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South African Audiologists' Use of Speech-in-Noise Testing for Adults with Hearing Difficulties

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Author's Declarations

This work is being submitted for fulfilment of a degree of Masters in Audiology at the University of Witwatersrand. I declare that this work has not been submitted to any other university locally or internationally. The research was carried out following the rules and regulations of the University. It further followed any and all ethical considerations made throughout the process of data collection and analysis. The views and opinions expressed in the dissertation are that of the author and are in no way a reflection of the university. The results were obtained, and findings expressed ethically and honestly by the author. Other sources which were used for information are referenced and a reference list is available at the end of the dissertation.



Signed: Hema Thakor Date: August 2020

Abstract

Background: The appropriate diagnostic assessment of adults with hearing difficulties enables an effective and evidence-based management plan for the complaints reported and identified. The primary complaint of adults with hearing difficulties is hearing and understanding speech in the presence of background noise. Despite the availability of speech-in-noise (SIN) assessment tools to describe and quantify this concern, audiologists in South Africa do not standardly administer these tests. No study has previously described South African audiologists' use of SIN tests in assessing and addressing this concern, or the factors influencing the application of SIN testing.

Objective: The aim of this study was to describe the South African audiologists' speech audiometry practices with specific reference to SIN testing. Furthermore, it aimed to describe factors influencing the practice of SIN testing in the South African context.

Method: This research utilised a cross-sectional, descriptive, exploratory research design within a mixed methods research approach. The study first employed a descriptive, cross-sectional, survey followed by content analysis of focus group discussions. A sample of 107 audiologists, who administered diagnostic hearing assessments on adults in South Africa, completed the online survey and were represented in the study. Their mean age was 31.28 years and they had on average 4.46 years of work experience. More than half of the participants worked in the private sector whilst others worked in the public healthcare sector or NGO's. Two focus groups were then held which included six participants each, purposively selected from the survey sample. The mean age of these participants was 38.17 years and the average duration of work experience was 11.5 years.

Results: The results of the study revealed that whilst the majority of participants administered speech recognition threshold (87%, $n_1 = 93$) and word recognition (85%, $n_1 = 91$) testing, speech-in-noise testing was only administered by 36% ($n_1 = 37$) of participants. The three most commonly used languages for speech audiometry were English, Afrikaans and isiZulu, presented using live voice. Interestingly, most participants were not extremely confident about the results obtained from speech audiometry. The main factors which influenced the implementation of SIN testing were the patients' main listening complaint, participants' perceptions of SIN testing, patient counselling, availability of resources, testing validity, and training and knowledge; and they shared their ideal SIN test description..

Conclusions: The unique information gathered through this research project highlights the urgency to develop national guidelines for speech audiometry practices; and identify or develop SIN tests most appropriate for use in the South African context, based on factors influencing the implementation of SIN testing identified in this study.

Keywords: Speech-in-noise testing, adults, speech audiometry, South Africa.

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Definition of Terms

Terms often used in the context of this dissertation are defined below:

Speech-in-noise (SIN) refers to speech in the presence of background or competing noise (Taylor, 2003). This is a common complaint of individuals with and without detectable hearing difficulties and SIN testing should be a part of a comprehensive diagnostic audiological evaluation (Wilson, 2004).

Speech recognition threshold (SRT) is the lowest intensity at which an individual can recognise 50% of a closed set of pre-familiarised words correctly (Martin & Clark, 2003).

Word recognition (WR) testing includes the presentation of monosyllabic words in quiet at varying intensities to determine an individuals' performance in response to amplification; (Taylor, 2003).

Abbreviations

AIDS	: acquired immunodeficiency syndrome
ASHA	: American Speech-Language-Hearing Association
HIV	: human immunodeficiency virus
HPCSA	: Health Professions Council of South Africa
ICF	: International Classification of Functioning, Disability and Health
NGO	: non-governmental organisation
SAAA	: South African Association of Audiologists
SASLHA	: South African Speech – Language – Hearing Association
SIN	: speech-in-noise
SLT/A	: speech-language therapist and/or audiologist
SRT	: speech recognition threshold
TB	: tuberculosis
UCT	: University of Cape Town
UKZN	: University of Kwa-Zulu Natal
UNAIDS	: the Joint United Nations program on HIV/AIDS
UP	: University of Pretoria
WHO	: World Health Organization
Wits	: University of the Witwatersrand
WR	: word recognition

Chapter 1: Introduction

This chapter begins with the problem statement describing hearing loss and the primary listening complaint of adults. Assessments available for this purpose, and the benefits thereof are discussed leading to the research question. It includes definition of terms and abbreviations. The chapter concludes with an outline of all the chapters which follow.

