

# Clinical Outcomes of the Hearing Questionnaire

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## Abstract

**Aims:** This study investigated the participation restrictions associated with hearing impairment using a modified version of the Hearing Handicap Inventory termed the “Hearing Questionnaire”. The Hearing Questionnaire features updated terminology in keeping with the current guidelines from the World Health Organization (2001a). This study aims to determine the critical change score for a New Zealand population of experienced hearing aid wearers using the Hearing Questionnaire. The researcher hypothesised that there would be no significant change in the degree of perceived participation restrictions resulting from hearing impairment in a six-week interval between administrations of the Hearing Questionnaire.

**Methodology:** The sample population for this study consisted of 52 adults with hearing impairment that had been fitted with at least one hearing aid in the last two years. All participants were current clients of Bay Audiology, the largest distributor of hearing aids in New Zealand. Each participant received a mailed study packet which included the Hearing Questionnaire and a demographic questionnaire. Participants completed a second copy of the Hearing Questionnaire after a period of approximately six weeks. A paper-pencil administration method was chosen to reflect the most common mode of administration in New Zealand according to clinician reports. The researcher performed paired t-tests and correlational analysis to identify significant differences between the scores from multiple administrations of the Hearing Questionnaire. Partial correlational analysis was used to identify possible covariates from demographic information including gender, ethnicity, relationship status, income, level of education and working status. A Shapiro-Wilk test was used to test for normality of the sample population. Finally, the critical change score for the Hearing Questionnaire was calculated.

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**Results:** No significant difference existed between the scores from the first and second administrations of the Hearing Questionnaire ( $t(51) = .63, p = .53$ ). Scores for the first and second administrations were significantly positively correlated ( $r = .62; p < .000$ ). The critical change score was 7.8 points based on a 95% confidence interval using the calculations described by Demorest and Walden (1984). No significant covariates were identified from the demographic information collected.

**Conclusions:** The degree of perceived participation restrictions associated with hearing impairment measured via the Hearing Questionnaire remains stable over a six-week period for experienced hearing aid users in New Zealand. While the critical change score for the Hearing Questionnaire is comparable to some versions of the Hearing Handicap Inventory the test-retest reliability of the Hearing Questionnaire is considerably poorer (Newman et al., 1991). The researcher concludes that refinements are required if the Hearing Questionnaire is to be used clinically in New Zealand. This study has highlighted a number of aspects of the Hearing Handicap Inventory that require updating and contributed to the collective knowledge available regarding experienced hearing aid users in New Zealand. Further research is needed to explore other potential uses of the Hearing Questionnaire such as a version for significant others as a proxy measure of participation restriction.

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### 1 Introduction

#### 1.1 Hearing Impairment

The ear is divided into four areas - outer, middle and inner ear, as well as the auditory nervous system that runs to the brain. The outer ear consists of the pinna and the external auditory canal to the tympanic membrane. The pinna serves to direct sound from the environment through the external auditory canal. The middle ear consists of the medial side of the tympanic membrane, the three ossicles (malleus, incus and stapes) and the proximal end of the Eustachian tube. The ossicles in the middle ear convert sound waves into mechanical vibrations to transfer energy to the inner ear. The inner ear includes the semi-circular canals which contain the organs of balance, and the cochleae which contain the organs of hearing. Movement of the middle ear ossicles results in vibrations in the fluid of the inner ear, which in turn move delicate hair cells in the cochlea. This activates neurons which send electrical impulses to the brain.

Hearing impairment refers to a disruption of the auditory pathway, anywhere from the pinna to the brain outside of the normal range (World Health Organization, 1980, 2001a). It is commonly thought of as an impairment that affects older adults (Erler & Garstecki, 2002; Kochkin, 2007). Indeed, approximately one-third of older adults experience a moderate to profound hearing impairment (Chang & Chou, 2007; Cruickshanks et al., 1998; Jennings & Jones, 2001; Parving, Biering-Sørensen, Bech, Christensen, & Sørensen, 1997; Uchida, Nakashima, Ando, Niino, & Shimokata, 2003). Though the prevalence of hearing impairment does increase with age, age is certainly not the only cause of hearing impairment.

A hearing impairment can be the result of a change in the structure or function of any component of the ear or nerves to the brain and is classified as conductive, sensorineural or

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mixed. Conductive hearing impairment is the result of pathologic changes to the outer- or middle-ear, preventing sound from reaching the inner-ear fluids. Sensorineural hearing impairment refers to pathologies of the inner-ear or disruption of the nervous signal being sent to the auditory cortex of the brain. A mixed hearing impairment is a combination of these two.

### **1.2 Measuring a Hearing Impairment**

There are many ways to measure hearing but each test can be classified as objective or subjective measurement. Objective measurement includes distortion-product otoacoustic emissions and auditory brainstem response audiometry. For these measures, the client does not need to actively participate; therefore results are not influenced by behavioural performance. A more commonly used practice is pure-tone audiometry, which falls into the subjective measurement category. This method involves the client indicating to the audiologist when they have heard a sound. The hearing thresholds to pure-tones of varying frequencies are determined and plotted on an audiogram as decibel hearing level (dBHL). The New Zealand Audiological Society recommends a combination of subjective and objective measurement to allow obtain a complete view of a client's hearing (New Zealand Audiological Society, 2008).

Hearing impairment can be classified by type, degree and configuration based on their audiometric results. The American Speech-Language-Hearing Association (ASHA) recommends the scale of hearing impairment devised by Goodman (1965) and modified by Clark (1981) which describes slight (15 - 25 dBHL), mild (26 - 40 dBHL), moderate (41 - 55 dBHL), moderately-severe (56 - 70 dBHL), severe (71 - 90 dBHL) and profound ( $\geq 91$  dBHL) degrees of hearing impairment.

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### 1.3 Prevalence of Hearing Impairment

#### 1.3.1 Global prevalence

Hearing impairment is undoubtedly a major health concern today, affecting adults and children alike. Recent World Health Organisation (WHO) data suggest 538 million people worldwide have a hearing impairment greater than 35 dBHL (regarded as a significant disability) (Stevens et al., 2013). The prevalence of hearing impairment is significantly higher in middle- and low-income countries than in high-income countries (Stevens et al., 2013), being most prevalent in South Asia, Asia-Pacific and Sub-Saharan Africa (World Health Organization, 2016). Despite this, hearing impairment is a global issue. It was estimated to be the third most common cause of disability in 2008 (Mathers, Fat, & Boerma, 2008) and as such represents a substantial burden on society.

It is well known that hearing impairment is more common in the older adults. In fact, it is the third most common condition affecting adults > 65 years of age (Cruickshanks et al., 1998). This is particularly important as the global population ages. Between 2012 and 2015 the global population of adults  $\geq$  65 years of age increased from 562 million (8%) to 617.1 million (8.5%) (He, Goodkind, & Kowa, 2015). This trend is expected to continue, reaching 1 billion older people (12%) in 2030 and 1.6 billion (16.7%) in 2050 (He et al., 2015). Concordantly, the prevalence of hearing impairment is expected to increase. For example, the prevalence of hearing impairment in the Australian population is estimated to rise from approximately 17% to about 28% of the population by 2050 (2006).

Hearing impairment also represents a significant monetary cost to society. Australian data estimates the financial cost of hearing impairment in 2006 to be AU\$11.75 billion (2006).

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There are no current estimates on the financial cost of hearing impairment in developing countries (Cook et al., 2006).

### **1.3.2 A New Zealand context**

In New Zealand, it is estimated that between 5.7% and 7.5% of adults ( $\geq 15$  years of age) not living in institutions have significant hearing impairment (Greville, 2005; Sanders, Houghton, Dewes, McCool, & Thorne, 2015). Unfortunately, this burden is expected to worsen as the population of New Zealand ages (Bascand, 2012; Exeter, Wu, Lee, & Searchfield, 2015).

Interestingly, Dawes et al. (2014) found males were at no higher risk of hearing impairment than females. This is in contrast to worldwide data and previous New Zealand data that show the prevalence of hearing impairment in adult males to be higher than in females (Gates, Cooper Jr, Kannel, & Miller, 1990; Greville, 2001; World Health Organization, 2016). A national census in 2001 found Māori were more likely than non-Māori to have a hearing impairment causing disability yet Māori adults were only half as likely as non-Māori to use hearing aids or other assistive devices (Greville, 2001). Affordability was the most commonly specified reason for unmet need for amplification.

With hearing impairment being such an issue and its prevalence increasing as New Zealand's and the world's population ages, it is important to understand its influence on people so effective strategies and interventions can be put into place.

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### 1.4 Subjective Measurement

#### 1.4.1 “Handicap”

##### 1.4.1.1 *Handicap is different from impairment*

The definition of “handicap”, published by WHO in 1980 is

*“a disadvantage for a given individual resulting from an impairment or a disability, that limits or prevents the fulfilment of a role that is normal (depending on age, sex, and social and cultural factors) for that individual”* (World Health Organization, 1980).

The term “handicap” does not describe physiological differences between people, but rather the social and emotional effects of a physiological difference. It is important to recognise that the degree of hearing impairment is not necessarily equal to the degree of *perceived* hearing impairment (Andersson, Melin, Lindberg, & Scott, 1995; Chang, Ho, & Chou, 2009; Mulrow, Aguilar, Endicott, Velez, et al., 1990; Newman, Weinstein, Jacobson, & Hug, 1990; Nondahl et al., 1998; Weinstein, Richards, & Montano, 1995). That is to say, a person’s hearing handicap cannot be predicted by pure-tone audiometry alone. Indeed, many studies have found only a moderate correlation between hearing handicap and hearing impairment in older adult populations (Bertoli, Probst, & Jordan, 1996; Chang et al., 2009; Jupiter & Palagonia, 2001; Weinstein & Ventry, 1983). One study found that though the degree of hearing impairment was undoubtedly related to hearing handicap, only 37% of the variance in handicap was accounted for by pure-tone hearing thresholds (Ventry & Weinstein, 1982).

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WHO have since revised their model replacing the word “disability” with “activity limitation” and the word “handicap” with “participation restriction” (World Health Organization, 2001a). The International Classification of Functioning, Disability and Health (ICF) model describes multiple components that interact to influence a person’s health and wellbeing. These interactions can be seen in Figure 1. For example, a person may have a hearing impairment due to the degradation of hair cells in the cochlea, which would fall under the title of Body Functions and Structure. This impairment may lead to difficulty understanding speech (activity limitation) and this may lead to the person avoiding social situations (participation restriction). The physical and social environment also play a role in determining the degree of perceived participation restrictions (Noble & Héту, 1994). Contextual Factors of the ICF model are divided into Environmental Factors and Personal Factors. Environmental Factors represent the person’s attitudinal, physical and social environment including their immediate environment such as home, work and school as well as societal environment including attitudes and ideologies. Personal Factors are not classified in the ICF model but this model recognises the impact that gender, race, age, and lifestyle can have on an individual’s health.

Though a person may have elevated pure-tone thresholds, they may not report any participation restrictions in their everyday lives, whether this be because they do not feel handicapped or because they do not wish to acknowledge a problem with their hearing (Wallhagen & Pettengill, 2008; Weinstein et al., 1995). Evidently, there is more to hearing-related health than pure-tone thresholds alone. An individual’s lifestyle, communication partners, physical environment and societal pressure are just a few of the elements that determine a person’s health. In turn, there are many factors that influence help-seeking for a hearing problem.

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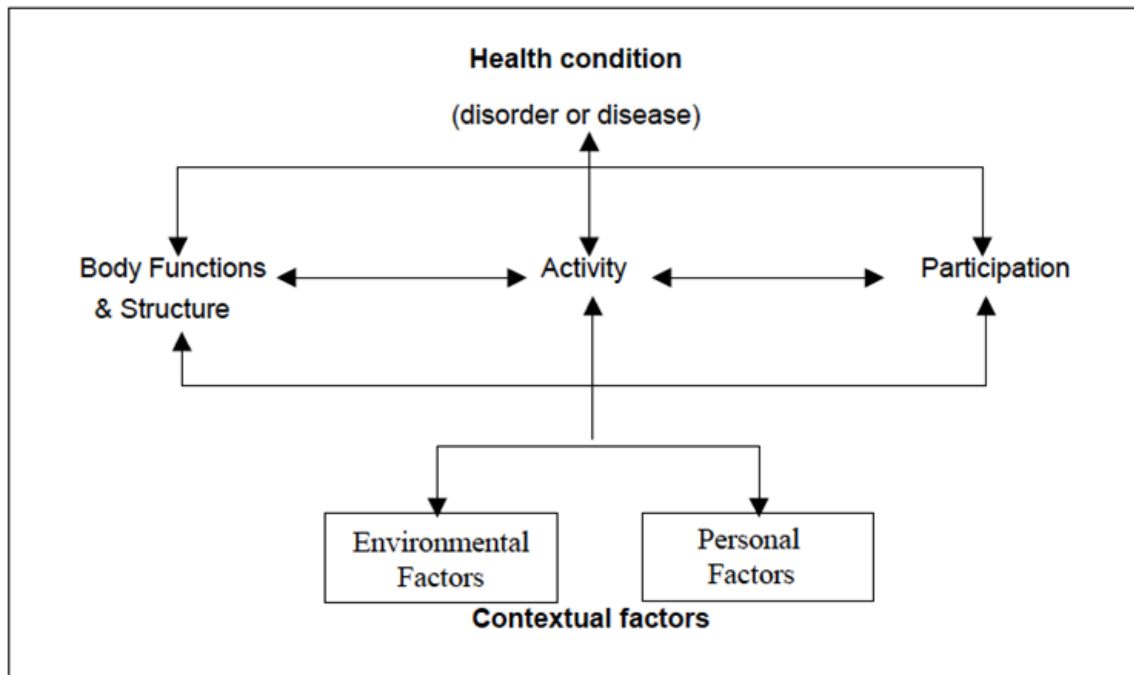


Figure 1: The World Health Organization ICF model (World Health Organization, 2001a)

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#### 1.4.1.2 Help-seeking

The prevalence of hearing impairment increases with age (Jennings & Jones, 2001; Ji-Su, 2015; Wilson et al., 1999; World Health Organization, 2016), though the probability of reporting a hearing impairment decreases with age (Wiley, Cruickshanks, Nondahl, & Tweed, 2000). Indeed, studies have found that older adults waited approximately eight to ten years before seeking audiologic assistance (Brooks, 1979; Davis, Smith, Ferguson, Stephens, & Gianopoulos, 2007; Weinstein, 1989). Many studies have noted the low rate of hearing aid use among people with significant hearing impairment (Greville, 2001; Kochkin, 1999). This is because there are many barriers to seeking help regarding a hearing impairment. Common reasons for this delay in help-seeking include not recognising a slowly progressing hearing impairment, an unwillingness to accept a hearing impairment because of the stigma still associated with hearing impairment, or even being advised that their hearing impairment is

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not severe enough to be worthy of attention (Brooks, 1979; Kochkin, 2007; Southall, Gagné, & Jennings, 2010; Southall, Gagné, & Leroux, 2006).

