should think carefully and try to respond as honestly as possible.

Sample size was also a limitation. The margin of error used in the study was 7% rather than the recommended 5%, therefore the sample size was 195 participants instead of the recommended 377 participants. Given the time limitation, it was beyond the scope of this study to include 377 participants; however, the smaller sample size led to compromised validity of the results and therefore compromised generalisability as well (Faber & Fonseca, 2014). A very small sample size of nineteen participants was used for objective four, which was due to several factors. Many patients at the practices came for their obligatory one-week follow up after fitting and did not return for a one-month follow up. In these cases, an email was sent to the participants requesting that they complete the questionnaire again. However, some participants did not have an email address or did not respond to the email despite the researcher sending reminder emails. Several participants who returned for a one-month follow up chose not to complete the questionnaire as they felt it was an inconvenience. Due to the researcher changing jobs during the data collection process, follow-up of the participants fitted with a hearing aid/s was challenging. Some participants only wore their hearing aids for a few hours each day, instead of the recommended minimum of eight hours per day according to the hearing aid software. Those participants were not included in the follow-up cohort. The time limitation of the study meant that only a one month post-fitting follow-up was included, rather than a three or six month follow-up. The ageing process results in changes which can increase the difficulty older adults may have in adjusting to new challenges, such as first-time hearing aid use (Mondelli & de Souza, 2012). One month may not be the optimal amount of time for older adults to adjust to new hearing aids, therefore a longer follow-up period would have been beneficial, allowing participants more time to adapt to amplification (Mondelli & de Souza, 2012). The time limitation also prevented the inclusion of other factors, such as general health status, presence of visual impairments and vestibular disorders, all of which can impact on an individual’s driving (Conlon et al., 2017).

Recommendations for Future Research

Although the current study was able to provide some insight into the factors affecting driving confidence, further research is required to confirm this finding with a larger sample and in other contexts. The current study’s adaptation of two existing questionnaires was the first step towards a new driving confidence questionnaire for the South African context. Therefore, future studies that intend on adapting a questionnaire should consider the importance of using the colloquial vocabulary of the country or community in which the study will be conducted, to ensure that the questionnaire is context-appropriate.

Data collection procedures. In order to reduce the effect of reference bias and the better-than-average effect, future studies should include a comparison of self-reported driving confidence either with an on-road driving assessment with a driving instructor or driving simulator. Participants' insurance claims and traffic offences records could also be used to collect information of participants' traffic violations. This will allow comparisons to be made between objective driving abilities, self-reported traffic violations, actual traffic violations and self-reported driving confidence, which will provide more information on whether older driver's confidence levels and self-reported traffic violations are accurate, underestimated or overestimated. This, in turn, could provide insight into whether older adults are continuing to drive unsafely, putting themselves at risk of MVCs and violating traffic laws. Contrarily, it could provide insight into whether older adults are ceasing to drive prematurely, paving the way for older drivers to be made more aware of their driving abilities and whether they may still continue to drive safely. In addition, the outcomes of future research in this area could assist in advising legislation relating to licensing and safe driving for older adults.

Future studies should follow a longitudinal design and incorporate a longer follow-up period of at least one year, with multiple post-test driving confidence questionnaires to closely track any changes in driving confidence after the fitting of a hearing aid/s. A longitudinal study would also help in limiting recall bias, as participants will be regularly recalling current or recent events, likely leading to more accurate self-report data (Caruana, Roman, Hernandez-Sanchez, & Solli, 2015). Future studies should also include a more complex objective hearing assessment such as the Speech in Noise test rather than only pure-tone testing, as well as a measure of subjective hearing loss to provide a more inclusive view of participants' hearing loss. Vestibular assessments should also be conducted as balance impairment is common among older adults and may have an impact on driving. Future studies should also account for the general health and visual acuity of the participants when grouping participants and analysing the data.

Participant recruitment. Future studies should aim to include a larger sample to increase the validity and generalisability of the results. Individuals in younger age groups should be included to examine driving confidence in younger or middle-aged adults, with and without hearing loss. It is recommended that future studies be conducted in both developing and developed countries, in rural and urban settings, and with a sample of individuals not limited to private practice in order to ensure generalisability of results.

Conclusion

Research has shown that age-related hearing loss has profound implications on all aspects of an individual's life, including cognitive abilities. The relationship between hearing loss and cognition has led to research which indicates an association between objective hearing loss and reduced driving performance in older adults. However, little research exists on the relationship between self-perceived hearing loss and driving confidence, particularly in the South African context. This study aimed to evaluate predetermined factors which could potentially influence driving confidence among adults aged 65 to 85 years in Cape Town. The study explored the influence of objective and subjective hearing loss, age, sex and a combination of age plus sex on driving confidence. The relationship between hearing loss and traffic violations and the change in driving confidence after the use of a hearing aid/s for a period of one month was also examined. The results indicated an insignificant or weak relationship between both objective and self-perceived hearing handicap and driving confidence. Age, sex and a combination of both were also significantly associated with level of driving confidence. Lastly, a significant increase in driving confidence was found after one month of first-time hearing aid use. No association was found between objective hearing loss and driving safety. The study therefore concluded that age, sex, first-time hearing aid use and self-perceived hearing handicap are influential factors in driving confidence among older adults in Cape Town.

Overall, there is little literature to directly support or contradict this study's findings, as much of the research on driving among older adults has focused on driving performance rather than confidence. At present, no other studies have investigated the relationship between self-perceived hearing loss and driving confidence, therefore the insignificant or weak relationship found in this study can be considered novel. Only one other study has investigated the relationship between objective hearing loss and driving confidence, the results of which were consistent with the insignificant relationship found in the current study. The decline in driving confidence with increasing age is supported by previous research, which has indicated that ageing reduces reaction time and other key skills required for driving. Reduced driving confidence among women is also supported by previous research, which has indicated that men drive more and report fewer driving difficulties than women, who by contrast cease or limit their driving earlier than men. Objective hearing loss was not found to be significantly associated with traffic violations and MVCs, which is somewhat supported by previous research indicating that older adults self-rated driving abilities are much better than their true driving abilities. The most important and novel finding in this study was the significant increase in driving confidence after one month of hearing aid use.

