
Hearing Aid Self-Efficacy through the Fitting Process

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Abstract

Background: Self-efficacy (SE) is one factor which contributes to successful hearing aid (HA) outcomes. This study investigated new and experienced HA users HA-SE over a 12-week interval post-HA fitting, using satisfaction with HAs and hours of use as outcome measures. The current study aimed to investigate 3 questions: 1) What is the pattern of HA-SE over the trial period and are there significant differences between new and experienced HA owners? 2) Does HA-SE at the various assessment points predict satisfaction with HAs for new or experienced HA owners? 3) Does HA-SE at the various assessment point predict HA use for new or experienced HA owners?

Method: This research employed a longitudinal intervention study design. New (n = 80) and experienced (n = 113) adult HA users were recruited from a private HA clinic Phoenix, Arizona, USA. Participants completed the Measure of Audiologic Rehabilitation Self-Efficacy for Hearing Aids (MARS-HA; West & Smith, 2007) at 4 stages through the fitting process: immediately following the HA fitting, 1 week post-fitting, 4 to 6 weeks post-fitting and 12 weeks post-fitting. Information was also collected on age, gender, hearing handicap, hearing impairment, number of appointments attended, average hours of use, and cost of the hearing aid to the participant. Hours of use was measured via data logging and self-report at 4 to 6 weeks post fitting and satisfaction was measured at 12 weeks post-fitting using the Satisfaction with Amplification in Daily Life questionnaire (SADL; Cox & Alexander, 1999).

Results: There was little evidence to support a difference between HA-SE for new and experienced HA users, so the groups were combined for the remaining analyses. HA-SE significantly improved over the 12-week interval, although some subscales still showed a low proportion of users with adequate HA-SE at the end of the 12 weeks. Various MARS-HA

scores entered into regression equations to predict SADL scores at 12-weeks, although hours of use at 4 to 6 weeks could not be predicted by any predictor variables.

Conclusions: This research supported previous literature that many HA users do not have adequate HA-SE in important areas (Kelly-Campbell & McMillan, 2015; Kricos, 2000, 2006; Meyer, Hickson, Lovelock, Lampert, & Khan, 2014; Weinstein, 2000; West & Smith, 2007). This research also built on previous work linking HA-SE and satisfaction with HAs (Kelly-Campbell & McMillan, 2015) by showing the ability of MARS-HA scores to predict SADL outcomes. The outcome of future studies could potentially lead to targeted interventions aimed at improving HA-SE, which as a consequence could target increased satisfaction with HAs. If satisfaction with HAs can be improved, it may be possible to see increased uptake and continued use of HAs, which would have the effect of reducing the negative effects of untreated HI.

Table of Contents

Acknowledgements	ii
Abstract.....	iii
Table of Contents	v
List of Figures.....	viii
List of Tables	x
List of Abbreviations	xi
1. INTRODUCTION.....	1
2. LITERATURE REVIEW	4
2.1. Hearing Impairment.....	4
2.1.1. Overview	4
2.1.2. Prevalence	6
2.1.3. Impacts of Hearing Impairment	7
2.2. Hearing Aids.....	9
2.2.1. Rates of Hearing Aid Use	11
2.2.2. Predicting Hearing Aid Outcomes	12
2.2.2.1. <i>Health Belief Model</i>	12
2.2.2.2. <i>Evidence for the Health Belief Model</i>	16
2.2.3. Outcomes of Hearing Aids.....	17
2.2.3.1. <i>Measuring Outcomes with Hearing Aids</i>	19
2.2.3.2. <i>Hearing Handicap Questionnaire (HHQ)</i>	20
2.2.3.3. <i>Satisfaction with Amplification in Daily Life (SADL)</i>	22
2.2.4. Ways to Improve Outcomes.....	26
2.3. Self-Efficacy.....	27
2.3.1. Self-Efficacy with Hearing Aids (MARS-HA).....	28
2.3.2. Self-Efficacy and Satisfaction.....	31
2.4. Rationale and Aims.....	35
2.5. Research Questions and Hypotheses.....	37
3. METHODS	40
3.1. <i>A Priori</i> Analysis.....	40
3.2. Ethical Approval.....	40
3.3. Participants.....	40

3.4. Measures	41
3.4.1. Age.....	41
3.4.2. Degree of Hearing Impairment	41
3.4.3. Hearing Aid Experience.....	42
3.4.4. Hours of Hearing Aid Use	42
3.4.5. Cost of Hearing Aid to Participant	43
3.4.6. Hearing Handicap Questionnaire (HHQ).....	43
3.4.7. Measure of Audiologic Rehabilitation Self-Efficacy for Hearing Aids (MARS-HA)	43
3.4.8. Satisfaction with Amplification in Daily Life (SADL)	44
3.5. Procedure.....	44
3.6. Statistical Analyses.....	46
4. RESULTS	48
4.1. Sample Characteristics.....	48
4.2. Descriptive Statistics.....	49
4.3. Research Question One	51
4.4. Research Question Two.....	59
4.5. Research Question Three	67
5. DISCUSSION	69
5.1. Question One: Hypotheses and Relationship to the Literature.....	70
5.1.1. Hypotheses 1a: Between Groups Difference	70
5.1.2. Hypotheses 1b: Difference in HA-SE over Time	72
5.2. Question Two: Hypotheses and Relationship to the Literature	76
5.2.1. Non-Significant Predictor Variables.....	76
5.2.2. Predictor Variables that Occur Frequently	77
5.2.3. Positive Effect.....	79
5.2.4. Service and Cost	80
5.2.5. Negative Features.....	81
5.2.6. Personal Image.....	83
5.2.7. Global Satisfaction.....	83
5.3. Question Three: Hypotheses and relationship to the literature	85
5.4. Clinical Implications.....	87
5.4.1. Targeted Interventions	88
5.4.1.1. AH at T0.....	89
5.4.1.2. AD at T2.....	90
5.4.1.3. AL at T3.....	91
5.4.1.4. BH.....	92
5.4.2. Hours of Use as an Outcome Measure.....	92

5.5. Limitations and Directions for Future Research	94
5.6. Conclusion	96
REFERENCES.....	97
APPENDICES	110

List of Figures

Figure 1.	<i>Mean and Standard Error for Experienced (n=113) and New (n=80) HA users over the HA trial period (T0-T3) on the Aided Listening subscale.</i>	53
Figure 2.	<i>Mean and Standard Error for Experienced (n=113) and New (n=80) HA users over the HA trial period (T0-T3) on the Basic Handling subscale.</i>	54
Figure 3.	<i>Mean and Standard Error for Experienced (n=113) and New (n=80) HA users over the HA trial period (T0-T3) on the Adjustment subscale.</i>	54
Figure 4.	<i>Mean and Standard Error for Experienced (n=113) and New (n=80) HA users over the HA trial period (T0-T3) on the Advanced Handling subscale.</i>	55
Figure 5.	<i>Mean and Standard Error for Experienced (n=113) and New (n=80) HA users over the HA trial period (T0-T3) for total HA-SE.</i>	55
Figure 6.	<i>Proportion of HA users (n=193) with adequate SE ($\geq 80\%$) for HA-SE subscale Aided Listening over the HA trial period (T0 through to T3).</i>	56
Figure 7.	<i>Proportion of HA users (n=193) with adequate SE ($\geq 80\%$) for HA-SE subscale Basic Handling over the HA trial period (T0 through to T3).</i>	57
Figure 8.	<i>Proportion of HA users (n=193) with adequate SE ($\geq 80\%$) for HA-SE subscale Adjustment over the HA trial period (T0 through to T3).</i>	57
Figure 9.	<i>Proportion of HA users (n=193) with adequate SE ($\geq 80\%$) for HA-SE subscale Advanced Handling over the HA trial period (T0 through to T3).</i>	58
Figure 10.	<i>Proportion of HA users (n=193) with adequate SE ($\geq 80\%$) for total HA-SE over the HA trial period (T0 through to T3).</i>	58
Figure 11.	<i>Twentieth to 80th percentile normative score ranges in each of the SADL questionnaire scales and the mean scores for experienced HA users (n=113).</i>	59
Figure 12.	<i>Twentieth to 80th percentile normative score ranges in each of the SADL questionnaire scales and the mean scores for new HA users (n=80).</i>	60
Figure 13.	<i>P-P plot of regression standardized residual for the dependent variable Positive Effect.</i>	61

Figure 14.	<i>P-P plot of regression standardized residual for the dependent variable Service and Cost.</i>	62
Figure 15.	<i>P-P plot of regression standardized residual for the dependent variable Negative Features.</i>	63
Figure 16.	<i>P-P plot of regression standardized residual for the dependent variable Personal Image.</i>	64
Figure 17.	<i>P-P plot of regression standardized residual for the dependent variable Global Satisfaction.</i>	65
Figure 18.	<i>Number of times a predictor variable appeared in any of the equations to predict any aspect of satisfaction (global or subscale) with HAs at T3.</i>	66

List of Tables

Table 1.	<i>Degree of HI as classified by Jerger and Jerger (1980).</i>	5
Table 2.	<i>Key concepts and Definitions of the Health Belief Model adapted from “The Health Belief Model”, Champion & Skinner (2008).</i>	15
Table 3.	<i>Mean, standard deviation, and 20th and 80th percentile values for Global scores and each subscale of the SADL adapted from Cox & Alexander (1999).</i>	25
Table 4.	<i>Descriptive statistics of continuous variables from demographic questionnaire.</i>	49

List of abbreviations

AD	Adjustment (MARS-HA)
AH	Advanced Handling (MARS-HA)
AL	Aided Listening (MARS-HA)
ANOVA	Analysis of Variance
ARE	Audiological Rehabilitation Evaluation
BEPTA	Better Ear Pure Tone Average
BH	Basic Handling (MARS-HA)
BTE	Behind-the-ear Hearing Aid
dB HL	Decibel Hearing Level
GAR	Group Audiological Rehabilitation
HA	Hearing Aid
HA-SE	Self-Efficacy with Hearing Aids
HBM	Health Belief Model
HHQ	Hearing Handicap Questionnaire
HI	Hearing Impairment
Hz	Hertz
IOI-HA	The International Outcome Inventory for Hearing Aids
ITE	In-the-ear Hearing Aid
MARS-HA	Measure of Audiologic Rehabilitation Self-Efficacy for Hearing Aids
NF	Negative Features (SADL)
PE	Positive Effect (SADL)
PI	Personal Image (SADL)
PTA	Pure Tone Average
RITE/RIC	Receiver-in-the-ear Hearing Aid
SADL	Satisfaction with Amplification in Daily Life
SC	Service and Cost (SADL)
SE	Self-Efficacy

SNHL	Sensorineural Hearing Loss
SSQ	Speech, Spatial and Qualities of Hearing Scale
WEPTA	Worse Ear Pure Tone Average
WHO	World Health Organisation

1 INTRODUCTION

Disabling hearing impairment (HI) is a condition which affects around 5% of the world's population (World Health Organization, 2015). HI impacts communication by reducing the ability to hear and understand speech signals. Untreated HI leads to well documented negative consequences such as: problems with communication, negative impacts on mental and physical health, and negative impacts on relationships to name a few (Appollonio, Carabellese, Frattola, & Trabucchi, 1996; Arlinger, 2003; Bess, Lichtenstein, Logan, Burger, & Nelson, 1989; Chia et al., 2007; Dalton et al., 2003; Lin et al., 2011; Strawbridge, Wallhagen, Shema, & Kaplan, 2000; Weinstein & Ventry, 1982). Although hearing aids (HAs) have been shown to be a successful intervention for improving quality of life (Mulrow et al., 1990; Öberg, Marcusson, Nägga, & Wressle, 2012; Tsakiropoulou, Konstantinidis, Vital, Konstantinidou, & Kotsani, 2007; Vuorialho, Karinen, & Sorri, 2006) uptake is low with penetration rates between 14 and 25% (Bade, 1991; Chien & Lin, 2012; Hesse, 2004; Kochkin, 1997; Popelka et al., 1998; D. Stephens, Lewis, Davis, Gianopoulos, & Vetter, 2001; S. Stephens et al., 1990). Consequently it is important to find ways to target behaviours which may promote successful HA outcomes.

There are many factors that contribute to successful HA outcomes including: motivation (Knudsen, Öberg, Nielsen, Naylor, & Kramer, 2010; Laplante-Lévesque, Hickson, & Worrall, 2012), attitude towards HAs (Hickson, Meyer, Lovelock, Lampert, & Khan, 2014; Knudsen et al., 2010; Meyer, Hickson, Lovelock, et al., 2014), degree of HI (Hickson et al., 2014; Knudsen et al., 2010; Meyer, Hickson, Lovelock, et al., 2014), self-perceived HI (Hickson et al., 2014; Hickson, Worrall, & Scarinci, 2007; Knudsen et al., 2010; Laplante-Lévesque et al., 2012), age of HI onset (Knudsen et al., 2010), personality (Knudsen et al., 2010; Kricos, 2000), social support (Hickson et al., 2014; Kricos, 2000;

Meyer, Hickson, Lovelock, et al., 2014), counselling (Brooks, 1979; Knudsen et al., 2010; Noble, 1998) and self-efficacy (Hickson et al., 2014; Kricos, 2000; Meyer, Hickson, & Fletcher, 2014; Meyer, Hickson, Lovelock, et al., 2014).

Self-efficacy (SE) is the belief that an individual has in their ability to complete a specific task, for example change a HA battery. Bandura (1997) suggested that people's behaviour is often better predicted by what they believe they can do rather than what they can actually achieve. There is extensive evidence for the importance of SE in the successful management of other health conditions including: cardiac rehabilitation (Ni et al., 1999; Winkleby, Flora, & Kraemer, 1994), cancer (Rogers et al., 2005), vision loss (Brody et al., 1999; Horowitz, Reinhardt, & Kennedy, 2005), and balance disorders (Tinetti, Richman, & Powell, 1990). The main findings of these studies indicate individuals with higher SE for managing their health condition have higher adherence to their treatment, better treatment outcomes and better maintenance of health behaviours (Smith, 2014).

SE has also been suggested to contribute to successful HA use (Hickson et al., 2014; Meyer, Hickson, Lovelock, et al., 2014) with low SE linked to low uptake and discontinued use of HAs (Carson & Pichora-Fuller, 1997; Kricos, 2000, 2006; Weinstein, 2000). Due to the importance of improving HA outcomes and the potential influence of SE, West and Smith (2007) developed a tool for measuring HA-SE: the Measure of Audiologic Rehabilitation Self-Efficacy for Hearing Aids (MARS-HA; West & Smith, 2007).

A previous study by Kelly-Campbell and McMillan (2015) assessed the relationship between HA-SE and satisfaction with HAs. They measured satisfaction using the Satisfaction with Amplification in Daily Life (SADL; Cox and Alexander, 1999). Cox and Alexander (1999) argue the use of satisfaction as the most appropriate outcome measure when the client's point of view is of interest and state that it is perhaps more important than benefit alone. Kelly-Campbell and McMillan (2015) found that most participants had adequate SE

for the sub-scales of basic handling (83%) and adjusting to wearing HAs (76.6%) but that fewer participants had adequate SE for the aided listening (53.3%) and or advanced handling sub-scales (51.1%). Furthermore, they found that participants with adequate SE had higher satisfaction with their HAs than those with low SE.

This research aims to build on previous work by Kelly-Campbell and McMillan (2015), which highlighted several gaps in the literature. Firstly, there is no knowledge of the pattern of perceived HA-SE over time. Another issue is that lack of research surrounding the effect of the ongoing intervention by clinicians on both HA-SE and satisfaction with HAs. Lastly, the need to look at the interaction of HA-SE and satisfaction longitudinally was identified.

This thesis thus aims to firstly assess the pattern of MARS-HA responses over the HA fitting process, as there is currently no knowledge of perceived HA-SE longitudinally. This will be investigated for both new and experienced HA users, in order to examine the longitudinal pattern and to look for a difference between the two groups in HA-SE. A second aim of the study is to assess the levels of HA-SE at various points during the HA trial period and to compare this to satisfaction with HA's at the end of the fitting process. The final aim of this research is to investigate the relationship between HA-SE and HA use at the end of the fitting process.

2 LITERATURE REVIEW

This chapter provides information on HI including the prevalence, impacts and possible interventions. HA-SE and satisfaction with HAs is also discussed, as well as previous research examining the relationship between the two measures. The rationale, aims, and hypotheses of the investigation are also described.

2.1. Hearing Impairment

2.1.1. Overview

According to the World Health Organisation, a person who is not able to hear as well as someone with normal hearing- which is classed as thresholds at 25 dB HL or better in both ears- has a hearing impairment (HI) (World Health Organization, 2015). There are varying degrees of HI and either one or both ears can be affected. This reduced sensitivity to auditory input generally leads to difficulty hearing speech and/or other environmental sounds (World Health Organization, 2015).

The current gold standard for detecting and quantifying HI is pure-tone audiometry. This is used to establish hearing thresholds across a range of frequencies, giving an audiogram. A threshold, measured in dB HL, is the lowest level that a person can detect a stimulus at least half of the time it is presented. The frequencies commonly tested are octave frequencies from 250 Hz to 8000 Hz, which aims to cover the important speech frequency range (Clark, 1981; Elert, 2003).

The WHO defines a disabling HI as 40 dB HL or worse in the better ear in adults (World Health Organization, 2015). HI can be further described by site of dysfunction, degree of loss and configuration.

There are 3 broad terms that can be used to categorize HI: conductive, sensorineural and mixed HI. Conductive HI is a mechanical issue, where sound is not conducted correctly through the outer or middle ear. This affects the transmission of sound to the cochlea but can often be corrected through medical or surgical intervention. Sensorineural hearing loss (SNHL) is caused by damage to the cochlea or retrocochlear structures, for example the auditory nerve pathway to the brain. Causes of SNHL include age, noise damage, genetic factors, ototoxic medications, infections and tumours. While some SNHL can be treated, it is generally considered permanent (American Speech-Language Hearing Association, 2015; Hicks & Wright 3rd, 1991; Nakagawa, 2014). Mixed HI is a combination of both conductive and SNHL.

There are several systems to classify degree of HI. One system developed by Jerger and Jerger (1980) is shown in Table 1. Degree of HI can be given for each frequency tested.

Table 1. *Degree of HI as classified by Jerger and Jerger (1980).*

Degree of HI	Normal Hearing	Mild	Moderate	Moderately-Severe	Severe	Profound
dB HL	≤20	21 to 40	41 to 55	56 to 70	71 to 90	>90

Configuration of HI describes the shape of the audiogram, the relationship between all the thresholds. Configurations are flat, sloping (decline of threshold with increasing octaves), rising (improvement of threshold with increasing octaves), notched (decline in threshold with complete or near recovery at adjacent frequencies), U-shaped (decline in thresholds at mid-frequencies but not at extreme frequencies), peaked (decline in thresholds at extreme frequencies but not mid frequencies) or corner (small amount of hearing preserved at elevated thresholds in the low frequencies) (Carhart, 1945; Lloyd & Kaplan, 1978).

Another way to define HI is through the Pure Tone Average (PTA). This is the average of three or four frequency thresholds between 500 Hz and 4000 Hz, the frequencies

most important for speech perception (Clark, 1981). In addition, adjective descriptors can then be given based on the PTA (Clark, 1981).

2.1.2. Prevalence

Prevalence of HI varies depending on several factors such as criteria used to define HI and characteristics of the population in question. Despite the variation, HI is very common. HI can be quantified through either self-report or by using objective measures.

Self-reported rates of HI range from around 10 to 16% (Kochkin, 1997; Statistics New Zealand, 2013; Wilson, Walsh, Sanchez, & Reed, 1998). In New Zealand, the rate of self-reported HI is 11%, according to the 2013 Disability Survey (Statistics New Zealand, 2013). This self-reported HI was more likely to be experienced by men (12% of the general population) than women (9% of the general population) and was strongly related to age, with 34% of men and 23% of women over the age of 65 experiencing HI. The criterion for HI was not defined by objective measures, but was self-reported. The people who reported experiencing a HI did so based on their feeling that their HI caused long-term limitations in their ability to carry out daily activities.

If HI is examined using objective measures, the prevalence of thresholds in the better ear of 25 dB HL or worse is around 16% in an adult population (Agrawal, Platz, & Niparko, 2008; Davis, 1989; Wilson et al., 1998). If the criterion of a HI is increased to 35 dB HL or worse, the proportion of adults with a HI halves to 8% (Davis, 1989). Each further increase of 10 dB HL halves the proportion of adults with a HI, until the limits of 110 dB HL (Davis, 1989; Dillon, 2010). Using the WHO definition of a disabling hearing loss, over 5% of the world's population has a HI, including 328 million adults (World Health Organization, 2015). WHO also estimates that over one-third of people over 65 have a disabling HI.

Prevalence of HI increases with age (Agrawal et al., 2008; Cruickshanks et al., 1998). Prevalence also increases in male populations compared to females even when controlling for

factors such as age, noise exposure and occupation (Agrawal et al., 2008; Cruickshanks et al., 1998).

2.1.3. Impacts of Hearing Impairment

The impacts of HI vary for each individual but can be broken down into types of impact including functional, social and emotional, and economic. A typical way to measure functional impact is through the activity limitations and participation restrictions that occur due to the HI. An activity is defined as the individual carrying out a task and participation is defined as involvement in a life situation (World Health Organization, 2001). As a result activity limitations are difficulties at a personal level while participation restrictions are at a societal level (World Health Organization, 2001). Activity limitations generally lead to participation restrictions, which affect the individual in a wider sense. For example, an activity limitation could be that a person struggles to hear their partner speak in noisy situations. This may lead to a participation restriction of social isolation, due to avoidance of situations in which the activity limitation occurs. The World Health Organization (2015) previously described activity limitations as disability and participation restrictions as handicap.

Social and emotional impacts of HI can be described through activity limitations and participation restrictions but can also be described in different ways. HI can lead to limited access to communication which can cause feelings of loneliness, isolation and frustration in the individual (Arlinger, 2003; Weinstein & Ventry, 1982). These communication difficulties can lead to poor quality of life, as well as poor emotional status. Untreated HI has also been statistically linked to depression, social isolation, reduced ability to communicate, decreased cognitive function, reduced access to health services, and a general decrease in physical and psychosocial well-being (Appollonio et al., 1996; Arlinger, 2003; Bess et al., 1989; Chia et

al., 2007; Dalton et al., 2003; Lin et al., 2011; Strawbridge et al., 2000; Weinstein & Ventry, 1982).

HI also has a large economic impact for the individual and society. The World Health Organization (2015) states that adults with HI have a higher unemployment rate than individuals with normal hearing. In the United States of America, 44.8% of deaf adults were not in the labour force compared to 22.6% of the general population (United States Census Bureau, 2011). In addition to this, those with HI who are employed are more likely to be in lower grades of employment compared to the general workforce (United States Census Bureau, 2011; World Health Organization, 2015). Work productivity can be affected by communication issues in those individuals who are employed (Dillon, 2012). Outside the level of the individual, the World Health Organization (2015) mentions that HI substantially effects social and economic development in communities and countries.