1.1 Problem statement

Globally, hearing impairment is a growing concern. The prevalence rate of disabling hearing impairment is greater in sub-Saharan Africa in contrast to higher-income countries (Mulwafu, Kuper, & Ensink, 2016). In South Africa, the unique quadruple burden of disease (Norman, Bradshaw, Schneider, Pieterse & Groenewald, 2006) further places the population at greater risk for hearing impairment. The primary listening complaint of adults with hearing difficulties is the challenge of understanding speech in the presence of background noise (Beck & Nilsson, 2013; Evans, McGettigan, Agnew, Rosen, & Scott, 2016; Kochkin, 2010; Moore, Edmondson-Jones, Dawes, Fortnum, McCormack, Pierzycki, & Munro, 2014; Mueller, 2016; Paglialonga, Grandori, & Tognola, 2013; Spyridakou & Bamiou, 2015; Taylor, 2003, 2010, 2011; Wilson, 2004).

It is therefore recommended that a simple-to-administer speech-in-noise (SIN) test should be routinely incorporated into the hearing assessment protocol to evaluate one's baseline ability to understand speech in the presence of background noise (Beck & Nilsson, 2013). There are several SIN tests, which are quick-to-administer and easy-to-score, available for use clinically (Taylor, 2003). These include, but are not limited to the Quick SIN test, Hearing in Noise Test (HINT), Bamford-Kowal-Bench SIN (BKB-SIN), Words-in-Noise (WIN), Connected Speech Test (CST), Speech Perception in Noise Test (SPIN) and the Listening in Spatialized Noise – Sentences (LISN-S) test.

Although there has been focus on research into speech-in-quiet testing in the South African context (Hanekom, Soer, & Pottas, 2015; Panday, Kathard, Pillay, & Govender, 2007; Panday, Kathard, Pillay, & Wilson, 2018; van Zyl, Swanepoel, & Myburgh, 2018; Wilson,

Jones, & Fridjhon, 1998; Wilson & Moodley, 2000), limited information is available on SIN testing in the South African context (Scourfield, 2011). Furthermore, limited guidance is provided by the Health Professions Council of South Africa (HPCSA).

Research has suggested the multiple benefits of SIN testing in the evidence-based assessment of adults presenting with hearing difficulties (Beck & Nilsson, 2013; Mueller, 2016; Taylor, 2003, 2011; Wilson, 2004). Despite these findings, there has been limited research describing South African audiologists' speech audiometry practices; or the factors influencing the clinical application of SIN testing in South Africa.

Hearing and understanding speech in a noisy environment are well-known primary hearing complaints amongst adults. Despite this, SIN tests are not routinely administered to address this concern. In an effort to address the dearth of information on this topic, the present study addressed the following research question: to what extent are South African audiologists making appropriate use of speech audiometry in the assessment of adults' hearing complaints?

1.2 Chapter outlines

The first chapter introduces the purpose of the study by describing the problem statement. It further includes definitions of commonly used terminology and an explanation of the abbreviations used in the dissertation. The chapter ends with a summary outlining each of the six chapters in the dissertation.

Chapter two provides a review of literature related to the research topic. There is a review of the global prevalence, and cause of hearing loss. The impact of hearing loss on the individual and their frequent communication partner is discussed. This is followed by a review of the recommended assessment protocols for adult hearing difficulties used both internationally and nationally. Adult hearing concerns and speech audiometry tests are then explored. The chapter concludes with a review of languages spoken within the South African context and an exploration of the challenge.

The methodology of the study is the focus of the third chapter. The chapter commences with the research aims and is followed by a description of the research design used in this study. The participants are described together with the measures and equipment used. The data collection procedures are outlined, and ethical considerations addressed. The reliability, validity and trustworthiness of the study is considered. Lastly, the quantitative and qualitative elements of the data analysis is discussed.

The results of the research study are presented in chapter four. The results are presented in accordance with the aims of the study. It documents the results obtained from the survey using descriptive statistics. It also presents the responses of the focus group using content analysis and participants responses are quoted many times to describe their perceptions and opinions on the topic. In this way, quantitative and qualitative results are integrated on the description of speech audiometry practices and the factors which influence SIN testing in the South African context. Tables and graphs are used to visually represent some of the research results.

Chapter five provides a critical discussion of the results of the study presented in chapter four. This chapter discusses the trends identified in speech audiometry practices among adult patients in South Africa. It further describes in detail the seven factors identified through content analysis which influenced the implementation of SIN testing. It discusses the significance of the results obtained and compares them to other research findings on the topic. The results are systematically discussed with reference to the literature presented in the literature review section of the dissertation to provide a detailed understanding of the findings.

The final chapter provides the conclusion of the research dissertation. It summarises the main aims and findings of the study. It further discusses the strengths and limitations of the study. Recommendations are made with regards to future research, guideline development and training requirements. Finally, the implications of the study are mentioned.