Audiologists should include counselling on the potential positive effects of hearing aid use on driving confidence as part of their duty of care. Older drivers could also be encouraged by their audiologist or general practitioner to consider whether they still feel safe driving in situations in which they are particularly unconfident. Future research should include an on-road driving assessment to compare objective driving abilities with self-rated driving confidence, as well as larger sample sizes and a longer follow-up period to track changes in driving confidence over an extended time frame. Future studies should also include a more complex objective hearing assessment such as the Speech in Noise test rather than only pure-tone testing, as well as a measure of subjective hearing loss.

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Appendix A

Adelaide Driving Self-Efficacy Scale and Permission

Flinders UNIVERSITY

Adelaide Driving Self-Efficacy Scale (ADSES)

ID Number: ______________ Date administered: ______________

How confident do you feel doing the following activities?

Please allocate a number from 0-10, where 0 is not confident and 10 is completely confident, for the 12 questions below.

0 (not confident) — 5 — 10 (completely confident)

1. *Driving in your local area:* _____
2. *Driving in heavy traffic:* _____
3. *Driving in unfamiliar areas:* _____
4. *Driving at night:* _____
5. *Driving with people in the car:* _____
6. *Responding to road signs/traffic signals:* _____
7. *Driving around a roundabout:* _____
8. *Attempting to merge with traffic:* _____
9. *Turning right across oncoming traffic:* _____
10. *Planning travel to a new destination:* _____
11. *Driving in high speed areas:* _____
12. *Parallel parking:* _____

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5/10/2018 Mail - CHNROM002@myuct.ac.za

Fw: Master's student at University of Cape Town seeks permission to use ADSES

Stacey George <stacey.george@flinders.edu.au>

Thu 2018-05-03 06:59 AM

To: Romy Cohen <CHNROM002@myuct.ac.za>;

Dear Romy yes happy for you to use Regards

From: Crotty, Maria (Health) <Maria.Crotty@sa.gov.au>
Sent: Tuesday, 1 May 2018 7:13 PM
To: Romy Cohen
Cc: Stacey George
Subject: Re: Master's student at University of Cape Town seeks permission to use ADSES

Hi Romy

Thanks for interest. Im forwarding your email to Stacey George. Good luck with your project

Maria

Maria Crotty
Professor of Rehabilitation and Aged Care
Flinders University
Repatriation General Hospital
Daws Road, Daw Park 5041 SA
61882751103

From: Romy Cohen <CHNROM002@myuct.ac.za>
Sent: Tuesday, 1 May 2018 7:00 PM
To: Crotty, Maria (Health)
Subject: Master's student at University of Cape Town seeks permission to use ADSES

To whom it may concern

I hope this email finds you well.

My name is Romy Cohen and I am currently pursuing a Master's Degree in Audiology at the University of Cape Town. As part of my degree, I am required to carry out a research study. My study will focus on the various factors which may potentially influence driving confidence amongst older adults. An expert panel will be adapting the Adelaide Driving Self-Efficacy Scale to the South African context, after which the research participants will complete the adapted questionnaire.

I am therefore writing to you to request permission to use and adapt the ADSES for my research.

If you have any queries, please do not hesitate to contact my supervisors, Christine Rogers (christine.rogers@uct.ac.za) and Jay Chouhan (jay.chouhan@uct.ac.za).

5/10/2018 Mail - CHNROM002@myuct.ac.za

Yours faithfully

Romy Cohen

MSc Audiology student
University of Cape Town
Email: chnrom002@myuct.ac.za
Tel: 073 073 1225

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Appendix B

Driving Comfort Scale (Day) and Permission

Table 2: Items and Rating Instructions for Initial Pool and Iterations of the Driving Comfort Scales

Ratings of Initial Item Pool*

How confident are you driving?

1. At night?
2. In light rain?
3. In heavy rain?
4. In fog?
5. In rain at night?
6. In the first snow storm?
7. In winter conditions (snow, ice)?
8. There is glare or reflections?
9. Caught in an unexpected or sudden storm?
10. In unfamiliar routes (different areas), detours or sign changes?
11. In heavy traffic or rush hour?
12. Making a left hand turn at a turning lane in traffic?
13. Making a left hand turn with no lights or stop signs in traffic?
14. Completing a left turn on a yellow or red light?
15. On a 2-lane highway?
16. On a highway with 3 or more lanes?
17. Driving long distances?
18. Changes lanes in traffic?
19. Parking in a tight spot with large vehicles on either side?
20. Seeing street or exit signs with little warning?
21. At high speeds?
22. Passengers distract you or tell you how to drive?
23. Multiple transport trucks are around you?
24. Other drivers do not signal at all or with little warning?
25. Other drivers tailgate or drive too close behind you?
26. Other drivers pass on the right (or inside) lane of a highway?
27. Other drivers pass on a nonpassing lane or shoulder?
28. Other drivers appear distracted (loud music, talking)?
29. You have not driven for a while?
30. In a big city?

Preliminary DCS†

How comfortable are you driving in the daytime?

1. In light rain?
2. In heavy rain?
3. In fog?
4. In the first snow storm?
5. In winter conditions (snow, ice)?
6. When there is glare or reflection from the sun?
7. Caught in an unexpected or sudden storm?
8. In unfamiliar routes (different areas), detours or sign changes?
9. Making a left hand turn with no lights or stop signs?
10. Completing a left hand turn on a yellow or red light when already at mid-intersection?
11. On 2-lane highways?
12. On highways with 3 or more lanes?
13. On trips lasting more than 2 hours?
14. Changing lanes in traffic?
15. Pulling in or backing up from tight spots in parking lots with large vehicles on either side?
16. Seeing street or exit signs with little warning?
17. Keeping up with the flow of highway traffic when the flow is over the posted speed limit of 100km/h (60 miles/h)?
18. With passengers who distract you or tell you how to drive?
19. With multiple transport trucks around you?
20. Other drivers do not signal at all or with little warning?
21. Other drivers tailgate or drive too close behind you?
22. Other drivers pass on the right (or inside) lane of a highway?
23. Other drivers pass in a nonpassing lane or shoulder?
24. Other drivers appear distracted (loud music, talking)?
25. In heavy traffic or rush hour?