In addition to the negative effects on the individual, significant others are also expected to experience negative social and emotional consequences (Dillon, 2012; Scarinci, Worrall, & Hickson, 2008). This has been called third party disability and commonly affects the main communication partners of the HI individual (Scarinci, Worrall, & Hickson, 2009). Some consequences can include participation restrictions, annoyance, embarrassment, isolation and a sense of burden (Scarinci et al., 2008; Stark & Hickson, 2004).

2.2. Hearing Aids

There are multiple rehabilitation options for adults with HI including: hearing aids (HAs), hearing assistive technologies, cochlear implants, sign language, communication strategies and training programs. As the treatment intervention for this study is HAs, these will be focused on.

The function of a HA is essentially to make sounds louder in order to make them audible but comfortable to the listener. There are various types of HAs but all contain key components including (Dillon, 2012):

- A microphone (or more than one)- to detect acoustic signals and convert these to electrical signals
- An amplifier- to increase the strength of the electrical signal
- A receiver- to transform the electrical signal back into an acoustic signal
- A coupler- to couple the amplified sound to the ear canal, for example an earmould
- A battery- to power the system

HAs are produced by several manufacturers and can be classified in various ways, including by technology, price, style and size. One of the most obvious ways to distinguish different HAs is by style. The place the components of the HA sit on the body determines the style. There are three main categories: behind-the-ear (BTE), receiver-in-the-ear canal (RITE or RIC) and in-the-ear (ITE).

A BTE is a two-piece hearing aid. All of the electronic components listed above are housed in a casing that sits behind the ear. The acoustic output from the receiver is then coupled via a tube to the ear. This tube will either end in a custom ear mould or a soft dome that sits within the ear canal (Dillon, 2012).

A RITE is also a two-piece hearing aid that is similar in appearance to a BTE. The difference is that the receiver is located within the ear canal, rather than housed in the case

behind the ear. An electrical cable connects the casing behind the ear to the receiver. The receiver can be housed in either a custom ear mould or a soft dome. Due to the receiver being located separately from the other electrical components, the case which sits behind the ear can often be smaller than a BTE case (Dillon, 2012).

An ITE is different to the previous styles, in that all of the components are contained within a single case. This casing is moulded to the individual's ear and sits in the ear canal. There are several types of ITEs, which are classified depending on how far they extend out from the ear canal. Full shell ITEs are the largest and they extend outwards from the ear canal. They can be various sized depending on how much of the external pinna they fill: whole concha, half-concha, half-shell. In-the-canal HAs are smaller ITEs, where the outer portion of the HA is parallel to the ear canal opening. Completely-in-the-canal HAs are the smallest ITEs, where the entire case fits completely within the canal (Dillon, 2012).

As previously mentioned, untreated HI has been linked to multiple negative personal and societal impacts (Arlinger, 2003; Lin et al., 2011; World Health Organization, 2015). HAs have been shown to be a successful intervention for improving several of the negative impacts associated with untreated HI. A randomized trial carried out by Mulrow et al. (1990) assigned veterans with HI to either receive a HA or join a waiting list. Of those who received HAs, there was a significant improvement at follow up in social and emotional function, communication ability, cognitive function and depression in comparison to those placed on the waiting list. Vuorialho et al. (2006) found similar results looking at pre- and post-fitting hearing handicap. They found that 6 months post-fitting of HAs, there was a significant reduction in hearing handicap. In addition to this 40% to 60% of individuals reported fewer social or emotional problems. Findings by Tsakirpoulou et al. (2007) agreed with the previous literature, with 80% of patients reporting benefit from their HAs. They demonstrated a trend of better quality of life with bilateral HI and binaural HA use. Öberg et al. (2012)

carried out a survey looking at differences between those with HI who owned HAs and those with HI who did not. They found that those individuals with untreated HI had poorer mental health as well as poorer general health than those who owned HAs. A systematic review with meta-analysis was carried out by Chisolm et al. (2007) to examine the evidence surrounding the use of HAs for improving health related quality of life in adults with SNHL. The conclusions of the review were that HAs improve adults' health related quality of life by reducing psychological, social, and emotional effects of SNHL. Therefore there is a substantial body of literature supporting the efficacy of HAs as an intervention for HI.

2.2.1. Rates of Hearing Aid Use

Not all people who have a HI will be successful users of HAs. As previously discussed, prevalence of HI ranges from 5 to 16% of adult populations, with even higher prevalence when looking only at older age groups (Agrawal et al., 2008; Davis, 1989; Kochkin, 1997; Wilson et al., 1998). Despite this, most people who have a HI (either objectively determined, or self-reported) do not own a HA. The amount of people who own a HA as a proportion of those who have a HI is called the penetration rate (Dillon, 2012). Depending on the study, the penetration rate has been shown to be between 14% and 25% (Bade, 1991; Chien & Lin, 2012; Hesse, 2004; Kochkin, 1997; Popelka et al., 1998; D. Stephens et al., 2001; S. Stephens et al., 1990).

Penetration rates increase with increasing amount of HI (Chien & Lin, 2012; Davis, 1989, 1995; Kochkin, 2007; Popelka et al., 1998). Chien and Lin (2012) carried out a study looking at prevalence of HA use in the United States. They found that for individuals with a mild HI, HA use was consistently low across all age ranges (penetration of less than 4%). When there was a moderate or greater HI, use of HAs was greater across all age ranges (penetration rate of around 11% to 48% depending on the age group) (Chien & Lin, 2012).

Davis (1995) reported similar findings, in that the penetration rate reached 50% once the BEPTA reached 40 dB HL or more.

Self-report is one reliable way to establish how often individuals are wearing their HAs. Research comparing self-report to objective measures (such as data logging) has shown that people tend to over-estimate their HA usage (Brooks, 1981; Haggard, Foster, & Iredale, 1981; Mäki-Torkko, Sorri, & Laukli, 2001). The amount of exaggeration does not make self-report useless, and the two measures are well correlated, although data logging is the more accurate way to measure HA use.

Among those who are fitted with HAs, there is a proportion of individuals that will completely stop using their HAs. Estimates range from 1% to 29% of people fit with HAs who later discontinue use (Bertoli et al., 2009; Breidablik, 1998; Dillon, Birtles, & Lovegrove, 1999; Kochkin, 2005; Lupsakko, Kautiainen, & Sulkava, 2005; Popelka et al., 1998).

2.2.2. Predicting Hearing Aid Outcomes

Due to the low penetration rate and high rates of disuse, it is important to have some insight into what might promote successful HA outcomes. There are several models that can help predict health-related behaviour of individuals. In addition to this there are multiple factors that are being identified to contribute to positive HA outcomes.

2.2.2.1. Health Belief Model

The Health Belief Model (HBM) can be a useful framework for exploring the impact of a health condition, for example HI, on an individual. It can also be a useful tool for exploring the individual's subsequent health related behaviours. In addition to this the HBM can provide a guide for recommending interventions and to support the ensuing changes in health behaviour.

The HBM was developed by social psychologists (Rosenstock, 1966) at the U.S.A. Public Health Service and remains one of the most widely used models in health behaviour research (Carpenter, 2010; Champion & Skinner, 2008; Janz & Becker, 1984). The HBM was initially developed in order to attempt to gain insight into the widespread failure of individuals to participate in programs targeting disease prevention or early detection screening (Janz & Becker, 1984; Rosenstock, 1974; Strecher & Rosenstock, 1997). Later applications of the model aimed to predict patients' responses to symptoms (Kirscht, 1974) and compliance with recommended treatments (Becker, 1974). The HBM has been developed and expanded since its creation in order to incorporate new evidence from social psychology. One of the most notable changes was the addition of self-efficacy as a construct for influencing decision-making and behaviour.

There are several theoretical constructs that are the fundamental components of the HBM. These are proposed to predict engagement in health related behaviours, for example, adoption of a HA or other rehabilitation option. These key concepts are shown in Table 2 and will be explored in relation to HI and HAs as an intervention.

Table 2. *Key concepts and Definitions of the Health Belief Model adapted from “The Health Belief Model”, Champion & Skinner (2008).*

Concept	Definition	Application
Perceived Susceptibility	Belief about the chances of experiencing a risk or getting a disease	Define population(s) at risk or risk levels Personalize risk based on an individual Make perception more consistent with individual’s actual risk
Perceived Severity	Belief about how serious a condition is	Specify consequences of risks and condition
Perceived Benefits	Belief in the efficacy of the advised action/intervention	Define intervention: how, where, when Clarify the expected positive effects
Perceived Barriers	Belief about the tangible and psychological costs of the advised action	Identify and reduce perceived barriers through reassurance, correction of misinformation, incentives and assistance
Cues to Action	Strategies to trigger engagement	Provide “how-to” information, promote awareness, use appropriate reminders
Self-Efficacy	Confidence in one’s ability to complete the action/intervention	Provide training and guidance in performing the desired action Use progressive goal setting Give verbal reinforcement Demonstrate desired behaviours Reduce anxiety

Individual beliefs are views that a person has about themselves in relation to their HI. Perceived susceptibility refers to the belief an individual has about their probability of experiencing a HI. If someone does not believe there is a chance of them having a HI, there is little possibility of them seeking a diagnostic appointment, let alone engaging in rehabilitation. Perceived severity covers the individual’s beliefs about the seriousness of HI and the consequences of leaving it untreated, both medically and socially. Susceptibility and severity combined are labelled as perceived threat. A perceived benefit describes the belief the individual has about the effectiveness of the proposed treatments. Lastly a perceived barrier refers to an individual’s opinion of the negative aspects of the intervention. For

example if the individual has heard about others finding HAs uncomfortable, they may see this unpleasantness as a barrier to the treatment's effectiveness. The individual will consider (consciously or unconsciously) both the potential benefits and barriers of HAs. For example, this HA may help me hear my family when they are speaking to me but it will be uncomfortable to wear- in a cost-benefit analysis. Thus, "combined levels of susceptibility and severity provide the energy or force to act and the perception of benefits (minus barriers) provide a preferred path of action" (Rosenstock, 1974, p. 332).

Self-Efficacy (SE) is the confidence that one has in their ability to accomplish a certain behaviour or task (Bandura, 1977, 1986, 1997). SE was added to the HBM (Rosenstock, Strecher, & Becker, 1988) as a separate construct to those previously mentioned. The original model was developed in order to explore the use and disuse of preventative measures, which was not thought to involve complex behaviours such as SE. Bandura (1997) highlighted the importance of SE in the process of change in and maintenance of health-behaviours. With the additional use of the model to explore ongoing compliance with health intervention, this was an important construct to add. Individuals must believe that they are competent, or have the SE, to overcome perceived barriers.

Other diverse variables such as age, gender, ethnicity, personality, socioeconomics and knowledge also have an indirect effect on health related behaviour. These modifying factors influence perceptions and beliefs, which may have an effect on the individual's behaviours. For example, level of education is believed to have an indirect effect on behaviour by influencing the perception of susceptibility, severity, benefits and barriers (Champion & Skinner, 2008). Studies suggest that if consumer health related information exceeds the average American reading level of 7th grade, consumer comprehension may be compromised (National Centre for Education Statistics, 2003; United States Department of Health and Human Services, 2000; Walsh & Volsko, 2008). This is compared to the average

level of HA information (on the Internet) which ranges from level 9 to 14 (Laplante-Lévesque & Thorén, 2015). The average American will be unable to fully comprehend this information and as a result, their perception of susceptibility, severity, benefits and barriers may be affected.

The HBM suggests that a cue to action is necessary to prompt engagement in health-related behaviour. These triggers may be internal, such as physiological symptoms, or external, such as advertisement from a HA clinic or a friend/family member also engaging in hearing rehabilitation (Carpenter, 2010; Janz & Becker, 1984; Rosenstock, 1974). Although cues to action are included in the HBM, they have not been systematically explored in relation to their role, partly due to difficulty of exploring such a concept through explanatory surveys (Carpenter, 2010; Janz & Becker, 1984).

In summary, for an individual to successfully change their health related behaviour, they must feel threatened by their current behavioural patterns (perceived susceptibility and severity). They must feel that the HA intervention will result in a good outcome (perceived benefit) at an acceptable cost (perceived barriers). They must also believe they are capable (self-efficacy) of overcoming any obstacles (perceived barriers). These perceptions will be influenced by modifying factors (such as level of education) and will ultimately impact the individual's behaviour after they receive a cue to action.

2.2.2.2. Evidence for the Health Belief Model

A critical review by Janz and Becker (1984) looked at HBM related investigations in terms of engagement with preventative health behaviours (including screening behaviours and risk factor behaviours), sick-role behaviours and clinic utilisation. Janz and Becker included studies published between 1974 and 1984 that investigated health conditions in adults and addressed the 4 fundamental HBM individual beliefs, while having at least one behavioural outcome measure. The researchers found overall that there was substantial

support for the HBM, with perceived barriers as the most powerful construct across the various study designs and behaviours. Perceived susceptibility, benefits and severity were also consistently associated with outcomes, although less strongly than barriers. Janz and Becker highlight that it is possible to see these results despite the variation in outcome measures used, which they say highlights the robustness of the model.

Janz and Becker (1984) also mention some limitations of the HBM including the fact that it is a psychosocial model that does not cover all forces of influence over health behaviour. Some examples of other forces that influence health behaviour are: habitual components of behaviour, non-health related reasons for participation in health behaviour and economic/environmental restrictions. It is also important to note that this review was completed when the use of the HBM was focused on screening and preventative outcomes rather than for looking at compliance with interventions. In addition to this SE was not explored as a construct at this stage, although the researchers mentioned its potential use. Due to these factors, the findings of the study have limited applications to supporting the use of the HBM in predicting HA outcomes. The study is relevant in that it gives an evidence base and shows empirical support for the HBM as a valid model that can explain and predict behaviours associated with positive health outcomes.

2.2.3. Outcomes of Hearing Aids

An outcome is a change of something in the life of an individual as a result of an intervention (Dillon, 2012). There are multiple possible outcome domains to examine when considering HAs as an intervention: activity limitations and participation restrictions, emotional consequences, amount of use and satisfaction.

Activity limitations and participation restrictions have been described previously and are one way that effectiveness of an intervention can be measured. If the intervention were successful, one would expect to see a decrease in activity limitations. This means the

individual has an improved ability to complete some task, for example is better able to hear speech during conversations. As a result of the decreased activity limitations, one would expect to see decreased participation restrictions also. Individuals should feel less limited in their ability to participate in life situations, compared to prior to the intervention.

As mentioned previously, HI can lead to a range of emotional problems that can have negative impacts on the individual's life. The aim is that as a result of using HAs, there will be a reduction of emotional problems. One measure for assessing emotional problems (as well as participation restrictions) associated with HI is the Hearing Handicap Questionnaire (HHQ; Gatehouse & Noble, 2004), which will be discussed in more detail in Section 2.2.3.2.

Amount of use is another important outcome domain. Information about hours of use can help to provide an explanation about the success of the intervention. Use of HAs does not necessarily correlate with benefit of HAs as people who only wear their HAs a few hours a week can still benefit as much as those who wear their HAs 6 hours a day (Dillon, 2012; Mulrow, Tuley, & Aguilar, 1992; Ovegard & Ramström, 1994). However people who are not wearing their HAs cannot receive any benefit from them, which may help to explain cases where there is no benefit or less benefit than expected. Amount of use can be assessed through subjective self-report measures or through objective measures such as data logging.

Satisfaction has been identified to be one of the key outcome domains for treatment efficacy (Beck, 2000). Satisfaction is defined as the pleasure felt when a desire or need is gratified or when a consumer feels their needs, desires and goals have been fulfilled in a pleasurable manner (Oliver, 1997). Dillon (2012) says that satisfaction in relation to HAs probably expresses how happy clients are with their HAs. This takes into account different factors such as benefit in different situations, financial and psychological cost in relation to expectations and ease of use. Cox and Alexander (1999) argue that while use, benefit and satisfaction have traditionally been used to examine HA outcomes, the focus must now shift

away from benefit and towards satisfaction. They reason that benefit is too narrow as an outcome measure and that satisfaction is perhaps more important than benefit alone. There is a body of literature that supports that benefit is only one component necessary for an acceptable HA fitting (Hawes, Durand, & Clark, 1985; Kochkin, 1992; Stock, Fichtl, & Heller, 1997) while satisfaction is becoming recognised as an increasingly important and frequently used outcome measure (Cox & Alexander, 1999; Dillon et al., 1999; Kochkin, 2000, 2005). Findings are not consistent across studies, but satisfaction has found to be related to experience, personality and attitude, usage (including situations in which HAs are used), type of HAs, sound quality, and problems with use (Cox, Alexander, & Gray, 2007; Wong, Hickson, & McPherson, 2003). This lack of consistency is likely due to a lack of validity of the tools used and poor study design (Wong et al., 2003). One measure of satisfaction with HAs is the Satisfaction with Amplification in Daily Life (SADL; Cox & Alexander, 1999), which will be discussed further in Section 2.2.3.3.

2.2.3.1. Measuring Outcomes with Hearing Aids

Outcome measures aim to quantify the difference in the individual's life due to the intervention. Using effective outcome measures is important for both clinicians and clients. Measures can help clinicians to identify which interventions are successful, in comparison to others, and also whether the intervention has been sufficiently successful for the client. Outcome measures can also help clients to see benefit when it may not be obvious to them and additionally give them a platform to provide feedback to the clinician about their experience.

Outcome measures can be objective, such as performance on a speech recognition test, or subjective, such as a self-report questionnaire (Dillon, 2012). Subjective measures evaluate the patient's interpretation of the impact of the intervention (Erdman, 1994). These questionnaires can be self-report or they can involve the input of significant others.

Self-report questionnaires can be classified based on two factors: when the measure is completed and if the measure is standardised. Individuals can complete a questionnaire after the intervention has taken place, in order to make a direct assessment of benefit of the intervention. Alternatively, it is possible to complete a questionnaire before and after the intervention. This change in score provides information about the success of the intervention and generally provides a more complete view of disability compared with direct assessments (Dillon, 2012). In addition to this, questionnaires can be classed based on whether or not they are standardised. Questionnaires can be on a spectrum from being the same for all individuals through to being individually tailored to each patient. Results are more easily compared across individuals if the questions are standardised but they are more relevant to the patient and generally shorter if individualised (Dillon, 2012; Erdman, 1994). With these different classifications there are four main types of self-report measures: standard questionnaires that directly assess benefit, standard questionnaires that compare disability before and after intervention, individualised questionnaires that directly assess benefit and individualised questionnaires that compare disability before and after intervention (Dillon, 2012).

Self-report measures can assess either one or multiple outcome domains. It is also possible to have sub-scales on the questionnaires in order to examine outcomes separately for different constructs, for example in different listening environments. Self-report measures can assess anything from disability and device usage through to satisfaction.

2.2.3.2. Hearing Handicap Questionnaire (HHQ)

The Hearing Handicap Questionnaire (HHQ) was developed by Gatehouse and Noble (2004) as part of a study developing the Speech, Spatial and Qualities of Hearing Scale (SSQ). The study aimed to discover what disabling effects a HI led to and what impact those disabilities had on the degree of handicap experienced by the person with HI. As discussed earlier, disability and handicap are words previously used by WHO to describe activity

limitations and participation restrictions, respectively. The SSQ aimed to focus on disability (activity limitations), while the HHQ was designed to focus on handicap (participation restrictions).

The HHQ was designed to provide a measure of “personal and social effects-emotional distress and discomfort, social withdrawal, and general restriction on participation” (Gatehouse & Noble, 2004, p. 88). Gatehouse and Noble (2004) aimed for the scale to focus on assessing personal and social consequences of HI.

The HHQ is a 12-item self-administered questionnaire available in the appendix of the original SSQ article (Gatehouse & Noble, 2004). The items included in the HHQ are derived from the Hearing Disabilities and Handicaps Scale (Hétu, Getty, Philibert, Desilets, & Noble, 1994) and also an unpublished general health scale (the Glasgow Health Status Inventory). All items have been shown to be appropriate in previous applications. The HHQ was designed to be unifactorial by Gatehouse and Noble (2004). Hickson et al. (2007) verified the single factor structure of the HHQ, and also demonstrated it had good internal consistency.

Gatehouse and Noble (2004) aimed to separate the HHQ from the disability domain in two ways. Firstly, they made the content relevant to handicap and prepared the items so that they were independent of specific listening circumstances or capabilities. In addition to this, they separated completion of the HHQ from The SSQ temporally. Participants completed the HHQ prior to the initial appointment with the aim of making the assessments as separate as possible. They argued that this was a better procedure than having participants complete a handicap rating followed directly by a disability rating.

Responses are given on a 5-point scale for each item, with the response alternatives along a continuum (Never, Rarely, Sometimes, Often, Almost always). Responses are averaged to give an individual’s global handicap score and then scaled to have a possible range from 0 to 100. Higher scores equal higher self-perceived handicap.

2.2.3.3. Satisfaction with Amplification in Daily Life (SADL)

There are single scale measures which can give an idea about the level of satisfaction an individual has with their HA, but these are limited in the information they provide. They do not show why the individual feels the way they do and give no indication to the clinician about how to resolve feelings of dissatisfaction (Dillon, 2012). It has also been argued that multiple question measures are more robust than single-scale items (Dillon, 2012). In addition to this there are currently various measures for HA satisfaction, which makes it hard to compare results across studies. Cox and Alexander (1999) identified this issue and aimed to resolve it through the development of the Satisfaction with Amplification in Daily Life (SADL) Scale.

As previously mentioned, Cox and Alexander (1999) argued the importance of satisfaction as an outcome measure. They propose that satisfaction is the outcome variable that encompasses the full range of elements necessary for a successful HA fitting. They suggested that satisfaction is potentially more important than benefit as an outcome variable, due to the focus on the overall amplification outcome from the client's point of view. They noted that the current measures for gauging satisfaction generally focused on global satisfaction, which did not provide enough information in order to be utilised clinically. Global scores provide no insight for the clinician into the reasons behind an individual's level of overall satisfaction. The aim was to create a measure concise enough for clinical use but also comprehensive enough to provide validity of a multidimensional variable.

Cox and Alexander (1999) developed the SADL in several stages. Structured interviews were carried out in order to identify areas of importance when dealing with HA satisfaction. An initial 14-item questionnaire was generated. The clients were asked to rank the elements of satisfaction in order of importance. Analyses of these responses allowed the researchers to place the elements within four domains, which translated to four sub-scale

areas. A 25-item questionnaire was then devised in order to target the important categories of benefit and quality, physical and psychological comfort, value, and image. The items were selected from previous literature or generated based on comments from the initial interviews. Sixty-seven items that were judged to be the most salient to satisfaction were then reviewed by focus groups in order to generate the final 25 trial items. This questionnaire was completed by 257 individuals, and the resulting analysis led to the exclusion of several items.

As a result the SADL is a 15 item self-administered questionnaire which aims to measure satisfaction with HAs. The questionnaire results in a global satisfaction scale as well as scores on each of the four subscales:

- Positive Effect (PE), which evaluates acoustic benefit, communication disability, sound quality, and psychological benefit (six items)
- Service and Cost (SC), which assesses competence of the clinician, cost and dependability (three items)
- Negative Features (NF), which looked at difficulty with background noise, feedback, and telephone use (three items)
- Personal Image (PI), which asks about personal appearance and the perceived reactions of others (three items) (Cox & Alexander, 1999).