Chapter 2: Literature Review

This chapter provides a review of literature in order to set the context to the research study. It begins by discussing the prevalence, cause and impact of hearing loss. A comparison is made between national and international recommendations of hearing assessment protocols specific to speech audiometry practices. The main hearing complaints of adults is strongly presented and further explored within the literature. Speech audiometry tests are discussed. The chapter concludes with a discussion on SIN tests and their relevance within the multilingual South African context.

2.1 Prevalence of hearing loss internationally and nationally

Hearing loss is the most prevalent sensory disability globally (Mulwafu et al., 2016; Peer, 2013). The World Health Organization (WHO) estimated that 466 million people (6.12% of the world's population) has disabling hearing loss (World Health Organization, 2018b). This figure is estimated to grow to over 900 million people by the year 2050 (World Health Organization, 2018b). For adults, hearing loss which is disabling is defined as a hearing loss of more than 40dB in the better ear (World Health Organization, 2018a).

The WHO further estimated that the prevalence of disabling hearing impairment for adults aged 15-65 years was 6.5% in sub-Saharan Africa versus 5.4% in high-income countries (World Health Organization, 2018a). The prevalence of disabling hearing impairment for adults 65 years and older was 44.4% in sub-Saharan Africa compared to 18.4% in high-income countries (World Health Organization, 2018a). A systematic review of 28 relevant articles on the prevalence and causes of hearing loss in Africa demonstrated that the prevalence of disabling hearing impairment in Africa was much higher than estimated by the WHO (Mulwafu et al., 2016).

In South Africa, the national census provides information on the prevalence of hearing impairment. The results of the last census undertaken in South Africa in 2011 documented a total prevalence of 3.6% for hearing difficulties, with 2.9% being mild difficulties and 0.7%

being severe difficulties (Statistics South Africa, 2014). In contrast, Ramma and Sebothoma (2016) revealed an overall prevalence rate of 12.35% for hearing impairment and 4.57% for disabling hearing impairment in the urban area they surveyed in the Western Cape. Furthermore, a prevalence rate of 19.88% for hearing impairment and 8.94% for disabling hearing impairment was found in a rural community in Limpopo (Joubert & Botha, 2019). A 17.5% prevalence rate of hearing disorders was found in patients ≥3 years of age at two primary health care clinics in an underserved area in Tshwane, South Africa (Louw, Swanepoel, Eikelboom, & Hugo, 2018). Hearing loss prevalence data across studies varied greatly (Louw et al., 2018). It can be deduced that the prevalence of hearing impairment was much higher than the estimates obtained through the national census (Joubert & Botha, 2019; Ramma & Sebothoma, 2016) and rapidly increasing in sub-Saharan Africa (World Health Organization, 2018a).

The World Health Assembly has urged member states to collect high-quality population-based data in order to develop evidence based strategies for hearing loss and to establish programs to train people in the field of hearing care (World Health Organization, 2017). However, based on data already obtained from previous studies, the prevalence of disabling hearing impairment internationally and in the South African context is a topic of constantly growing importance and concern.

2.2 Causes of hearing loss in adults

There are multiple possible causes of acquired hearing loss in adults. Hearing loss could be caused by infectious diseases (including meningitis, measles and mumps); excessive occupational or recreational noise exposure; chronic ear infections; or trauma to the head or ears (World Health Organization, 2018b). In addition, the degeneration of sensory cells with aging, or presbycusis, is a common cause of hearing loss in adults (World Health Organization, 2018b). Certain medication can also place an individual at risk for a hearing loss (World Health Organization, 2018b) and is therefore known to be ototoxic.

Ototoxicity, or drug induced hearing loss, presents as a high-frequency hearing loss which may be accompanied by tinnitus and/or vertigo (Khoza-Shangase, 2017). Ototoxicity is especially relevant in South Africa due to the quadruple burden of disease faced by the country

(Norman et al., 2006). The quadruple burden of disease is described as the four broad causes of death in South Africa. These include the human immunodeficiency virus (HIV) epidemic together with the burden of tuberculosis (TB), high maternal and child mortality, high levels of violence and injury, and a growing burden of communicable diseases (Basu, 2018).

With an estimate of 7.1 million people living with HIV in the country in 2016, South Africa was estimated to have the largest, and most high-profile HIV epidemic (UNAIDS, 2017). South Africa accounts for a third of all new HIV infections in southern Africa (UNAIDS, 2017). HIV positive people are prone to developing hearing loss – primarily from the disease, from opportunistic infections, or from the effects of drugs related to treatment (Peer, 2013).