Kochkin (2007) describes three occurrences that prelude seeking help regarding hearing impairment. First, the individual must recognise the existence of a hearing impairment. Second, the individual must decide that the hearing impairment is problematic to some degree. Third, any potential therapy or solution must be viewed as less costly to the individual than the hearing impairment itself. This is consistent with the findings of Southall et al. (2010) who identified three themes present in the help-seeking process. Initially the participants of this study described a build-up of negative stress in the first few years after an individual recognises they have a hearing impairment. During this time, it was noted that people felt frustrated and stressed because of negative societal attitudes; lack of understanding from friends, family and co-workers; and lack of knowledge about their own hearing and where to seek help. This build-up of stress was followed by social and occupational interactions becoming increasingly difficult (activity limitations). This would lead to withdrawal (participation restrictions) and a state of depression until the level of stress became unmanageable. This juncture served to trigger help-seeking in these individuals.

Intuitively, this behaviour makes complete sense – a person does not seek help because of a hearing impairment, they seek help because of how a hearing impairment limits their abilities (Knudsen, Öberg, Nielsen, Naylor, & Kramer, 2010). For example, a person who cannot understand their friends in a bar or restaurant will begin to attend these social occasions less readily, which may affect their relationships and psychological wellbeing. Indeed, difficulty understanding speech in the presence of background noise and trouble understanding the television or radio are two of the most commonly reported activity limitations experienced by individuals with hearing impairment (Cox & Alexander, 1995; Kochkin, 2010; Stark & Hickson, 2004; Stephens & Zhao, 1996).



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Despite the advantages of hearing aids, many people are still hesitant to seek professional help regarding their hearing. There is a tendency to underestimate the significant negative consequences associated with hearing impairment (Sprinzl & Riechelmann, 2010; Wiley et al., 2000). These negative consequences involve not only the person with hearing impairment, but their friends and family too. In fact, Mahoney, Stephens, and Cadge (1996) found that pressure from family members was the most important factor influencing help-seeking behaviour in older adults with hearing impairment. These findings are consistent with a longitudinal study which found 50% of help-seekers were advised to seek care from significant others (Cameron, Leventhal, & Leventhal, 1993). It is only when the activity limitations and participation restrictions become too much of a strain on a person's quality of life and the lives of those closest to them that a person will seek help from an audiologist.

### **1.4.2 Quality of life**

There are many definitions of quality of life. There is widespread agreement that quality of life is multidimensional and complex, with many influences and of course individual variation. Felce and Perry (1995) describe five domains relevant to quality of life, each with multiple subcategories: physical wellbeing, material wellbeing, social wellbeing, emotional wellbeing, and development and activity. Hearing impairment can affect each of these quality of life domains. Indeed, many studies have demonstrated a significant association between hearing impairment and decreased cognitive function and depression independent of age and education level (Cacciatore et al., 1999; Naramura et al., 1999; Valentijn et al., 2005). Adults with a mild degree of hearing impairment have reported greater perceived activity limitations and a reduction in emotional wellbeing compared to normal-hearing study participants (Monzani, Galeazzi, Genovese, Marrara, & Martini, 2008).

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Interestingly, a number of studies have found hearing impairment had no or only moderate effects on mental health and subjective wellbeing (Jones, Victor, & Vetter, 1984; Mulrow, Aguilar, Endicott, Velez, et al., 1990; Stewart, 2001; Wallhagen, Strawbridge, Shema, Kurata, & Kaplan, 2001) though it should be noted that much data on mental health is based on small sample of people. However, people experience degrees of hearing impairment very differently (Manchaiah & Freeman, 2011). In their study, Ventry and Weinstein (1983) found people with mild degrees of hearing impairment reported greatly differing degrees of participation restrictions via the Hearing Handicap Inventory of the Elderly (HHIE; Ventry & Weinstein, 1982).

Perhaps then, participation restrictions are more relevant to a person's quality of life than hearing impairment. Supporting this, Tambs (2004) found self-reported hearing impairment was more closely related to depression than was measured hearing thresholds. Undoubtedly, participation restrictions due to hearing are strongly related to decreased quality of life (Dalton et al., 2003; Gopinath et al., 2012; Kelly-Campbell & Atcherson, 2012; Mulrow, Aguilar, Endicott, Velez, et al., 1990). It has been shown to have a multitude of harmful effects including social isolation (Chia et al., 2007; Mulrow, Aguilar, Endicott, Velez, et al., 1990; Weinstein, 1989; Weinstein & Ventry, 1982), depression (Keidser, Seeto, Rudner, Hygge, & Ronnberg, 2015; Weinstein, 1989), and negative effects on significant others (Armero, 2001; Hetu, Jones, & Getty, 1993; Worrall, Donaldson, & Hickson, 2004).

Gopinath et al. (2012) found older adults with significant participation restrictions are at an increased risk for decreased quality of life. The authors go on to suggest addressing these participation restrictions could be valuable for preventing the reduction in quality of life in this population. This could be achieved with educational programmes on hearing impairment and communication which have been shown to decrease HHIE scores previously (Hickson & Worrall, 2003; Hickson, Worrall, & Scarinci, 2007).

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Restoration of auditory stimulation has also been shown to improve quality of life for individuals with hearing impairment (Chisolm et al., 2007; McArdle, Chisolm, Abrams, Wilson, & Doyle, 2005; Mulrow, Aguilar, Endicott, Tuley, et al., 1990; Vuorialho, Karinen, & Sorri, 2006). Olze et al. (2012) found cochlear implantation provided increased quality of life, reduced tinnitus and reduced stress even for patients over the age of 70 years. Similarly, Mulrow et al. (1990) found hearing aids improved the social, emotional and communicative functions of older adults with hearing impairment and significantly reduced levels of depression over a four-month period. These results were comparable to a later study showing improved quality of life and reduced levels of depression over a one year period of hearing aid use (Mulrow, Tuley, & Aguilar, 1992). Questionnaires such as the HHIE are one tool used by hearing specialists to identify and quantify a person's participation restrictions and activity limitations in order to best reduce them (Ventry & Weinstein, 1982). These tools help audiologists to understand the effect of a hearing disorder on a person's quality of life so that any intervention can be tailored to their client.

### **1.4.3 Client-centred care**

When measuring the success of any endeavour, it is important to consider the goal. As immediately obvious as this may seem, the matter is complicated by differing views on what the goal of amplification is. In recent years there has been a shift from clinicians' focus on the disorder to the person (DeJong & Sutton, 1995). That is to say, where once the goal of amplification was to restore lost hearing sensitivity and audibility of speech sounds, the current goal of amplification (for an adult at least) is generally considered to be to provide improvements to the client's quality of life. This philosophy has accompanied the idea of client-centred care.

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When employing the traditional practitioner-centred approach to health care, the balance of power between client and clinician lays toward the clinician. The clinician prescribes treatments that are passively accepted by the client (Mead & Bower, 2000). Client-centred care, otherwise known as patient-centred care, revolves around the idea that each client is unique (Rogers, 1951). In contrast to the practitioner-centred approach, client-centred care involves encouraging clients to be active in their own rehabilitation. In the area of health care, this holistic approach to treatment is associated with greater client satisfaction, improved adherence to treatment and better overall health outcomes compared to less client-centred interaction (Krupat et al., 2000; Michie, Miles, & Weinman, 2003; Ong, De Haes, Hoos, & Lammes, 1995).

There are many advocates for client-centred care in audiology (English, 2005; Gagne & Jennings, 2011; Grenness, Hickson, Laplante-Lévesque, & Davidson, 2014a; Laplante-Lévesque et al., 2012). Indeed it is considered the most ethical way to practice health care (Goodyear-Smith & Buetow, 2001). Despite this, client-centred care in audiology remains an under-researched field (Grenness, Hickson, Laplante-Lévesque, & Davidson, 2014b).

### **1.4.4 Successful intervention**

Even if a person seeks professional help regarding their hearing, the recommended therapy or intervention may not be entirely successful. This is because success of amplification is a complex subject. As previously mentioned, the goal of amplification has shifted from the disorder to the person and as such, three measures are commonly used to determine the success of amplification: hearing aid usage, benefit and satisfaction (Dillon, Birtles, & Lovegrove, 1999; Gatehouse, 1994; Huch, 1999; Jerram & Purdy, 2001).

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Hearing aid usage is believed to be a poor measure of success for several reasons. First, self-reported use is not necessarily the same as actual usage time (Brooks, 1981). There is also only a weak correlation between usage time and self-assessed benefit or satisfaction (Dillon, James, & Ginis, 1997; Dillon et al., 1991; Oja & Schow, 1984) and usage is more highly correlated with degree of hearing impairment than subjective benefit (Hutton, 1983).

Satisfaction and subjective benefit, on the other hand, are more useful measures of hearing aid fitting success and are highly correlated with each other (Dillon et al., 1997). Indeed, Kapteyn (1977) found that hearing aid benefit accounted for nearly 40% of the variance in users' ratings of satisfaction.

### ***1.4.4.1 Benefit***

One definition of hearing aid benefit is the difference between aided and unaided performance on a particular task (Weinstein, 1996). Benefit may be measured in an objective fashion, such as with speech recognition assessment (Taylor, 1993), or in a subjective fashion, using questionnaires such as the HHIE (Newman & Weinstein, 1988).

Objective measures of benefit do have their advantages. Speech recognition scores allow clinicians to calculate the change in speech understanding following amplification with a known reliability (Dillon et al., 1997). It is well established that amplification can provide improvements to the audibility of sounds including speech. Recall that poor speech understanding in noise is one of the most common activity limitations that drive people to seek help with their hearing (Cox & Alexander, 1995; Kochkin, 2010; Stark & Hickson, 2004; Stephens & Zhao, 1996). Therefore, measuring a change in speech recognition scores is a valuable tool for validation (Mendel, 2007). However, many audiologists do not include speech recognition testing as an objective measure of hearing aid benefit (Martin, Champlin, & Chambers, 1998). Instead audiologists commonly rely on probe microphone measurements

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and prescription targets together with feedback from the client to determine fitting success (Martin et al., 1998).

However; standardised objective testing has its drawbacks too. For one, assessment conditions have a strong impact on the results. The signal-to-noise ratio (SNR) is very important when assessing speech understanding. Situations with a higher SNR will make it easier to understand speech than situations with a poorer SNR (Cox & Alexander, 1991). A person will encounter many different environments in their everyday life with a range of SNRs, so it stands to reason that speech recognition be assessed at a range of SNRs in the audiologist's clinic when attempting to determine the degree of objective benefit following amplification. However, the audiologist is unlikely to know which range of SNRs is appropriate for their client, not to mention the process of testing many different situations is very time consuming.

Moreover, any benefit to speech understanding measured in a clinic cannot reliably predict the daily real-world benefit a person will experience (Cox & Alexander, 1992; Walden, Demorest, & Hepler, 1984). This has been demonstrated by the weak to moderate correlations between objective and subjective measures of hearing aid benefit (Cox & Alexander, 1992; Haggard, Foster, & Iredale, 1981). Taylor (1993) found that though audiometric measures of benefit remained constant over a one-year period, the study participants (all novice hearing aid wearers over the age of 64 years) experienced significant fluctuations in their emotional and social wellbeing (measured via the HHIE).

In-keeping with a client-centred approach to patient care, the outcome of amplification is now determined by objective measures combined with subjective assessments (American Speech-Language-Hearing Association, 1997). Questionnaires such as the HHIE and Hearing Handicap Inventory for Adults (HHIA; Newman et al., 1990) are often used to assess any

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change in a client's emotional and social wellbeing. These combined measures of benefit allow for a more holistic view of the success of a hearing aid fitting (Humes, 1999).

### *1.4.4.2 Other factors related to amplification success*

#### **1.4.4.2.1 Clients' satisfaction with amplification**

Satisfaction is another key element of fitting success and is often used as an outcome measure (Cox & Alexander, 1999; Dillon et al., 1999; Kochkin, 2000a). Satisfaction with amplification has many components including, but not limited to, the hearing aids themselves (i.e. hearing aid benefit) and how the client feels with the audiologist and the service they have provided (Cox & Alexander, 1999, 2001; Dillon et al., 1997). Satisfaction is also highly positively correlated with subjective benefit (Dillon et al., 1997).

Walden et al. (1984) have noted that it is common for clients to overstate their difficulties when first seen by the clinician and overstate any improvement at the final evaluation. This is likely to ensure their difficulties are taken seriously and to show their appreciation for the clinician's help. This behaviour may lead to the client's level of satisfaction with amplification being overestimated. Indeed, a significant proportion of hearing aid owners report being dissatisfied with them (Kochkin, 2000b, 2005). This is important because dissatisfaction with hearing aids can often result in their disuse (Polonenko et al., 2010).