An example question is “Compared to using no hearing aid at all, does your hearing aid help you understand the people you speak with most frequently?” For each question the individual must choose the “best answer” from a seven-point rating scale (Not At All, A Little, Somewhat, Medium, Considerably, Greatly, Tremendously). Global satisfaction scores are the average score of all responses, while the subscale scores are the average of responses within that section. A higher score indicates greater satisfaction.

Cox and Alexander (1999) report that the SADL typically takes less than 10 minutes to complete, making it acceptable for clinical use. In addition to this, the measure is written at a seventh-grade reading level, which is an acceptable level for consumer health information (National Centre for Education Statistics, 2003; United States Department of Health and Human Services, 2000; Walsh & Volsko, 2008).

Cox and Alexander (1999) also developed interim norms in order to facilitate the interpretation of SADL scores. These values are presented in Table 3. The values provided are based on respondents from both the first and final questionnaires, so consequently there are varying numbers of included participants due to changes in the subscales and items as the questions were refined. Participants were only included in a subscale if they had completed every item within the subscale of the final questionnaire. Cox and Alexander (1999) acknowledged that some of the norms are based on data from relatively few participants and stressed the need for additional data to refine the values. Uriarte, Denzin, Dunstan, Sellars, and Hickson (2005) collected data from older Australians fit with HAs in order to compare scores to these norms provided by Cox and Alexander (1999). They found that the level of satisfaction was significantly higher than reported in the norms, both for global and subscales, highlighting the need for refining the norms for use in different populations (Uriarte et al., 2005). A study by Hosford-Dunn and Halpern (2000) also agreed with the need for refinement of the SADL norms. Consequently, caution must be taken when comparing scores to these norms.

Table 3. *Mean, standard deviation, and 20th and 80th percentile values for Global scores and each subscale of the SADL adapted from Cox & Alexander (1999).*

Score	N	Mean	SD	20 th	80 th
Global	53	4.9	0.8	4.3	5.6
Positive Effect	257	4.9	1.3	3.8	6.1
Service and Cost	142	5.4	1.2	4.0	5.7
Negative Features	256	3.6	1.4	2.3	5.01
Personal Image	103	5.6	1.1	5.0	6.7

Test-retest reliability of the SADL was assessed by Cox and Alexander (1999) at the time of development ($r = 0.81$). There are some caveats to this reliability as there was a relatively long time (ranging from 12 to 30 weeks, with a mean duration of 23 weeks) between the initial test and subsequent retest. In addition to this, the questionnaire was not identical both times (with the first measure being the 25-item questionnaire). In order to ensure the SADL was a useable measure for assessing satisfaction with HAs, Cox and Alexander (2001) later explored its validity. They found evidence to support both construct validity and internal validity, meaning that the SADL is a valid tool for assessing HA satisfaction. Hosford-Dunn and Halpern (2000) found analogous results, confirming the psychometric properties of the SADL and verifying its use as a measure of HA satisfaction. They also agreed that the subscales closely corresponded to the four satisfaction domains. Humes, Wilson, Humes, et al. (2002) compared results of the SADL to another measure of HA satisfaction: the expanded version of the MarkeTrak-IV Survey (Kochkin, 1996). They found that the two measures correlated well and that the results for each measure were consistent with previous larger studies. Humes, Wilson, Humes, et al. (2002) suggested the utility of the SADL for clinical use, due to its efficiency compared to the MarkeTrak-IV measure.

2.2.4. Ways to Improve Outcomes

Much research has been conducted to examine the factors related to HA outcomes. There are a number of factors, both audiologic and non-audiologic that contribute to successful HA outcomes. Some of these factors include: motivation (Knudsen et al., 2010; Laplante-Lévesque et al., 2012), attitude towards HAs (Hickson et al., 2014; Knudsen et al., 2010; Meyer, Hickson, Lovelock, et al., 2014), degree of HI (Hickson et al., 2014; Knudsen et al., 2010; Meyer, Hickson, Lovelock, et al., 2014), self-perceived HI (Hickson et al., 2014; Hickson et al., 2007; Knudsen et al., 2010; Laplante-Lévesque et al., 2012), age of HI onset (Knudsen et al., 2010), personality (Knudsen et al., 2010; Kricos, 2000), social support (Hickson et al., 2014; Kricos, 2000; Meyer, Hickson, Lovelock, et al., 2014), counselling (Brooks, 1979; Knudsen et al., 2010; Noble, 1998) and self-efficacy (Hickson et al., 2014; Kricos, 2000; Meyer, Hickson, & Fletcher, 2014; Meyer, Hickson, Lovelock, et al., 2014).

2.3. Self-Efficacy

Self-Efficacy (SE) is one factor that has recently begun to be explored in the literature as a potential predictor, and influencer, of HA outcomes. Bandura is a social psychologist who was the originator of the self-efficacy theory (Bandura, 1977; Bandura & McClelland, 1977). He suggested that people's behaviour is often better predicted by what they believe they can do rather than what they are actually able to achieve (Bandura, 1977, 1986). SE is the domain-specific belief that one can successfully complete a particular task (Bandura, 1977, 1986). SE is different to general self-confidence, which is a personality construct, in that it is task specific. For example, an individual may have high self-confidence overall but low self-efficacy for using HAs. As mentioned previously, SE is a concept which is part of the HBM (Rosenstock et al., 1988) as a predictor for health behaviour.

Bandura's (1997) research provides a way to understand changes in behaviour, including behaviours related to managing health conditions. Research suggests that SE plays a part in the adoption and maintenance of health behaviours (Schwarzer & Fuchs, 1996) and there is extensive evidence highlighting the importance of SE in the successful management of a range of health conditions (Marks & Allegrante, 2005). Examples include: cardiac rehabilitation (Ni et al., 1999; Winkleby et al., 1994), cancer (Rogers et al., 2005), vision loss (Brody et al., 1999; Horowitz et al., 2005), and balance disorders (Tinetti et al., 1990). The main findings of these studies indicate individuals with higher SE for managing their health condition have higher adherence to their treatment, better treatment outcomes, and better maintenance of health behaviours (Smith, 2014).

Bandura (1992) stated that there were 4 main information sources that can moderate SE: prior experience, observation of others engaging in particular tasks, the encouragement or discouragement received from others, and physical and emotional reactions an individual experiences prior to attempting to achieve a goal.

2.3.1. Self-Efficacy with Hearing Aids (MARS-HA)

As previously mentioned, SE is closely tied to outcomes with HAs. It is thought that SE may be a key factor in predicting HA outcomes, especially discontinuance. Several authors have suggested SE is an important consideration, with low SE for the care and use of HAs potentially linked to low uptake and continued use of HAs (Carson & Pichora-Fuller, 1997; Kricos, 2000, 2006; Weinstein, 2000).

Due to the probable influence of SE on HA outcomes, West and Smith (2007) identified the need for the development of a measure for assessing HA-SE beliefs. They argued that individuals are more likely to reject their HAs if they do not have confidence in their ability to resolve their problems. As a result, they developed the Measure of Audiologic Rehabilitation Self-Efficacy for Hearing Aids (MARS-HA; West & Smith, 2007).

Based on audiologic literature covering issues related to HA use, 25 items were generated for inclusion in the questionnaire. Based on a model of successful HA use (Smith & West, 2006), items were designed to cover specific sub-skills including handling of HAs, adjustment to use of HAs, and aided listening skills. One item (“I can adjust a specific hearing aid in each ear so that I feel the hearing aids are balanced”) was later excluded. The measure was constructed in agreement with guidelines established by Bandura (2006) for SE scale development. These guidelines covered phrasing of the items, response scale format, graduations of challenge, respondent instructions and practice items.

As a result, the MARS-HA self-report questionnaire contains 24 items and assesses HA-SE. The questionnaire contains 4 sub-scales and assesses SE in each domain, as well as overall HA-SE:

- Aided Listening (AL), covering perceived ability to hear in specific listening situations while wearing HAs, for example “I could understand one-on-one conversation in a quiet place if I wore hearing aids” (9 items)

- Basic Handling (BH), questioning skills necessary for using and managing HAs, for example “I can insert a battery into a hearing aid with ease” (7 items)
- Adjustment (AD), which asks questions about the individual’s ability to get used to the HAs, including “I could get used to the sound quality of hearing aids” (3 items)
- Advanced Handling (AH), which looks at belief in ability to carry out more difficult skills associated with managing HAs, for example “I can stop a hearing aid from squealing” (5 items) (West & Smith, 2007).

For each question, respondents must say how certain they are that they can complete the item from 0% (Cannot do this at all) to 100% (I am certain I can do this), on a 10-unit interval scale. A higher score indicates higher SE. West and Smith (2007) state that scores of 80% or greater are suggestive of adequate levels of SE. Scores are obtained for each subscale and an overall score can also be calculated.

West and Smith (2007) also wanted to determine the reliability and validity of the measure. This was done by completing separate analyses for two participant groups: new and experienced HA users. Internal consistency and test-retest reliability was assessed for each subscale and the questionnaire as a whole, while validity was examined by comparison to the Hearing Handicap Inventory for the Elderly-Screening as well as through examination of the expected impact of group differences, HA features, and audiologic training.

West and Smith (2007) found the measure to be reliable. Internal consistency was calculated using Cronbach’s α and Pearson product moment correlations. Results showed that there was a high internal consistency and strong correlations of the MARS-HA subscales for both new and experienced HA users. In order to assess test-retest reliability, participants were sent two copies of the MARS-HA, which they completed within a two-week interval. For both new and experienced HA users, there was high test-retest reliability for both the total

and subscales, with the exception of moderate test-retest reliability for the adjustment scale in the experienced users group. There are two possible reasons for this result. Firstly there are only three items on this scale, and few items can lead a higher chance of random error and thereby lower reliability (Hyde, 2000). Secondly, around one third of the participants in the experienced group were fit with new, technologically superior, HAs during the two-week interval. They would have been in the adjustment phase when completing the MARS-HA for the second time, which could have affected the results. Thus, responses may have changed for valid reasons, resulting in reduced test-retest reliability. This reduced reliability was not reflected in the new users group, and despite this finding, the psychometric makeup of the MARS-HA is still strong for each user group.

West and Smith (2007) also found the measure to be a valid tool for assessing HA-SE. They carried out several validity measures, including a measure of construct validity, the impact of long-term experience and the impact of training. In order to assess construct validity, a group of participants completed the Hearing Handicap Inventory for the Elderly-Screening. This is a 10-item questionnaire measuring emotional and social handicap in a range of listening situations. Analysis showed no overlap of the two measures, indicating the MARS-HA is a valid independent measure of HA-SE. West and Smith (2007) also compared the effect of long term-experience by comparing scores from the new and experienced user groups, as one expects differences in SE between the two groups. Results showed significant differences between the new and experienced users, especially in the subscale of advanced handling (with experienced users having higher SE) and aided listening (with new users having higher SE). The researchers also examined the effect of training on SE, as it was expected to increase SE. They found that compared to novice users, those individuals who received a standard HA orientation had significantly higher SE. Overall, the researchers

commented that the strong psychometric properties of the measure recommended it for use in a clinical setting.

West and Smith (2007) acknowledge that while there is strong evidence for the MARS-HA being a reliable and valid tool, it is necessary for clinical studies to show its value as a positive contributor to rehabilitative audiology. There is currently evidence that intervention does improve SE in audiological rehabilitation (Jennings, 2006; West & Smith, 2007). There is also evidence to support the relationship of HA-SE with both help-seeking behaviour and successful HA use (Hickson et al., 2014; Meyer, Hickson, Lovelock, et al., 2014), with successful HA use defined as at least moderate self-reported benefit and a minimum of one hour use per day.

2.3.2. Self-Efficacy and Satisfaction

A recent study by Kelly-Campbell and McMillan (2015) was the first research to look at the relationship between HA-SE and satisfaction with HAs in a group of adult HA owners. Kelly-Campbell and McMillan (2015) recruited 57 adults who were acquiring HAs, either new users or experienced users who were replacing their HAs, from private HA clinics in New Zealand. All participants completed a demographic questionnaire, the HHQ (Gatehouse & Noble, 2004), and received an audiometric assessment prior to their HA fitting.

Participants were counselled on the use and care of their HAs and were seen for a minimum of one follow-up appointment after the initial fitting. Adjustments were made to the HA fitting as required during the HA trial period. Common issues including feedback, occlusion, loudness, and clarity were also addressed during this period, through either counselling or modification of the HA fitting. Twelve weeks post-HA fitting, all participants completed the MARS-HA (West & Smith, 2007) and the SADL (Cox & Alexander, 1999). Based on their completion of the pre- and post-questionnaires, 47 participants (27 experienced and 20 new users) were included in the results.

The researchers compared the experienced and new HA owners and found no significant differences in HA-SE or satisfaction with HAs. This contradicts findings from West and Smith (2007), potentially due to the small sample size having insufficient power to detect a statistical difference between the groups that was small to medium. In addition to this, there were differences between the two studies in terms of sex of participants, clinical practice setting and amount of experience with HAs before administration of the MARS-HA.

In general, the researchers found that the participants with adequate SE had higher satisfaction with HAs than those with low SE. They found that most participants had adequate SE for the sub-scales of basic handling (83%) and adjusting to wearing HA (76.6%). In addition to this, they found that fewer participants had adequate SE for aided listening (53.3%) and the lowest number of participants had adequate SE for the advanced handling sub-scale (51.1%).

The findings for SE of basic handling and aided listening are comparable to the results found in the study by Meyer, Hickson, Lovelock, et al. (2014). Meyer, Hickson, Lovelock, et al. (2014) also found that the majority of people had high SE for basic handling and around half of the participants had adequate SE for aided listening. The proportion of people who had adequate SE for the adjustment scale was relatively high in the Kelly-Campbell and McMillan study (76.6%) compared to findings from Meyer, Hickson, Lovelock, et al. (2014) (58%). Kelly-Campbell and McMillan (2015) mention that this is potentially due to differences in how the MARS-HA was administered and subsequent response bias in their study, or it is possible that the participants in their study engaged with their audiologist and HAs; causing them to actually have higher adjustment SE. Their study also found a higher proportion of people with adequate advance handling SE (51.1%) compared to Meyer, Hickson, Lovelock, et al. (2014) who found only a third of people had adequate advance

handling SE. The reasons for these differences are potentially due to the same factors as with the adjustment factor (differences in administration or genuine differences between studies).

The relationship between HA-SE and satisfaction was confirmed in 3 domains: PE, NF and SC, as well as global satisfaction. There was no significant relationship between PI and HA-SE. Participants with adequate SE in the adjustment factor, and adequate global SE had significantly greater satisfaction on the PE subscale of the SADL. Kelly-Campbell and McMillan (2015) indicate the possibility that the two are related constructs, specifically of self-confidence. The SC subscale of the SADL was related to adequate SE in aided listening, basic handling, and advanced handling. Kelly-Campbell and McMillan (2015) suggested that this is unsurprising, as those who do not have confidence in their ability to communicate with HAs or handle them are unlikely to be satisfied with the value of the HAs and/or have confidence in their clinician. Lastly, greater satisfaction with the NF of HAs was related to high confidence in the ability to understand in situations and to get used to HAs. HA owners may perceive NF as less of an issue if they have confidence in their ability to cope in difficult situations, such as background noise.

Kelly-Campbell and McMillan (2015) concluded that many HA owners do not have adequate SE in important HA domains, which supports previous research by Meyer, Hickson, Lovelock, et al. (2014). They highlighted the relationship of adequate SE to positive HA outcomes, including satisfaction, and the subsequent need to address ways to improve HA-SE.

One limitation of the research by Kelly-Campbell and McMillan (2015) is that it is not clear to what extent the intervention (HA tuning and counselling provided as part of ongoing contact with the clinician) during the HA trial period may have impacted responses both on the MARS-HA and SADL scales. In addition to this, there is no evidence to show what the pattern of responses on the MARS-HA is over time. Prior research has shown that

the SADL responses are higher at 2 weeks post-fitting than 1 year post-fitting (Humes, Wilson, Barlow, Garner, & Amos, 2002; McLeod, Upfold, & Broadbent, 2001) and that HA satisfaction seems to become stable by 4 to 6 weeks post-fitting (Dillon et al., 1991; H. Dillon, James, & Ginis, 1997; Humes, Wilson, Barlow, et al., 2002) although some people may experience a decline in satisfaction long-term (Humes, Wilson, Barlow, et al., 2002). There is currently no research examining the pattern of HA-SE over time.

2.4. Rationale and Aims

Disabling HI is a condition which affects around 5% of the world's population (World Health Organization, 2015). The negative consequences of untreated HI are well documented and include problems with communication, negative impacts on mental and physical health, and negative impacts on relationships to name a few (Appollonio et al., 1996; Arlinger, 2003; Bess et al., 1989; Chia et al., 2007; Dalton et al., 2003; Lin et al., 2011; Strawbridge et al., 2000; Weinstein & Ventry, 1982). Although HAs have been shown to be a successful intervention for improving quality of life (Mulrow et al., 1990; Öberg et al., 2012; Tsakirópoulou et al., 2007; Vuorialho et al., 2006) uptake is low with a penetration rate of between 14 and 25% (Bade, 1991; Chien & Lin, 2012; Hesse, 2004; Kochkin, 1997; Popelka et al., 1998; D. Stephens et al., 2001; S. Stephens et al., 1990). As a result it is important to find ways to target behaviour which may promote successful HA outcomes.

There is extensive evidence for the importance of SE in the successful management of other health conditions including: cardiac rehabilitation (Ni et al., 1999; Winkleby et al., 1994), cancer (Rogers et al., 2005), vision loss (Brody et al., 1999; Horowitz et al., 2005), and balance disorders (Tinetti et al., 1990). SE has also been suggested to contribute to successful HA outcomes (Hickson et al., 2014; Meyer, Hickson, Lovelock, et al., 2014).

This research aims to build on previous work by Kelly-Campbell and McMillan (2015), which highlighted several gaps in the literature. Firstly, there is no knowledge of the pattern of perceived HA-SE over time. Another issue is the lack of research surrounding the effect of the ongoing intervention by clinicians on both HA-SE and satisfaction with HAs. Lastly, the need to look at the interaction of HA-SE and satisfaction longitudinally was identified.

One purpose of the current research is to assess the pattern of MARS-HA responses over time, as there is currently no knowledge of perceived HA-SE longitudinally. The current

study aims to look at the changes in HA-SE over the time of the fitting process. HA-SE has been linked to positive outcomes with HAs (Hickson et al., 2014; Kricos, 2000; Meyer, Hickson, & Fletcher, 2014; Meyer, Hickson, Lovelock, et al., 2014) so it is important to identify when HA-SE is highest and which aspects of the intervention may be related to changes to an individual's perceived HA-SE.

A second aim of the study is to assess the levels of HA-SE at various points during the HA trial period and to compare this to satisfaction with HAs. A limitation of the previous study was that the pattern of responses on the MARS-HA and its relationship to the SADL were not investigated during the trial period. Therefore, specific elements of intervention that are related to HA-SE and satisfaction with HA could not be identified. The current study examines HA-SE at 4 stages throughout the fitting process: immediately following the HA fitting, at 1 week post-fitting, at 4 to 6 weeks post-fitting and at 12 weeks post-fitting. These assessment points will be termed T0 through to T3, respectively. These assessment points will be looked at in relation to satisfaction with HAs at the end of the fitting process (12 weeks post-fitting) in order to determine if HA-SE at different points throughout the fitting process has an effect on satisfaction with HAs.

The final aim of this research is to investigate the relationship between HA-SE at various points and HA use at the end of the fitting process (12-weeks). Hickson et al. (2014) and Meyer, Hickson, Lovelock, et al. (2014) have previously reported successful HA use is related to HA-SE, with successful use defined as using HAs for at least 1-hour per day and receiving at least moderate self-reported benefit. This research aims to investigate this relationship further and see if HA-SE is able to predict hours of use.

2.5. Research Questions and Hypotheses

This study sought to answer the following questions:

- 1) What is the pattern of HA-SE over the HA trial period and are there significant differences in HA-SE between new and experienced HA owners?
- 2) Does HA-SE at the various assessment points predict HA satisfaction for new or experienced HA owners?
- 3) Does HA-SE at the various assessment points predict HA use for new or experienced HA owners?

Based on the literature discussed, the following hypotheses are proposed:

- 1) a. There will be significant differences in HA-SE between new and experienced HA owners over time.
 - i. There will be significant differences in SE between groups for the Aided Listening subscale
 - ii. There will be significant differences in SE between groups for the Basic Handling subscale
 - iii. There will be significant differences in SE between groups for the Adjustment subscale
 - iv. There will be significant differences in SE between groups for the Advanced Handling subscale
 - v. There will be significant differences in SE between groups for Global HA-SE
- 1) b. There will be a significant difference in HA-SE over time.
 - i. There will be a significant difference in SE for the Aided Listening subscale over time

- ii. There will be a significant difference in SE for the Basic Handling subscale over time
- iii. There will be a significant difference in SE for the Adjustment subscale over time
- iv. There will be a significant difference in SE for the Advanced Handling subscale over time
- v. There will be a significant difference in Global HA-SE over time

2) HA-SE will predict satisfaction with HA's.

- a. For new HA users, SE at various assessment point will predict satisfaction.
 - i. SE at T0 will predict satisfaction with HAs for new users
 - ii. SE at T1 will predict satisfaction with HAs for new users
 - iii. SE at T2 will predict satisfaction with HAs for new users
 - iv. SE at T3 will predict satisfaction with HAs for new users
- b. For experienced HA users, SE at various assessment points will predict satisfaction.
 - i. SE at T0 will predict satisfaction with HAs for experienced users
 - ii. SE at T1 will predict satisfaction with HAs for experienced users
 - iii. SE at T2 will predict satisfaction with HAs for experienced users
 - iv. SE at T3 will predict satisfaction with HAs for experienced users

3) HA-SE will predict HA use.

- a. For new HA users, SE at various assessment points will predict HA use.
 - i. SE at T0 will predict HA use for new users
 - ii. SE at T1 will predict HA use for new users
 - iii. SE at T2 will predict HA use for new users
 - iv. SE at T3 will predict HA use for new users

- b. For experienced HA users, SE at various assessment points will predict HA use.
 - i. SE at T0 will predict HA use for experienced users
 - ii. SE at T1 will predict HA use for experienced users
 - iii. SE at T2 will predict HA use for experienced users
 - iv. SE at T3 will predict HA use for experienced users

3 METHODS

This research employed a longitudinal intervention study design to investigate the relationship between hearing aid self-efficacy (HA-SE) and satisfaction with HAs among adult users in Phoenix, Arizona, USA. The following sections describe the *a priori* analysis, participants, measures, procedures, and statistical analysis of this study.

3.1. *A Priori* Analysis

Prior to data collection, a sample size analysis was carried out. With a power level of .80 and an experiment-wise alpha level of .05, at least 60 participants were needed in each group to perform the planned analyses.

3.2. Ethical Approval

Approval of this study was gained from the University of Canterbury Human Ethics Committee on 27 January 2016 (Appendix A). All procedures were carried out in accordance with the approval.