How comfortable are you driving at night?

1. In good weather and traffic conditions?
2. In light rain?
3. In heavy rain?
4. In fog?
5. In winter conditions (snow, ice)?
6. When there is glare or reflection from lights?
7. In unfamiliar routes (different areas), detours or sign changes?
8. On 2-lane highways?
9. On highways with 3 or more lanes?
10. On trips lasting more than 2 hrs?
11. Seeing street or exit signs with little warning?
12. Keeping up with the flow of highway traffic when the flow is over the posted speed limit of 100km/h (60 miles/h)?
13. With multiple transport trucks around you?
14. Other drivers tailgate or drive too close behind you?
15. In heavy traffic?

17-Item DCS-D† and 18-Item DCS-N‡

How comfortable are you driving in the daytime?

1. In light rain?
2. In heavy rain?
3. In winter conditions (snow, ice)?
4. When there is glare or reflection from the sun?
5. Caught in an unexpected or sudden storm?
6. In unfamiliar routes (different areas), detours or sign changes?
7. Making a left hand turn with no lights or stop signs?
8. Completing a left hand turn on a yellow or red light when already at mid-intersection?
9. Pulling in or backing up from tight spots in parking lots with large vehicles on either side?
10. Seeing street or exit signs with little warning?
11. On 2-lane highways?
12. Keeping up with the flow of highway traffic when the flow is over the posted speed limit of 100km/h (60 miles/h)?
13. With multiple transport trucks around you?
14. Merging with traffic and changing lanes?
15. Other drivers tailgate or drive too close behind you?
16. Other drivers pass on a nonpassing lane?
17. Other drivers do not signal or seem distracted?

How comfortable are you driving at night?

1. In good weather and traffic conditions?
2. In light rain?
3. In heavy rain?
4. In winter conditions (snow, ice)?
5. When there is glare or reflection from lights?
6. Caught in an unexpected or sudden storm?
7. In unfamiliar routes (different areas), detours or sign changes?
8. Making a left hand turn with no lights or stop signs?
9. Completing a left hand turn on a yellow or red light when already at mid-intersection?
10. Pulling in or backing up from tight spots in parking lots with large vehicles on either side?
11. Seeing street or exit signs with little warning?
12. On 2-lane highways?
13. Keeping up with the flow of highway traffic when the flow is over the posted speed limit of 100km/h (60 miles/h)?
14. With multiple transport trucks around you?
15. Merging with traffic and changing lanes?
16. Other drivers tailgate or drive too close behind you?
17. Other drivers pass on a nonpassing lane?
18. Other drivers do not signal or seem distracted?

*Instructions: Please rate your level of confidence when driving in each of the following situations by choosing a number from the scale below (0%, no confidence; 50%, moderate confidence; 100%, complete confidence). If you do not normally drive in the situation, try and imagine how confident you would be if you absolutely had to go somewhere 1 day and found yourself in the situation.

†Instructions: Using the scale below, please rate your level of comfort by choosing a number from the scale below (0%–100%) and writing it in the blank beside each situation. If you do not normally drive in the situation, imagine how comfortable you would be if you absolutely had to go somewhere and found yourself in the situation. In your ratings, consider confidence in your own abilities and driving skills, as well as the situation itself (including other drivers). Assume normal traffic flow unless otherwise specified.

‡Now we would like you to rate your level of comfort when driving in the following situations at night. Even if you do not normally drive at night, imagine that you were out in the afternoon, got delayed, and it was dark on your way back. In your ratings, consider confidence in your own abilities and driving skills, as well as the situation itself (including other drivers). Assume normal traffic flow unless otherwise specified.

5/24/2018 Mail - CHNROM002@myuct.ac.za

Master's student at the University of Cape Town seeks permission to use DCS-D

Romy Cohen

Mon 2018-05-14 06:32 PM

Sent Items

To: amyers@uwaterloo.ca <amyers@uwaterloo.ca>;

To whom it may concern

I hope this email finds you well.

My name is Romy Cohen and I am currently pursuing a Master's Degree in Audiology at the University of Cape Town. As part of my degree, I am required to carry out a research study. My study will focus on the various factors which may potentially influence driving confidence amongst older adults. An expert panel will be adapting the Day Driving Comfort Scale to the South African context, after which the research participants will complete the adapted questionnaire.

I am therefore writing to you to request permission to use and adapt the DCS-D for my research.

If you have any queries, please do not hesitate to contact my supervisors, Christine Rogers (christine.rogers@uct.ac.za) and Jay Chouhan (jay.chouhan@uct.ac.za).

Yours faithfully

Romy Cohen

MSc Audiology student
University of Cape Town
Email: chnrom002@myuct.ac.za
Tel: 073 073 1225

5/24/2018 RE: Master's student at the University of Cape Town seeks permission to use DCS-D

Reply all | Delete Junk | ...

RE: Master's student at the University of Cape Town seeks permission to use DCS-D

AM Anita Myers <amyers@uwaterloo.ca> Reply all |
Yesterday, 02:27 PM
Romy Cohen; Christine Rogers; Jay Chouhan; alex.crizzle@usask.ca

Inbox

Action Items

Hi Romy, you have my permission to use the Driving Comfort Scales (both Day and Night if you choose) for your master's research study. I certainly would advise you to use both scales as driving comfort (confidence) at night often declines before daytime comfort.