#### **1.4.4.2.2 Clients' expectations**

Many studies have explored the relationship between expectations and outcome in regard to amplification (Cox & Alexander, 2000; Jerram & Purdy, 2001; Kricos, Lesner, & Sandridge, 1991; Meister, Walger, Brehmer, von Wedel, & von Wedel, 2008; Saunders, Lewis, & Forsline, 2009). Researchers have postulated that unrealistic expectations may contribute to a client's dissatisfaction with hearing aids and ultimately their disuse. It is therefore necessary

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for the audiologist to identify and manage their clients' needs and expectations. Schum (1999) explored the relationship between the expected and perceived benefit from hearing aids in a sample of new and experienced hearing aid users. Consistent with the results of other studies, novice users had high expectations for speech understanding in quiet and in noise (Cox & Alexander, 2000; Kricos et al., 1991; Meister et al., 2008). Experienced users however, acknowledged their performance with hearing aids was likely to be better in quiet than in noise. This is a critical area for counselling on realistic expectations given that speech understanding in noise is one of the most common reasons for help-seeking in individuals with hearing impairment (Cox & Alexander, 1995; Kochkin, 2010; Stark & Hickson, 2004). Schum (1999) also found that expectations for hearing aid benefit were, on average, higher than that actually achieved, a finding consistent with that of Saunders et al. (2009) and Cox and Alexander (2000).

Interestingly, many studies have shown a positive relationship between expectations and a favourable outcome (Cox & Alexander, 2000; Cox, Alexander, & Gray, 2007; Jerram & Purdy, 2001). That is to say, participants with higher expectations from their hearing aids reported greater benefit from amplification than those with lower expectations. Despite this correlation, it is not recommended that audiologists raise their clients' expectations as much as possible. This is for a number of reasons. First, it should be noted that the results of some of these studies were based on a small sample size. For example, the study by Cox and Alexander (2000) involved 31 participants between the age of 46 to 87 years, 29 of which were male. This may limit the degree to which these results can be generalised to a wider population. Second, it has not been conclusively demonstrated that higher expectations *cause* a better outcome. In all likelihood, personality plays a strong role in the level of benefit and satisfaction reported (Cox, Alexander, & Gray, 1999). As yet, it is unclear whether pre-fitting expectations regarding hearing aids has a direct effect on self-assessed benefit, with some



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studies showing no relationship (Bentler, Niebuhr, Getta, & Anderson, 1993; Gatehouse, 1994) and others showing a significant relationship (Cox & Alexander, 2000; Schum, 1999).

Counselling prior to hearing aid fitting is the most common recommendation for managing expectations of clients. However, this approach appears to have a small if any effect on the attitudes or expectations of novice hearing aid wearers (Norman, George, & McCarthy, 1994; Saunders et al., 2009). Saunders and Forsline (2012) found that pre-fitting counselling can significantly improve hearing aid use and satisfaction; however, the authors recommend a counselling session at least a few weeks after hearing aid fitting. This recommendation is supported by the findings of Vuorialho et al. (2006) who showed hearing aid use increased and activity limitations and participation restrictions (measured via the Hearing Handicap Inventory for the Elderly – Shortened Version (HHIE-S; Ventry & Weinstein, 1983) decreased when counselling was provided six months after fitting hearing aids. The rationale behind post-fitting counselling being that the client has knowledge of the hearing instrument and problems associated with listening in certain situations and is therefore more motivated and better able to understand any solutions provided in the counselling session. Saunders and Forsline (2012) report that participants in their study particularly appreciated counselling on communication strategies, a topic that is not often covered by practicing audiologists (Stika & Ross, 2006). Applying these counselling strategies in audiological practice may limit clients' unrealistic expectations and improve clients' satisfaction with hearing aids.

### **1.4.4.2.3 Clients' ability to manage their aids**

Many studies have identified the hearing aid user's ability to manage their aids as a significant contributor to the disuse of hearing aids (Baumfield & Dillon, 2001; Hickson, Hamilton, & Orange, 1986; Humes, 2006; Kochkin, 2000b, 2010). This highlights the importance of adequate counselling on hearing aid use and maintenance. Desjardins and Doherty (2009) found that over half of the experienced hearing aid users in their study could

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not adequately clean their hearing aids or use the telephone with their hearing aids in. Despite this, 96% reported that they could use their hearing aids well, and 88% reported they could clean their hearing aids well. The obvious disparity between clients' perceived ability to manage their hearing aids and their actual ability is likely to contribute to a client's dissatisfaction with the hearing aid when it begins to fail due to poor maintenance.

One study found clinicians spent an average of 45 minutes throughout the entire trial period explaining how to use and care for hearing aids (Kochkin, 2005). This is a brief amount of time considering how much there is to learn and how important it is to have these skills. For clients with poor working memory, this becomes even more of a challenge (Salthouse, 1990). This may explain why more older hearing aid users report the need for hearing aids to be easily manipulated than younger users (Meister & von Wedel, 2003).

### **1.4.4.2.4 Clients' experience with amplification**

Experience with amplification is also related to benefit and satisfaction. Cox and Alexander (1992) found that experienced hearing aid wearers gained greater benefit than did first-time wearers for both objective and subjective measures over a ten-week period. These results suggest that experience using hearing aids has a significant effect on the client's performance with amplification and presumably their satisfaction with them. However; the authors did note that previous hearing aid experience was not as important as degree of hearing impairment when determining the results of objective measures. It should be noted that the pool of participants in this study may have been subject to self-selection bias. The fact that they are experienced hearing aid wearers suggests these participants are already advocates of amplification and are convinced of the benefits it can provide. Conversely, some of the participants in the novice group had negative opinions regarding hearing aids when the study had ended and may reject amplification due to lack of perceived benefit.

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### 1.4.5 Self-Assessment

Benefit and satisfaction are two of the most useful measures of success when it comes to hearing aid fitting (Dillon et al., 1997). However, since the outcome of a hearing aid fitting is such a complex issue, an audiologist cannot simply ask

*“How satisfied are you with your hearing aids?”*

Any single answer given by the client would be too vague to be useful to the clinician. Instead, both benefit and satisfaction can be measured via questionnaires (Erdman, 1993). These questionnaires come in standardised or individualised forms.

The 64-item Hearing Aid Performance Inventory (HAPI; Walden et al., 1984) and its abbreviated 25 item version, the Shortened Hearing Aid Performance Inventory (SHAPI; Dillon, 1994), are examples of a measurement tools for subjective benefit. These standardised questionnaires were designed to assess the effectiveness of amplification in a range of listening situations typical of those encountered in everyday life. Clients are asked to rate their performance after amplification on a five-point scale for each of the situations given. Benefit is referred to as the difference in perceived performance following amplification.

The HHIE (Ventry & Weinstein, 1982) is a 25-item questionnaire with emotional and situational subscales designed to assess the participation restrictions and activity limitations of individuals aged 65 years and above. Clients are asked to answer a predetermined list of questions about how their hearing affects their lives and are scored based on how often they have difficulty. Though Ventry and Weinstein (1982) did not originally intend for the HHIE to be used as an outcome measure, it is commonly used in this way (Humes, 1999; Newman & Weinstein, 1988).

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The Satisfaction with Amplification in Daily Life (SADL) developed by Cox and Alexander (1999) is one of the only standardised questionnaires that measures hearing aid satisfaction. Though clients are never asked to rate satisfaction directly, four subscales are used to assess hearing aid satisfaction in general (Cox & Alexander, 2001): positive effect, service and cost, negative features and personal image. Clients are asked to rate their hearing aids on a seven-point scale for each of the 15 predetermined items.

While standardised questions provide the advantage of comparison between populations, there may be some questions that are not applicable to every client. The Client Oriented Scale of Improvement (COSI) is a method of directly assessing benefit for situations specific to each client (Dillon et al., 1997). Clients are asked to identify up to five listening situations in which they would like better hearing. Any benefit perceived by the client is rated after the provision of amplification. Having the client identify their own areas of difficulty ensures the items are relevant to each and every client (Dillon et al., 1997).

In the field of audiology, perceptions are undeniably important whether it be the perception of sound itself; cosmetic concerns related to hearing instruments; or the degree of hearing impairment a person believes themselves to have. To measure the success of an intervention, audiologists must somehow learn the opinion of their clients and determine if a particular intervention (such as hearing aids) are meeting their clients' needs. Self-assessment questionnaires are a useful method of investigating perception and are commonly used for rehabilitative planning or assessing the effectiveness of a rehabilitative tool such as hearing aids (Armero, 2000; Dillon et al., 1997).

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### 1.4.6 Other-Assessment

#### 1.4.6.1 *Use of proxy measures*

Questionnaires such as the Hearing Handicap Inventory for the Elderly Spouse version (HHIE-SP; Newman & Weinstein, 1988) are often used as proxy measures of participation restrictions and activity limitations for an individual with hearing impairment (Armero, 2000; Hoover-Steinwart, English, & Hanley, 2001; Huch, 1999; Kamil & Lin, 2015; Wallhagen, Strawbridge, Shema, & Kaplan, 2004; Weinstein, 1996). That is to say, the spouse or significant other would describe the impact of a hearing impairment on the life of the person with hearing impairment regardless of whether the significant other had a hearing impairment themselves.

Proxy measures can be used as a counseling tool. Indeed, they are an effective method of measuring congruence between couples (Preminger & Meeks, 2010) for use in counseling. For instance, a husband who underestimates their wife's activity limitations and participation restrictions may be less inclined to encourage help-seeking behaviour or employ effective communication strategies. This is important as research has shown that support from family members increases the likelihood of a positive outcome for individuals with hearing impairment (Miller, 1983; Schow & Nerbonne, 1982). Further, the level of family support and pressure from family members is an important motivator for individuals with hearing impairment to seek help in the first place (Mahoney et al., 1996). This in turn may benefit both parties. Indeed, a number of studies have reported benefits of hearing aids to both the people with hearing impairment and their significant others (Brooks, Hallam, & Mellor, 2001; Jerger, Chmiel, Florin, Pirozzolo, & Wilson, 1996; Mulrow, Aguilar, Endicott, Tuley, et al., 1990; Stark & Hickson, 2004).

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Proxy measures have also been used as a tool for measuring hearing aid benefit. A modified version of the HHIE was used in the study by Jerger et al. (1996) to investigate the perceptions of significant others. The significant others completed the questionnaire in addition to the person with hearing impairment before and after the provision of hearing aids and/or assistive listening devices. This is not how the HHIE was intended to be used but offers important insight into the perceptions of significant others.

### *1.4.6.2 Use of third-party disability measures*

Hearing impairment does not affect just those with the impairment but also those to whom they are close. This is recognised in the World Health Organization's current ICF model as third-party disability (World Health Organization, 2001a). The effect of hearing impairment on significant others has recently come under investigation and it is now well established that close friends and family may experience confusion, sadness, irritation, loneliness and embarrassment in relation to their significant other's hearing impairment (Armero, 2001; Brooks et al., 2001). Both the person with hearing impairment and their partner can feel frustrated at the lack of communication (Kelly-Campbell & Parry, 2014; Scarinci, Worrall, & Hickson, 2009b). Spouses have even been described as "victims" (Armero, 2001) and "intermediaries" (Brooks et al., 2001). Indeed, Armero (2001) noted that significant others and close family members were more than twice as likely to complain of reduced social activities than the person with hearing impairment. Scarinci et al. (2009b) reported that the spouses of people with hearing impairment experience significant activity limitations and participation restrictions.

Much of the literature concerning the impact of hearing impairment on significant others is focused on older, retired couples; however, it is important to consider the needs of younger couples as they may have a different perspective and differing needs to older adults. Rice,

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Jones, Kyle, and Wood (1988) found that 40% of the participants aged 20-60 years described their relationship with their partner who has hearing impairment to be “less personal” because of the hearing impairment, with intimate talking and joking being “not worth the effort”.

Morgan-Jones (2001) describes some of the many roles the significant other may take on to compensate for their partner’s hearing impairment including interpreter, mediator and buffer. All of which place extra strain on the personal relationship and extra stress and effort for the significant other.

The World Health Organization ICF model recognises the substantial impact that hearing impairment has on the close friends and family of individuals with hearing impairment (World Health Organization, 2001a). However there are few questionnaires designed to measure activity limitations and participation restrictions of frequent communication partners. Two that exist are the Significant Other Scale for Hearing Disability (SOS-HEAR; Scarinci et al., 2009a) and the Hearing Impairment Impact-Significant Other Profile (HII-SOP; Preminger & Meeks, 2012).

The SOS-HEAR is a 27-item scale designed to measure third-party disability of spouses of individuals with hearing impairment. The questionnaire has good test-retest reliability and internal consistency (Cronbach’s alpha for total scale = .94) (Scarinci et al., 2009b) and was validated with 100 spouses in Australia (Scarinci et al., 2009a). Items for the questionnaire were based on a single earlier study by the same authors (Scarinci, Worrall, & Hickson, 2008). The SOS-HEAR features six subscales: communication changes; communicative burden; relationship changes; going out and socialising; emotional reactions to adaptations; and concern for the partner.

The HII-SOP is a 20-item scale validated on 82 spouses in America (Preminger & Meeks, 2012). The authors report that the questionnaire has good internal consistency (Cronbach’s

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alpha for total scale = .927) and test-retest reliability ( $r = .90$ ). Items for the HII-SOP were developed based on a number of studies involving both young and older adults. The questionnaire includes three subscales: Communication Strategies, Relationship and Emotions, and Social Impact. Preminger and Meeks (2012) also report the critical difference score for the HII-SOP. This is crucial when using this questionnaire as an outcome measure for audiological rehabilitation (Demorest & Walden, 1984).