Medication such as those used in the treatment of drug-resistant tuberculosis (DR-TB), HIV and cancers can be ototoxic and increase the risk of hearing loss (World Health Organization, 2018b). In 2015, TB and HIV lead to 7.2% and 4.8% respectively of underlying natural causes of death in South Africa (Statistics South Africa, 2017). The increase in multidrug resistant tuberculosis (MDR-TB) in South Africa has been linked to the HIV epidemic and patients on second-line drug therapy are more likely to have ototoxicity which is permanent (Peer, 2013). In patients with MDR-TB, the incidence of ototoxicity with HIV-positive and HIV-negative patients was 70% and 42% respectively (Harris, Bardien, Schaaf, Petersen, de Jong, & Fagan, 2012). These findings suggest that the South African adult population is especially at risk for hearing loss, and the difficulties thereof.

2.3 Adults' hearing difficulties

Patient report is the recommended method for obtaining a characteristic account of patients' hearing related complaints (Macefield, Jacobs, Korfage, Nicklin, Whistance, Brookes, Sprangers, & Blazeby, 2014). Hearing complaints reported by patients should be valued as they can be used as a tool to help the clinician to determine the diagnosis (Samelli, de Andrade, Pereira & Matas, 2013). Hearing complaints have been found to correlate positively with the type of hearing loss an individual may present with (Samelli et al., 2013). The prognosis may improve by addressing hearing complaints as it reduce the gap between the patients' perceptions of the complaint and the audiological diagnosis (Samelli et al., 2013). To

address hearing complaints, it is important to identify the primary presenting concern of adults with hearing difficulties.

The literature suggests that the primary listening complaint reported by adults with hearing difficulties was the inability to hear and understand speech in the presence of background or competing noise (Beck & Nilsson, 2013; Evans et al., 2016; Kochkin, 2010; Moore et al., 2014; Mueller, 2016; Paglialonga et al., 2013; Spyridakou & Bamiou, 2015; Taylor, 2003, 2010, 2011; R. Wilson, 2004). Patient report regarding hearing difficulties, and the impact it has on them and their significant others cannot be negated.

2.4 Impact of hearing loss

The International Classification of Functioning, Disability and Health (ICF) provides a framework with a common language for the description of health and health-related states (Granberg, Swanepoel, England, Moller, & Danermark, 2014). The ICF has two categories namely (i) functioning and disability, which includes body functions, body structures and activities, and participation; and (ii) contextual factors which takes into considerations environmental and personal factors (Granberg et al., 2014). The ICF has a multidimensional view of functioning and disability stating that both internal influences (such as the body function and structure) and external influences (such as persons or things in the environment), can facilitate or hinder daily living (Granberg et al., 2014).

The ICF is a tool which can therefore be employed to evaluate both the internal and external influences of hearing difficulties (Granberg et al., 2014). Participation and participation restrictions surfaced as important considerations in adults with a hearing loss (Granberg et al., 2014). Background noise was confirmed as a significant barrier for persons living with hearing loss with regards to speech understanding (Granberg et al., 2014). It was emphasized as an environmental barrier, or external influence, to effective communication in numerous studies (Granberg et al., 2014). This in turn can lead to activity limitations where the individual may rather stop performing routine activities due to barriers or challenges experienced.

The effects of hearing difficulties are substantial and include, but are not limited to: (i) emotional reactions (e.g. loneliness, isolation, dependence, frustration, depression, anxiety, anger, embarrassment, and guilt); (ii) behavioural reactions (such as bluffing, withdrawing, blaming, and demanding); and lastly, (iii) cognitive reactions (such as confusion, difficulty focusing, distracting thoughts, decreased self-esteem, and communication disorders) (Ciorba, Bianchini, Pelucchi & Pastore, 2012).

The impact of hearing impairment is pervasive, not only on the person with the impairment but also their significant others, as it affects the quality of life for all involved (Scarinci, Worral, & Hickson, 2009). The effects of hearing impairment on the spouse is commonly known as third-party disability. This implies that the spouse may experience limitations in activity and restrictions in participation which manifests as a result of their partner's hearing impairment (World Health Organization, 2001).

Understanding the impact of hearing impairment on the individual and his or her communication partners is important to family-centered practice (Scarinci et al., 2012). Family-centered practices aim to optimise the healthcare outcomes by encouraging the active participation of patients and their significant others (Singh, Barr, Montano, English, Russo, & Launer, 2017). Therefore, their involvement in each step of the process is recommended. Due to the far-reaching consequences of hearing difficulties, a thorough, evidence-based, assessment protocol should holistically address the hearing complaints and lifestyle challenges of the individual concerned and their significant others.

2.5 Hearing assessment

High-quality clinical practice guidelines, which are supported by evidence, aim to bridge the gap between policy, best practice, local contexts and patients' informed choice (Kredo, Bernhardsson, Machingaidze, Young, Louw, Ochodo & Grimmer, 2016). Clinical guidelines are known to be an essential part of quality medical practices for many years (Kredo et al., 2016). In many spheres of medical assessment and management of patients in South Africa, there is a reliance on international resources for guidance (Peer, 2013). Developing countries however have a unique set of challenges and therefore often adapt these international protocols and guidelines for local use (Peer, 2013).