Can you please send us (copied Dr. Crizzle on this as well, one of my colleagues) information on how you plan to adapt the scale(s) for the Cape Town context? If you change the scale(s) appreciably (e.g., item wording) you should pilot test with the target audience and check test-retest reliability.

Please let me know if I can be of further assistance and I would love to know your study results.

And be sure to cite our work on the development of these scales. I have cc your supervisors on this.

Good luck with your work.

Best regards, Anita Myers (developer of the DCS-Day and DCS-Night scale).

Appendix C

Email to Potential Delphi Panel Participants

RC Romy Cohen

Audiology MA research study

o drkross@sgmclinic.co.za

Hi Dr. Ross

I hope this email finds you well.

I am currently completing my Masters degree in Audiology at UCT and I am conducting research around driving confidence amongst older adults. I am looking for a few specialists in the field to have a look at the driving confidence questionnaire I have compiled and provide feedback on whether the questions are appropriate and relevant to older drivers, whether any questions need to be modified or anything added in.

I would hugely appreciate your input. Please let me know if you would be able to assist.

Many thanks

Romy Cohen

Appendix D

Information Letter for Delphi Panel Participants

Division of Communication Sciences & Disorders
Department of Health & Rehabilitation Sciences
Faculty of Health Sciences
F45 Old Main Building
Groote Schuur Hospital
Telephone: 021 406 6628
Email: Christine.Rogers@uct.ac.za
Jay.Chouhan@uct.ac.za
15/05/2018

Dear [name of potential participant will be inserted here]

Re: Influential Factors in Driving Confidence among Hearing-Impaired Older Adults in Cape Town

My name is Romy Cohen and I am a Master's degree student at the University of Cape Town. My research is looking at the relationship between hearing loss and driving confidence among older adults. This study is important as very limited research on the relationship between hearing loss and driving confidence exists, particularly in the South African context.

One recent study conducted overseas found that participants with more severe hearing loss were less concerned about the effect of their hearing loss on their driving than their mildly hearing-impaired and normal-hearing counterparts, possibly due to hearing-impaired drivers developing coping strategies. I would like to find out if hearing loss might affect driving confidence in the South African context. This research may help audiologists to give advice about driving to older drivers. This study has been approved by the University of Cape Town Faculty of Health Sciences Human Research Ethics Committee and the reference number is 497/2018.

I am looking for panelists from the fields of audiology, older adults, driving instruction or road traffic safety, and you have been chosen as a possible expert due to your expertise in your field. I am therefore asking if you are interested in taking part in a Delphi Consensus, which is described in more detail below. Through the Delphi Consensus, I am trying to create an instrument from two existing instruments which measure driving confidence, to ensure that it is clear, complete and relevant to the South African context.

In round 1, I will ask you to review both instruments by answering questions on a form I have created. In round 2, I will then collate your feedback and return to you a merged questionnaire with another round of questions for you to answer about the instrument. In the final round, I will only ask you to provide feedback on questionnaire items on which agreement had not been reached in previous rounds.

Each round should not take you longer than 30 minutes to complete, and will be done on an online platform. An internet connection is therefore required. You will have two weeks to send your feedback to me for each round.

There are no risks to being part of this study. Your name and your personal information will be kept private, and no person outside of this study will have access to the raw data or your particulars. All data will be stored in password-protected files on an external hard-drive, a copy of which will be stored on Dropbox, a secure online storage system. Data will be kept for a period of 5 years.

You do not have to be part of this study. You can choose not to participate, even if you have already started to fill in the forms. You will receive a R100 Woolworths voucher as a small token of appreciation for your participation.

If you have any questions about the study or if you would like more information, please contact the researcher at the following telephone number/email address:
Tel: 073 073 1225
Email: chnrom002@myuct.ac.za

My supervisors are Christine Rogers and Jay Chouhan. Their contact details are at the top of this page.

Should you have any concerns about your human rights and welfare as a research participant, please contact the University of Cape Town Faculty of Health Sciences Human Research Ethics Committee:

Chair/Prof: Marc Blockman
The Human Research Ethics Committee
Floor E53, Room 46
Old Main Building
Groote Schuur Hospital
Observatory, 7925
Telephone: 021 406 6338

Yours faithfully

Romy Cohen

Appendix E

Informed Consent Sheet for Delphi Panel Participants

Division of Communication Sciences & Disorders
School of Health & Rehabilitation Sciences
Faculty of Health Sciences
F45 Old Main Building
Groote Schuur Hospital
Telephone: 021 406 6401
Fax: 021 406 6323
Email: Christine.rogers@uct.ac.za
Jay.chouhan@uct.ac.za

Influential Factors in Driving Confidence Among Hearing-Impaired Older Adults in Cape Town

Please tick the all of the boxes below to confirm that you have read each statement and that it is correct.

I have read and understood the information sheet provided to me. ☐

I have had the opportunity to ask questions and have my questions answered. ☐

I understand that my answers, my personal information and my identity will remain private and anonymous. ☐

I understand that participation is voluntary and that I may withdraw from the study at any time without any consequences. ☐

I have not been forced to participate in this study. ☐

I am over the age of 18 years old and am legally able to provide consent. ☐

I agree to participate in this study. ☐

____________________ ____________________

Signature of participant Date

Appendix F

Delphi Panel Questions

Panel members will be required to answer the following questions regarding each question on the driving confidence questionnaires:

1. Is this question relevant to driving in South Africa?

2. Could this question be more appropriately phrased for the South African context? If so, please rephrase the question.

3. Is this question clear? If not, please rephrase the question.

4. Are there any other questions that should be added into this questionnaire? If so, please list the additional question/s below.