3.3. Participants

Recruitment of participants was accomplished through a single private audiology practice clinic in Phoenix, Arizona, USA. Adults seeking new or replacement HAs from the clinic were invited to participate in the study. All participants were required to meet the following inclusion criteria:

1. be at least 18 years of age
2. be able to complete the study questionnaires in the English language
3. agree to complete the questionnaires over the assessment points
4. did not enrol in a non-HA based management option.

All clients who met these criteria were invited to take part in the study. Participants were then placed in the new HA group if they had never worn HAs prior to study enrolment, or placed in the experienced HA group if they were seeking new HAs after having worn HAs for at least 3 years. Recruitment continued until the required minimum sample sizes were obtained for both the new and experienced groups. No inducements were offered to participants.

3.4. Measures

The independent variables investigated in relation to HA satisfaction were age, degree of HI, HA experience (new versus experienced users), hours of HA use, cost of HA to participant, hearing handicap and self-efficacy. The outcome measures of this study were client satisfaction with HAs and hours of use. Details on how each variable was measured are discussed below.

3.4.1. Age

Information about the participant's age was collected through the demographic questionnaire. Participants were asked to provide their date of birth and their age was calculated for the date they completed the demographic questionnaire.

3.4.2. Degree of Hearing Impairment

Degree of HI was quantified in this study by using a pure-tone average (PTA) of air-conduction thresholds across four frequencies (500, 1000, 2000 and 4000 Hz) for each individual ear. This resulted in a PTA for the better ear (BEPTA) and for the worse ear (WEPTA).

All participants underwent a standard audiological test battery prior their HA fitting, which included bilateral pure tone audiometry. Air conduction thresholds were obtained in octave intervals from 250 to 8000 Hz. A Maico MA 33 audiometer with ER 3A insert

earphones was used for all participants to test air conduction thresholds. Bone conduction thresholds were obtained for octave frequencies from 500 to 4000 Hz via a RadioEar B71W bone conductor vibrator with the same audiometer. Clinicians holding the Certificate of Clinical Competence in Audiology (CCC-A) and a state license followed the American Speech-Language-Hearing Association (2005) guidelines for obtaining puretone thresholds. Masking was employed as needed. All equipment and test rooms were calibrated in accordance with the American National Standards Institute (ANSI, 1999, 2010).

3.4.3. Hearing Aid Experience

Participants were asked if they had used HAs before, in order to separate the individuals into new versus experienced users. Participants were placed in the new group if they had never worn HAs before, and they were placed in the experienced group if they were seeking new HAs after having worn HA for at least 3 years. Participants seeking replacement HAs after less than 3 years were not eligible to participate in the study.

3.4.4. Hours of Hearing Aid Use

Self-report information about hours of HA use was collected using question 1 of the International Outcome Inventory for Hearing Aids (IOI-HA; Liu et al., 2011) “Think about how much you used your present hearing aid(s) over the past two weeks. On an average day, how many hours did you use the hearing aid(s)?” (Liu et al., 2011, p.35). Response categories are: none, less than 1 hour per day, 1 to 4 hours per day, 4 to 8 hours per day, and more than 8 hours per day. This participants responded to this question at the final fitting appointment (T2).

Data logging technology in HAs records the number of hours HAs are turned on and presents information about the average numbers they are worn per day. This information was

collected at the T2 appointment and passed on to the researchers by the clinicians at the end of the research.

3.4.5. Cost of Hearing Aid to Participant

Information about cost of the HA to the participant was also collected. This value was the amount the participant had to personally contribute towards the HA. This can be different to the value of the HA as some participants are eligible for funding, reducing their personal contribution.

3.4.6. Hearing Handicap Questionnaire (HHQ)

Hearing handicap was measured through the HHQ (Gatehouse & Noble, 2004). The HHQ consists of 12 questions that ask individuals to rate how often they feel handicapped by their HI in specific situations. Answers are provided on a 5-point scale (Never, Rarely, Sometimes, Often, Almost Always). Responses are averaged and then scaled to have a possible range of 0 to 100 to give an individual's global handicap score. Higher scores reflect greater handicap.

3.4.7. Measure of Audiologic Rehabilitation Self-Efficacy for Hearing Aids (MARS-HA)

HA-SE was measured via the MARS-HA (West & Smith, 2007). The MARS-HA consists of 24 items which assess HA-SE in 4 domains (Aided Listening, Basic Handling, Adjustment, and Advanced Handling). Participants rate their perceived ability to complete the different tasks on a 10-unit interval scale ranging from 0% (Cannot do this at all) through to 100% (I am certain I can do this). This results in a SE score for each sub-scale, as well as a total HA-SE score. A higher score indicates greater SE, with scores of 80% or greater being suggestive of adequate SE.

3.4.8. Satisfaction with Amplification in Daily Life (SADL)

The outcome measure of satisfaction was examined using the SADL (Cox & Alexander, 1999), which is a 15 item questionnaire that measures satisfaction with HAs. Participants rate their opinions about their HAs in different situations on a 7-point scale (Not At All, A Little, Somewhat, Medium, Considerably, Greatly, Tremendously). This results in a global satisfaction score, as well as a score on each of the four subscales (positive effect, service and cost, negative features, and personal image). Higher scores indicate higher satisfaction with HAs.

3.5. Procedure

All participants underwent a standard audiological test battery. This battery included:

1. a detailed case history
2. visual inspection of the outer ear using a lighted otoscope
3. assessment of middle ear function using a Maico MI 34 middle ear analyser
4. obtaining puretone air conduction thresholds in octave intervals from 250 to 8000 Hz using a Maico MA 33 audiometer via ER 3A insert earphones
5. obtaining puretone bone conduction thresholds in octave intervals from 250 to 4000 Hz using the Maico MA 33 audiometer via a RadioEar B71W bone conduction vibrator
6. obtaining speech recognition thresholds (SRT) under insert earphones for each ear using the CID W-1 spondaic word list (Hirsh et al., 1952) using a 2-dB step-size following the American Speech-Language Hearing Association (1998) guidelines for determining threshold level for speech
7. obtaining a 50-word suprathreshold word recognition score under insert earphones in quiet for each ear using the Auditec CD recordings of the NU-6 monosyllabic word lists at 40 dB SL re: SRT.

Contralateral masking was employed when needed.

Following the audiological test battery, participants underwent an audiological rehabilitation evaluation (ARE) to determine their candidacy for various management options. For the experienced HA users, the ARE was done at the same appointment as the audiological assessment. For the new HA users, the ARE was done at a second session. The time between the initial assessment and the ARE ranged between 8 and 15 days for the participants in this study. During the ARE, participants discussed their rehabilitation goals and preferences for types of management options. Participants who elected to pursue amplification as their preferred management option were invited to enrol in the study. Clients who elected to pursue only non-HA management options were not eligible to participate because they were not fitted with HAs. Non-HA management options included purchasing hearing assistance technology, attending communication strategies training, and participating in specifically tailored online educational material regarding HI and HAs. Clients who elected to attend communication strategies training and participate in the online educational modules along with HAs were not invited to participate in this study. The rationale for this is that there are currently no data on the prevalence of these specific elements as a management options. As a result, it is not clear how generalizable the data would be if these participants were included. In addition it is not clear the extent to which these elements may influence HA satisfaction (and hence become moderator variables).

Participants completed a study packet at the initial HA fitting appointment, which typically occurred within 1 week of the ARE appointment. This assessment is termed T0. During this appointment, clinicians fitted the HAs to the NAL-NL2 targets and verified the targets using the Audioscan RM500 Real-Ear Hearing Aid Analyzer. Adjustments to the initial fitting were made as required to address problems with the sound quality or comfort of the HA fitting. Immediately following this appointment, participants completed the informed

consent form as well as providing the following data: demographic information, HHQ, and MARS-HA (T0). The demographic information provided by the participants included; age, gender, self-identified ethnicity, languages(s) spoken at home, length of HI in years, relationship status, level of education in years, and annual net income.

Participants returned to the clinic for a follow-up appointment approximately 1 week after the initial fitting. This assessment is termed T1. Clinicians made any additional adjustments to the HA fitting as required. Immediately following this appointment, participants completed the MARS-HA (T1) for the second time in a quiet room. Participants returned for a final appointment 4 to 6 weeks after the initial fitting. This assessment is termed T2. Directly following this appointment, participants completed the MARS-HA (T2) for the third time in a quiet room. Participants completed the fourth and final administration of the MARS-HA (T3), as well as the SADL, at home. This occurred 12 weeks following their initial HA fitting.

It is pertinent to mention that some participants attended additional appointments between the initial fitting (T0) and the final appointment (T2). Number of appointments was added as a possible covariate in the analysis, and it was found to be significant.

All participants in this study elected to keep their HAs following the HA trial. However, if participants had not kept their HAs, their data would have been analysed separately.

3.6. Statistical Analyses

The IBM Statistical Package for the Social Sciences (SPSS) Version 21 was used for carrying out statistical analysis. Descriptive statistics were completed for each continuous variable to obtain the following: mean, minimum, maximum, standard deviation, skewness, and kurtosis. For the non-continuous variables (gender and HA experience), frequency counts were obtained.

A series of analyses were carried out in order to answer the research questions. First, a series of mixed model repeated measure ANOVA were performed. The within subjects factor was time of MARS-HA administration and the between-subjects factor was HA experience. Possible covariates were identified through a series of Pearson correlational analyses. In addition, a series of multiple regression analyses were performed. The potential predictor variables included the MARS-HA factor scores at each of the four administration times as well as the other independent variables (listed in Table 4). The outcome variables for the first series of regression analyses were the four SADL subscale scores and the SADL Global Score. The outcome variable for the final regression analysis was hours of HA use as measured by data logging. In addition to this, a discriminant analysis was carried out to determine the predictor variables that would predict HA use as measured by self-report.

4 RESULTS

4.1. Sample Characteristics

A total of 193 clients who met the study's inclusion and exclusion criteria were invited to participate in this study. Participants included 113 experienced HA users and 80 new HA users. There were no drop outs, therefore full data sets were collected for all 193 participants.

Participants included 78 females and 115 males. There were 184 were native English speakers and 9 non-native English speakers. A total of 22 participants were fit unilaterally, due to a unilateral HI. No CROS aids were fitted. All participants with a bilateral loss were fitted bilaterally. In the experienced HA user group, the mean length of HA experience ranged from 3 to 20 years with a mean of 8.21 years ($SD = 4.33$). All other descriptive statistics are reported in Table 4.

Preliminary analysis of the data set to examine for skewness and kurtosis showed the data to be normally distributed. There were no outliers in the data set.

4.2. Descriptive Statistics

Table 4. *Descriptive statistics of continuous variables from demographic questionnaire.*

		N	Minimum	Maximum	Mean	SD
Age *	Experienced	113	46	92	72.50	9.30
	New	80	46	92	68.60	10.04
	Total	193	46	92	70.89	9.78
HHQ	Experienced	113	12.50	75.00	49.49	14.75
	New	80	12.50	75.00	50.25	16.43
	Total	193	12.50	75.00	49.80	15.43
BEPTA	Experienced	113	21.25	67.50	39.19	11.16
	New	80	21.25	67.50	38.17	13.58
	Total	193	21.25	67.50	38.77	12.20
WEPTA	Experienced	113	27.50	87.50	50.50	16.82
	New	80	27.50	87.50	46.38	15.26
	Total	193	27.50	27.50	48.79	16.28
Number of appointments *	Experienced	113	2	4	2.58	.68
	New	80	2	6	2.94	1.10
	Total	193	2	6	2.73	.90
Average hours of use per day	Experienced	113	.00	15.00	9.50	3.31
	New	80	.00	15.00	9.64	3.71
	Total	193	.00	15.00	9.56	3.47
Cost to participant	Experienced	113	.00	10499.00	2793.98	2499.25
	New	80	.00	8478.00	3069.97	2615.87
	Total	193	.00	10499.00	2908.38	2545.14

* = Items that were identified using ANOVA to be significantly different between group means (p<.05)

An analysis of variance (ANOVA) was performed in order to identify any differences in predictor variables between experienced and new HA users. Mean age of participants was identified to be significantly different between groups ($F(1,192) = 7.731, p = .006$). Number of appointments was also identified to be significantly different between groups ($F(1,192) = 7.544, p = .007$). These variables were identified to be covariates.

4.3. Research Question One

Research question one examines the pattern of HA-SE over the trial period and whether there are significant differences in HA-SE between new and experienced HA users. A Mixed Model Repeated Measures Multivariate Analysis of Covariance (RM-MANCOVA) was carried out in order to answer the question.

The within subjects factor was the time of MARS-HA administration (4 levels: T0, T1, T2, T3). The between subjects variable was HA experience (experienced user vs. new user). Age and number of appointments were covariates.

There were no significant interactions between HA experience (between subjects factor) and time of administration (T0, T1, T2, T3) for any MARS-HA factor, indicating the pattern of responses on the MARS-HA was similar for experienced and new HA owners. Therefore, simple main effects were used to address the study hypotheses.

For each RM-MANCOVA, Mauchly's test of sphericity indicated this assumption was not violated. Therefore, the values for sphericity assumed were used for all RM-MANCOVA testing. Significant within subjects findings were followed up with pairwise testing, using a Bonferroni correction. All pairwise comparisons met the assumption of equal variance.

4) Hypothesis a: There will be significant differences in HA-SE between new and experienced HA owners over time.

- i. Aided Listening: Not supported. There was no main effect of HA experience: $F(1,189) = 3.206, p = .075, \eta^2 = .017$.
- ii. Basic Handling: Supported. There was a main effect of HA experience, with experienced owners exhibiting higher SE for basic handling. However, there was a relatively small effect size: $F(1,189) = 3.43, p = .017, \eta^2 = .018$.

- iii. Adjustment: Not supported. There was no main effect of HA experience: $F(1,189) = 1.752, p = .187, \eta^2 = .009$.
- iv. Advanced Handling: Not supported. There was no main effect of HA experience: $F(1,189) = 0.027, p = .870, \eta^2 = < .001$.
- v. Total SE: Not supported. There was no main effect of HA experience: $F(1,189) = 0.007, p = .991, \eta^2 = < .001$.

The only significant difference between new and experienced users for HA-SE was on the Basic Handling sub-scale. As this was a small difference and there were no other significant differences between the groups, the groups were combined to carry out the remaining analyses.

1) Hypothesis b: There will be a significant difference in HA-SE over time.

- i. Aided Listening: Supported. There was a significant improvement in SE for aided listening over time: $F(3, 187) = 39.14, p < .001, \eta^2 = .172$. This improvement was significant ($p < .001$) at each time interval.
- ii. Basic Handling: Supported. There was a significant improvement in SE for basic handling over time: $F(3, 187) = 360.38, p < .001, \eta^2 = .656$. This improvement was significant ($p < .001$) at all time intervals, except T0 vs. T1 ($p = .061$).
- iii. Adjustment: Supported. There was a significant improvement in SE for adjustment over time: $F(3, 187) = 459.162, p < .001, \eta^2 = .880$. This improvement was significant ($p < .001$) at each time interval.
- iv. Advanced Handling: Supported. There was a significant improvement in SE for adjustment over time: $F(3, 187) = 257.87, p < .001, \eta^2 = .577$. This improvement was significant ($p < .001$) at each time interval.

- v. Total SE: Supported. There was a significant improvement in SE for adjustment over time: $F(3, 187) = 1712.163, p < .001, \eta^2 = .901$. This improvement was significant ($p < .001$) at each time interval.

Figures 1-5 are provided to show the mean and standard error for each MARS-HA subscale, as well as overall HA-SE.

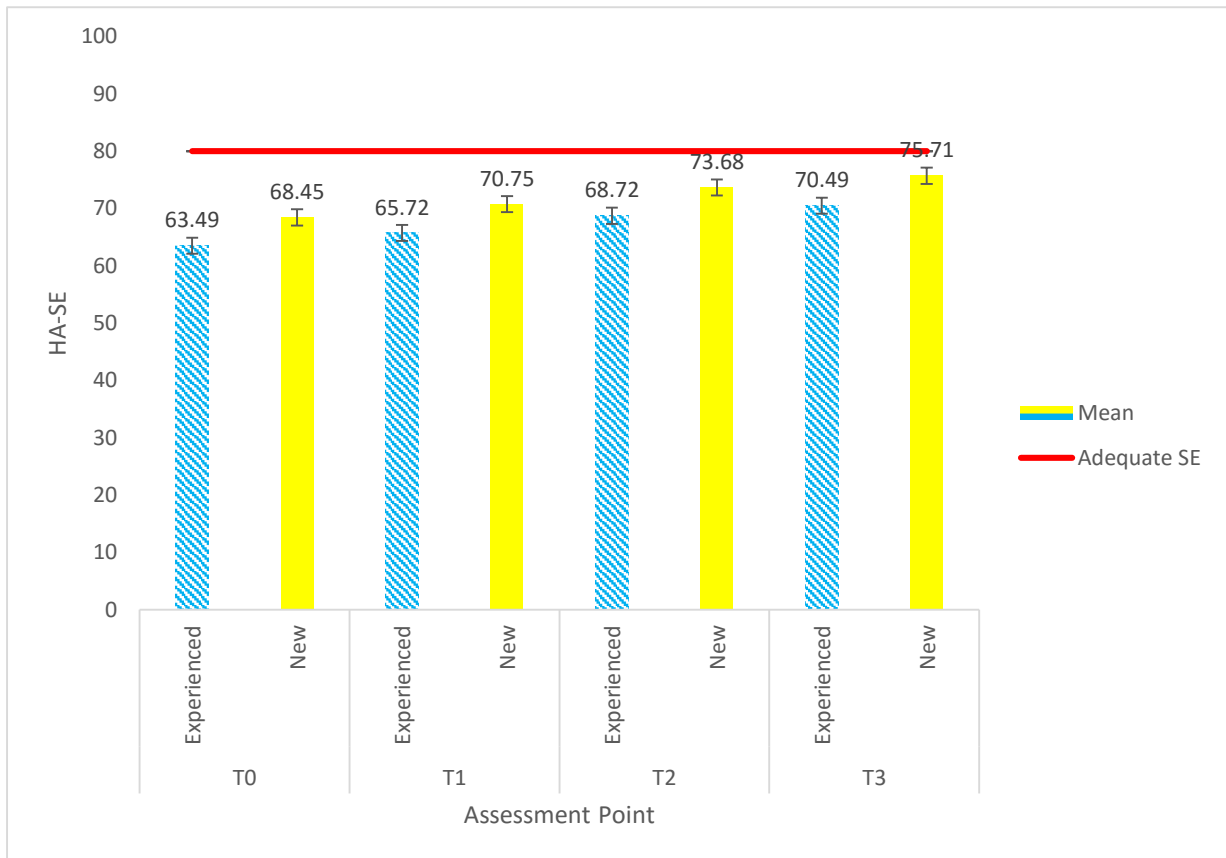


Figure 1. Mean and Standard Error for Experienced ($n=113$) and New ($n=80$) HA users over the HA trial period (T0-T3) on the Aided Listening subscale.

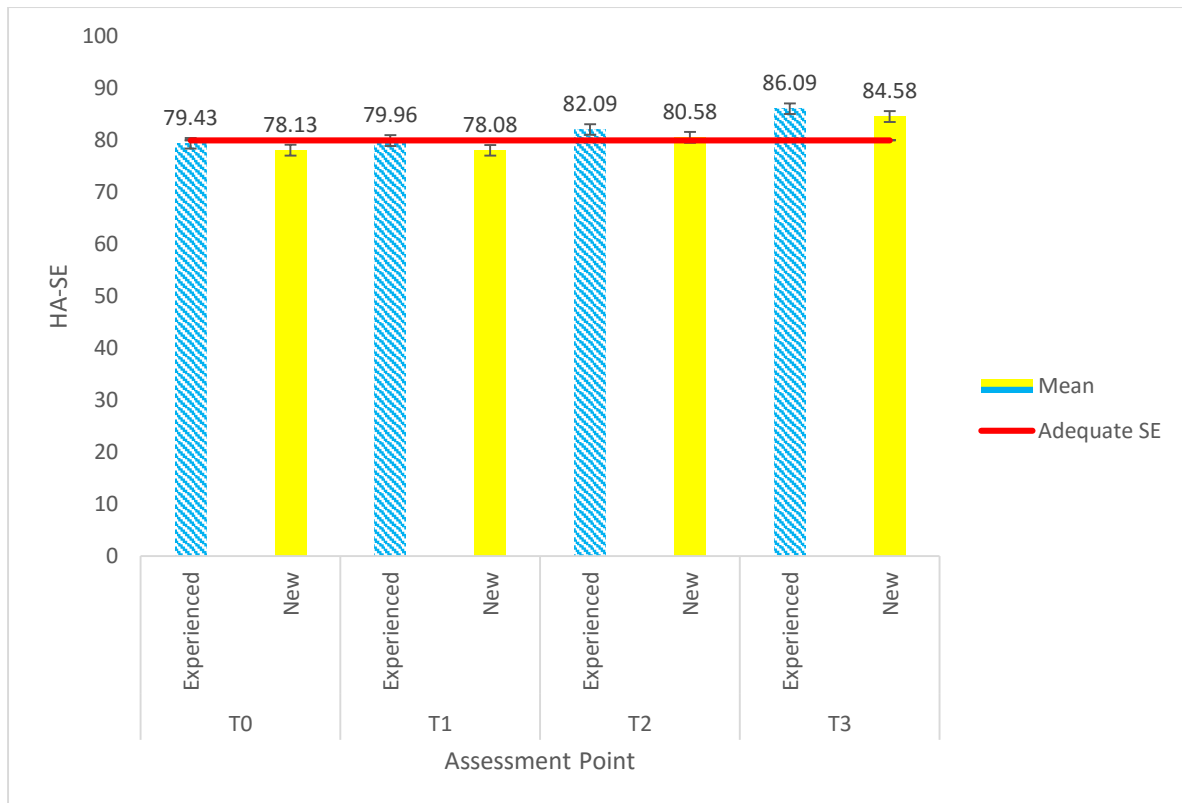


Figure 2. Mean and Standard Error for Experienced (n=113) and New (n=80) HA users over the HA trial period (T0-T3) on the Basic Handling subscale.