Various clinical practice guidelines for hearing assessments in adults are available globally. The American and British guidelines are well-recognised and often used as a reference by South African audiologists. These guidelines are described below and compared with the South African guideline.

The American Speech-Language Hearing Association (ASHA) introduced a policy document related to clinical practices to improve the quality of audiological services and as an educational tool (ASHA, 2006). The recommended clinical tests for assessment includes (i) a case history; (ii) external ear examination; (iii) an otoscopic examination; (iv) acoustic immittance procedures including tympanometry, static immittance, and acoustic reflex measures; (v) air-conduction and bone-conduction pure-tone threshold measures; (vi) speech reception threshold (SRT) or speech detection/awareness thresholds with appropriate masking; (vii) word recognition (WR) measures with appropriate masking and; (viii) speech-language screening (ASHA, 2006).

In 2011, the National Health Services (NHS) in Britain released a clinical policy outlining recommendations for the assessment of adults with hearing difficulties. The policy supports the inclusion of (i) a clinical interview to assess hearing and communication needs; (ii) a full otoscopic examination; (iii) measurements of pure-tone air and bone conduction thresholds; (iv) assessment of activity restrictions and participatory limitations; (v) assessment of loudness discomfort levels and (vi) an integration of assessment findings with patient expectations (Department of Health and NHS, 2012). Although there was a focus on matching the assessment results with the individuals' activity restrictions and expectation, speech audiometry practices were not included.

In contrast to the British policy, the American policy included middle ear analysis as part of the assessment. It further emphasised the role of speech audiometry during the assessment by including SRT testing and WR measures. However, similar to the American policy, the British policy made no mention of assessing the ability to hear and understand speech in the presence of background noise.

A draft guideline for diagnostic hearing assessments in adults was developed for audiologists in South Africa (HPCSA, 2009). This draft guideline suggested the inclusion of (i) an otoscopic examination; (ii) pure tone air conduction, bone conduction and extended high frequency testing; (iii) SRT testing; (iv) immittance audiometry including tympanometry, ipsilateral and contralateral reflexes, Eustachian tube dysfunction testing and reflex decay testing; (v) WR testing; (vi) otoacoustic emissions and; (vii) auditory brainstem response testing (HPCSA, 2009).

Similar to the American policy, the South African guideline promoted the value of middle ear measures and speech audiometry. The mention of SIN testing was however unique to this South African guideline. Under the WR (speech discrimination) section of this draft guideline, it was stated that: "Ideally, speech in noise assessments should be included, although prerecorded standardised assessments are not readily available in South Africa." (HPCSA, 2009 pp 2-3). There was a recognition of the need to implement SIN testing, together with the challenge faced with the availability of test material.

There was limited emphasis placed on the role of SIN testing as part of assessment of adults presenting with hearing difficulties both nationally and internationally. This is concerning as adults with hearing difficulties most often present with complaints regarding their ability to hear and understand speech in the presence of background noise.

"The development and standardisation of (SIN) assessments should be given research priority" (HPCSA, 2009 pp 2-3). Research regarding the use of SIN testing in South Africa was not available (Scourfield, 2011), even during the present study. There was also no information available on the factors influencing South African audiologists' clinical application of SIN testing.

2.6 Speech recognition threshold

SRT is an old procedure that has been implemented since the 1940s (Hall, 2017). SRT is the lowest decibel level at which 50% of spondee words are identified correctly (Martin &

Clark, 2003). One of the primary purposes of the SRT testing is to determine the reliability of the assessment based on its' correlation with the pure-tone average (PTA) (Wilson, Morgan, & Dirks, 1973). However, if a patient responds reliably during the assessment, SRT testing may not be essential. Therefore, more recent literature had suggested that SRT may not be necessary on all patients, but rather only on patients where response reliability is questionable (Hall, 2017).

There are many popular tests available internationally and nationally for SRT testing which include, but are not limited to, the following:

- Central Institute for the Deaf Spondaic (CID) W1 wordlist (Hirsh, Davis, Silverman, Reynolds, Eldert, & Benson, 1952)
- Northwestern University (NU) 6 wordlist (Tillman & Carhart, 1966)
- National Acoustic Laboratories – Arthur Boothroyd (NAL - AB) wordlist (Boothroyd, 1968)
- South African Spondaic (SAS) wordlist (Hanekom et al., 2015)
- Digit pairs (Ramkissoon, Proctor, Lansing, & Bilger, 2002)
- isiZulu wordlist (Panday et al., 2007)

Familiarity is one of the most important factors to consider when selecting SRT test stimuli because it aims to measure the threshold of speech intelligibility (Ramkissoon, 2001). Patients therefore need to be familiar with the speech material being presented to improve the probability that the audiologist is assessing the patients auditory threshold and not word knowledge (Ramkissoon, 2001).