### **1.5 Selecting a Measurement Tool**

#### **1.5.1 Technical Considerations - Test-retest Reliability & Stability**

Careful selection of a questionnaire is important. For a measurement tool to be effective it must be reliable, valid, appropriate, have adequate test-retest stability and be used for its intended purpose on its intended target population (Chisolm, Abrams, McArdle, Wilson, & Doyle, 2005; Hyde, 2000). If a tool does not meet these criteria then a clinician must be aware of its limitations and generalisability before drawing conclusions from the results.

Reliability represents the reproducibility of results. There are a number of different domains of reliability that must be considered when designing a measurement tool. Internal consistency is the degree to which a group of items focuses on a single construct and is commonly measured using Cronbach's alpha coefficient (Hyde, 2000; Peterson, 1994). It is generally accepted that a tool is considered to be internally consistent if it has an alpha value greater than .6 (Mitchell & Jolley, 2012). However, Carmines and Zeller (1979) recommend a Cronbach's alpha value of .8 for widely-used scales.

Test-retest reliability is another domain of reliability that warrants consideration. This refers to the relationship between multiple presentations of the same scale over a period of time, indicating the proportion of the total variance that can be attributed to the subjects alone



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(Hyde, 2000). Nunnally (1978) suggests a correlation coefficient value of at least .8 is necessary to be deemed reliable. This is where the interval between test and retest is crucial. Too short an interval and memory effects begin to affect results. Conversely, too long an interval may bring other factors into the equation and affect the reliability of the test (Hyde, 2000).

Even with no measurement error, a sufficiently long interval between test and retest measurements will produce a change in the measured characteristic due to “instability” (Heise, 1969). The length of this interval depends on the situation (Hyde, 2000). Reducing the interval between test and retest measurements could increase the test-retest stability but this is not always practical for clinical application (Heise, 1969; Hyde, 2000). A treatment outcome measure should have adequate test-retest stability to be useful for clinical or research purposes (Chisolm et al., 2005; Humes, 2001).

Validity can be defined by the “extent to which a measure reflects what it is intended to measure” (Hyde, 2000, p. 11) however; it can also refer to whether the use to which the tool is put is valid. That is to say, validity can indicate the appropriateness of the scale for the purpose it is being used (Nevo, 1985). It is vital to consider the normative population when applying any set of scales. If the items on a questionnaire are not appropriate for the intended population, then the results will not be useful. For example, an item regarding a person’s performance in the workplace would not be appropriate for a population of retirees.

Standardised questionnaires such as the HHIE have the potential to include irrelevant items. This is a problem as answers to these irrelevant questions are often weighted equally to those that are more important to the client, thereby affecting the validity of the questionnaire (Dillon et al., 1997). Irrelevant items are also time-consuming and may decrease the client’s confidence in any conclusions drawn from the measure. A solution to the problem of

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irrelevance is individualised questionnaires such as the COSI, for which the client identifies three to five situations where they desire better hearing. This ensures every item is important and relevant to each client. The COSI is at least as reliable and valid as other popular questionnaires such as the HHIE (Dillon et al., 1997).

When a questionnaire is not reliable, valid, appropriate, used for its intended purpose, and on its intended target population the questionnaire becomes unsuitable for use (Hyde, 2000). The Hearing Performance Inventory (HPI) developed by Giolas, Owens, Lamb, and Schubert (1979) was designed to measure hearing aid benefit for older adults using pre- and post-fit administrations. The questionnaire had 158 items, a number of which were not relevant to many older adults' lifestyle. Importantly, the HPI was not standardised on exclusively older adults and though significant changes were noted for situational items, the questionnaire was not sensitive to emotional changes in study participants. For these reasons, the HPI has since been updated to a 90 item questionnaire (Lamb, Owens, & Schubert, 1983).

### ***1.5.1.1 Measurement across Administration Method***

How a questionnaire is administered is another factor that warrants consideration when measuring an outcome (Cox, 2003). Two common methods of administering a questionnaire are the paper-pencil method and the face-to-face method. The paper-pencil method involves the individual answering written questions by writing their own responses. The face-to-face method is one whereby an interviewer will ask questions and the interviewee will answer them in a similar manner (usually verbally) (Newman & Weinstein, 1989). Both methods have their advantages. The paper-pencil method ensures that questions are delivered in the same manner to every individual; they are inexpensive and can be administered to many people at once. This can be greatly beneficial when gathering information from many clients in a busy clinic waiting room. Face-to-face administrations, on the other hand, allow for

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greater flexibility (Newman & Weinstein, 1989). They permit the clinician to ask follow-up questions for given answers and may allow the clinician to explain aspects of a question to ensure the client understands before answering. The clinician also has a chance to establish a rapport with the client which can be useful in a clinical practice (Noble, 1979). Face-to-face administrations are often more time-consuming, however, and may require the clinician to be specially trained.

Studies have used each of these methods to administer their questionnaires over the years and sometimes a combination. For example, Dillon et al. (1997) used a “supervised self-administration” method for the HHIE in their study which involved a few questions being administered by the clinician, the next few being self-administered but with supervision from the clinician, and the rest self-administered with no supervision.

Importantly, the HHIE and the HHIA were designed to be administered in a face-to-face style. However, this is not always practical in a busy clinical setting or a research study as it takes time and requires the client to be present at the clinic. For these reasons, questionnaires are often completed in a paper-and-pencil style in a clinic waiting room. Indeed, in multiple studies the HHIE is administered face-to-face initially then mailed to the client after a certain period of time (Malinoff & Weinstein, 1989b; Newman & Weinstein, 1989; Newman, Weinstein, Jacobson, & Hug, 1991; Weinstein, Spitzer, & Ventry, 1986). In these cases, not only is the administration method different to how it was intended, but it is also inconsistent between administrations.

Importantly, the confidence intervals for detecting a significant clinical change vary depending on whether the HHIE is administered in a paper-pencil format by the client or in a face-to-face format by the clinician. Weinstein et al. (1986) found the 95% confidence interval for the HHIE was 19 points when administered by the clinician but increased to 36

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points when administered in a paper-pencil format. This goes to show that when designing a questionnaire, collecting data and interpreting the results it is important to consider the method of administration and its effect on those results. Only then can one be sure that any change observed from one administration to the next is a true change and not simply a consequence of varying the administration method (Weinstein et al., 1986).

### *1.5.1.2 Measurement over Time*

When measuring the benefit provided by amplification, a baseline score can be measured prior to intervention, then a second measurement taken after intervention. The Hearing Handicap Inventory is often used this way to assess the effect of amplification on participation restrictions (American Speech-Language-Hearing Association, 1997). A potential disadvantage of administering a questionnaire before and after the provision of amplification is that the random measurement errors associated with each administration are likely to be independent of one another (Dillon et al., 1997). This means the uncertainty of benefit from amplification may be as large as the benefit measured. For this reason, a crucial factor in test-retest studies is, of course, the interval between test and retest measurements. Too short a duration will increase the likelihood of memory effects influencing the outcome; whereas too long an interval may result in factors other than amplification influencing the outcome. Nunnally (1978) counsels caution when using the test-retest method to establish reliability due to these memory effects but it is commonly used nonetheless.

Questionnaires have been administered over many different time intervals. Some studies use a short interval of three to six weeks, while others have opted for six months to three years. Malinoff and Weinstein (1989b) administered the HHIE before and after the first three weeks of hearing aid use and found a significant reduction in participation restrictions over this period. The authors did speculate that this initial reduction in participation restrictions may be

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partly reflect the participants' enthusiasm for their hearing aids and that reported participation restrictions may increase again as the novelty wears off. Indeed, Malinoff and Weinstein (1989a) and Taylor (1993) showed self-assessed participation restrictions can increase between three weeks and three months, after which they become stable. Dillon et al. (1997) found no significant change in scores with the HHIE or COSI between six weeks and three months post-fitting, suggesting there is no need to wait longer than six weeks post-fitting before measuring self-assessed benefit of hearing aids. This is consistent with the findings of Mulrow, Aguilar, Endicott, Tuley, et al. (1990) and Dillon et al. (1991).

Humes and colleagues conducted a longitudinal study of hearing aid benefit in a population of older adults over the course of three years (Humes, Garner, Wilson, & Barlow, 2001; Humes & Wilson, 2003; Humes, Wilson, Barlow, & Garner, 2002). Their goal was to record objective and subjective hearing aid outcome measures for a large group of novice hearing aid wearers. The HHIE, among other questionnaires, was administered via the paper-pencil method at one month, six months, one year, two years and three years' post-fit time points. By examining the time course of hearing aid benefit, one can determine the most appropriate time interval to administer the HHIE for this population. Indeed, the researchers found that participants experienced a significant reduction in participation restrictions following one month of hearing aid use (Humes et al., 2001). There was no significant change in participation restrictions at any of the subsequent time points measured, indicating that benefit had stabilised. This is important because a stable outcome means that results obtained at initial appointments will be indicative of long-term outcomes, therefore a long-term follow up would not be necessary. Newman and Weinstein (1989) noted that a one year interval between pre- and post-administration of the HHIE is not practical for a number of reasons. Firstly, it is beyond the hearing aid trial period that is offered by hearing aid distributors, therefore it would not be possible to return the hearing aid free of charge. Secondly, it is

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beyond the manufacturer's warranty period, allowing repairs to be made free of charge. Even so, there are some advantages with such a long interval between administrations, such as for monitoring the well-being of the client and to ascertain whether additional counselling or listening devices are required. Indeed, Malinoff and Weinstein (1989b) have suggested that multiple administrations of the HHIE with both short and long intervals may be the best for the client.

Overall, the literature suggests novice hearing aid wearers over the age of 64 years experience a significant reduction in participation restrictions over the first three to four weeks of use. This is followed by a slight increase in self-assessed participation restrictions which stabilises from six weeks. Therefore, administering the HHIE at six weeks post-fitting will give a good indication of a client's long-term participation restrictions. Questionnaires such as the HHIE and HHIA are often developed using test-retest studies with a six week time interval (Weinstein et al. 1986; Newman & Weinstein 1989; 1991).

An alternative to administering outcome measures before and after intervention is to administer a questionnaire once at some point after intervention. The Profile of Hearing Aid Benefit (PHAB), developed by Cox, Gilmore, and Alexander (1991), was designed to be used in this way. The PHAB is 66-item inventory which assess the client's performance in a number of everyday situations. Ten weeks after the provision of amplification, the client rates their ability with hearing aids on and with hearing aids off. The audiologist then quantifies the hearing aid benefit by calculating the difference between the two scores. When measuring the difference score it is desirable for there to be a small number of independent variables. This allows researchers and clinicians to be confident that any difference measured is the result of intervention and not extraneous factors. By having the client judge their performance with and without hearing aids at the same time, the correlation between measurements is

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likely to be high. One disadvantage of this approach is that clients will have to rely on their memory of their ability prior to amplification.

### *1.5.1.3 Measurement of Significant Clinical Change*

When administering a questionnaire multiple times there will be some degree of error inherent in the measurement. A clinician will need to know whether a change in score observed between separate administrations is a true change or simply due to random error if the information is to be clinically useful (Chisolm et al., 2005). This requires a known standard error of measurement which can be calculated using the equation described by Demorest and Walden (1984):

$$s_e = s_x \sqrt{1 - r_{xx'}}$$

Where  $x$  is the total score,  $s_x$  is the estimated variance of the total score,  $s_e$  is the standard error of measurement and  $r$  is the reliability coefficient.

When the HHIE was developed the standard error of measurement was 6.1%. A client's "true" score on the HHIE is unlikely to be more than two standard deviations (an approximate 95% confidence interval) away from their reported score (Demorest & Walden, 1984). Therefore, a clinician could be confident that a client's "true" score was within  $\pm 12.2\%$  of their reported score. Using this information, a clinician could confidently conclude that any change noted between the first and second administrations of this questionnaire was a true change if it was greater than 12.2% (the 95% confidence interval).

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### **1.5.2 Non-Technical Considerations**

Though clinicians and researchers tend to focus on the technical aspects of a particular outcome measure, research has shown that non-technical aspects can be more predictive of its successful use (Dillon & So, 2000). These aspects include the utility of the outcome measure, the burden to the clinician as well as to the client, and how the outcome measure is scored (Cox, 2003).

The patient burden represents the problems a patient may have in completing the outcome measure. For example, a long questionnaire may mean a client loses interest and answers thoughtlessly or not at all. This can also occur with irrelevant items or if the reading level is too high for the client. The clinician burden represents the problems faced by clinicians when administering and interpreting an outcome measure. For example, a clinician may not use a questionnaire unless the results are easy and quick to interpret and provide clinically meaningful information. Consideration of these non-technical aspects is important when designing and selecting a clinically useful outcome measure.

### **1.5.3 Limitations of Self-report Questionnaires**

Self-report questionnaires have many advantages to an audiologist. Chief among them is that they allow a clinician to ascertain their clients' thoughts regarding their hearing. Self-report questionnaires do have their limitations, however. The responses given will always be subject to contextual factors, both from the environment and from the client themselves. Personality traits have a significant effect on hearing aid seeking behaviour and the level of satisfaction reported by hearing aid users (Cox et al., 1999; Cox, Alexander, & Gray, 2005; Gatehouse, 1994; Hutchinson, Duffy, & Kelly, 2005). In addition to the effects of a client's personality, a hearing aid outcome measure may also be influenced by whether or not the client is having a



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‘good day’. Normative values are essential in this case to help clinicians account for the small differences between individuals.