Appendix G

Information Letter for Potentially Hearing-Impaired Participants

Division of Communication Sciences & Disorders
School of Health & Rehabilitation Sciences
Faculty of Health Sciences
F45 Old Main Building
Groote Schuur Hospital
Telephone: 021 406 6401
Fax: 021 406 6323
Email: Christine.Rogers@uct.ac.za
Jay.Chouhan@uct.ac.za
15/05/2018

Hello

My name is Romy Cohen and I am a Master's degree student at the University of Cape Town. My research is looking at hearing loss and driving in older adults. I would like to find out if hearing loss might affect driving confidence. This research may help audiologists to give advice about driving to older drivers. This study has been approved by the University of Cape Town Faculty of Health Sciences Human Research Ethics Committee and the reference number is 497/2018.

I am asking if you are interested in being part of my study. If you agree, I will ask you to complete an activity where you need to remember three words and draw the time on a clock face. There is no need to feel worried about this activity, it is simply to ensure your rights as someone willing to take part in this study are safe-guarded. I will make a note of the results of your hearing test for my research record. I will also ask you to fill in some forms about how you find your hearing and how confident you feel when you drive, and your driving record. This should not take longer than 10-15 minutes. You need to fill in the forms on your own, but I will be able to answer any questions you may have. If you purchase a hearing aid, I will ask you to fill in some of the forms again in a month. We can either do this when we meet for your follow-up, or I will email them to you.

There are no risks to being part of this study. I will be recording your name and some information, but only I will have access to it. Your name and your personal information will be kept private. No person outside of this study will have access to the raw data or your particulars. All data will be stored in password-protected files on an external hard-drive. A copy of the data will be stored on Dropbox, a secure online storage system. Data will be kept for 5 years.

You do not have to be part of this study. You can choose not to participate and can stop at any time, even if you have already started to fill in the forms. You will receive a pen and notepad as a small token of appreciation for your participation.

If you have any questions about the study or if you would like more information, please contact the researcher at the following telephone number/email address:
Tel: 073 073 1225
Email: chnrom002@myuct.ac.za

My supervisors are Christine Rogers and Jay Chouhan. Their contact details are at the top of this page.

Should you have any concerns about your human rights and welfare as a research participant, please contact:

Chair/Prof: Marc Blockman
The Human Research Ethics Committee
Floor E53, Room 46
Old Main Building
Groote Schuur Hospital
Observatory, 7925
Telephone: 021 406 6338

Yours faithfully

Romy Cohen

Appendix H

Waiting Room Poster

Appendix I

Demographics Questionnaire

Date: ______________________

Participant number: __________

Please fill in the information below as accurately as possible.

Age:__________

Sex (M/F): __________

Is English your home language (Yes/No)?_________

If “No”, how would you rate your English proficiency in the following areas (please circle):

- Understanding – excellent/good/fair/poor
- Speaking – excellent/good/fair/poor
- Reading – excellent/good/fair/poor
- Writing – excellent/good/fair/poor

Do you drive at least once per week (Yes/No)?__________

In the last year, how many times have you:

- Been pulled over by a traffic officer? __________
- Been in a collision involving another vehicle? __________
- Been in a near-collision involving another vehicle? __________
- Bumped, dented or scraped your own/someone else’s car? __________
- Received a parking or speeding ticket? __________

Appendix J

Mini-Cog and Permission

Mini-Cog™

Instructions for Administration & Scoring

ID: ____________ Date: ____________________

Step 1: Three Word Registration

Look directly at person and say, "Please listen carefully. I am going to say three words that I want you to repeat back to me now and try to remember. The words are [select a list of words from the versions below]. Please say them for me now." If the person is unable to repeat the words after three attempts, move on to Step 2 (clock drawing).

The following and other word lists have been used in one or more clinical studies.[1-3] For repeated administrations, use of an alternative word list is recommended.

Version 1	Version 2	Version 3	Version 4	Version 5	Version 6
Banana	Leader	Village	River	Captain	Daughter
Sunrise	Season	Kitchen	Nation	Garden	Heaven
Chair	Table	Baby	Finger	Picture	Mountain

Step 2: Clock Drawing

Say: "Next, I want you to draw a clock for me. First, put in all of the numbers where they go." When that is completed, say: "Now, set the hands to 10 past 11."

Use preprinted circle (see next page) for this exercise. Repeat instructions as needed as this is not a memory test. Move to Step 3 if the clock is not complete within three minutes.

Step 3: Three Word Recall

Ask the person to recall the three words you stated in Step 1. Say: "What were the three words I asked you to remember?" Record the word list version number and the person's answers below.

Word List Version: _____ Person's Answers: ________________ ________________ ________________

Scoring

Word Recall: _____ (0-3 points)	1 point for each word spontaneously recalled without cueing.
Clock Draw: _____ (0 or 2 points)	Normal clock = 2 points. A normal clock has all numbers placed in the correct sequence and approximately correct position (e.g., 12, 3, 6 and 9 are in anchor positions) with no missing or duplicate numbers. Hands are pointing to the 11 and 2 (11:10). Hand length is not scored. Inability or refusal to draw a clock (abnormal) = 0 points.
Total Score: _____ (0-5 points)	Total score = Word Recall score + Clock Draw score. A cut point of <3 on the Mini-Cog™ has been validated for dementia screening, but many individuals with clinically meaningful cognitive impairment will score higher. When greater sensitivity is desired, a cut point of <4 is recommended as it may indicate a need for further evaluation of cognitive status.