SRT can be assessed using live-voice or pre-recorded materials as the presentation method. Pre-recorded materials are preferred and recommended in the literature as research suggests that it improves the reliability and standardisation of the responses (Mendel & Owen, 2011). The majority of the pre-recorded SRT tests available are recorded in British or American English. In South Africa, a multi-lingual country, this poses a challenge to the reliability of SRT testing using pre-recorded materials (Mendel & Owen, 2011). Therefore

locally developed digit-pairs or wordlists, such as the South African Spondaic (SAS), an English wordlist that South Africans are more familiar with (Hanekom et al., 2015), are available. Research on the utilisation of these tests was limited.

2.7 Word recognition testing

WR testing, sometimes referred to as speech discrimination testing, is one of the most commonly used measures during speech audiometry (Kim et al., 2015). The purpose of the test is multifold. First, WR is used to estimate the communicative skills of a patient at normal and increased conversational levels (Schoepflin, 2012). Secondly, hearing aid considerations in terms of the level of technology which may be required, and lastly, it is used to analyse error patterns in word recognition (Schoepflin, 2012). Monosyllabic words are the most commonly used stimuli during word recognition testing (Schoepflin, 2012).

Below is a list of some of the commonly used international and locally developed tests for word recognition:

- Central Institute for the Deaf (CID) W22 wordlist (adapted from the PB 50 wordlist) (Hirsh et al., 1952)
- Northwestern University (NU) 6 wordlist (Tillman & Carhart, 1966)
- Phonetically balanced (PB) 50 wordlist (Egan, 1948)
- National Acoustic Laboratories – Arthur Boothroyd (NAL - AB) wordlist (Boothroyd, 1968)
- Foneties Verteenwoordigende Enkellettergrepige Woordlyste in Afrikaans (FVEWA) (Naude, 2018)

Similar to SRT testing, pre-recorded test materials that are familiar to the patients are preferred to increase the reliability and validity of WR threshold responses obtained. However, standardised, pre-recorded WR tests appropriate for the South African population are limited. Furthermore, literature suggested that SIN testing should be administered instead of WR testing as SIN results can be a predictor of WR results but WR results cannot be a predictor of SIN results (Wilson, 2004).

2.8 Speech-in-noise tests

Almost 50 years ago, in 1970, Carhart and Tillman popularised the significance of evaluating the patients' recognition performance of speech in the presence of background noise (Spyridakou & Bamiou, 2015). They further recommended that SIN testing be included in the standard audiologic test battery (Spyridakou & Bamiou, 2015). This recommendation was supported by other researchers (Mueller, 2016; Taylor, 2003, 2011; Wilson, McArdle & Smith, 2007).

There are valuable clinical reasons to employ SIN tests (Mueller, 2016). As SIN is a primary complaint of adults with hearing difficulties, the assessment thereof directs the clinician in assessing and quantifying the primary concern (Mueller, 2016). The results from SIN testing may lead the clinician to select the most appropriate amplification technology for the individual; and establish a baseline for measuring aided benefit, and monitoring performance over time (Mueller, 2016). The results of the test influences patient counselling and assists the individual to make an informed decision regarding the pathway of management (Mueller, 2016). In doing so, there is improved patient satisfaction and loyalty (Mueller, 2016).

Various internationally developed SIN test choices are available for inclusion as part of the assessment protocol (Beck & Nilsson, 2013; Mueller, 2016; Taylor, 2011) . These include, but are not limited to, the following:

a. Hearing-in-Noise Test (HINT) (Nilsson, Soli & Sullivan, 1994)
b. Quick Speech-in-Noise (QuickSIN) (Killion, Niquette, Gudmundsen, Revit & Banerjee, 2004)
c. Bamford-Kowal-Bench Speech-in-Noise (BKB-SIN) (Niquette, Arcaroli, Revit, Parkinson, Staller, Skinner & Killion, 2003)
d. Words-in-Noise (WIN) (Wilson, 2003)
e. Connected Speech Test (CST) (Cox, Alexander & Gilmore, 1987)
f. Speech Perception in Noise Test (SPIN) (Kalikow, Stevens, & Elliot 1977)

g. Listening in Spatialized Noise – Sentences Test (LISN – S) (Cameron & Dillon, 2007)

The literature explores multiple benefits for including SIN tests into the assessment protocols of adults presenting with hearing difficulties, and the availability of various test materials. The pre-recorded tests listed above are recorded in English and therefore unveils a challenge for patients who are non-English speakers or English second-language speakers. The impact of dialect and accent differences, as well as word familiarity cannot be negated (Nissel, Harris, Channell, Richardson, Garlick & Eggett, 2013) even for South Africans who speak English as a first language.