The acquiescence response set is the “general tendency to respond agreeably (or disagreeably) independently of item content” (Wiggins, 1973 pp. 437-438). A client may do this in order to show their appreciation for the audiologist’s help or to emphasise the difficulty they are experiencing. Acquiescence adds a degree of bias to the outcome measure in either case. Clinicians can reduce this bias by explaining the purpose of the outcome measure and reassuring their clients their needs will be met as closely as possible.

A client’s memory can affect the accuracy of self-report questionnaires, particularly for older adults. Self-report questionnaires such as the HAPI require the client to rate the benefit provided by their hearing aids in number of listening situations. This requires the client to remember how they performed without their hearing aids which can be problem for some people. A further issue with this type of self-report questionnaire is that the client’s understanding of the question may differ from the clinician’s understanding (i.e. the content validity of the questionnaire). Instead of rating the benefit provided by hearing aids, a client may rate the difficulty they have in each of the situations described, for example. A good explanation of the self-report measure is vital in these circumstances. A clinician may also ask questions to the client or work through the first few items of a questionnaire to check their client understands and reduce the drawbacks of self-report questionnaires.

### **1.6 Use of the HHI**

The Accident Compensation Corporation (ACC) provides personal injury cover for New Zealand residents (Accident Compensation Corporation, 2016b). This includes hearing impairment caused by work- or accident-related injury. ACC will provide monetary compensation for those that qualify which can be set toward the cost of rehabilitative devices

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such as hearing aids (Accident Compensation Corporation, 2016a). In order to qualify for ACC compensation an applicant must have their hearing assessed by an audiologist or General Practitioner as well as by an Ear, Nose and Throat specialist (ENT). The shortened version of the HHIE (HHIE-S) or HHIA (HHIA-S; Newman et al., 1991) is one component of this assessment. These questionnaires are used to assess the social and emotional impact of hearing impairment and help guide aural rehabilitation (Weinstein et al., 1986).

Research has shown that disease-specific measures are preferable to generic measures for identifying handicaps or negative effects on quality of life (Mulrow, Aguilar, Endicott, Tuley, et al., 1990). By administering the questionnaire before and after a hearing aid fitting, clinicians can judge the benefit provided by the device and affirm that it is suitable for ACC funding. The HHIE-S and HHIA-S are often used in this way. Indeed, the American Speech-Language-Hearing Association (ASHA) recommend the HHIE-S to audiologists for its high test retest reliability as shown by Ventry and Weinstein (1983) (American Speech-Language-Hearing Association, 1997). Many studies have demonstrated reductions in the emotional and social effects of hearing impairment after hearing aid fitting using the HHIE (Humes et al., 2001; Malinoff & Weinstein, 1989a, 1989b; Stark & Hickson, 2004), the HHIE-S (Newman, Jacobson, Hug, Weinstein, & Malinoff, 1991; Primeau, 1997), the HHIA (Primeau, 1997).

### **1.7 Versions of the HHI**

#### **1.7.1 Hearing Handicap Inventory for the Elderly**

The HHIE is a 25-item questionnaire published in the article by Ventry and Weinstein (1982). The questionnaire was designed to assess the participation restrictions of individuals aged 65 years and above. Normative values for the HHIE were based on 100 individuals (65 to 92 years of age) from three speech and hearing centres in New York City in 1982. The

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researchers' aim was to select participants that would likely be representative of a population of older adults that would commonly be serviced by speech and hearing centres in an urban area.

The HHIE was designed to be administered face-to-face. It consists of a 13-item subscale regarding the emotional effects of hearing-related participation restrictions and a 12-item subscale concerning the social and situational effects. For each item of the questionnaire, the client can respond with "yes", "sometimes" or "no". Each response is assigned a score: "yes" = 4, "sometimes" = 2, "no" = 0 for a maximum score of 100 points. The sum of a client's scores indicates the degree of participation restriction the client experiences, with a score of 0 - 16 being "no handicap", 17 - 42 being "mild to moderate handicap" and  $\geq 43$  being a "significant handicap" (Ventry & Weinstein, 1983).

### ***1.7.1.1 Reliability and Stability***

Weinstein et al. (1986) demonstrated high test-retest reliability of the HHIE for both a paper-pencil administration (Pearson-product moment correlation = .84;  $p < .01$ ) and for face-to-face administration (Pearson-product moment correlation = .96;  $p < .01$ ). Ventry and Weinstein (1982) have shown the HHIE to have high internal consistency (Cronbach's alpha = .95 for the entire HHIE, .93 for the emotional subscale and .88 for the social/situational subscale).

### ***1.7.1.2 Audiometric Correlates***

The study conducted by Weinstein and Ventry (1983) investigated the audiometric correlates of hearing handicap as measured by the HHIE. That is, to what degree the participants' audiometry results correlate with measures of their hearing handicap. The researchers found

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that the participants' pure-tone sensitivity thresholds were significantly correlated with total, emotional and social/situational measures of hearing handicap ( $r = .56$  to  $.62$ ,  $p < .01$ ).

Further, hearing handicap correlated most highly with the participants' pure-tone sensitivity thresholds in the better-hearing ear ( $r = .61$ ,  $p < .01$ ). However, there was substantial variability in the participants' response to hearing impairment in this study. Researchers found that participants over the age of 64 years with a mild hearing impairment were most variable in their response to hearing impairment, more so than individuals with no hearing impairment or with moderate hearing impairment. The authors suggest that for a population of older adults, a pure-tone average of  $> 40$  dBHL in the better ear will likely be associated with significant participation restrictions. The authors do stress, however, that inferences regarding a client's participation restrictions should not be made from pure-tone sensitivity data alone and advocate some form of self-report measure such as the HHIE before making inappropriate recommendations. Indeed, audiometric measures explained less than 50% of the variance in participation restrictions, supporting the notion that hearing-related participation restriction is a complex phenomenon influenced by a number of factors other than pure-tone sensitivity (American Speech-Language-Hearing Association, 1981; Noble & Héту, 1994; World Health Organization, 2001a).

### ***1.7.1.3 HHIE – S***

A year after the HHIE was published the same authors released the HHIE-S, a shortened version of the HHIE (Ventry & Weinstein, 1983). This was to be used as a screening tool in an effort to reduce the number of unnecessary referrals. The HHIE-S is comprised of only ten items and includes an emotional and social/situational subscale of five items each. The HHIE-S is to be scored in the same way as the HHIE, affording a maximum score of 40

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points. Total score were classified as “no handicap” (0 - 8), “mild to moderate handicap” (10 - 22) and “significant handicap” ( $\geq 24$ ) (Ventry & Weinstein, 1983).

The HHIE-S has a high degree of reliability as shown by Lichtenstein, Bess, and Logan (1988) (between-occasion correlation = .84;  $p < .0001$ ) and Tomioka et al. (2013) (intra-class correlation coefficient = .85 (95% CI: .81–.89). The internal consistency (Cronbach’s alpha) of the screening version was .87 (Ventry & Weinstein, 1983), slightly less than for the HHIE (.95 as shown by Ventry and Weinstein (1982)) but still considered good (Carmines & Zeller, 1979; Mitchell & Jolley, 2012; Nunnally, 1978).

### 1.7.2 Hearing Handicap Inventory for Adults

Following the popularity of the HHIE, Newman et al. (1990) developed a modified version of the scale for a population of younger adults. Where the HHIE was designed for adults 65 years of age and over, the HHIA was created for adults up to the age of 65 years. Three items of the HHIE were substituted to be more appropriate for non-retired adults and this new questionnaire was standardised on a sample of 67 individuals (18 to 64 years of age) from a single hospital in Michigan, United States of America.

The HHIA, like the HHIE, consists of 25 items divided into a 13-item emotional subscale and a 12-item social/situational subscale and is designed to be administered face-to-face. The HHIA is scored in the same way as the HHIE, with a maximum total score of 100 points.

#### 1.7.2.1 Reliability and Stability

Newman et al. (1990) demonstrated the high degree of internal consistency (Cronbach’s alpha) for the total HHIA scale (alpha = .93), emotional scale (alpha = .88) and social/

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situational scale ( $\alpha = .85$ ). The standard error for measurement was low in this study as well as the subsequent study by the same authors (Newman et al., 1991). This later study examined the test-retest reliability of the HHIA on a group of 28 adults with hearing impairment from the same hospital in Michigan. The HHIA was administered to all participants in a face-to-face format, then mailed to each participant approximately six weeks later and completed via the paper-pencil method. Authors report a high test-retest reliability values for the total HHIA scale ( $r = .97$ ) as well as the emotional ( $r = .93$ ) and social/situational ( $r = .95$ ) subscales.

### ***1.7.2.2 Audiometric Correlates***

Newman et al. (1990) found weak, but statistically significant correlations ( $r = .29$  to  $.35$ ,  $p < .05$ ) between the participants' audiometric results and their hearing handicap as measured by the HHIA. Even weaker correlations existed between hearing handicap and speech recognition scores ( $-.26$  to  $-.28$ ,  $p < .05$ ).

Newman, Hug, Jacobson, and Sandridge (1997) investigated the audiometric correlates of hearing handicap for a group of 63 participants (18 to 64 years of age) with unilateral or mild hearing impairment. Their study shows a high degree of variability in participants' responses to hearing impairment, consistent with the study by Weinstein and Ventry (1983) who report similar findings using the HHIE-S for a group of older adults.

### ***1.7.2.3 HHIA – S***

As with the HHIE, a shorter version of the HHIA was developed for use as a screening tool for hearing handicap (Newman et al., 1991). The HHIA-S is a ten-item inventory with two five-item subscales concerning the emotional and social/ situational effects of hearing

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handicap. The test-retest reliability correlation coefficients for the HHIA-S are high for the total scale ( $r = .93$ ), emotional subscale ( $r = .88$ ) and social/ situational subscale ( $r = .82$ ) (Newman et al., 1991). The high correlations and low standard error for measurement fit criteria for clinical use (Demorest & Walden, 1984; Nunnally, 1978).

### **1.8 Current Issues with Hearing Handicap Inventory**

The various forms of the Hearing Handicap Inventory are widely used for their brevity, ease of administration and interpretation, and excellent reliability (Hickson & Scarinci, 2007; Newman et al., 1990; Newman, Weinstein, et al., 1991; Weinstein et al., 1986; Weinstein & Ventry, 1983). The HHIE-S has even been translated for clinical use involving Spanish-speaking (Lichtenstein & Hazuda, 1998) and Chinese-speaking (Jupiter & Palagonia, 2001) persons. However, there are a number of issues with the Hearing Handicap Inventory that warrant attention.

#### **1.8.1 Need for Wording Change**

The HHIE, HHIA and their respective screening versions have not been updated since their development. As such, they contain out-dated terms such as “handicap” that clinician reports indicate patients find derogatory. In 2001 the World Health Organization updated their terminology replacing the word “disability” with the words “activity limitations” and “handicap” with the words “participation restrictions” (World Health Organization, 2001a). A revised questionnaire is needed to remain consistent with modern terminology.

#### **1.8.2 Need for Single Questionnaire**

There is currently a division between adults under the age of 65 years and those 65 years and older in regard to hearing handicap inventories. There are two key differences between the

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HHIE and the HHIA. Firstly, the HHIA contains items related to employment where the HHIE does not. This is presumably to account for the retirement age in America (National Academy of Social Insurance, 2016). However, in 2015 there were almost 8.5 million people in America over the age of 64 that were still employed (Bureau of Labor Statistics, 2015). In New Zealand the percentage of people over the age of 64 years that are still employed has been increasing since 1997 (Statistics New Zealand - Tatauranga Aotearoa, 2015). Items on the HHIA relating to employment may be more suitable for this population of older adults than the HHIE.

The second key difference between the HHIE and the HHIA is the sample population on which they were standardised. The HHIE normative data was based on a group of older adults in New York, whereas the normative data for the HHIA was based on a group of younger adults in Michigan. This is important when a clinician is drawing conclusions from the results as to whether a client's scores are typical or atypical. A clinician may wish to administer the HHIA to an employed client over the age of 64 but then will not be able to compare those results to a standardized population.

A solution to these issues is to have a single questionnaire containing items pertinent to employed and unemployed persons that is standardised on a sample population of young and older adults.

### **1.8.3 Need for Single Administration Method**

Though the face-to-face administration style has been shown to be preferable than the paper-and-pencil method as the standard error and confidence intervals are smaller (Weinstein et al., 1986), clinical anecdotes suggest this is not how the HHIE and HHIA are typically administered in New Zealand. Administration method affects the reliability of the



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questionnaire as demonstrated by Newman and Weinstein (1989) and (Weinstein et al., 1986). Indeed, Newman, Weinstein, et al. (1991) advises researchers to obtain test-retest reliability estimates for the HHIA and HHIA-S when administered in the face-to-face format both times. Having reliability statistics and normative data for an administration mode that is not clinically applicable limits the confidence with which a clinician can draw conclusions from those results. A revised form of the Hearing Handicap Inventory is necessary. One that is consistent in the mode of administration and considerate of the clinical utility for time-pressured clinicians.

### **1.9 Study Rationale**

#### **1.9.1 No normative data for method of administration**

Normative data for the HHIE was obtained by administering the questionnaire to 100 individuals in a face-to-face format (Ventry & Weinstein, 1982). The HHIA was developed using a face-to-face format for the first administration followed by a paper-pencil administration approximately six weeks later (Newman, Weinstein, et al., 1991). To date, a set of normative values has not been obtained using a paper-pencil administration approach for the HHIA, the most common form of administration according to clinicians' anecdotal reports. If this is the case, then clinicians are currently basing their conclusions on normative data obtained using a different method to their clients' data. Therefore there is sound justification for normative data to be obtained using the paper-pencil method for both test and retest administrations.