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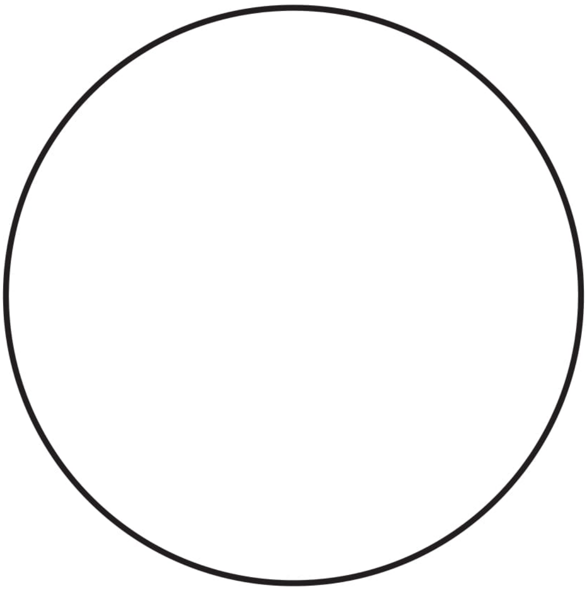
v. 01.19.16

Clock Drawing

ID: ______________ Date: ________________________



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1. Borson S, Scanlan JM, Chen PJ et al. The Mini-Cog as a screen for dementia: Validation in a population-based sample. J Am Geriatr Soc 2003;51:1451–1454.
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7. Scanlan J & Borson S. The Mini-Cog: Receiver operating characteristics with the expert and naive raters. Int J Geriatr Psychiatry 2001; 16: 216-222.

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v. 01.19.16

5/10/2018 Mail - CHNROM002@myuct.ac.za

Re: Master's student at the University of Cape Town seeks permission to use the MiniCog

soob <soob@uw.edu>

Tue 2018-05-01 05:46 PM

To: Romy Cohen <CHNROM002@myuct.ac.za>;

Permission granted. Good luck with your study.
Soo Borson MD

Soo Borson MD
Professor Emerita, University of Washington School of Medicine and Affiliate Professor, School of Nursing

---

From: Romy Cohen <CHNROM002@myuct.ac.za>
Sent: Tuesday, May 1, 2018 2:44:05 AM
To: soob
Subject: Master's student at the University of Cape Town seeks permission to use the MiniCog

To whom it may concern

I hope this email finds you well.

My name is Romy Cohen and I am currently pursuing a Master's Degree in Audiology at the University of Cape Town. As part of my degree, I am required to carry out a research study. My study will focus on the various factors which may potentially influence driving confidence amongst older adults. I will be using the MiniCog to screen for cognitive impairment, the results of which will determine whether participants may continue to participate in the study.

I am therefore writing to you to request permission to use the MiniCog for my research.

If you have any queries, please do not hesitate to contact my supervisors, Christine Rogers (christine.rogers@uct.ac.za) and Jay Chouhan (jay.chouhan@uct.ac.za).

Yours faithfully

Romy Cohen

MSc Audiology student
University of Cape Town
Email: chnrom002@myuct.ac.za
Tel: 073 073 1225

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Appendix K

Letter of Ethical Approval from the Human Research Ethics Committee

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room E53-46 Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6492
Email: sumayah.ariefdien@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

14 September 2018

HREC REF: 497/2018

Mrs C Rogers
Division of Communication Sciences & Disorders
F-45
OMB

Dear Mrs Rogers

PROJECT TITLE: INFLUENTIAL FACTORS IN DRIVING CONFIDENCE AMONGST HEARING IMPAIRED OLDER ADULTS IN CAPE TOWN (MSc Candidate - Ms R Cohen)

Thank you for your response letter dated 04 September 2018, addressing the issues raised by the Human Research Ethics Committee (HREC).

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

Approval is granted for one year until the 30 September 2019.

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

We acknowledge that the student: Miss Romy Cohen will also be involved in this study.

Please quote the HREC REF in all your correspondence.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval, where necessary, before the research may occur.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE

Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938

This serves to confirm that the University of Cape Town Human Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical Research Council (MRC-SA), Food and Drug Administration (FDA-USA), International Convention on Harmonisation Good Clinical Practice (ICH GCP), South African Good Clinical Practice Guidelines (DoH 2006), based on the Association of the British Pharmaceutical Industry Guidelines (ABPI), and Declaration of Helsinki (2013) guidelines.
The Human Research Ethics Committee granting this approval is in compliance with the ICH Harmonised Tripartite Guidelines E6: Note for Guidance on Good Clinical Practice (CPMP/ICH/135/95) and FDA Code Federal Regulation Part 50, 56 and 312.

Appendix L

Letters of Permission from Cape Hearing Aids and Kind2Hearing

Division of Communication Sciences & Disorders
School of Health & Rehabilitation Sciences
Faculty of Health Sciences
F45 Old Main Building
Groote Schuur Hospital
Telephone: 021 406 6401
Fax: 021 406 6323
Email: Christine.Rogers@uct.ac.za
Jay.Chouhan@uct.ac.za

Dear Ms. Barrow

Re: Influential Factors in Driving Confidence amongst Hearing Impaired Older Adults in Cape Town

I am currently pursuing a Master's Degree in Audiology at the University of Cape Town. As part of my degree, I am required to carry out a research study.

The study will be focusing on the various factors which may potentially influence driving confidence amongst older adults. I would like to request permission to conduct my research at the Sea Point and Gardens branches of your practice, Cape Hearing Aids.

For my study, I will be administering questionnaires which should take no longer than 10-15 minutes to complete. While they are in the waiting room, Cape Hearing Aids patients will be made aware that the audiologist is conducting a study, and they will be explicitly informed that the study has no connection to their appointment. If they are interested, they will be given an information sheet. Once their appointment is over, they will be asked if they would like to participate in the study. If so, they will sign an informed consent sheet. They will complete the Mini-Cog, which is a screening tool for cognitive impairment. If they complete the Mini-Cog successfully, they will then complete a demographics questionnaire, a hearing handicap questionnaire and a driving confidence questionnaire. I will also need to obtain the pure-tone averages of all participants. I therefore kindly request permission to review the audiograms of patients who I have tested myself at Cape Hearing Aids.

I have considered the potential inconveniences that may result from my study, in particular the use of valuable practice time. The questionnaires are very short and the patient will only be offered the forms to fill in if there is sufficient time after their appointment.

I have also considered the welfare of the patients who choose to participate in this study. There are no risks to those who participate and they may refuse to participate or withdraw from the study at any time with no consequences.

I would greatly appreciate your kind permission to conduct my research at Cape Hearing Aids.