2.9 Speech-in-noise tests in the South African context

South Africa is a multilingual republic where roughly 25 languages are spoken. Of these, 11 languages were granted official status (Department of Arts and Culture, 2003). Speakers of these 11 official languages account for 98% of the total South African population (Department of Arts and Culture, 2003). A challenge therefore faced by audiologists in South Africa is providing linguistically and culturally appropriate services to most of the population (Swanepoel, 2006).

English is spoken as a first language by only 9.6% of the South African population (Statistics South Africa, 2012). All SIN tests previously mentioned are recorded in British or American English. There have been locally developed SIN tests for use in the South African context. These include an Afrikaans SIN test, South African English digits in noise (DIN) test and the South African English SIN test using the Arthur Boothroyd (AB) wordlists.

Afrikaans is the first language of 13.5% of the South African population (Statistics South Africa, 2012). An Afrikaans SIN test was developed called the *Sinslyste in Afrikaans vir Volwassenes in Lawaai* [Sentence lists in Afrikaans for Adults in Noise] (SAV-L) (Scourfield, 2011). The tests was developed based on the City University of New York (CUNY) topic related sentences (Scourfield, 2011). Twenty-seven sentence lists containing 12 sentences each were recorded with three-talker babble as background noise (Scourfield,

2011). Further research was recommended to establish standardisation and test sensitivity (Scourfield, 2011) however it is a resource available for SIN testing for Afrikaans first language speakers in South Africa.

The first smartphone digits-in-noise (DIN) screening test, named hearZA, was developed in South Africa in 2016 (Potgieter, Swanepoel, & Smits, 2018). The South African DIN test was created using South African English numbers (0-9) as the stimulus (Potgieter, Swanepoel, Myburgh & Smits, 2018). Research has reported the five advantages of including it as part of a diagnostic audiometric test battery: (i) it was simple to administer and took only a few minutes; (ii) it had a low linguistic demand with simple speech material; (iii) it could be administered on individuals with hearing within normal limits to individuals with a profound hearing loss; (iv) it was user-friendly and could be administered on children and; (v) it could be administered on individuals with poor English language-speaking competence (Potgieter et al, 2018). It was also reported that the DIN test could be utilised for counselling, to determine hearing aid fittings, and manage patient' expectations (Potgieter et al, 2018).

The AB wordlists were designed to address some of the fundamental challenges experienced with the measurement of WR (Boothroyd, 1968). It employed short isophonemic wordlists that could be phonetically scored (Boothroyd, 1968). Each of the 15 lists was constructed from the same set of test phonemes using a consonant-vowel-consonant structure (Boothroyd, 1968). These wordlists were re-recorded using a South African first language English male speaker, thereby potentially overcoming some of the challenges associated with language and dialect differences. According to the developers, the recordings were made by a professional sound engineer and edited according to international standards (personal communication from R Hornby and R Roets, 2016). The South African English wordlists were pre-recorded with and without background noise and could therefore be used to assess WR in quiet and in noise.

It has been established that the many languages spoken in South Africa pose a unique challenge to the implementation of readily available and standardised internationally developed

SIN tests. Despite this challenge, it is encouraging that there are locally developed SIN tests available that are easy to include in the assessment protocol for adults with hearing difficulties.

2.10 Problem statement

Hearing difficulties remain a concern within the South African context as the unique quadruple burden of disease faced by South Africans magnifies the prevalence of hearing loss in the country. The impact of hearing loss is extensive not only for the person affected but also for their significant others through third-party effects. Many studies have previously shown the primary listening complaint of adults with hearing difficulty to be their inability to hear and understand speech in the presence of background noise (Mueller, 2016; Taylor, 2003, 2010; Wilson, 2004).

SIN tests have been developed internationally and locally to assess this very complaint. These tests are readily available to quantify and describe this difficulty. Despite this, SIN testing is not routinely included in hearing assessment protocols both internationally and nationally. As hearing and understanding speech in a noisy environment is the primary complaint and SIN tests are not routinely done to address this concern, this research study aims to determine to what extent South African audiologists are making use of speech audiometry in the assessment of adults' hearing complaints?

2.11 Summary

This chapter provided a review of the literature available on topics associated with the research aims. The prevalence, cause and impact of hearing loss were considered with specific reference to South African healthcare challenges. There was a discussion around the hearing assessment protocols both internationally and nationally. Internationally and locally developed speech audiometry tests were discussed along with specific reference to the unique language context of South Africa. The chapter concluded with a summary of the problem.