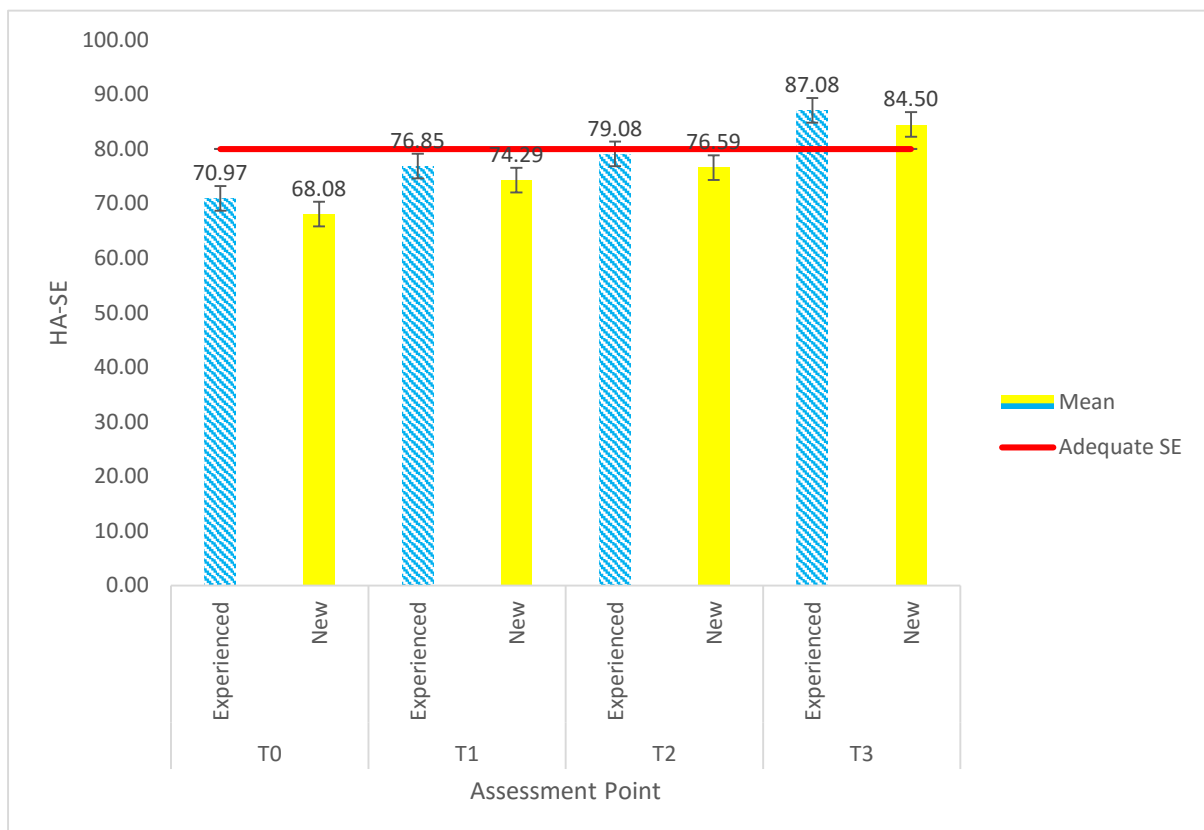


Figure 3. Mean and Standard Error for Experienced (n=113) and New (n=80) HA users over the HA trial period (T0-T3) on the Adjustment subscale.

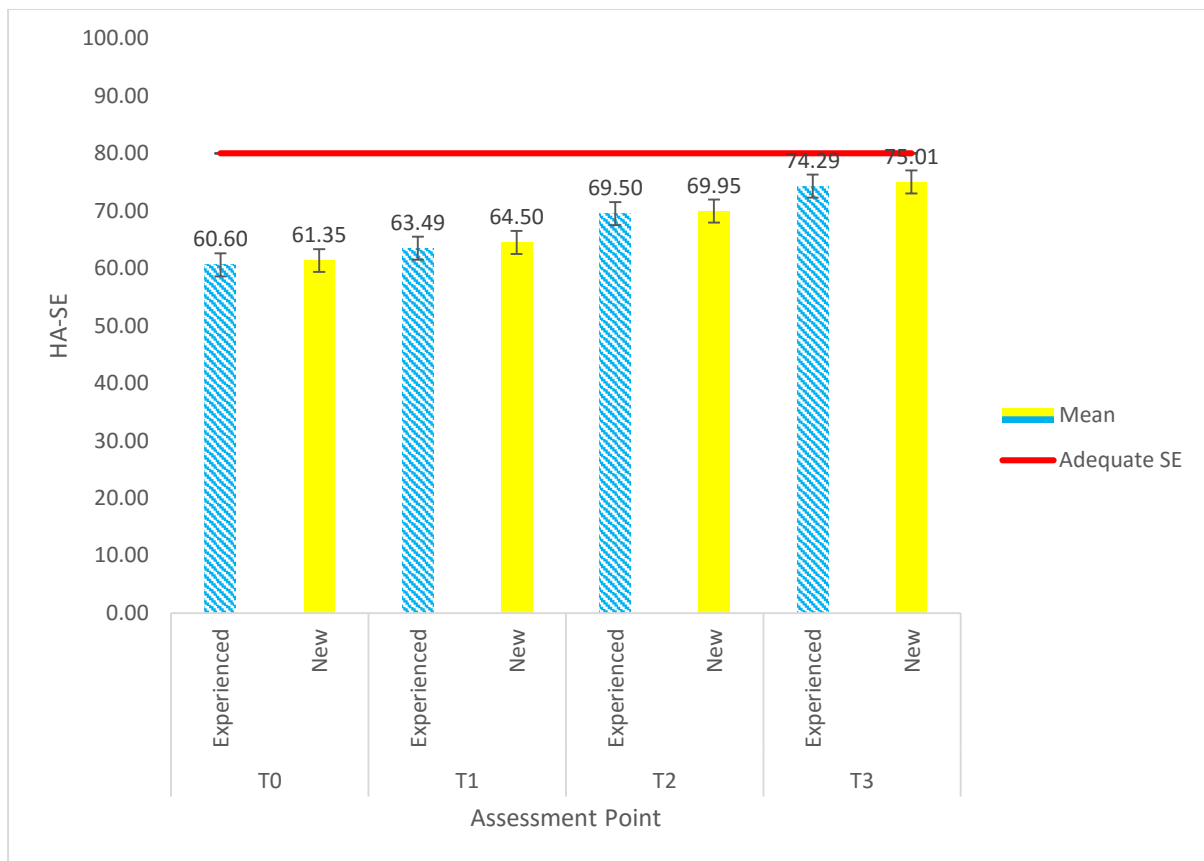


Figure 4. Mean and Standard Error for Experienced (n=113) and New (n=80) HA users over the HA trial period (T0-T3) on the Advanced Handling subscale.

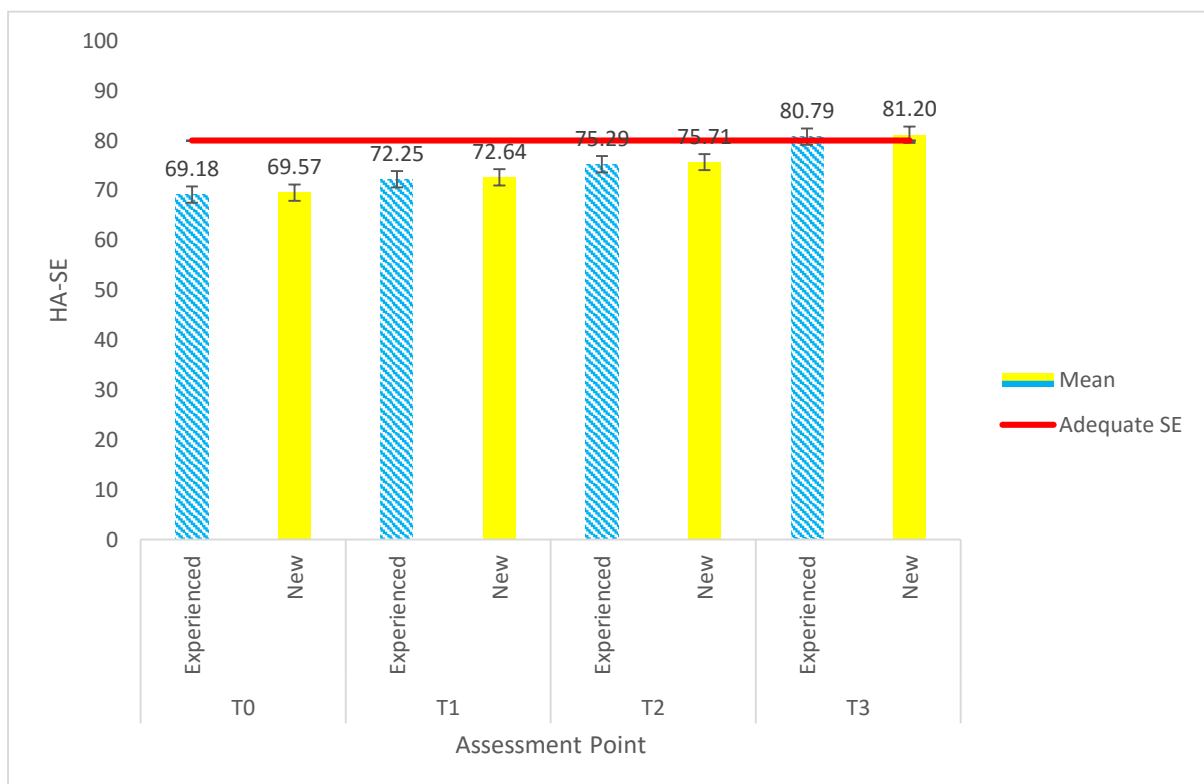


Figure 5. Mean and Standard Error for Experienced (n=113) and New (n=80) HA users over the HA trial period (T0-T3) for total HA-SE.

Participant scores on the MARS-HA were categorised as adequate or not adequate as defined by West and Smith (2007). Scores of 80% and higher on each HA-SE sub-scale and total HA-SE were coded as adequate. Scores below 80% on each HA-SE sub-scale and total HA-SE were coded as not adequate. The proportion of participants with adequate HA-SE are shown in figures 6-10. A similar mixed model repeated measures ANCOVA was performed on the proportion of adequate HA-SE. As with the previous analysis, there was no significant interaction between group and time of MARS-HA administration. There was no main effect of hearing aid experience on any MARS-HA sub-scale or the total MARS-HA. Therefore, the new and experienced users were grouped together for figures 6-10. The findings supported the previous RM-ANCOVA findings: there were no significant differences between new and experienced HA users in terms of HA-SE, but there was a significant difference in HA-SE over time. Specifically, there were significant differences in HA-SE at each assessment point for each sub-scale and for the total score ($p < .001$ for each analysis).

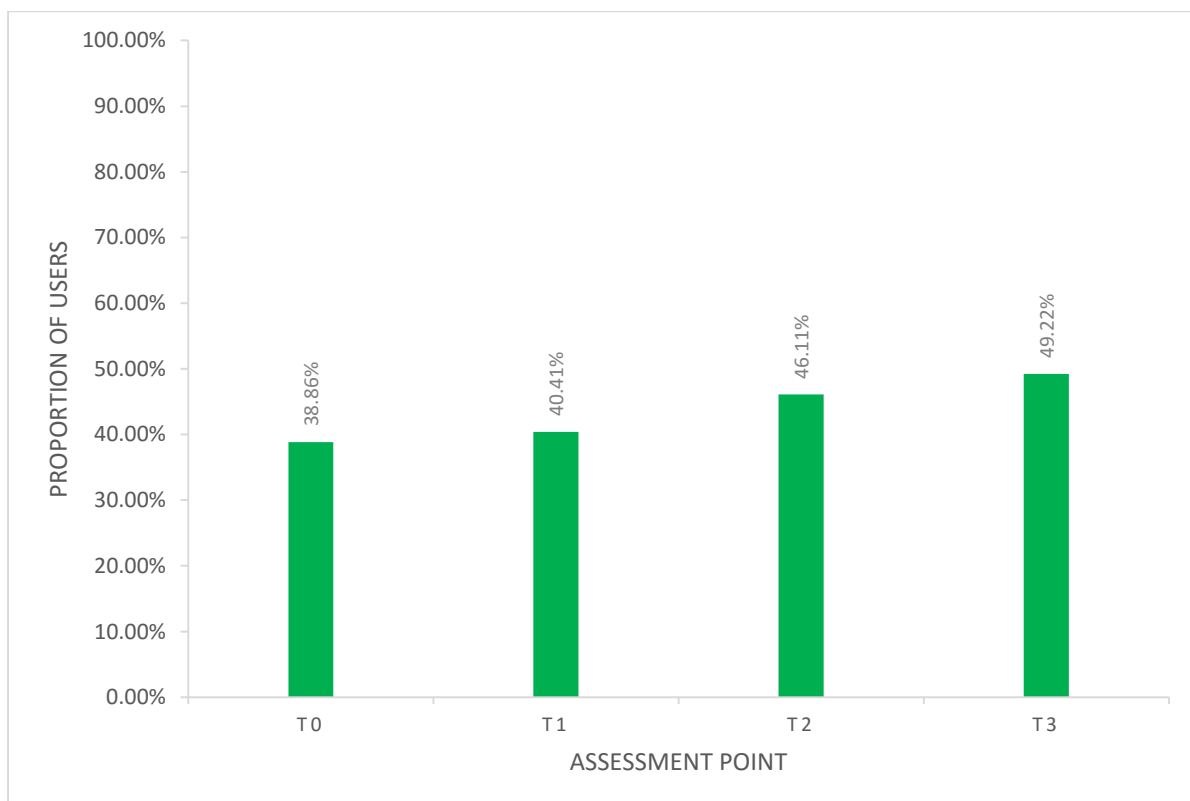


Figure 6. Proportion of HA users ($n=193$) with adequate SE ($\geq 80\%$) for HA-SE subscale Aided Listening over the HA trial period (T0 through to T3).

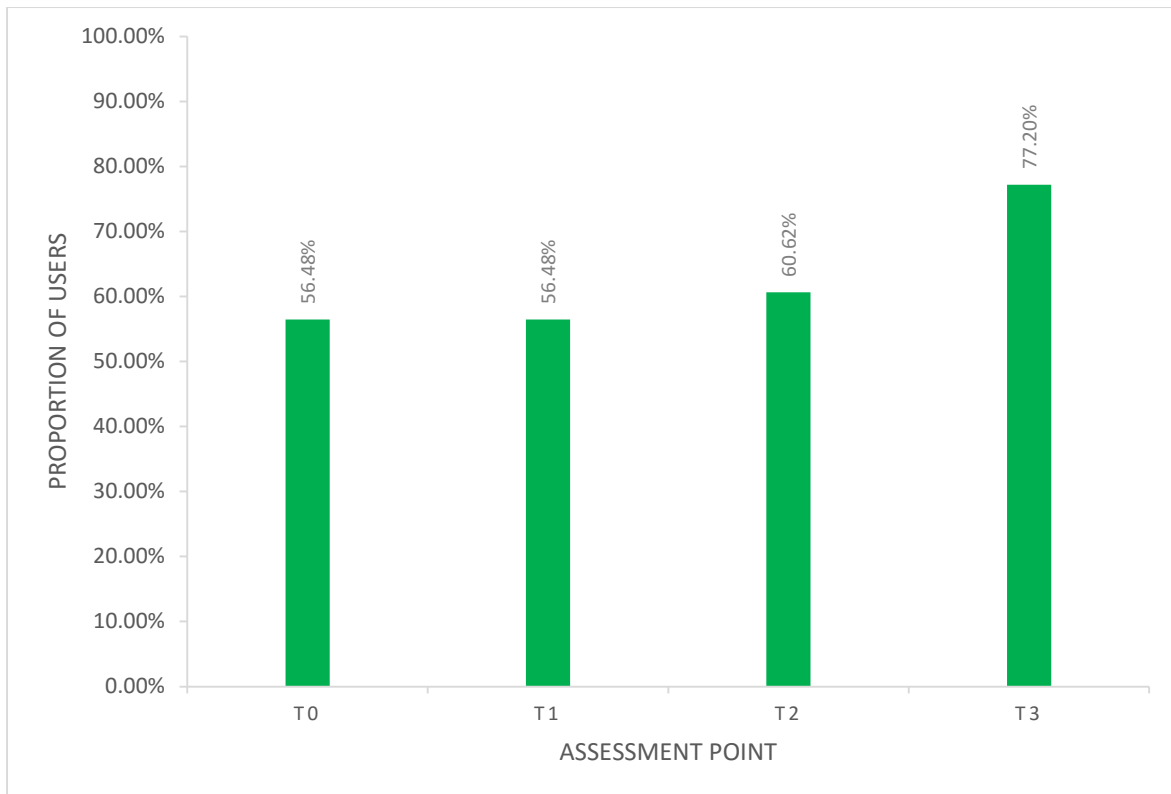


Figure 7. Proportion of HA users (n=193) with adequate SE ($\geq 80\%$) for HA-SE subscale Basic Handling over the HA trial period (T0 through to T3).

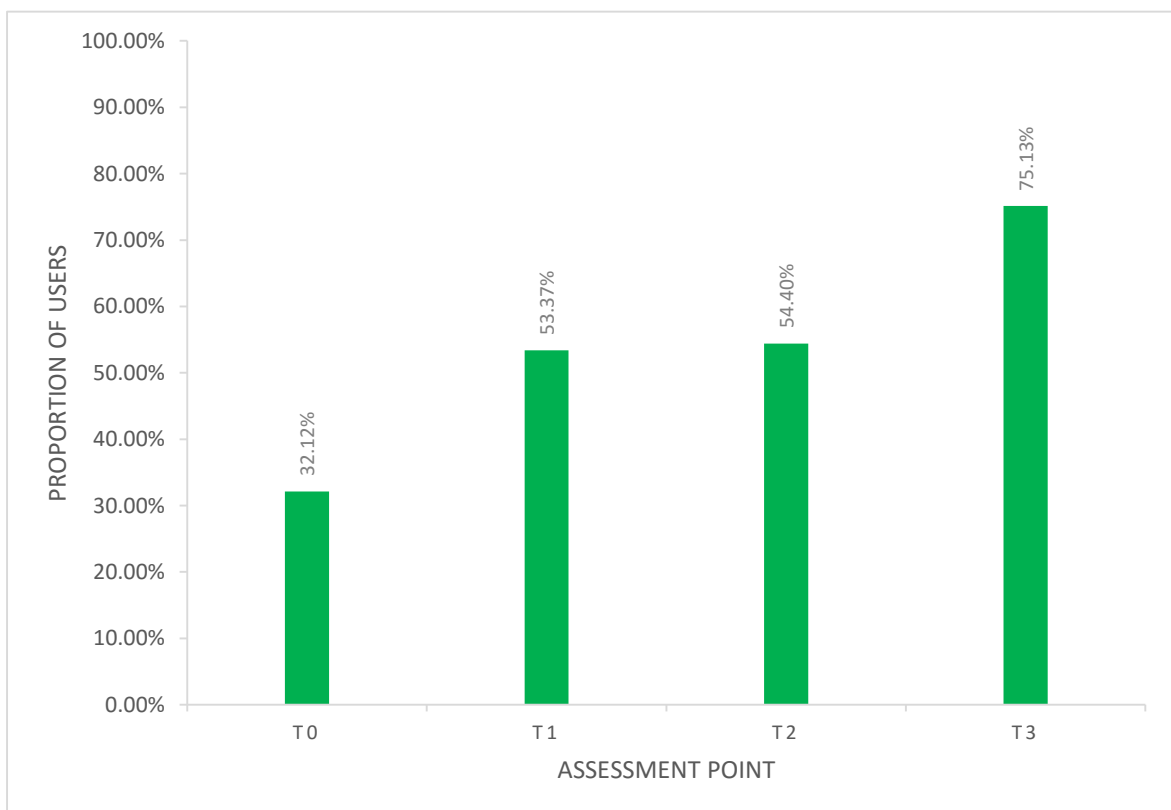


Figure 8. Proportion of HA users (n=193) with adequate SE ($\geq 80\%$) for HA-SE subscale Adjustment over the HA trial period (T0 through to T3).

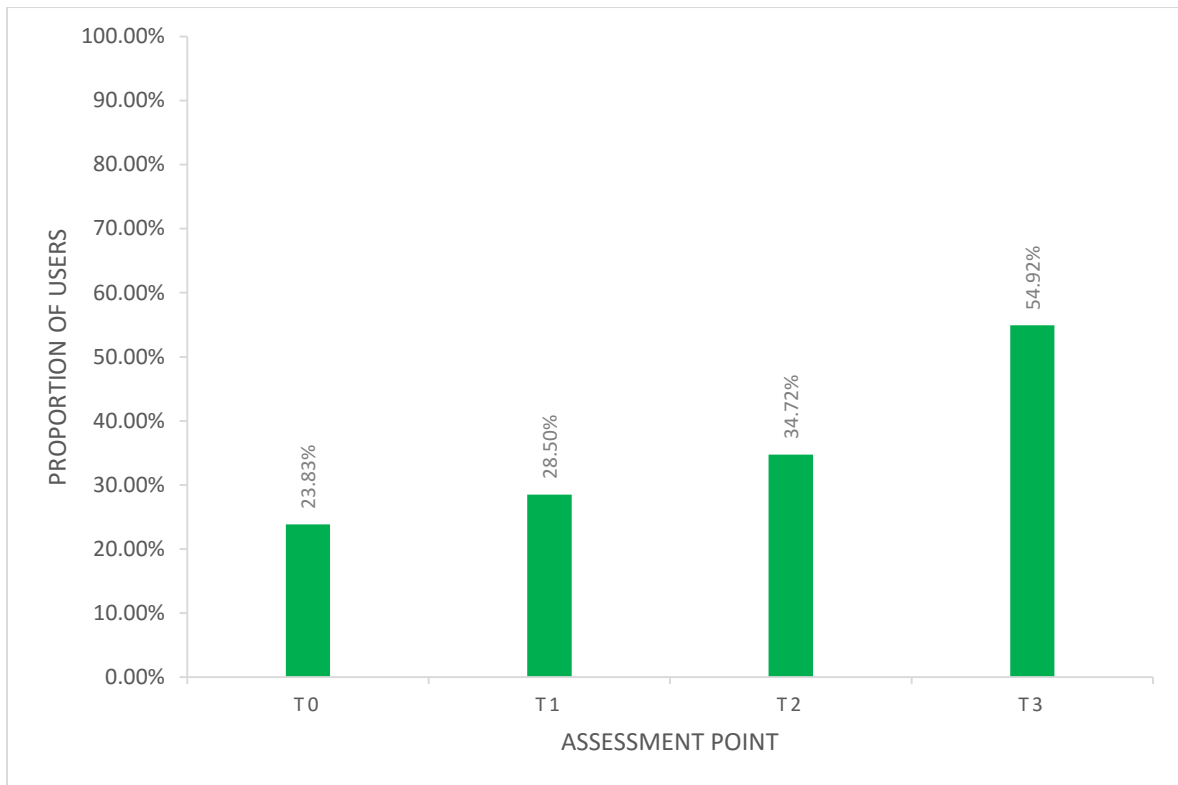


Figure 9. Proportion of HA users (n=193) with adequate SE ($\geq 80\%$) for HA-SE subscale Advanced Handling over the HA trial period (T0 through to T3).