If you have any queries, please do not hesitate to contact my supervisors, Christine Rogers and Jay Chouhan. Their email addresses can be found at the top of this page.

Yours faithfully

Romy Cohen

Division of Communication Sciences & Disorders
School of Health & Rehabilitation Sciences
Faculty of Health Sciences
F45 Old Main Building
Groote Schuur Hospital
Telephone: 021 406 6401
Fax: 021 406 6323
Email: Christine.Rogers@uct.ac.za
Jay.Chouhan@uct.ac.za

Influential Factors in Driving Confidence amongst Hearing Impaired Older Adults in Cape Town

I, the undersigned, hereby give permission for Romy Cohen to conduct the abovementioned research at Cape Hearing Aids in the fulfilment of her Masters degree in Audiology.

________________ 16.5.18

Signature Date

Appendix M

Informed Consent Sheet for Potentially Hearing-Impaired Participants

Division of Communication Sciences & Disorders
School of Health & Rehabilitation Sciences
Faculty of Health Sciences
F45 Old Main Building
Groote Schuur Hospital
Telephone: 021 406 6401
Fax: 021 406 6323
Email: Christine.rogers@uct.ac.za
Jay.chouhan@uct.ac.za

Influential Factors in Driving Confidence Among Hearing-Impaired Older Adults in Cape Town

Please tick the all of the boxes below to confirm that you have read each statement and that it is correct.

I have read and understood the information sheet provided to me.

I have had the opportunity to ask questions and have my questions answered.

I understand that my answers, my personal information and my identity will remain private and anonymous.

I understand that participation is voluntary and that I may withdraw from the study at any time without any consequences.

I have not been forced to participate in this study.

I am over the age of 18 years old and am legally able to provide consent.

I agree to participate in this study.

____________________ ____________________

Signature of participant Date

Appendix N

Letter for Participant's Doctor

Division of Communication Sciences & Disorders
School of Health & Rehabilitation Sciences
Faculty of Health Sciences
F45 Old Main Building
Groote Schuur Hospital
Telephone: 021 406 6401
Fax: 021 406 6323
Email: Christine.Rogers@uct.ac.za
Jay.Chouhan@uct.ac.za

16/07/2018

Dear Dr.

Re: [name of participant]

My name is Romy Cohen and I am a Master's degree student at the University of Cape Town. My research is looking at hearing loss and driving in older adults. Today, I requested the participation of [name of patient] in my study. To protect their rights and welfare as a potential research participant, I administered the Mini-Cog to screen for potential cognitive impairments.

The Mini-Cog consists of two tasks, namely a word recall task and a clock drawing task. For part one, I read instructions to the patient and then instructed them that they would need to remember three words. I read the words to them, and then asked them immediately to repeat them. For part two, I asked the patient to draw a clock with all the numbers in the correct place, and then set the hands to ten past eleven. For part three, I asked the patient to recall the three words read to them in step one.

A maximum of three points can be scored for the word recall, with one point being given for each word recalled without any cues. A maximum of two points can be scored for the clock drawing task, for a clock with all numbers present and in the correct position, with the hands pointing to the correct time. If the clock is drawn incorrectly or not drawn at all, no points are awarded. A total score of <3 indicates a possible need for further cognitive evaluation.

[Name of patient] obtained a word recall score of [X] and a clock drawing score of [X]. Their total score was [X], indicating the possible need for further cognitive evaluation.

Please be aware that the Mini-Cog is a screening test only and in no way attempts a formal evaluation or diagnostic process. The test was done purely to satisfy ethical concerns that patients were able to agree to participate in my research as fully autonomous individuals and to ensure that they were not vulnerable to possible exploitation.

Please would you assess the above as you see fit at [name of patient]'s next routine follow up with you.

Yours faithfully

Romy Cohen
chnrom002@myuct.ac.za

0730731225

Appendix O

Hearing Handicap Inventory for the Elderly Screening Version and Permission

Hearing Handicap Inventory in the Elderly – Screening Questionnaire*

Instructions: Answer Yes, No, or Sometimes for each question. Do not skip a question if you avoid a situation because of a hearing problem. If you use a hearing aid, please answer according to the way you hear with the aid.

	No	Sometimes	Yes
1. Does a hearing problem cause you to feel embarrassed when you meet new people?			
2. Does a hearing problem cause you to feel frustrated when talking to members of your family?			
3. Do you have difficulty hearing when someone speaks in a whisper?			
4. Do you feel handicapped by a hearing problem?			
5. Does a hearing problem cause you difficulty when visiting friends, relatives, or neighbors?			
6. Does a hearing problem cause you to attend religious services less often than you would like?			
7. Does a hearing problem cause you to have arguments with family members?			
8. Does a hearing problem cause you difficulty when listening to TV or radio?			
9. Do you feel that any difficulty with your hearing limits or hampers your personal or social life?			
10. Does a hearing problem cause you difficulty when in a restaurant with relatives or friends?			

Scoring: No = 0; Sometimes = 2; Yes = 4.

Interpretation of Total Score:
0-8 = no handicap; 10-24 = mild to moderate handicap; 26-40 = severe handicap.

** Adapted from: Ventry I, Weinstein B. Identification of elderly people with hearing problems. ASHA. 1983; 25:37-42.*

5/10/2018 Mail - CHNROM002@myuct.ac.za

Re: Master's student at the University of Cape Town seeks permission to use the HHIE-S

Weinstein, Barbara <BWeinstein@gc.cuny.edu>

Mon 2018-05-07 01:29 PM

To: Romy Cohen <CHNROM002@myuct.ac.za>;

Ronny
I grant permission. Best of luck in your work. Would love to learn of your results
Best
Barbara

Sent from my iPhone

On May 7, 2018, at 6:19 AM, Romy Cohen <CHNROM002@myuct.ac.za> wrote:

To whom it may concern

I hope this email finds you well.