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### **1.9.2 No New Zealand normative data**

A normative range of results allows a clinician to know whether a client's score is greater or less than an average of their peers. This knowledge can help identify clients that require further intervention or help counsel them on what to expect in terms of improved participation restrictions. For normative data to be useful, it needs to be exactly that: normal for that population. McCarthy (1998) suggested that it may be necessary to adjust commonly-used self-report questionnaires to accommodate cultural and lifestyle differences between populations. Normative data for the HHIA is currently 25 years old and data for the HHIE is 34 years old (Newman, Weinstein, et al., 1991; Ventry & Weinstein, 1982). Each study involved a sample population from a single state in America. It is possible that significant differences exist between the normative data from 1982 and those of a modern New Zealand population, given the advances in technology from the last 30 years and geographic distance between America and New Zealand. Hence, there is need for normative data measuring the participation restrictions of a New Zealand population.

### **1.10 Study Aims**

This study aims to determine the critical change score for a New Zealand population of experienced hearing aid wearers using a modified version of the Hearing Handicap Inventory termed the "Hearing Questionnaire".

This questionnaire will be appropriate for adults of all ages and replace the word "handicapped" with the word "limited" to align with the World Health Organisation (2001) International Classification of Functioning, Disability and Health (ICF) (World Health Organization, 2001b).

The Hearing Questionnaire will be completed via the paper-and-pencil method for both the test and re-test administrations to more closely resemble what clinicians report is the current

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method of administration in New Zealand. This method will more accurately depict the true stability of the questionnaire as the method of administration will be kept constant. The researcher's hypothesis is that there will be no significant change in degree of perceived participation restrictions resulting from hearing impairment in a six-week interval.

### **1.11 Planned Analyses**

The researcher will investigate possible covariates using the Pearson product-moment correlations and paired t-tests. Once any covariates have been identified, repeated-measures Analysis of Variance (ANOVA) (or Analysis of Covariance (ANCOVA)) will be used to determine whether a significant difference exists between the first and second administrations. Finally, the researcher will calculate a 95% confidence interval for any change in score.



## **2 Methodology**

### **2.1 Participants**

Participants in this study met the following criteria:

1. Were over the age of 17 years
2. Were fitted with at least one hearing aid in the last two years
3. Were current clients of Bay Audiology
4. Had the ability to return questionnaires via post or electronic mail.

A total of 67 individuals were recruited into this study. However, a drop-out rate of 19% meant the Test Group comprised only 54 individuals, less two individuals that produced outlying data. The mean age of the remaining 52 participants was 69.9 years (SD = 11.2). All participants had a mild degree of hearing impairment in at least one ear (Clark, 1981). The Speech Frequency Pure-Tone Average (SFPTA; 500, 1000, 2000 Hz) of the better ear was 34.6 dBHL (SD = 12.7) and 42.2 dBHL (SD = 14.1) for the poorer ear. No incentives were offered to participants, monetary or otherwise.

### **2.2 Procedures**

The researcher posted a study packet which contained a cover letter, an information sheet (Appendix A), two consent forms, a demographic questionnaire, the Hearing Questionnaire, a release of information form, and a postage-paid return envelope. Clients that wished to participate in the study sent their forms to the researcher directly. After a period of approximately six weeks, those participants were sent another packet to complete and return. Demorest and Walden (1984) recommend six weeks as an appropriate time to avoid the effects of memory on test results. Data collection ceased when 54 participants had returned

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the second questionnaire based on an *a priori* calculation (Faul, Erdfelder, Lang, & Buchner, 2007). The data was then analysed using SPSS version 22.

### **2.3 Statistical Analysis**

The researcher employed paired t-tests and correlational analysis to identify significant differences between the scores from multiple administrations of the Hearing Questionnaire. The demographic questionnaire was used to gather information on participants' gender, ethnicity, relationship status, income, level of education and working status. Partial correlational analysis was used to examine these factors to identify possible covariates. A Shapiro-Wilk test was used to test for normality of the sample population. The critical change score was calculated using the method described by Demorest and Walden (1984).

### **2.4 Ethical Considerations**

An ethics application to the University of Canterbury Human Ethics Committee (UC HEC) was approved in April 2017. All procedures in this study remained in accordance with UC HEC approval.

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### 3 Results

This study involved 67 individuals that completed the first administration of the Hearing Questionnaire (participant pool). The Dropout Group (Table 1) comprised of 13 individuals who did not complete the second administration of the Hearing Questionnaire. The Test Group, described in Table 2, contained 54 individuals that completed the Hearing Questionnaire a second time, less two participants whose test scores were identified as outliers. The average pure-tone audiometry thresholds for the Test Group are shown in Figure 2. The researcher's hypothesis was that there would be no significant change in the degree of perceived participation restrictions from hearing impairment in the six-week interval.

The researcher made a number of assumptions for the analysis of the study results. For the t-test researcher assumed homogeneity of variance. The six-week interval was considered long enough that memory effects did not influence scores on the second administration of the Hearing Questionnaire. The researcher also assumed that the estimated mean from the sample population could be generalised to a normally distributed population.

A t-test showed no significant difference existed between the scores from the first and second administrations of the Hearing Questionnaire ( $t(51) = .63, p = .53$ ). A Pearson correlational analysis showed that scores for the first and second administrations were significantly positively correlated ( $r = .62; p < .000$ ). The critical change score was 7.8 points based on a 95% confidence interval using the calculations described by Demorest and Walden (1984). Power for this study was above 80% (Friedman, 1982). The researcher examined gender, ethnicity, relationship status, income, level of education and working status as possible covariates. No significant covariates were identified using a partial correlational analysis.

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**3.1 Dropout Group**

Table 1: Demographic information for the Dropout Group.

		Total	Percentage of Dropout Group	Percentage of entire participant pool
Number of participants		13	100	19.4
Demographic Factor				
Age Range (years)	≤ 49	1	7.7	1.5
	50 - 59	2	15.4	3
	60 - 69	3	23.1	4.5
	70 - 79	3	23.1	4.5
	80 - 89	4	30.8	6
	90 - 99	0	0	0
Gender	Male	6	46.2	9
	Female	7	53.8	10.4
Ethnicity	New Zealand-European	12	92.3	17.9
	Māori	0	0	0
	Other	1	7.7	1.5
Relationship	In	11	84.6	16.4
	Out	2	15.4	3
Annual Income (x 000)	0 – 25	5	38.5	7.5
	25 – 50	2	15.4	3
	50 – 75	3	23.1	4.5
	75 – 100	1	7.7	1.5



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	> 100	1	7.7	1.5
Education	< High School	4	30.8	6
	High School	4	30.8	6
	Post-High School	3	23.1	4.5
	Post-Graduate	1	7.7	1.5
Currently Working	Yes	4	30.8	6
	No	9	69.2	13.4
Region	Auckland	2	15.4	3
	Bay of Plenty	1	7.7	1.5
	Canterbury	2	15.4	3
	Hawke's Bay	1	7.7	1.5
	Manawatu-Wanganui	1	7.7	1.5
	Marlborough	1	7.7	1.5
	Nelson	1	7.7	1.5
	Waikato	2	15.4	3
	Wellington	2	15.4	3

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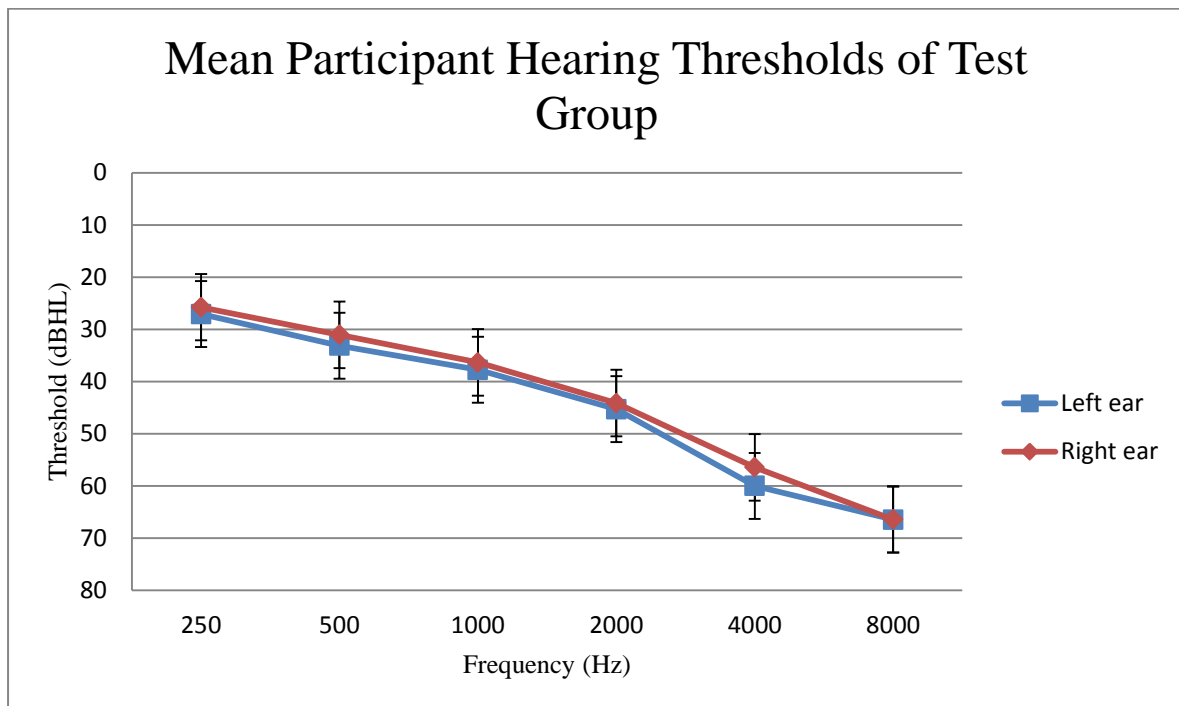
**3.2 Figure 2: Mean Audiogram**

Figure 2: Mean pure-tone hearing thresholds of study participants in Test Group (N = 52).

Bars indicate standard error. dBHL = decibels (hearing level).

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**3.3 Test Group**

Table 2: Demographic information for the Test Group.

		Total	Percentage of Test Group
Number of participants		52	100
Demographic Factor			
Age Range (years)	≤ 49	1	1.9
	50 - 59	5	9.6
	60 - 69	19	36.5
	70 - 79	19	36.5
	80 - 89	8	15.4
	90 - 99	2	3.8
Gender	Male	29	55.8
	Female	23	44.2
Ethnicity	New Zealand-European	46	88.5
	Māori	2	3.8
	Other	3	5.8
Relationship	In	34	65.4
	Out	17	32.7
Annual Income (x 000)	0 – 25	10	19.2
	25 – 50	19	36.5
	50 – 75	8	15.4
	75 – 100	8	15.4
	> 100	3	5.8

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Education	< High School	13	25.0
	High School	15	28.8
	Post-High School	17	32.7
	Post-Graduate	5	9.6
Currently Working	Yes	16	30.8
	No	35	67.3
Region	Auckland	12	23.1
	Bay of Plenty	4	7.7
	Canterbury	1	1.9
	Hawke's Bay	4	7.7
	Manawatu-Wanganui	3	5.8
	Marlborough	1	1.9
	Nelson	1	1.9
	Northland	3	5.8
	Otago	4	7.7
	Southland	1	1.9
	Taranaki	3	5.8
	Tasman	2	3.8
	Waikato	5	9.6
	Wellington	7	13.5
West Coast	1	1.9	

## **4 Discussion**

### **4.1 Aims and hypothesis**

The aim of this study was to determine the critical change score for a New Zealand population of experienced hearing aid wearers using the Hearing Questionnaire, a modified version of the Hearing Handicap Inventory (Newman et al., 1990; Ventry & Weinstein, 1982). The Hearing Questionnaire (Appendix B) featured a number of key differences to the Hearing Handicap Inventory. Firstly, the terminology used in the Hearing Questionnaire was concordant with the World Health Organisation (2001) ICF framework (World Health Organization, 2001b). Secondly, the Hearing Questionnaire was administered via the paper-pencil method for both test and retest measures. Thirdly, the test-retest measures were administered to a sample population that included both young and older adults. The researcher's hypothesis was that there would be no significant change in the degree of perceived participation restrictions resulting from hearing impairment in the six-week interval. Results of this study support this hypothesis and showed that there was indeed no significant change in the degree of perceived participation restrictions for this sample population.

This result was expected given the fact that the sample population comprised hearing aid users with one to two years' experience and no intervention occurred in the six-week interval between administrations of the Hearing Questionnaire. Certainly, many studies have found that participation restrictions of older adults reported via the HHIE stabilise after the first six weeks of hearing aid use (Dillon et al., 1997; Humes & Wilson, 2003; Humes et al., 2002; Malinoff & Weinstein, 1989a; Mulrow, Aguilar, Endicott, Velez, et al., 1990; Taylor, 1993). Were the Hearing Questionnaire administered to a group of individuals before and after trying hearing aids for the first time, one would expect a greater change in the degree of

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perceived participation restrictions (Malinoff & Weinstein, 1989b). The lack of significant difference between separate administrations of the Hearing Questionnaire attests to the stability of the tool over a six-week period. Future studies should investigate the long-term stability of the Hearing Questionnaire by administering the questionnaire after a further 6 to 12 months as the utility of the tool would be improved if its stability was established over a long period of time (McArdle et al., 2005).

### **4.2 The Hearing Questionnaire**

In order to calculate the critical change score for the Hearing Questionnaire, the researcher first needed to determine the reliability and standard error of measurement (Demorest and Walden, 1984). For this, the researcher performed a paired t-test and correlational analysis.

The results of this study show that the correlation coefficient for the Hearing Questionnaire, though statistically significant, was only .62. Nunnally (1978) suggests a correlation coefficient value of at least .8 is necessary for a questionnaire to be deemed reliable. Using this criterion, the Hearing Questionnaire does not meet Nunnally's recommendations for reliability.