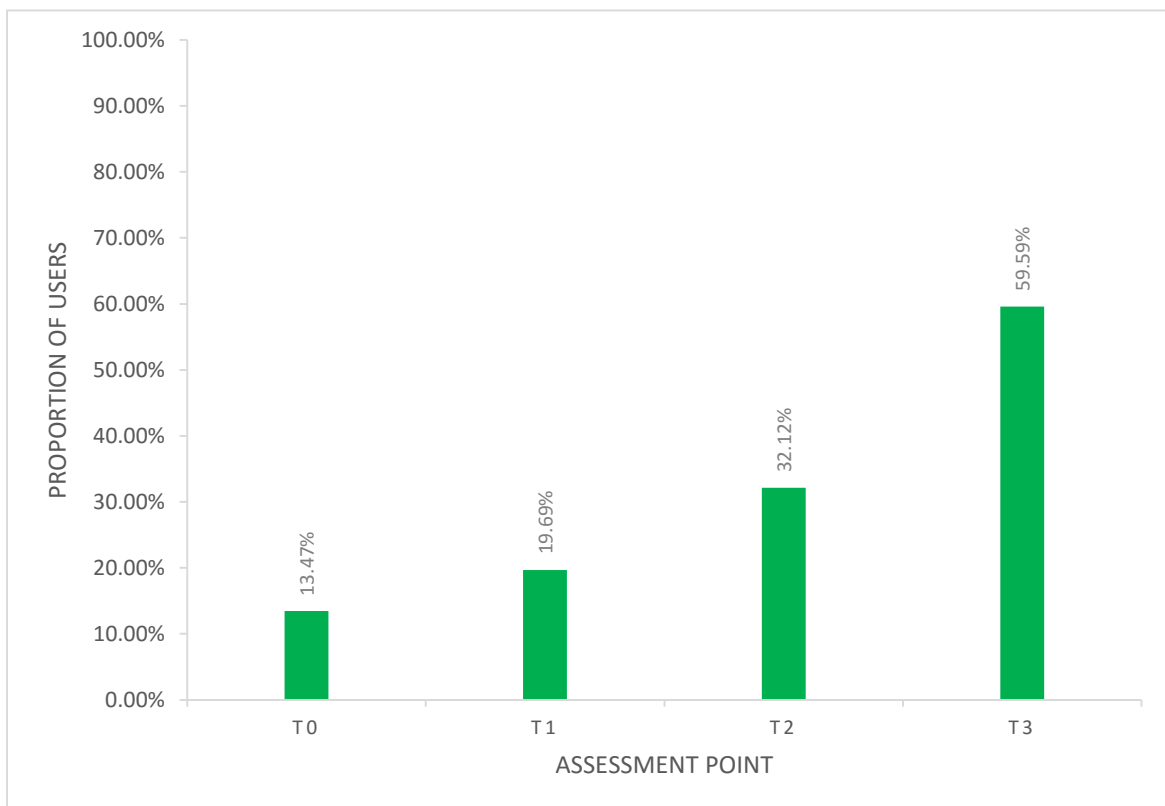


Figure 10. Proportion of HA users (n=193) with adequate SE ($\geq 80\%$) for total HA-SE over the HA trial period (T0 through to T3).

4.4. Research Question Two

Research question two examined whether HA-SE at the various assessment points is able to predict HA satisfaction for new or experiences HA owners. The only significant difference between new and experienced users for HA-SE was on the Basic Handling sub-scale ($F(1,189) = 3.43, p = .017, \eta^2 = .018$). As this was a small difference and there were no other significant differences between the groups, the groups were combined to carry out the remaining analyses. Figures 11 and 12 show the mean and standard deviation for satisfaction for experienced and new users (respectively) as measured by the SADL at T3. A series of multiple regression analyses were performed in order to determine if MARS-HA variable (or other independent variables) were able to predict SADL scores.

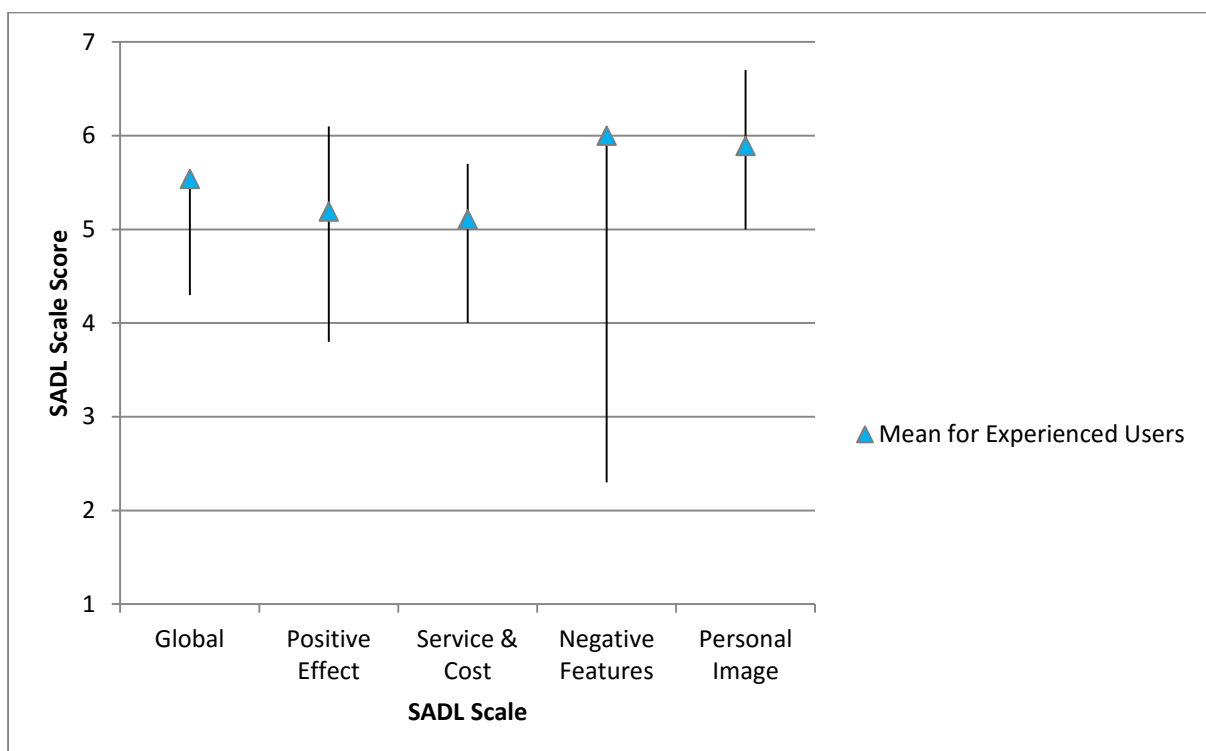


Figure 11. Twentieth to 80th percentile normative score ranges in each of the SADL questionnaire scales and the mean scores for experienced HA users (n=113).

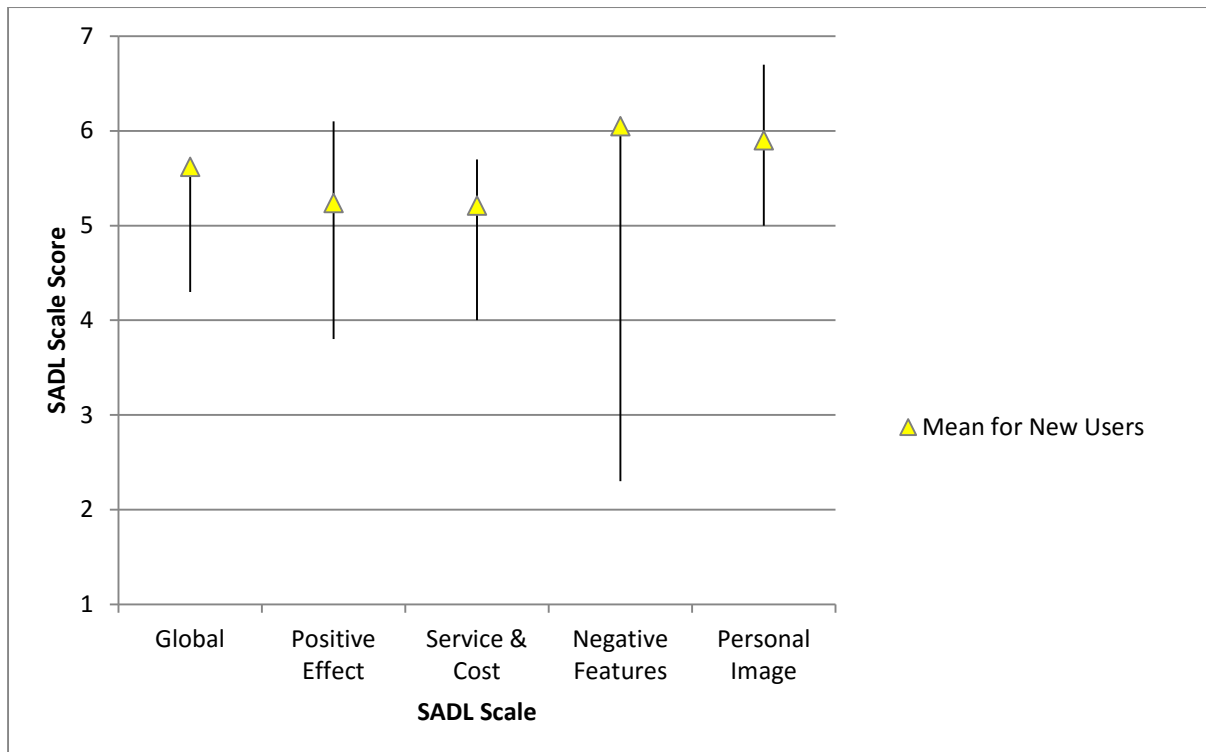


Figure 12. Twentieth to 80th percentile normative score ranges in each of the SADL questionnaire scales and the mean scores for new HA users (n=80).

All MARS-HA scores were used as potential predictor variables (i.e., each of the four factors at each of the four administration times) as well as the predictor variables listed in Table 4. A step-wise regression was used in each analysis due to the large number of potential predictor variables. A significance level of .05 was required for a variable to enter the equation. A significance level of .10 was required for a variable to be removed from the equation. For each analysis, the model that had a significant ($p < .05$) F-change statistic for each variable was used to describe the relationship between HA-SE and SADL score. None of the regression analyses violated the assumption of colinearity and each met the assumption of normality of error terms (residuals). (See the P-P plots for each variable: Figures 13-17).

- i. Positive Effect: Four variables were entered into the equation ($R^2 = .746$, $F(4,188) = 68.07$, $p < .001$). Advanced Handling at T0 ($\beta = .539$, $p < .001$), Aided Listening at T0 ($\beta = .363$, $p < .001$), Adjustment at T2 ($\beta = .325$, $p < .001$), and Basic Handling at T1 ($\beta = .310$, $p < .001$) significantly predicted Positive Effect at 12-weeks post-fitting.

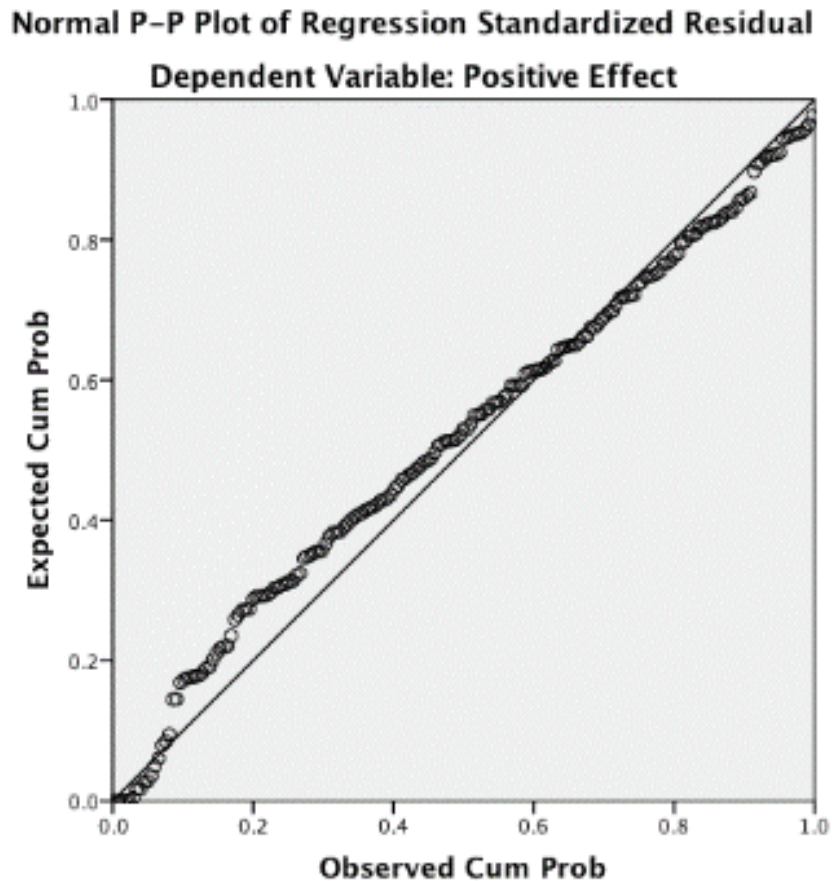


Figure 13. P-P plot of regression standardized residual for the dependent variable Positive Effect.

- ii. Service and Cost: Four variables were entered into the equation ($R^2 = .529$, $F(4,188) = 89.08$, $p < .001$). Advanced Handling at T0 ($\beta = .482$, $p < .001$), Adjustment at T2 ($\beta = .299$, $p < .001$), Basic Handling at T2 ($\beta = .259$, $p < .001$), and Aided Listening at T3 ($\beta = .239$, $p < .001$) significantly predicted Service and Cost at 12-weeks post-fitting.

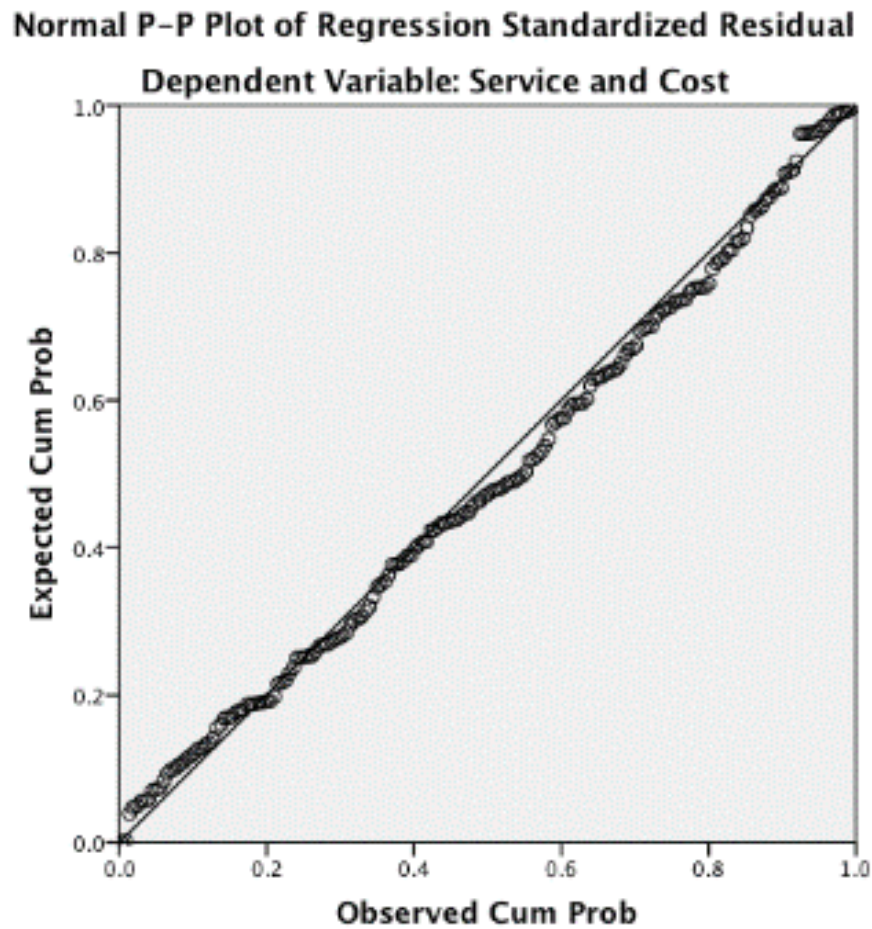


Figure 14. P-P plot of regression standardized residual for the dependent variable Service and Cost.

- iii. Negative Features: Four variables were entered into the equation ($R^2 = .432$, $F(4,188) = 92.72$, $p < .001$). Advanced Handling at T0 ($\beta = .576$, $p < .001$), Adjustment at T2 ($\beta = .301$, $p < .001$), Basic Handling at T3 ($\beta = .258$, $p < .001$), and Aided Listening at T3 ($\beta = .255$, $p < .001$) significantly predicted Negative Features at 12-weeks post-fitting.

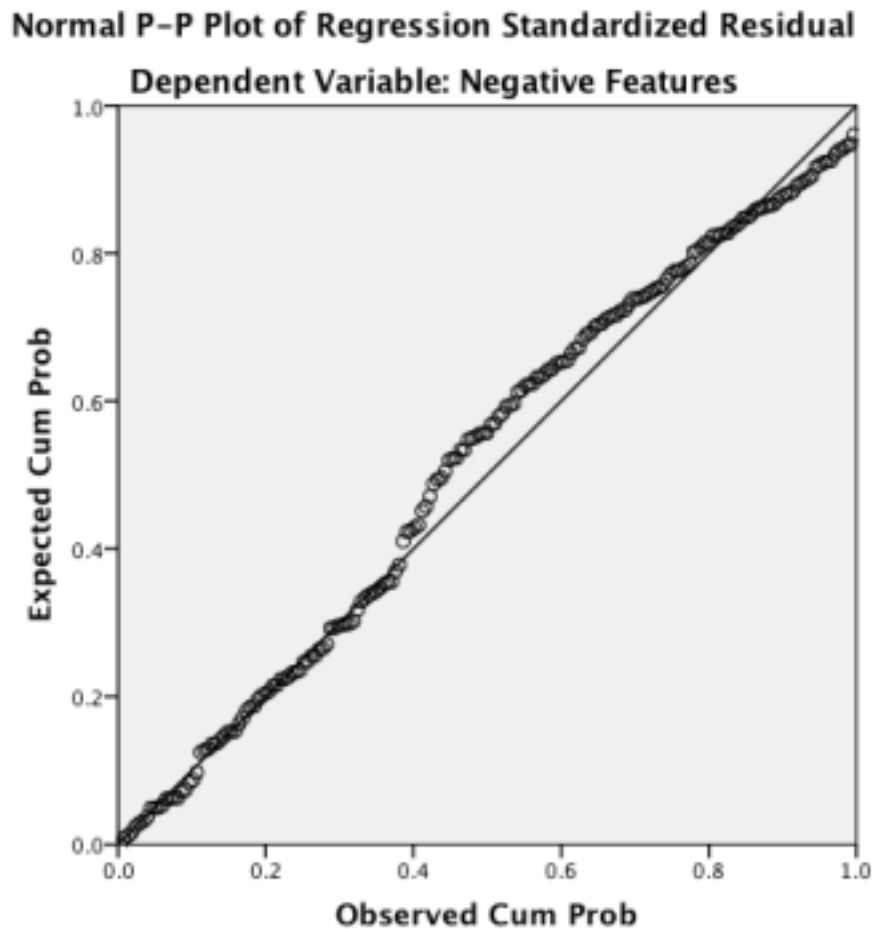


Figure 15. P-P plot of regression standardized residual for the dependent variable Negative Features.

- iv. Personal Image: Three variables were entered into the equation ($R^2 = .695$, $F(3, 189) = 56.28$, $p < .001$). Advanced Handling at T0 ($\beta = .658$, $p < .001$), Adjustment at T2 ($\beta = .328$, $p < .001$), and Aided Listening at T3 ($\beta = .302$, $p < .001$) significantly predicted Personal Image at 12-weeks post fitting.

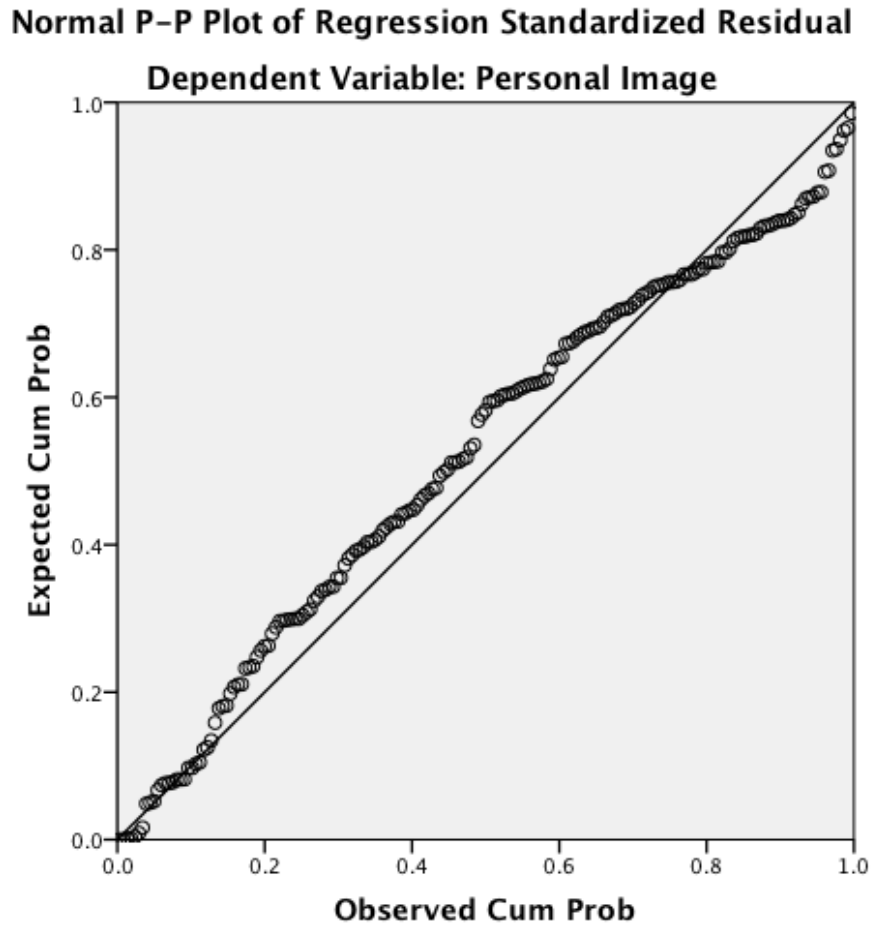


Figure 16. P-P plot of regression standardized residual for the dependent variable Personal Image.

- v. Global Score: Four variables were entered into the equation ($R^2 = .835$, $F(4, 188) = 204.28$, $p < .001$). Advanced Handling at T0 ($\beta = .625$, $p < .001$), Adjustment at T2 ($\beta = .343$, $p < .001$), Aided Listening at T3 ($\beta = .329$, $p < .001$), and Basic Handling at T3 ($\beta = .286$, $p < .001$) predicted Global Score at 12-week post fitting.