My name is Romy Cohen and I am currently pursuing a Master's Degree in Audiology at the University of Cape Town. As part of my degree, I am required to carry out a research study. My study will focus on the various factors which may potentially influence driving confidence amongst older adults. As part of the study, I will be asking participants to complete the HHIE-S.

I am therefore writing to you to request permission to use the HHIE-S for my research.

If you have any queries, please do not hesitate to contact my supervisors, Christine Rogers (christine.rogers@uct.ac.za) and Jay Chouhan (jay.chouhan@uct.ac.za).

Yours faithfully

Romy Cohen

MSc Audiology student

University of Cape Town

Email: chnrom002@myuct.ac.za

Tel: 073 073 1225

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Appendix P

Driving Confidence Questionnaire

Instructions: Please rate your level of confidence when driving in the following situations on a scale of 0-10, where 0 is not confident at all and 10 is completely confident.

0 (not confident) — 5 — 10 (completely confident)

How confident do you feel:

1. Driving in your local area: ____
2. Driving in heavy traffic: ____
3. Driving in new or unfamiliar areas: ____
4. Driving at night: ____
5. Driving with passengers in the car: ____
6. Understanding and reacting to road signs/traffic signals: ____
7. Driving around a traffic circle: ____
8. Attempting to merge with traffic: ____
9. Turning right across oncoming traffic: ____
10. Planning a road trip to a new place: ____
11. Driving on the freeway at the national speed limit (120km/h): ____
12. Parallel parking: ____
13. Driving in light rain: ____
14. Driving in heavy rain: ____
15. Driving in extreme weather conditions (snow, ice, fog or mist): ____
16. Driving when there is glare or reflection from the sun: ____
17. Driving when caught in an unexpected or sudden storm: ____
18. Driving in unfamiliar routes (different areas), detours or sign changes: ____
19. Making a right-hand turn with no lights or stop signs: ____
20. Completing a right-hand turn on a yellow/red robot when already mid-intersection: ____
21. Pulling in or reversing out of tight spots in parking lots with large vehicles on either side: ____
22. When you suddenly see and need to react to off-ramp signs and street signs unexpectedly: ____
23. Driving on 2-lane highways/freeways: ____
24. Keeping up with the flow of highway/freeway traffic when the flow is over the speed limit of 120km/h: ____
25. Driving with many large trucks near you on the road: ____
26. Merging into traffic and changing lanes: ____
27. Driving when other drivers drive too close behind you: ____
28. Driving when other drivers overtake you on a solid line: ____
29. Driving when other drivers do not indicate or seem distracted: ____
30. Driving on a mountain pass: ____
31. Driving on a road with no yellow line/shoulder to pull over into: ____
32. Driving on a road with livestock or pedestrians walking nearby: ____

Appendix Q

Signed Singapore Statement

Singapore Statement on Research Integrity

Preamble. The value and benefits of research are vitally dependent on the integrity of research. While there can be and are national and disciplinary differences in the way research is organized and conducted, there are also principles and professional responsibilities that are fundamental to the integrity of research wherever it is undertaken.

PRINCIPLES

Honesty in all aspects of research

Accountability in the conduct of research

Professional courtesy and fairness in working with others

Good stewardship of research on behalf of others

RESPONSIBILITIES

1. Integrity: Researchers should take responsibility for the trustworthiness of their research.

2. Adherence to Regulations: Researchers should be aware of and adhere to regulations and policies related to research.

3. Research Methods: Researchers should employ appropriate research methods, base conclusions on critical analysis of the evidence and report findings and interpretations fully and objectively.

4. Research Records: Researchers should keep clear, accurate records of all research in ways that will allow verification and replication of their work by others.

5. Research Findings: Researchers should share data and findings openly and promptly, as soon as they have had an opportunity to establish priority and ownership claims.

6. Authorship: Researchers should take responsibility for their contributions to all publications, funding applications, reports and other representations of their research. Lists of authors should include all those and only those who meet applicable authorship criteria.

7. Publication Acknowledgement: Researchers should acknowledge in publications the names and roles of those who made significant contributions to the research, including writers, funders, sponsors, and others, but do not meet authorship criteria.

8. Peer Review: Researchers should provide fair, prompt and rigorous evaluations and respect confidentiality when reviewing others' work.

9. Conflict of Interest: Researchers should disclose financial and other conflicts of interest that could compromise the trustworthiness of their work in research proposals, publications and public communications as well as in all review activities.

10. Public Communication: Researchers should limit professional comments to their recognized expertise when engaged in public discussions about the application and importance of research findings and clearly distinguish professional comments from opinions based on personal views.

11. Reporting Irresponsible Research Practices: Researchers should report to the appropriate authorities any suspected research misconduct, including fabrication, falsification or plagiarism, and other irresponsible research practices that undermine the trustworthiness of research, such as carelessness, improperly listing authors, failing to report conflicting data, or the use of misleading analytical methods.

12. Responding to Irresponsible Research Practices: Research institutions, as well as journals, professional organizations and agencies that have commitments to research, should have procedures for responding to allegations of misconduct and other irresponsible research practices and for protecting those who report such behavior in good faith. When misconduct or other irresponsible research practice is confirmed, appropriate actions should be taken promptly, including correcting the research record.

13. Research Environments: Research institutions should create and sustain environments that encourage integrity through education, clear policies, and reasonable standards for advancement, while fostering work environments that support research integrity.

14. Societal Considerations: Researchers and research institutions should recognize that they have an ethical obligation to weigh societal benefits against risks inherent in their work.

The Singapore Statement on Research Integrity was developed as part of the 2nd World Conference on Research Integrity, 21-24 July 2010, in Singapore, as a global guide to the responsible conduct of research. It is not a regulatory document and does not represent the official policies of the countries and organizations that funded and/or participated in the Conference. For official policies, guidance, and regulations relating to research integrity, appropriate national bodies and organizations should be consulted. Available at: **www.singaporestatement.org**