The standard deviations in the scores were large for both administrations of the Hearing Questionnaire. This translates to a large standard error of measurement calculated using the method described by Demorest and Walden (1984). A questionnaire with a large standard error of measurement is less reliable than one with small standard deviations and smaller standard error. Practically speaking, a large standard error of measurement increases the critical change score of the Hearing Questionnaire. This means the instrument is not as precise in determining the degree of hearing limitation as with a small standard error of measurement.

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### 4.3 Critical change score

The critical change score for the Hearing Questionnaire was calculated as 7.8 points using the formula described in (Demorest & Walden, 1984). In practical terms, if a client's score on the Hearing Questionnaire (with similar administration format to this study) were to change by 8 points or more (20%), a clinician could be confident that the change in score is a true change and not due to random measurement error. This is comparable to the critical change scores for similar questionnaires: Newman et al. (1991) calculated the critical change score for the HHIA-S to be 8.8 points (22.5%) (95% confidence interval for a true change) when administered face-to-face followed by the paper-pencil method. Similarly, the critical change score for the HHIE was 19.2% in the study by Newman & Weinstein (1989) when administered face-to-face then via the paper-pencil method.

Weinstein et al. (1986) reported the critical change score for the HHIE as 36% when the paper-pencil method was used for both test and retest administrations. The critical change score for the Hearing Questionnaire in this study was substantially less than this (20%) despite having a similar method of administration. In contrast, Weinstein et al. (1986) showed the critical change score decreased to 18.7% when the face-to-face method was used for both test and retest administrations. Changing the method of administration then, is likely to reduce the critical change score of the Hearing Questionnaire.

### 4.4 Future models

Improvements to the reliability and variance are necessary to enhance the utility of the Hearing Questionnaire. This may be achieved in a number of ways.

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### 4.4.1 Increasing the sample size

An *a priori* calculation indicated that 16 participants were required for this study to have an r-squared value of .3 (Faul et al., 2007). However, such a small number of participants is unlikely to be representative of experienced hearing aid users in New Zealand as a whole. Previous studies have used between 28 and 100 participants to examine the reliability of the HHIE or HHIA (Newman et al., 1990; Newman, Weinstein, et al., 1991; Ventry & Weinstein, 1982). Based on this research a total of 67 individuals were recruited into this study. However, a drop-out rate of 19% meant the Test Group comprised only 52 individuals. A limited timeframe associated with a Master thesis meant the researcher was unable to continue recruitment, however a larger sample population would be favourable to reduce the standard deviation and increase the generalisability of these results (Aron, Coups, & Aron, 2013).

### 4.4.2 Testing for more covariates

As has been discussed throughout this thesis, hearing limitation is a multifaceted phenomenon, not dictated by hearing impairment alone (Andersson, Melin, Lindberg, & Scott, 1995; Chang, Ho, & Chou, 2009; Mulrow, Aguilar, Endicott, Velez, et al., 1990; Newman, Weinstein, Jacobson, & Hug, 1990; Nondahl et al., 1998; Weinstein, Richards, & Montano, 1995). This study examined participants' age, gender, ethnicity, employment status, relationship status, income, level of education and region of residence in New Zealand as possible covariates of hearing limitation, yet none were identified as significant. It is possible that further testing could identify a significant covariate not mentioned here.



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### **4.4.3 Changing the method of administration**

An increase in the reliability of the Hearing Questionnaire could be achieved by changing the method of administration from paper-pencil to face-to-face format. Weinstein et al. (1986) determined the test-retest reliability of the HHIE using two administration approaches. A group of 20 participants had administered the HHIE via the face-to-face method and a group of 27 participants completed the HHIE via the paper-pencil method. The researcher found that the face-to-face method resulted in higher test-retest correlations, lower standard error of measurement and narrower confidence intervals than the paper-pencil method. Later, Newman and Weinstein (1989) determined the test-retest reliability of the HHIE using a face-to-face format followed by a paper-pencil administration and reported values very similar to the face-to-face test-retest method. Based on these findings, it is likely that the test-retest reliability of the Hearing Questionnaire would be increased with a face-to-face mode of administration. The researcher chose the paper-pencil method of administration for both test and retest measurements in order to reflect what clinicians report is the current method of administration in New Zealand. The researcher's rationale being that if the Hearing Questionnaire is to be used clinically it is better for a study to report its stability for the most common mode of administration than to give an unrealistic view of its performance.

### **4.4.4 Reducing the interval between administrations**

An alternative method of reducing the variance and increasing the reliability of the Hearing Questionnaire could be to adjust the interval between test and retest. It was assumed that scores for the first and second administrations of the Hearing Questionnaire were independent of one another. That is to say, the six-week interval between administrations of the Hearing Questionnaire was deemed long enough that participants would not remember the scores from the first administration. Indeed, a number of studies have used a six-week

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interval for test-retest measurements (Demorest & Erdman, 1988; Dillon et al., 1997; Newman & Weinstein, 1989; Newman, Weinstein, et al., 1991; Weinstein et al., 1986).

Shortening the interval to four-weeks would mean less opportunity for extraneous factors to confound the results. However, this may also mean the participant remembers their previous score and bases their judgements off of that instead of their participation restrictions at the time. Although the correlation between first and second administrations would be high, it would compromise the validity of the study.

Shortening the interval time to one month may have other clinical advantages. Many hearing aid distributors offer a one-month free trial on hearing aids. Using a four-week interval between administrations would be more relevant to clinicians as it would better reflect the clinical procedure used in New Zealand. Studies have shown that a person's participation restrictions are expected to stabilise following four to six weeks of hearing aid use based on numerous studies regarding the time course of hearing handicap with hearing aid intervention (Dillon et al., 1991; Humes et al., 2001; Humes & Wilson, 2003; Humes et al., 2002). If similar results are shown for new hearing aid users with the Hearing Questionnaire then a four-week interval would be ideal for pre-post hearing aid fittings as a measure of hearing aid benefit while simultaneously decreasing the variance of the results. Of course, hearing limitation is a complex phenomenon and without proper testing one cannot be sure that shortening the interval by two weeks would have a significant effect on the variance of results.

### **4.4.5 Informed administration**

Informed follow-up administration of the Hearing Questionnaire is also worth consideration. That is, allowing participants to see the first scores during the second administration. There is a precedence of audiologic questionnaires being administered using

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an informed format. For example, the Abbreviated Profile of Hearing Aid Benefit (APHAB) designed by Cox and Alexander (1995). This 24-item questionnaire, validated on experienced older adults who were hearing aid users, measures aided and unaided performance as well as hearing aid benefit. However, there is currently no standardised procedure stating whether the Hearing Handicap Inventory should be administered in a blind or informed format.

Allowing clients to assess their hearing limitation with reference to their previous score is likely to reduce the individual variance from clients trying to recall their baseline score, as has been shown in other fields of health care (Guyatt, Berman, Townsend, & Taylor, 1985; Guyatt, Townsend, Keller, & Singer, 1989). This could be especially meaningful when using the Hearing Questionnaire to determine hearing aid benefit by comparing scores before and after hearing aid fitting.

To date, only one study has investigated the effect of blind versus informed administration on hearing aid outcome using the HHIE/ HHIA (Silverman, Cates, & Saunders, 2011). The authors administered the HHIE or HHIA to a group of 65 military veterans (mean age = 66.0 years) attending a routine hearing aid evaluation. The questionnaires were administered 9.5 weeks apart (range = 3.3 - 22.1 weeks) in a paper-pencil format. The second administration involved 36 participants completing an informed administration of the questionnaire and 29 participants completing the questionnaire in the blind condition. Silverman et al. (2011) found that informed administration of the HHIE/HHIA did not yield significantly different benefit scores to the blind administration condition.

However, there were a number of limitations to the study that may have impacted the results. The group of participants that completed both administrations of the questionnaire consisted of only a small number of veterans from a single medical centre. This may limit the

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generalisability of the findings to a wider population. The informed administration group included substantially more new hearing aid users than experienced hearing aid users (27 versus nine, respectively) which may have masked the effect of administration method on the results. Further, there was sizeable variation in the interval between administrations of the HHIE/HHIA, ranging from 3.3 to 22.1 weeks. It is likely that individuals in this study were at different stages of the hearing aid acclimatisation period. For some participants their degree of participation restrictions would have stabilised and for others it would still be fluctuating (Dillon et al., 1997; Humes et al., 2001; Humes & Wilson, 2003; Humes et al., 2002; Mulrow, Aguilar, Endicott, Velez, et al., 1990). This would add variability to the results and possibly hidden the effects of administration method.

One study is not sufficient to say conclusively whether an informed administration method would improve the reliability of the HHIE or HHIA. In theory, informed administration may lead to greater consistency in clients' responses thereby improving the validity of self-report questionnaires (Guyatt et al., 1989; Silverman et al., 2011).

### **4.4.6 Multiple languages**

Future models of the Hearing Questionnaire could be adapted for non-English speaking individuals. Italian, Spanish and Chinese versions of the Hearing Handicap Inventory have already been judged suitable for clinical use (Jupiter & Palagonia, 2001; Lichtenstein & Hazuda, 1998; Monzani et al., 2007). In New Zealand, more than 87,000 people (2% of the population) did not state that they could hold a conversation about everyday things in English (Statistics New Zealand - Tatauranga Aotearoa, 2013). Translated versions of the Hearing Questionnaire would provide a tool for clinicians to measure the participation restrictions of a wider range of individuals than only those that speak English.

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### 4.5 Demographic data

The Hearing Questionnaire was administered to adults around New Zealand with one to two years' experience with hearing aid use. The researcher investigated a number of demographic factors for this group including gender, ethnicity, relationship status, income, level of education and working status. A partial correlational analysis did not identify any of these factors as significant covariates.

The most recent national census for New Zealand was in 2013 and there is no up-to-date national demographic data on people with hearing impairment. This makes it difficult to determine whether the sample population in this study is truly representative of experienced hearing aid users with hearing impairment in New Zealand, however, one can make estimates based on the data available.

#### 4.5.1 Hearing impairment

The mean pure-tone hearing thresholds for the participants of this study are shown in Figure 2. The Speech Frequency Pure-Tone Average (SFPTA; 500, 1000, 2000 Hz) of the better ear was 34.6 dBHL (SD = 12.7) and 42.2 dBHL (SD = 14.1) for the poorer ear. These figures are comparable to studies on the Hearing Handicap Inventory (Jupiter & DiStasio, 1998; Ventry & Weinstein, 1982; Weinstein et al., 1986; Weinstein & Ventry, 1983) and other questionnaires such as the Hearing Aid Users Questionnaire (HAUQ; Dillon et al., 1999) and Client-Oriented Scale of Improvement (COSI; Dillon et al., 1997).

Other studies have involved participants with better thresholds and within a smaller range than this study (Newman et al., 1990). For example, the participants involved in the investigation by Newman et al. (1991) had a SFPTA of 24.0 dBHL (SD = 10.8) for the better ear and 29.4 dBHL (SD = 12.3) for the poorer ear. So long as the range of thresholds is not

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vastly different between studies, the variation in participation restrictions should be minor considering the degree of hearing impairment accounts for only 37% of perceived participation restrictions (Ventry & Weinstein, 1982).

### **4.5.2 Age**

While the results of this study were relevant to a group of elderly hearing aid users in New Zealand, only one participant was below of age of 50 years. This may limit the relevance to a younger population living in the same country. According to the most recent national census, 39% of people in New Zealand (N = 294,000) over the age of 44 years have a hearing impairment, but only 5% (N = 86,000) of the population below the age of 45 years have hearing impairment (Statistics New Zealand - Tatauranga Aotearoa, 2013). This suggests that the sample group in this study will be representative of the majority of people will hearing impairment in New Zealand.

### **4.5.3 Ethnicity**

Over 90% of the participants in this study identified themselves as New Zealand-European (Table 2). Other ethnicities such as Māori may be under-represented in this study as 2013 census data suggests New Zealand-European make up only 66.6% of the population of New Zealand whereas Māori make up 13.8% (Statistics New Zealand - Tatauranga Aotearoa, 2013).

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### **4.6 Limitations of present study**

#### **4.6.1 Sampling bias**

Every participant in this study was recruited via Bay Audiology, the largest provider of audiology services in New Zealand. While this was logistically necessary for this master thesis, it would be preferable to recruit participants from many audiology service providers around the country to reduce sampling bias and maximise the generalisability of these results.

As previously mentioned, current demographic data for hearing aid users in New Zealand is unavailable. However there are a number of disparities between the sample population in this study and the census data from 2013 (Statistics New Zealand - Tatauranga Aotearoa, 2013). Further research is required in which participants more closely reflect the demographics of a New Zealand population of experienced hearing aid users.

The participants in this study were individuals that had been fitted with hearing aids from Bay Audiology in the last one to two years. These individuals had chosen to accept hearing aids and continue wearing them, and therefore are most likely receiving some reduction in participation restrictions from them. While the results of this study may be representative of a population of adults who are experienced hearing aid users, it may not be appropriate to assume this result for all new hearing aid wearers. A normative range of scores should be generated based on a New Zealand population of novice hearing aid users. This information can then be used by clinicians to identify clients that fall outside of the normal range in terms of participation restrictions and as such require further assistance.

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### **4.6.2 Lack of normality**

The mean and median Hearing Questionnaire scores were very similar for the first administration (mean = 10.7, median = 10) and the second administration (mean = 10.4, median = 10) though a Shapiro-Wilk test for normality shows scores for both administrations were significantly positively skewed ( $p < .05$ ). This indicates that the majority of scores were toward the zero end of the scale, signifying little or no participation restrictions. Because the sample population was not normally distributed, these results may not be generalisable to a group that has high participation restriction scores even when wearing hearing aids. Clinicians may over-estimate the degree of participation restrictions for a population such as this, which would likely include new hearing aid wearers.