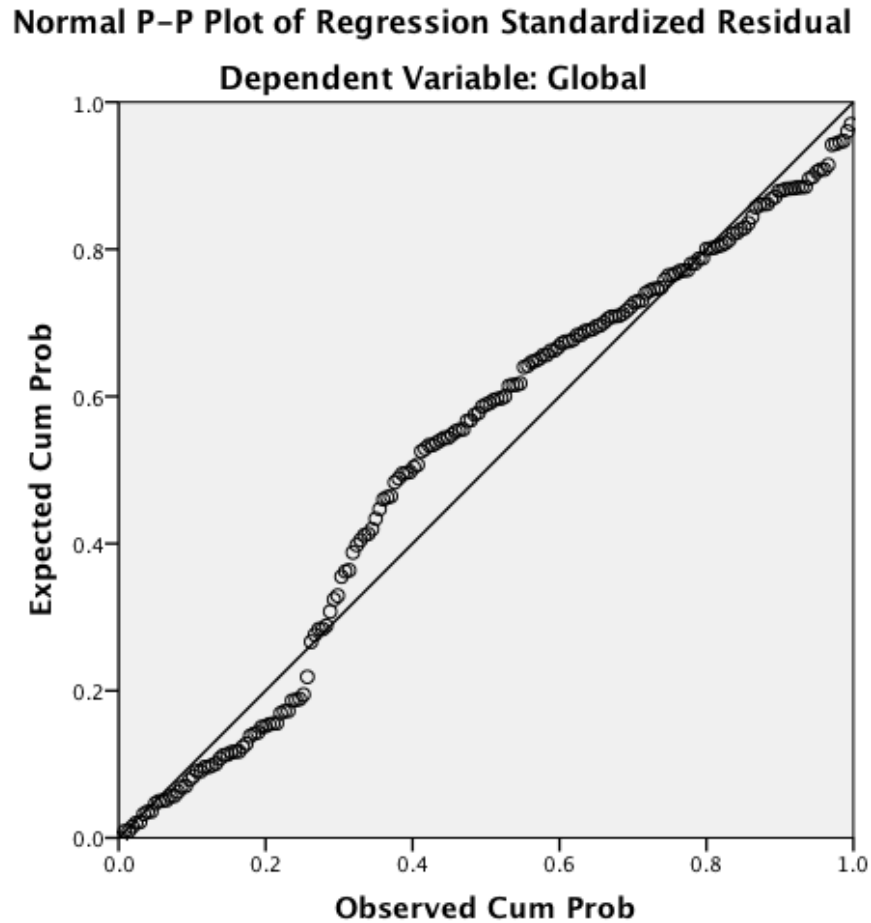


Figure 17. P-P plot of regression standardized residual for the dependent variable Global Satisfaction.

As shown in Figure 18, there were several variables which appeared frequently in the equations to predict satisfaction at T3.

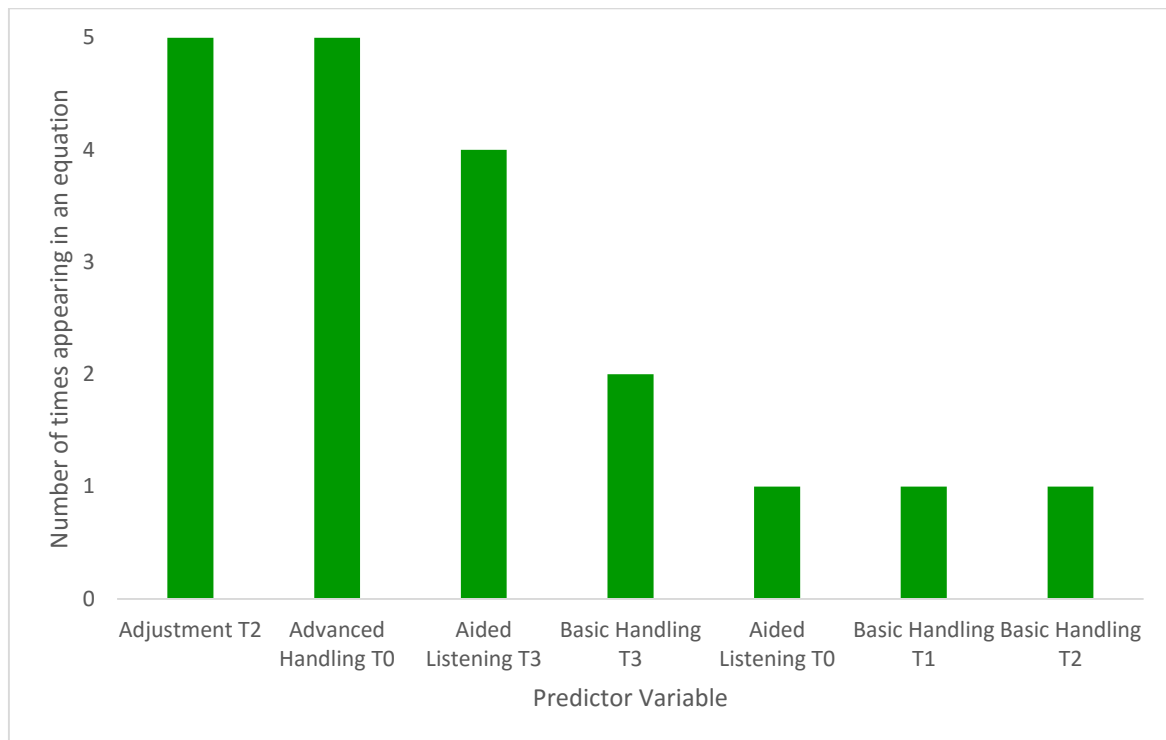


Figure 18. Number of times a significant predictor variable appeared in any of the equations to predict any aspect of satisfaction (global or subscale) with HAs at T3.

4.5. Research Question Three

Research question examines whether HA-SE at the various assessment points is able to predict HA use for new or experienced users. As previously mentioned there were no notable differences between new and experienced users, so the two groups were combined for this analyses. HA use was measured both by self-report and data logging, recorded at the T2 appointment. A discriminant analysis was performed to determine the HA-SE variables that would best predict self-reported HA use and a multiple regression analysis was performed to determine the HA-SE variables that would best predict HA use measured via data logging. As the outcome measures were taken at the T2 appointment, MARS-HA scores from T3 were not included in the analyses.

A discriminant analysis was performed to determine the HA-SE variables that would best predict self-reported HA use. All T0 through T2 MARS-HA scores were used as potential predictor variables (i.e., each of the four factors at T0, T1, and T2), as well as the other independent variables (listed in Table 4). A step-wise analysis was used due to the large number of potential predictor variables. No variables were entered into the equation, indicating that scores on the MARS-HA were not able to predict self-reported HA use at the final HA appointment (as measured by the IOI-HA).

A multiple regression analysis was performed to determine the HA-SE variables that would best predict HA use measured via data logging. All T0 through T2 MARS-HA scores were used as potential predictor variables (i.e., each of the four factors at T0, T1, and T2), as well as the other independent variables (listed in Table 4). A step-wise regression was used due to the large number of potential predictor variables. A significance level of .05 was required for a variable to enter the equation. A significance level of .10 was required for a variable to be removed from the equation. The model that had a significant F-change statistic for each variable was used to describe the relationship between HA-SE and HA use. Using

these parameters, no variables were entered into the equation, indicating that scores on the MARS-HA were not able to significantly predict self-reported HA use at the final HA appointment (as measured via data logging).

5 DISCUSSION

The present study aimed to investigate the pattern of MARS-HA over the fitting period for both new and experienced HA users, and to see if levels of HA-SE could predict both satisfaction and use at the outcome of a HA trial. The predictor variables were the MARS-HA scores (SE for Aided listening, Basic Handling, Adjustment, Advanced Handling and total SE) at the 4 assessment points (T0, T1, T2, T3). The first outcome measure was the SADL which gives a global satisfaction score as well as scores on 4 subscales (Positive Effect, Service and Cost, Negative Features, Personal Image). The second outcome measure was HA use, measured both by self-report and data logging. This chapter discusses the findings in relation to the literature, outlines the clinical implications and limitations of the study and describes future areas of research.

5.1. Question One: Hypotheses and Relationship to the Literature

Hypothesis 1a stated there would be a significant difference in HA-SE between new and experienced HA users over time. There was little evidence to support this hypothesis. The only significant difference between new and experienced users was on the Basic Handling subscale, although this was a small effect size that is likely not clinically meaningful.

Hypothesis 1b stated there would be a significant difference in HA-SE over time. New and experienced users were combined to carry out this analyses due to the lack of significant differences between the groups. This hypothesis was supported, with a significant improvement in HA-SE for each subscale, as well as overall HA-SE over the 12-week interval. This improvement was significant at every time interval with the exemption of T0 to T1 for the Basic Handling subscale.

5.1.1. Hypotheses 1a: Between Groups Difference

Hypothesis 1a was that there would be significant differences in HA-SE between new and experienced HA owners over time. This was investigated due to contradictory previous findings, with West and Smith (2007) finding a significant difference in HA-SE between groups and Kelly-Campbell and McMillan (2015) finding no significant difference.

Overall, there was little evidence to support hypothesis 1a. The current study showed no significant difference between new and experienced HA users HA-SE for the subscales: Aided Listening (AL), Adjustment (AD) or Advanced Handling (AH). There was also no significant difference between the overall HA-SE for new and experienced users.

The only significant difference between the new and experienced HA users was on the Basic Handling (BH) subscale. Experienced HA owners consistently showed significantly higher SE than new HA users across all assessment points (T0 through to T3). However, there was no significant interaction and a relatively small effect size. Due to the small effect

size and lack of other significant differences between new and experienced users, this difference is likely not clinically meaningful. One possible explanation for the experienced users having slightly higher SE is that they have experience with HAs. Bandura (1992) stated that there are 4 information sources that can moderate SE, one of which is prior experience. Experienced HA users would have likely been required to be familiar with the tasks on the BH scale in order to keep their HA operational. New HA users are much less likely to have had this exposure, which could explain the lower confidence in their ability to complete the tasks (such as changing a battery or putting their new HAs in).

Overall, HA experience does not appear to be related to HA-SE. This supports the most recent literature by Kelly-Campbell and McMillan (2015), who found no significant differences between new and experienced HA users, but contradicts the original findings by West and Smith (2007) who found some differences. Kelly-Campbell and McMillan (2015) compared individuals seeking HAs for the first time ($n = 20$) and those seeking replacement aids (experienced, $n = 27$) and found no significant differences between the groups. West and Smith (2007) compared new ($n = 83$) and experienced ($n = 128$) HA users, defined by having either less or greater than 6 months experience. West and Smith (2007) found that experienced HA users had higher SE on the AH subscale while new users had higher SE on the AL subscale. Kelly-Campbell and McMillan (2015) attributed their contradicting findings to differences between the two studies in terms of sex of participants, clinical practice setting and amount of experience with HAs before administration of the MARS-HA. The study by Kelly-Campbell and McMillan (2015) also had a small sample size ($n = 47$) which they mentioned may have potentially had insufficient power to detect a statistical difference between the groups that was small to medium.

The differences between the current study and previous findings by West and Smith (2007) was likely due to the same factors as Kelly-Campbell and McMillan (2015):

differences between samples in terms of amount of HA experience, sex of participants, clinical practice setting, and amount of experience with HAs before administration of the MARS-HA. West and Smith (2007) divided participants into new versus experienced HA users based on whether they had less or greater than 6 months experience, while the current study only allocated users to the experienced group if they had owned their HAs for 3 years or more. This large difference in experience between the West and Smith (2007) experienced group, and the experienced group for the current study could have contributed to the difference seen in the BH subscale. A minimum of 3 years' experience for inclusion in the current study is much greater than the 6 months as with West and Smith (2007). Furthermore West and Smith (2007) had only males recruited from a Veterans Affairs Centre, while Kelly-Campbell and McMillan (2015) and the current study recruited males and females from private clinics. In addition to this West and Smith (2007) had the participants complete the MARS-HA twice, initially at the HA fitting and then 2-weeks subsequently. Kelly-Campbell and McMillan (2015) had their participants complete the questionnaire once at 12-weeks post fitting, while the current study had the participants complete the MARS-HA at 4 points over a 12-week period. All of these differences could have contributed to the differences seen in the results.

5.1.2. Hypotheses 1b: Difference in HA-SE over Time

Hypothesis 1b was that there would be significant differences in HA-SE over time. This was investigated as there is no literature showing the pattern of HA-SE over time. The need to establish a pattern was identified by Kelly-Campbell and McMillan (2015), as a limitation of their research was the inability to identify specific aspects of the intervention that were related to HA-SE.

Hypothesis 1b was supported as there was a significant improvement in HA-SE for every subscale over time, as well as overall HA-SE. This improvement was significant at

every time interval with the exception of the time interval T0 to T1 for the BH subscale. In addition to this there is a trend of SE improving over time, with the proportion of participants with adequate SE ($\geq 80\%$; West & Smith, 2007) greatly increasing over the study period. Although the pattern over the 12 weeks looked at in the current study shows an increase in HA-SE over time, it is unclear what happens to HA-SE after this period.

For the AL subscale the mean score for both new or experienced HA users never reached an adequate level of HA-SE at any point throughout the study period. The AL subscale also showed the smallest effect size for improvement of SE over time. The proportion of individuals with adequate HA-SE on this subscale started low with just over a third of participants (38.86%) and increased the least of any of the subscales, with less than half of participants (49.22%) achieving adequate SE at T3. The AL subscale had the lowest proportion of users with adequate HA-SE at T3 for any of the scales. This suggests that many of the participants had little confidence in their ability to listen in different situations while wearing their HAs. It is possible that HA users, both new and experienced, are aware that listening problems can still occur even with use of their HAs and have low confidence as a consequence. These findings were similar to the previous study by Kelly-Campbell and McMillan (2015) who found around half of their participants (53.3%) had adequate SE for AL at 12-weeks post-fitting.

For the BH subscale the mean score started off close to adequate, and reached an adequate level by T2 for both new and experienced HA users. Mean BH scores did not significantly improve from T0 to T1. The proportion of participants with adequate HA-SE on the BH subscale was around half at T0 (56.48%) and increased to just over 3-quarters (77.20%) of the participants by T3. This was the only subscale where the mean reached an adequate level by T2, and had the highest proportion of participants with adequate HA-SE at T3 for any of the subscales. Given that the tasks on this factor can generally be considered

necessary for keeping a HA functional (for example: inserting/removing a battery, inserting/removing a HA), it is unsurprising that participants had highest confidence for this subscale. These tasks are included in the best practice guidelines (American Speech-Language-Hearing Association, 1998), so are likely to be explicitly and routinely taught to HA owners. These results were similar to those reported by Kelly-Campbell and McMillan (2015), where the majority (83%) of participants had adequate HA-SE for BH at 12-weeks post-fitting.

For the AD subscale the mean score reached an adequate level only at the final T3 assessment for both new and experienced HA users. Less than a third of individuals (32.12%) had adequate HA-SE at T0 for the AD subscale, which increased to around 3-quarters (75.13%) of participants by T3. This was the second highest proportion of participants (after the BH subscale) with adequate HA-SE at T3. The large improvement of AD over time is consistent with what the subscale is measuring. Both new and experienced users were likely to have had lower confidence at the early assessments, given that they were likely to have little information about what to expect. As they gained experience, the participant's confidence in their ability to adjust increased, which was likely due to them actually adjusting to the new aids. Consistent HA use is related to speed of adaptation to HAs (Kapteyn, 1977; Munro, 2008), with 65.45% of regular HA users becoming accustomed to HAs within 3 months (Brooks, 1985). This is consistent with the increasing confidence in ability to adjust seen in the current study. Previous findings by Kelly-Campbell and McMillan (2015) were also similar with most participants (76.6%) having adequate SE for AD at 12-weeks.

For the AH subscale the mean score never reached an adequate level at any stage through the assessment, for either new or experienced HA users. The proportion of participants with adequate SE began low (23.83%) but then more than doubled over the assessment period. Despite this increase the proportion of participants with adequate SE was

still low at T3 (54.92%). This suggests that people have little confidence in their ability to carry out tasks relating to complex handling of their HAs, such as troubleshooting if their aid stops working. It is not surprising that SE for this subscale is low at the first assessment points. Firstly, these tasks are advanced tasks that are difficult to complete. Furthermore, clinicians may be less likely to provide information which would allow individuals to become proficient in this scale and instead concentrate on ensuring clients have sufficient information on easier essential tasks (for example- BH). Although SE for AH increased greatly over the 12-week study period, it still remained lower than suggested adequate levels, both by mean and proportion of people with adequate SE. This agrees with previous literature showing that people have low HA-SE for this subscale (West & Smith, 2007). Kelly-Campbell and McMillan (2015) reported just over half (51.1%) of their participants had adequate SE for AH at 12-weeks.

The mean overall HA-SE reached an adequate level at the final T3 assessment for both new and experienced HA users. The proportion of participants with adequate overall HA-SE was initially very low (13.47%), but increased greatly with 59.59% of participants having adequate overall HA-SE at T3. This indicates that time/the standard HA trial intervention is already a strong tool for improving HA-SE.

5.2. Question Two: Hypotheses and Relationship to the Literature

Hypothesis 2 was that HA-SE measured at various points throughout the 12-week period would be able to predict satisfaction with HAs at 12-weeks post-fitting. The relationship between HA-SE and satisfaction has previously been explored by Kelly-Campbell and McMillan (2015), with both measured at the outcome of the HA-fitting. Kelly-Campbell and McMillan (2015) found in general that those with adequate HA-SE had higher satisfaction than those with low SE. A limitation of this study is that specific elements of the intervention that are related to HA-SE and satisfaction could not be identified.

Hypothesis 2 was supported, with various MARS-HA scores entering equations generated to predict SADL scores. As shown previously in Figure 18, there were several predictor variables that appeared frequently in the equations to predict satisfaction with HAs. AH at T0 appeared first in every equation, meaning it was the strongest predictor of every satisfaction outcome. AD at T2 also appeared in every equation and was the second strongest predictor for 4 out of 5 equations. AL at T3 appeared in 4 of the equations, BH at T3 appeared twice, while AL at T0, BH at T1, and BH at T2 each appeared once. There were MARS-HA predictor variables included in the equations from all stages of the fitting process, showing that HA-SE is important both early and late during the HA trial period. Some variables, for example BH, were important at several stages over time, compared to AH which only featured in the equations as measured at T0. Given the limited research surrounding the relationship between HA-SE and satisfaction, there is significant conjecture which must be carried out when attempting to interpret the findings of the current study.

5.2.1. Non-Significant Predictor Variables

Predictor variables entering the equations only came from scores on the MARS-HA questionnaire. Predictor variables that did not enter the equations at any stage included: age, HHQ, PTA, cost to participant, and number of appointments.

A review carried out by Wong et al. (2003) showed that satisfaction with HAs was related to experience, expectation, personality and attitude, usage, type of HAs, sound quality, listening situations, and problems in HA use. A later review by Knudsen et al. (2010) found that satisfaction was related to personality and attitude, expectations, self-reported disability, and hearing acuity (measured HI). Knudsen et al. (2010) found no relationship between satisfaction and age or gender.

The current research supports previous evidence that age is not related to satisfaction with HAs (Knudsen et al., 2010). There was no research looking at the relationship between the number of appointments attended, or cost, and satisfaction with HAs. The current research does not necessarily contradict previous findings showing a relationship between satisfaction and both self-reported hearing handicap and PTA (Knudsen et al., 2010; Wong et al., 2003). The current research does not show that there is no relationship between satisfaction and these predictor variables, just the scores on the MARS-HA are stronger predictors of satisfaction with HAs than the other variables measured.

5.2.2. Predictor Variables that Occur Frequently

AH at T0 appeared first in every equation for predicting satisfaction outcomes, meaning it was the strongest predictor of every satisfaction outcome. In some ways it is unsurprising that this is the strongest predictor variable. AH is the confidence an individual has in their ability to carry out complex tasks. These skills are arguably the most difficult tasks that will be dealt with when managing a HA, which is reflected by the fact that people generally have the lowest HA-SE for this subscale compared to other subscales (Kelly-Campbell & McMillan, 2015; West & Smith, 2007). T0 were the measurements taken at the HA-fitting appointment around 1 week after the ARE. Because this predictor variable was the strongest predictor for every satisfaction outcome, it is possible that AH at T0 is not specific to the individual subscales. Instead it may be that these individuals have a high confidence in

their ability to overcome obstacles. If a person has this confidence early on in the fitting process, it may lead to better outcomes (i.e. higher satisfaction). As West and Smith (2007) previously mentioned, this may be due to the fact that they are more likely to persevere when they encounter difficulties during the HA trial, whether it be for new or replacement aid.

AD at T2 appeared second in every equation, other than when predicting PE (where it appeared third). AD is an individual's confidence in their ability to get used to their HAs and T2 is the measurement taken at 4 to 6 weeks post HA fitting. By the time the individual reaches T2, they are well through the HA trial. This may be a "tipping point" or critical stage in the HA trial. If an individual does not have confidence in their ability to get used to their HA by this stage, then it makes sense that they may not be satisfied with their HA at the conclusion of the trial.

AL at T3 appeared in 4 of the equations, when predicting: SC, NF, PI, and global satisfaction. AL is a person's confidence in their ability to listen and communicate while wearing their HAs. This was especially important when measured at T3, 12-weeks post HA fitting. Aided speech is likely to improve over time, due to the fact that the individuals are hearing through amplified devices. This may mean that their confidence improves as they gain a collection of positive experiences listening with their HAs. It may be that there is a moderator variable occurring: aided speech perception. As most people seek services due to difficulty hearing and understanding speech, it makes sense that actual improvement in speech perception/understanding improves AL SE and consequently results in high levels of satisfaction.

BH was a predictor variable that appeared in 4 of the equations: PE, SC, NF, and global satisfaction. BH covers an individual's confidence in their ability to carry out simple tasks concerning the maintenance and operation of their HA. This predictor variable was important when measured across stages T1 through to T3, unlike the other predictor

variables, which were generally only important at one stage through the fitting process. Most of these tasks are necessary for keeping a HA operational (for example inserting/removing a HA), so it makes sense that they are important for all satisfaction factors. It may be that BH SE is a prerequisite for satisfaction, as you need to be able to wear the HA in order to be satisfied with it. It is important to note that BH SE alone is not sufficient to predict satisfaction- there are other significant variables in each equation.

5.2.3. Positive Effect

The mean score for Positive Effect (PE) was 5.22 (n = 193, no significant difference between new and experienced HA users). This was slightly higher than the mean given by Cox and Alexander (1999) in their normative data of 4.90 (n = 257), and the mean found by Uriarte et al. (2005) of 4.98 (n = 961). Cox and Alexander (1999) acknowledged that their norms were based on a relatively small amount of data, and as a consequence stressed the need for additional data to refine the values. Uriarte et al. (2005) gathered information from older Australians fit with HAs and found their scores were higher than Cox and Alexander (1999), which they agreed highlighted the need for refining the normative data. As a consequence, the data are provided to give a comparison but there is unlikely to be clinical importance in small differences between previous research and the current data.

There were 4 contributing variables entered into the equation when looking to significantly predict PE at 12-weeks post fitting: AH at T0, AL at T0, AD at T2, and BH at T1. PE concerns the individual's satisfaction with the psychoacoustic properties of the HA (for example natural sounding, helping you to understand people) and their psychological functioning (for example self-confidence). AL at T0 was the second strongest predictor of PE satisfaction. Given that AL is a measure of an individual's confidence in their ability to hear in different situations it makes sense that it would be a strong predictor of PE, which contains psychoacoustic questions relating to whether one feels that HAs help them to hear. BH is

another predictor. This is consistent with PE, due to the questions on the PE factor relating to whether the HA was worth the individual's time and was in their best interest. If an individual had low SE for BH they may struggle to maintain the HA and consequently they may not feel satisfied that the HA is worth their time. Kelly-Campbell and McMillan (2015) found that participants with adequate SE in the AD subscale and overall HA-SE had significantly greater satisfaction on the PE subscale. They proposed that SE for AD and PE satisfaction were related constructs- namely that of self-confidence. The current research agrees with these previous findings. The current study was able to generate a more complex model of the relationship between HA-SE and satisfaction, but still found that AD SE was related to PE satisfaction.

5.2.4. Service and Cost

The mean score for Service and Cost (SC) was 5.15 (n = 193, no significant difference between new and experienced HA users). This was slightly lower than the normative data mean given by Cox and Alexander (1999) of 5.40 (n = 142) and the mean established by Uriarte et al. (2005) of 5.70 (n = 835). As previously mentioned, small differences between the research studies are likely not meaningful clinically.

There were 4 contributing variables entered into the equation when looking to significantly predict SC at 12-weeks post fitting: AH at T0, AD at T2, BH at T2, and AL at T3. SC deals with the individual's confidence in their HA provider and satisfaction with the value of their HAs. Every subscale of the MARS-HA is present (although at various points in time) when predicting SC. This is unsurprising, as any lack of confidence with HA tasks would likely lead to a reduction of confidence in the provider and/or decreased perceived value of the HA. If HA users do not have confidence in their ability to look after their HAs (BH and AH), and are not confident in their ability to get used to them (AD) or communicate more effectively with them (AL), then it is unsurprising that they would not have a high level

of satisfaction with SC. This could be expressed through a low opinion of the value of their HAs or through little confidence in their HA provider. Kelly-Campbell and McMillan (2015) had similar findings, with the SC subscale being related to several MARS-HA variables: AL, BH and AH.

5.2.5. Negative Features

The mean score for Negative Features (NF) was 6.02 ($n = 193$, no significant difference between new and experienced HA users). This was almost twice the mean found by Cox and Alexander (1999) of 3.60 ($n = 256$) and also higher than the mean found by Uriarte et al. (2005) of 4.74 ($n = 940$). As previously mentioned, small differences between previous and current research are likely not meaningful, but this is a large difference. Cox and Alexander (2001) admitted that the normative values provided for the NF subscale were likely not appropriate, which helps to explain the extreme difference seen compared to the current study. The mean score on the NF factor was the highest out of any of the satisfaction scores. It is unclear why this difference between the current data and previous research by Uriarte et al. (2005) is present but it is possibly due to differences in listening situations, populations, or means of administering the SADL. It is possible that the participants were using their HAs in different settings, for example if they did not spend much time in noisy situations with significant background noise. Consequently the individuals from the current study may not have had as much opportunity to experience the NF of HAs. Additionally, they were from very different populations. Uriarte et al. (2005) only assessed participants who were new users (fit 3 to 6 months previously), while the current study looked at both new and experienced HA users. Also, around half of Uriarte et al. (2005) participants were fit unilaterally, with only around 10% of the current study fit unilaterally. These factors could have influenced their satisfaction with the NF of HAs. It is also possible that there was a difference between studies due to the procedures of the study. Uriarte et al. (2005) mailed out

the SADL questionnaire to participants and did not have direct contact with them, while the participants for the current study had spent time interacting with the clinicians (although the clinicians were not present at time of SADL administration). Participants in the current study may have been less likely to report low satisfaction with NF due to a potential response bias. Conversely, it is possible that the participants in the current study both engaged with their clinicians and also had more sophisticated HAs, resulting actually having higher satisfaction with NF. The previous study (Uriarte et al., 2005) was carried out a decade ago and it is quite probable that the NF of HAs have improved during that time, specifically due to advancements in: noise reduction/directional microphones, feedback, and telephone compatibility- targeting the 3 NF SADL items. This may indicate new SADL normative values are needed.

There were 4 contributing variables entered into the equation when looking to significantly predict NF at 12-weeks post fitting: AH at T0, AD at T2, BH at T3, and AL at T3. NF covers an individual's confidence in their ability to deal with background noise, feedback and telephone use. BH and AL were both predictive when measured at T3. These factors contain skills concerning confidence in maintaining HAs and the ability to listen and understand in different situations (including noisy situations). If HA users have a high confidence in their ability to listen in difficult situations (for example in the presence of background noise or in the car) then it makes sense that they may be better equipped to deal with the NF of HAs. Kelly-Campbell and McMillan (2015) found NF was related to AL and AD. They also highlighted the relationship between AL (the ability to manage in adverse situations) and higher satisfaction with NF. As mentioned previously, the current research was able to generate a more complex model by identifying time points at which different aspects of HA-SE were most important to NF satisfaction. Regardless of this the current study supported the previous findings, with AL and AD being related to NF scores.

5.2.6. Personal Image

The mean score for Personal Image (PI) was 5.92 ($n = 193$, no significant difference between new and experienced HA users). This was slightly higher than the normative mean given by Cox and Alexander (1999) of 5.60 ($n = 103$) and very similar to the mean found by Uriarte et al. (2005) of 5.86 ($n = 953$). As previously mentioned, small differences between the research results are likely not clinically meaningful.

There were 3 contributing variables entered into the equation when looking to significantly predict PI at 12-weeks post fitting: AH at T0, AD at T2, and AL at T3. PI deals with an individual's perception of how HAs affect their appearance and also how others may perceive them. Given that AL deals with a person's confidence in their ability to hear, it makes sense that this would be related to PI. If an individual feels they are not able to hear well in different situations, it may make them feel they appear less capable, or that their HI is more visible to others. Kelly-Campbell and McMillan (2015) found no relationship between PI and any of the HA-SE factors. This could have been due to the small sample size of their study or the fact that the MARS-HA was only completed at 12-weeks, rather than at several points over time.

5.2.7. Global Satisfaction

The mean score for Global Satisfaction was 5.58 ($n = 193$, no significant difference between new and experienced HA users). This was higher than the normative mean given by Cox and Alexander (1999) of 4.90 ($n = 53$) but similar to the mean given by Uriarte et al. (2005) of 5.27 ($n = 813$). Given that the current mean was close to the mean provided by Uriarte et al. (2005), there is likely no meaning in the difference with the Cox and Alexander (1999) data. The Global satisfaction mean provided by Cox and Alexander (1999) was based off very few participants ($n = 53$), and the difference seen is likely due to this.

There were 4 contributing variables entered into the equation when looking to significantly predict Global Score at 12-weeks post fitting: AH at T0, AD at T2, AL at T3, and BH at T3. Given that Global satisfaction is an average of all SADL questions, it is not surprising that this equation has the largest predictive ability. The predictive variables that are entered into the equation are similar to the equations for other satisfaction factors, covering all subscales of the MARS-HA.

5.3. Question Three: Hypotheses and relationship to the literature

Hypothesis 3 was that HA-SE measured at various points throughout the HA-trial period would be able to predict HA use at 12-weeks post-fitting. HA use was measured by both self-report and data logging. The hypothesis was not supported. No HA-SE scores at any assessment point were able to predict HA use as measured by either self-report or data logging. Both self-report and data logging information was collected at the T2 appointment, due to this being the last point of contact with the clinicians. This is a limitation of the research as it would be preferential to look at the relationship between HA-SE and HA use with use measured at T3.

The relationship between HA-SE and HA use was examined broadly by Hickson et al. (2014) and Meyer, Hickson, Lovelock, et al. (2014). Meyer, Hickson, Lovelock, et al. (2014) found that BH was related to individuals being successful HA owners, while Hickson et al. (2014) reported AD was related to the same success. Success as a HA owner was measured by receiving at least moderate benefit and using the HA for at least one hour per day. Other than this, the relationship between HA-SE and use has not been explored before. Due to the limitations of the data collection, it is not clear if the lack of significant findings is due to limitations in current study design or if HA-SE is actually unable to predict hours of HA use. Irrespective of the limitation of the data collection, it is possible that HA-SE and HA use are only broadly related constructs and that HA-SE may be unable to predict HA use. Given that the MARS-HA is a measure which assesses the client's opinion of, and confidence in, their abilities, it makes sense that it would be related to the SADL measure, which is a measure accounting for the client's point of view. There is not such a clearly defined relationship between HA-SE and hours of HA use.

The employment of hours of use as an outcome measure has its own limitations. Although Brooks (1985) demonstrated that those who wear their aids regularly are generally

satisfied with the help they receive from their aids, Parving and Philip (1991) found no direct correlation between time-related use of HAs and satisfaction. The relationship between HA use and satisfaction was also examined by Dillon et al. (1991), using a single question satisfaction measure. They found that the responses on this single satisfaction question correlated highly with self-reported HA use. Uriarte et al. (2005) also looked at the relationship between HA use and satisfaction (measured using the SADL). They found a significant linear association between HA use and higher levels of overall satisfaction, but that there were significant deviations from this trend when looking at SADL subscales. It has previously been shown that hours of HA use does not necessarily correlate with benefit of HAs as an outcome measure either. People who only wear their HAs minimally can receive as much benefit as those who wear their HAs for the entirety of the day (H. Dillon, 2012; Mulrow et al., 1992; Ovegard & Ramström, 1994).

Humes (1999) cautioned against utilising hours of use as an outcome measure due the potentially misleading information it provides. Some clients may only require their HAs in certain listening situations and may be happy with their performance within this space of time (Humes, 1999; Uriarte et al., 2005). Alternatively, those people who are reliant on their HAs for the majority of the day may persevere and have a high amount of use, while being dissatisfied with their performance. Cox and Alexander (1999) argue that satisfaction is the most appropriate outcome measure when the client's point of view is of interest and that while benefit and use are traditional outcome measures, the focus must now shift towards satisfaction.

5.4. Clinical Implications

Other than the previous study by Kelly-Campbell and McMillan (2015), there are limited data to support this research. As a consequence all implications and recommendations are made under the assumption that the model is correct. In addition to this there were no clinically meaningful differences between new and experienced HA users in the current study, so the following recommendations are relevant for all HA users regardless of if they are receiving a replacement HA or their first HA.

As previously mentioned, HI is a disabling condition affecting around 5% of the world's population (World Health Organization, 2015). Untreated HI leads to multiple negative consequences (Appollonio et al., 1996; Arlinger, 2003; Bess et al., 1989; Chia et al., 2007; Dalton et al., 2003; Lin et al., 2011; Strawbridge et al., 2000; Weinstein & Ventry, 1982), some of which HAs as an intervention are able to alleviate (Mulrow et al., 1990; Öberg et al., 2012; Tsakiropoulou et al., 2007; Vuorialho et al., 2006). Despite this uptake is low with penetration rates between 14 and 25% (Bade, 1991; Chien & Lin, 2012; Hesse, 2004; Kochkin, 1997; Popelka et al., 1998; D. Stephens et al., 2001; S. Stephens et al., 1990). Subsequently, it is important to find ways to promote successful HA outcomes.

SE was added to the HBM (Rosenstock et al., 1988) due to its important role in the process of changing and maintaining health behaviours (Bandura, 1997). SE is one factor which can contribute to successful HA outcomes (Hickson et al., 2014; Kricos, 2000; Meyer, Hickson, & Fletcher, 2014; Meyer, Hickson, Lovelock, et al., 2014) and there is evidence that interventions can improve SE in audiological rehabilitation (Jennings, 2006; West & Smith, 2007). Bandura (1992) stated that there are 4 main information sources that can moderate SE: prior experience, observation of others engaging in particular tasks, the encouragement or discouragement received from others, and physical and emotional reactions an individual

experiences prior to attempting to achieve a goal. Consequently, it is important to identify areas where targeted interventions will be most effective for improving HA-SE.

5.4.1. Targeted Interventions

As there was no relationship between HA-SE and hours of use, interventions will be recommended with satisfaction as the outcome target. It is important to note that the current study demonstrated HA-SE (as measured by the MARS-HA) is a better predictor of satisfaction than other predictor variables (i.e. self-reported handicap) which have previously been shown to be related to satisfaction with HAs (Knudsen et al., 2010; Wong et al., 2003). Consequently HA-SE is an extremely important area to target with the aim of improving satisfaction with HAs.

An important finding of this study and previous research (Kelly-Campbell & McMillan, 2015; Meyer, Hickson, Lovelock, et al., 2014) is that many HA users do not have adequate HA-SE in several domains. Only for the BH subscale is there a consistently high proportion of people with adequate HA-SE across the research. The current study showed overall HA-SE increased over time, both in mean score and proportion of participants with adequate levels of SE, indicating that time and/or the standard fitting intervention is already a strong tool for improving HA-SE. While there are some areas of HA-SE that are particularly important to address, HA-SE scores from all subscales measured throughout the fitting process are important for improving satisfaction, highlighting the importance of targeting all aspects of HA-SE over time. By targeting HA-SE throughout the fitting process, this will hopefully lead to improved satisfaction with HAs and better outcomes. Specific areas to target include: AH at T0, AD at T2, AL at T3, and BH throughout the HA trial.

One area which must be addressed in order to target all aspects of HA-SE is client expectations. An individual's reactions prior to attempting to achieve a goal is a modifying factor in SE. Clients must be adequately prepared for HA ownership in order to help manage

their reactions. There are assessment tools that clinicians can use in order to assess a client's state of mind, including the Expected Consequences of Hearing Aid Ownership (ECHO; Cox and Alexander, 2000). This would help clinicians address client reactions and potentially improve HA-SE in multiple domains.

Another important factor in moderating SE is the encouragement of others. A very simple but effective way to target this is to encourage family or other support members to attend appointments with the client. Having the clients main communication partners engage in the process and encourage the client could be a valuable tool for improving all aspects of HA-SE. This may also have the additional effect of helping to reduce third party disability.s

5.4.1.1. AH at T0

For the AH subscale the mean score never reached an adequate level at any stage during the assessment for any HA users (new or experienced). In addition to this, the proportion of participants with adequate SE was still low at T3 (54.92%). Although AH is low throughout the fitting process and should be targeted, AH at T0 is the strongest predictor variable for all equations when predicting satisfaction. As a result, this is a clear target for intervention. Targeted interventions could take place at the ARE and/or during the T0 (HA-fitting) appointment. This intervention could be in the form of counselling, including modelling and providing take away information.

Counselling at the ARE is an effective way to target multiple sources of information that can moderate SE. One of the factors that can moderate SE is the encouragement received from others. The ARE is a key opportunity for the clinician to build a positive environment for the client. Modelling is one counselling strategy that could be used early in order to target AH. Rather than showing the client pictures, or “dummy” aids, giving them an actual HA to manipulate would help to target AH SE. This would be relatively simple to achieve with RITE dome-style HAs. At the ARE, clinicians are likely to focus on keeping information as

simple as possible and concentrating on BH skills that are within the best practice guidelines (American Speech-Language-Hearing Association, 1998). The potential to target AH at T0 and promote more successful HA outcomes lies with addressing the more advanced skills early. Allowing a client access to a real HA and identifying the battery size, make, and different components could contribute to improving their HA-SE for AH. Allowing them to familiarize themselves with a real HA may help to build prior experience, before the HA fitting (T0), that will help moderate SE. Another option is providing information for the clients to take home and acquaint themselves with before the T0 appointment. This could be in the form of HA user guides, brochures, and/or videos that cover the information necessary to build AH SE. This is something that is likely already done but the literature suggests that this information doesn't adhere to best practice for health education, for example HA information is written at a level that health consumers cannot comprehend (Laplante-Lévesque & Thorén, 2015; National Centre for Education Statistics, 2003; United States Department of Health and Human Services, 2000; Walsh & Volsko, 2008). In order for these resources to be effective they must be written appropriately. Online learning modules are also an option to target SE through prior knowledge in the participants' own time. This tool would allow them to build their prior experience in their own time, before the T0 appointment. Lastly, reiterating all of the information covered at the ARE during the HA-fitting appointment (T0) should help to improve HA-SE over time by targeting encouragement.

5.4.1.2. AD at T2

The mean score for the AD subscale reached an adequate level only at T3, with around 3-quarters of participants experiencing adequate SE for this subscale at T3. There was a large improvement in AD over time. AD at T2 was present in all the equations to predict HA satisfaction, and was the second strongest predictor in all but one, making it an ideal

target for intervention. Group audiological rehabilitation (GAR) is a good option for targeting AD at T2.

AD is most important as an influencer of satisfaction at T2 (4 to 6 weeks post HA-fitting). As a consequence it gives the clinician more time to be able to put an intervention in place, compared for example to needing to target HA-SE at T0. GAR is a suitable option for addressing AD. It is a cost-effective and efficient service delivery method as you can target multiple clients at once (Abrams, Chisolm, & McArdle, 2002). Clients could be invited to sessions with other HA users and share experiences about how they are dealing with adjustment to their HAs. This would target SE through both observation of others engaging in tasks as well as encouragement received from others.

5.4.1.3. AL at T3

The mean AL score never reached an adequate level at any assessment point, meaning it is necessary to target AL throughout the fitting process. In addition to this, AL was the subscale with the lowest proportion of HA users with adequate SE at T3, with less than half of participants having adequate AL SE. AL at T3 was an important predictor variable in 4 of the equations, making it necessary to target this variable. GAR is also a suitable option for addressing AL SE.

It is possible for clinicians to organize GAR that would target all domains of HA-SE. In regards to AL specifically, GAR could be used to target SE so that clients could both receive encouragement from others and also observe others engaging in tasks. GAR sessions could be carried out in a way that participants could attempt to carry out different AL skills, and observe the strategies others use to deal with the difficult situations.

5.4.1.4. BH

BH is the sub scale that participants performed best on. The mean score started off close to adequate and had reached an adequate level by T2, earlier than for any other scale. Moreover, around half of the participants started off with adequate SE at T0. This did not improve as much as some other scales with only 3-quarters having adequate SE at T3. In addition to this T0 versus T1 for BH was the only time interval where there was no significant improvement out of all of the MARS-HA scores. BH scores were present in all equations (except when predicting PI), but covered a range of assessment points. It is clearly important to target BH throughout the fitting process, but an attempt to see an improvement from T0 to T1 should be sought.

Ways to target BH are the same as for AH. Counselling provided by the clinician through modelling and take away information are effective ways to target SE through prior experience and encouragement from others. As mentioned previously, GAR are great ways to target all aspects of HA-SE. Sessions could be run for individuals before they even purchase HAs in order to provide them with previous experience. Clients could attempt to carry out BH skills like changing a HA battery and could observe and gain encouragement from others.

5.4.2. Hours of Use as an Outcome Measure

Cox and Alexander (1999) have previously argued that emphasis must move away from the traditional use of benefit and hours of use as outcome measures for determining the success of a HA intervention. Cox and Alexander (1999) reason that these measures have a narrow focus, and there is a body of literature supporting that these factors are only one component necessary for an acceptable HA fitting (Hawes et al., 1985; Kochkin, 1992; Stock et al., 1997). It has already been shown that hours of HA use does not necessarily correlate with benefit of HAs, as people who only wear their HAs minimally can receive as much benefit as those who wear their HAs for the entirety of the day (Dillon, 2012; Mulrow et al.,

1992; Ovegard & Ramström, 1994). The current research adds to the literature that it is time to reassess which outcome measures are used routinely in a clinical setting, with satisfaction a strong candidate.

Satisfaction is a measure which probably expresses how happy clients are with their HAs (Dillon, 2012), taking into account different factors such as benefit in different situation, financial and psychological cost in relation to expectations, and ease of use (Cox & Alexander, 1999; Dillon, 2012). Satisfaction is increasingly becoming recognized as an important outcome measure, especially when a client-centred approach is taken (Cox & Alexander, 1999; Dillon et al., 1999; Kelly-Campbell & McMillan, 2015; Kochkin, 2000, 2005).

5.5. Limitations and Directions for Future Research

The first limitation of this study is that there were zero drop-outs, indicating that all participants kept their HAs. This is likely not representative of a general population- either for research or clinical groups. Often there are participants who drop out of studies for one reason or another, for example, they return their HAs and are no longer eligible for participation. The lack of drop-outs is likely due to the thorough ARE that occurs at this clinic. Individuals are offered multiple intervention options other than just HAs, including: purchasing hearing assistance technology, attending communication strategies training, and participating in specifically tailored online educational material regarding HI and HAs. This may have led to a bias of having people enrolled in the study who had much higher motivation and better attitude towards HAs than a general population. This potentially could have had some effect on the results of the study and must be kept in mind when interpreting the results.

Self-report and data logging for hours of HA use was obtained at the participants' last follow up appointment (T2). As a result it was only possible to look at the relationship between HA-SE and use from T0 through T2. It is not possible to be sure if there was no relationship found between HA-SE and HA use due to limitations in data collection, or due to the absence of a relationship. In order to clarify this, a direction for future research would be to look at the relationship again but to measure HA use at 12-weeks post-fitting.

Results from the current study showed that HA-SE significantly increased at every assessment point over the 12 week interval. It is unclear what happens after this 12 week window. Future research should aim to investigate what happens to HA-SE over a longer period of time. While it is possible that HA-SE continues to improve until every individual achieves scores of 100%, this is not likely. It is more likely that HA-SE reaches a plateau at some point. It would be especially interesting to look at HA-SE scores after the client had not

interacted with a clinician in a long time, for example at 1 year post-fitting. It is important to look at long term trends of HA-SE in order to identify if there is a need for targeted intervention further on. For example, if there was a plateau or even drop in HA-SE at 6 months post-fitting, this would be an appropriate time to have a follow-up appointment to aim to improve HA-SE.

Further studies with large sample sizes are needed across different countries in order to increase the generalizability of the findings and add to the evidence base. In addition to this although age, HHQ, PTA, number of appointments, and cost to participant were measured and controlled for in the study, other potentially important variables may have influenced the study's results. Additional research could identify if other variables such as cognitive ability, vision, dexterity, and support of significant others have an effect on the relationship between HA-SE and satisfaction with HAs.

The most important area for future research is to establish the value of implementing targeted strategies to improve HA-SE, and therefore satisfaction. A future study could compare a control group who just received a standard HA fitting intervention and a group who receives an additional intervention designed to address improving HA-SE. This additional intervention could be through modelling, providing take away information to the participants, providing online training resources, or through GAR sessions.

5.6. Conclusion

The aims of the study were to look at HA-SE for new and experienced HA users and to explore the pattern of HA-SE over a 12-week period beginning at the start of the HA trial. The study also aimed to see if HA-SE could be used to predict outcomes, measured by both satisfaction and hours of use. There was no notable difference between new and experienced HA users but HA-SE was shown to increase over the assessment period for all subscales. HA-SE was shown to be able to predict satisfaction, but not amount of HA use. Although further research is warranted, this study contributes towards building an evidence base surrounding the importance of HA-SE in improving outcomes with HAs. This research also adds to the evidence base for the value of using satisfaction as a holistic outcome measure. The outcome of future studies could potentially lead to targeted interventions aimed at improving HA-SE, which as a consequence could target improved outcomes with HAs. If satisfaction can be improved, it may be possible to see increased uptake and continued use of HAs, which would have the effect of reducing the negative effects of untreated HI.

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Appendix: A

HUMAN ETHICS COMMITTEE
Secretary, Lynda Griffioen

Email: human-ethics@canterbury.ac.nz

Ref: HEC 2015/87

27 January 2016

Rebecca Kelly-Campbell
Department of Communication Disorders
UNIVERSITY OF CANTERBURY

Dear Rebecca

The Human Ethics Committee advises that your research proposal "Hearing Aid Self-Efficacy through the Hearing Aid Fitting Process" has been considered and approved.

Best wishes for your project. Yours sincerely



Lindsey MacDonald

Chair

University of Canterbury Human Ethics Committee