### **4.6.3 Acquiescence response set**

As mentioned previously, the acquiescence response set is the “general tendency to respond agreeably (or disagreeably) independently of item content” (Wiggins, 1973 pp. 437-438). It is possible that some participants in this study were not reporting the true degree of participation restriction they experienced out of a desire to support the work of their audiologist. This is an unavoidable limitation of all self-report questionnaires and clinicians should bare this in mind when drawing conclusions from a client’s score. It may be possible to reduce this effect by carefully explaining the purpose of the self-report measure and the need to be honest and accurate, though this is particularly difficult when administering a questionnaire using a method other than face-to-face.



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### 4.6.4 Exclusion of outliers

No outliers were present for the first administration. The second administration of the HQ produced two significant outliers. These outliers were excluded in the analysis of results. By removing the outliers the sample size was decreased from 54 participants to 52, making it more difficult to generalise these results to a larger population. A smaller sample size also decreases the power of a study, making any significant finding more obscure. However, this study only required 16 participants to reach adequate power so the loss of two participants had no substantial effect on the power of this study. The two outlying points decreased the standard deviation by only .02 points, increased the t-score by .02 and increased the significance by .1 when included.

### 4.7 Conclusion

The critical change score for the Hearing Questionnaire is 8 points for a New Zealand population of experienced hearing aid wearers. This is comparable to that of the HHIA-S (Newman et al., 1991) however, the test-retest reliability of the Hearing Questionnaire was considerably less than that of the HHIE-S or the HHIA-S (Lichtenstein et al., 1988; Newman, Weinstein, et al., 1991). Based on these results, the researcher concludes that refinements are required if the Hearing Questionnaire is to be used clinically in New Zealand. Additionally, this study has contributed to the collective knowledge available regarding experienced hearing aid users in New Zealand.

### 4.8 Future Directions

Further development of the Hearing Questionnaire is worthwhile, if only as an updated version of the Hearing Handicap Inventory which conforms to the new terminology endorsed by the World Health Organization (World Health Organization, 2001b). If the reliability of the Hearing Questionnaire can be improved enough to comply with Nunnally's

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recommendations (Nunnally, 1978) then the next step should be to generate normative values for new hearing aid users in New Zealand. This will allow clinicians to make judgements concerning the degree of a client's residual participation restrictions in comparison to a wider population which could be useful for counselling purposes or to evaluate whether further intervention is required.

The Hearing Questionnaire could also be modified for use as a proxy measure of participation restrictions as a result of hearing impairment. That is to say, the Hearing Questionnaire could be completed by a frequent communication partner to discern their views on the participation restrictions of someone with hearing impairment. Development of a Hearing Questionnaire for Significant Others would be a powerful tool for an audiologist to use when counselling their clients and the attending friends and family. For example, by measuring the difference in the perception of activity limitations and participation restrictions between the person with hearing impairment and their significant other an audiologist could judge the need for additional counselling (Preminger & Meeks, 2010). If the discrepancy between the significant other's perception and the individual with hearing impairment's perception remains wide or increases following amplification then more counselling may be warranted.

A number of studies have suggested proxy reports such as the HHIE-SP (spouse version) serve as additional measures of hearing aid benefit (Jerger et al., 1996; Newman & Weinstein, 1986, 1988; Stark & Hickson, 2004). This suggestion is justified, given the integral part many significant others play in the acclimatisation to amplification and maintenance of hearing aids as well as the motivation to seek help to begin with (Abrahamson, 2000; Mahoney et al., 1996). At the very least, exploring the effect of a person's hearing on those around them could stimulate discussion on proactive methods of communication and ultimately lead to a better outcome for all.

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## Appendices

### Appendix A – Study Information Sheet

#### Research Information Sheet (Keep this for your records)

**Study Title:** Clinical Outcomes of the Hearing Questionnaire

**Primary Researcher:**

Dr Rebecca Kelly-Campbell  
Senior Lecturer  
Disorders  
Department of Communication Disorders  
University of Canterbury  
Email: [rebecca.kelly@canterbury.ac.nz](mailto:rebecca.kelly@canterbury.ac.nz)  
Phone: (03) 364 2987 ext 7077

**Additional Researchers:**

Steve Hall, Master of Audiology Student  
Department of Communication  
  
University of Canterbury  
  
Anna McMillan, Charge Audiologist  
Bay Audiology  
[Anna.McMillan@bayaudiology.co.nz](mailto:Anna.McMillan@bayaudiology.co.nz)

#### Why have I been contacted?

We contacted you to invite you to take part in the study: *Clinical Outcomes of the Hearing Questionnaire*. Participation in this study should take about 10 minutes of your time.

#### What is the aim of the study?

To find out how people who have been fit with hearing aids tend to answer items on a modified version of the Hearing Questionnaire.

#### Who do you need for the study?

We need 2 groups of people:

- Adults who have gotten hearing aids in the past 1-2 years
- Adults who are getting their first hearing aids

#### What will happen in the study?

You are asked to read the information in this packet. If you agree to be in the study, please complete the forms and send them to us in the postage-paid envelope. If you do not agree to be in the study, you do not need to do anything.

#### What are my rights?

You do not have to take part in the study – it is entirely up to you. You can withdraw from the study at any time, without giving a reason. This will NOT affect any future interactions you have with the University of Canterbury or Bay Audiology. If you do withdraw, we will remove all information relating to you, as long as you let us know by 1 November 2016. After that date, we will not be able to remove your information because it will not be practical.

## CLINICAL OUTCOMES OF THE HEARING QUESTIONNAIRE

### **What are the benefits of the study?**

There are no direct benefits to you. But, we hope this study will help us provide better support for people with hearing problems by understanding the typical responses to the questionnaires we use.

### **What are the risks of the study?**

There are no direct risks for you being in this study. But, you may feel distressed answering questions about your hearing problems. You may have whanau or a friend present to help you deal with any distress. You will also find a list of support services at the bottom of this letter.

### **Will my information stay private?**

The results of the study may be published, but your identity will be kept private throughout the study. Information you give will not be anonymous, but no information that could identify you will be used in any reports in the study. We will not share your information with anyone else. We will keep the data in a locked filing cabinet and in a password-protected computer. We will destroy the data ten years after we finish the study.

### **How can I find out about the study findings?**

Please tick the box on the consent form if you want us to send you the study results. Be sure to give us your contact details if you want the study results.

### **Has this study been approved?**

The study has been checked and approved by the University of Canterbury Human Ethics Committee. If you have a problem or complaint about this research, contact: The Chair, Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch ([humanethics@canterbury.ac.nz](mailto:humanethics@canterbury.ac.nz)) (03) 364 2987 ext 45588).

### **What do I do next?**

If you want to take part in this study, simply fill in the forms and send them to me in the postage-paid envelope. If you want to learn more about the study, please contact me by phone (03 364 2987 ext 7077) or email ([Rebecca.kelly@canterbury.ac.nz](mailto:Rebecca.kelly@canterbury.ac.nz)).

### **Who can I contact if I feel distressed?**

Lifeline: 0800 543 354

### **Who can I contact if I want more information about hearing loss and hearing aids?**

Your Bay Audiology clinician: 0800 700 851 (or phone the number of your local Bay Audiology Clinic)

New Zealand Audiological Society: 0800 625 166

Ministry of Health Healthline: 0800 611 116

Ministry of Health Disability Support: 0800 373 664



## CLINICAL OUTCOMES OF THE HEARING QUESTIONNAIRE

## CONSENT FORM

**(Keep this copy for your records)**Study title: *Clinical Outcomes of the Hearing Questionnaire (Hall)****Please read the following statements and, if you agree, tick the boxes and sign the form below.***

The information about this research study has been explained to me to my satisfaction. I have had the chance to ask questions. I know what I need to do to take part in the study.

I know that I can choose whether or not I take part in this research. I know that I may withdraw from the study until 1 November 2016, without penalty. If I withdraw, my information will also be withdrawn.

I know that any information or opinions I give will be kept private to the researchers. I know that any published or reported results will not identify me.

I know that all data collected for the study will be kept in locked and secure facilities or in password protected computers and will be destroyed after five years. I have been given a copy of this form and the Research Information Sheet.

I know that I can contact the primary researchers for more information. Her information is: Dr Rebecca Kelly-Campbell: rebecca.kelly@canterbury.ac.nz, (03) 364 2987 ext 7077. If I have any complaints, I can contact the Chair of the University of Canterbury Human Ethics Committee, Private Bag 4800, Christchurch ([human-ethics@canterbury.ac.nz](mailto:human-ethics@canterbury.ac.nz), (03) 364 2987 ext 45588).

I agree to allow Bay Audiology to give my hearing test results and Hearing Questionnaire to the researchers.

Yes  No

I agree to take part in this research.

---

Print name

---

Signature

Date

I would like a copy of the final results of the study.

Yes  No

Please provide your preferred contact details if you would like to know the results:

## CLINICAL OUTCOMES OF THE HEARING QUESTIONNAIRE

## CONSENT FORM

**(Please return this form in the enclosed envelope)**Study title: *Clinical Outcomes of the Hearing Questionnaire (Hall)****Please read the following statements and, if you agree, tick the boxes and sign the form below.***

The information about this research study has been explained to me to my satisfaction. I have had the chance to ask questions. I know what I need to do to take part in the study.

I know that I can choose whether or not I take part in this research. I know that I may withdraw from the study until 1 November 2016, without penalty. If I withdraw, my information will also be withdrawn.

I know that any information or opinions I give will be kept private to the researchers. I know that any published or reported results will not identify me.

I know that all data collected for the study will be kept in locked and secure facilities or in password protected computers and will be destroyed after five years. I have been given a copy of this form and the Research Information Sheet.

I know that I can contact the primary researchers for more information. Her information is: Dr Rebecca Kelly-Campbell: rebecca.kelly@canterbury.ac.nz, (03) 364 2987 ext 7077. If I have any complaints, I can contact the Chair of the University of Canterbury Human Ethics Committee, Private Bag 4800, Christchurch ([human-ethics@canterbury.ac.nz](mailto:human-ethics@canterbury.ac.nz), (03) 364 2987 ext 45588).

I agree to allow Bay Audiology to give my hearing test results and Hearing Questionnaire to the researchers.

Yes  No 

I agree to take part in this research.

\_\_\_\_\_  
**Print name**\_\_\_\_\_  
**Signature**\_\_\_\_\_  
**Date**

I would like a copy of the final results of the study.

Yes  No 

Please provide your preferred contact details if you would like to know the results:

## CLINICAL OUTCOMES OF THE HEARING QUESTIONNAIRE

## Demographic Form

**(Please return this form in the enclosed envelope)**

Date: \_\_\_\_\_ Current age: \_\_\_\_\_ Gender: \_\_\_\_\_

1. What ethnic group(s) do you belong to?

- |   |                                  |
|---|----------------------------------|
| <input type="checkbox"/> New Zealand European                                     | <input type="checkbox"/> Tongan  |
| <input type="checkbox"/> Maori  | <input type="checkbox"/> Niuean  |
| <input type="checkbox"/> Samoan   | <input type="checkbox"/> Chinese |
| <input type="checkbox"/> Cook Island Maori  | <input type="checkbox"/> Indian  |
| <input type="checkbox"/> Other, such as Dutch, Japanese, Tokelauan. Please state: |                                  |

\_\_\_\_\_

2. What is your relationship status? (please tick one box)

- |                                    |  |
|------------------------------------|--|
| <input type="checkbox"/> Single    | <input type="checkbox"/> Never married               |
| <input type="checkbox"/> Married   | <input type="checkbox"/> In a committed relationship |
| <input type="checkbox"/> Widowed   | <input type="checkbox"/> Divorced                    |
| <input type="checkbox"/> Separated |  |

3. What is the net annual income of your household? (please tick one box)

- |  |   |
|--|---|
| <input type="checkbox"/> \$0 – \$25,000      | <input type="checkbox"/> \$25,000 - \$50,000  |
| <input type="checkbox"/> \$50,000 - \$75,000 | <input type="checkbox"/> \$75,000 - \$100,000 |
| <input type="checkbox"/> more than \$100,000 |   |

4. What is the highest level of education you completed?

\_\_\_\_\_

5. Are you currently working?

- |                              |                             |
|------------------------------|-----------------------------|
| <input type="checkbox"/> Yes | <input type="checkbox"/> No |
|------------------------------|-----------------------------|

If so, what is your occupation?

\_\_\_\_\_

## CLINICAL OUTCOMES OF THE HEARING QUESTIONNAIRE

**Appendix B – The Hearing Questionnaire****Hearing Questionnaire**

**(Please return this form in the enclosed envelope)**

Select No, Sometimes or Yes in response to each question. (If you do not engage in a particular activity, picture yourself in a similar situation and respond accordingly)

	No	Sometimes	Yes
1. When wearing your hearing aid(s) ... does a hearing problem cause you to feel embarrassed when you meet new people?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. When wearing your hearing aid(s) ... does a hearing problem cause you to feel frustrated when talking to members of your family?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. When wearing your hearing aid(s) ... do you have difficulty hearing or understanding co-workers, clients, customers or shop assistants?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. When wearing your hearing aid(s) ... do you feel limited by a hearing problem?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. When wearing your hearing aid(s) ... does a hearing problem cause you difficulty when visiting friends, relatives or neighbours?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. When wearing your hearing aid(s) ... does a hearing problem cause you difficulty in the movies or in the theatre?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. When wearing your hearing aid(s) ... does a hearing problem cause you to have arguments with family members?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. When wearing your hearing aid(s) ... does a hearing problem cause you difficulty when listening to TV or radio?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. When wearing your hearing aid(s) ... do you feel that any difficulty with your hearing limits or hampers your personal or social life?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. When wearing your hearing aid(s) does a hearing problem cause you difficulty when in a restaurant with relatives or friends?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>