Chapter 3: Methodology

The methodology chapter details the aims and sub-aims of this study. The research design as well as the mixed methods approached employed for this study are discussed. The research phases are outlined together with the participant descriptions. Measures and equipment utilised are described in detail. The data collection method and analysis process are explained. Ethical considerations, as well as factors influencing reliability and validity are explored.

3.1 Research aims

The main aim of the study was to describe South African audiologists' use of SIN testing in the assessment of adults with hearing difficulties.

The main aim was achieved through the following objectives:

- To describe South African audiologists' speech audiometry practices in the assessment of adults with hearing difficulties
- To explore factors influencing South African audiologists' application of SIN testing for adults with hearing difficulties

3.2 Research Design

There was limited literature and research available on SIN testing in the South African context. Therefore, a cross-sectional, descriptive, exploratory research design within a mixed methods research approach was employed for this study. Descriptive studies intend to describe phenomena whilst exploratory studies are utilised to investigate fairly unfamiliar areas for research (Durrheim, 2006). Many researchers choose a mixed methods approach to address the strengths and weaknesses of quantitative and qualitative research methods (McKim, 2015).

There are certain fundamental differences apparent between quantitative and qualitative research paradigms (Atieno, 2009). Quantitative research tends to be confirmatory and deductive (Atieno, 2009) yet may not discover deeper underlying meanings and descriptions (Rahman, 2016). Qualitative research on the other hand is effective in simplifying data and managing it without losing the complexity and context (Atieno, 2009) but data analysis can be harder and issues of generalisability to the whole population could be considered and not ascertained (Rahman, 2016). A mixed methods approach was ideally selected to balance the strengths and limitations of each of the individual approaches.

3.2.1 Quantitative research design

A descriptive, cross-sectional survey design was utilised to collect quantitative data. Quantitative research commences with a series of predetermined categories, within a standardised quantitative measure, and uses this data to develop comparisons which are broad and generalisable (Durrheim, 2006). Responses obtained from a researcher-developed, online survey were utilised to understand more about a large population (Leedy & Ormrod, 2013) by using a sample of audiologists in South Africa.

Survey research involved gathering information about a group of audiologists –about their demographic information and clinical practices – by asking questions and analysing their responses (Leedy & Ormrod, 2013). A cross-sectional design permitted audiologists across various clinical settings to be surveyed, at a specific point in time (McBurney, 2001). The survey responses described audiologists' demographic information, clinical setting, speech audiometry practices and amplification devices fittings. Descriptive statistics were then employed to analyse the data derived from the survey (Durrheim, 2006).

3.2.2 Qualitative research design

Qualitative data was obtained through content analysis of two focus group discussions. Qualitative research focuses on phenomena which occurs in a natural settings and involves documenting and interpreting the complexity of those phenomena (Leedy & Ormrod, 2013). Focus groups are specifically useful when the group interactions may provide more insight than individually conducted interviews (Creswell, 2007). The aim of the focus groups was to

elaborate on the results from the survey and explore factors which influenced the implementation of SIN testing for adults with hearing difficulties.

3.2.3 Research Phases

The present research was administered using three phases, namely the developmental phase, the pilot study, and the main study. The developmental phase involved the development of the online survey tool, obtaining permission to conduct the study, and contacting various associations for permission to distribute the survey. The pilot study was used to test the survey tool and make the necessary amendments based on feedback obtained. The data collection and analysis processes were also tested. The main study involved the distribution of the survey for data collection and two focus group discussions.

Developmental phase

An online survey was developed based on the sub-aim of the research. It was first developed as a manual survey (Appendix A). Once the questions were finalised, the researcher identified that GoogleDocs was the most appropriate online platform to disseminate the survey. The manual survey was then transformed into an online survey and tested by the researcher. Permission was also requested and obtained via email from various profession specific associations to assist with circulating the survey (Appendix B - E).

Pilot study

The objective of the pilot study was to identify potential problems with the design, particularly the research instrument (Van der Riet & Durrheim, 2006). The online survey was distributed to three experts in the field for piloting. The inclusionary and exclusionary criteria for the pilot study participants were the same as the main study (Table 3-2). These three pilot study participants were not included in the main study.

The mean age of the participants was 45 years (Range: 42 to 51; ± 5.19) and they were all female. All three participants worked with both adults and paediatrics and had an average of 22 years of work experience (Range: 17 to 30; ± 7.23). Two participants graduated from

the University of the Witwatersrand and one participant graduated from the University of Pretoria.

Specific feedback was requested on the (i) time taken to complete the online survey; (ii) appropriateness of the participant information sheet; (iii) the technical usability of the online survey; (iv) format and flow of the survey, clarity of questions, the ease of answering, writing style, and any recommended changes (Appendix F). Participants reported that the survey took fifteen minutes to complete, including the time taken to read the participant information sheet. One participant recommended that there be more place to expand on closed-ended questions. Space was therefore added to allow for elaboration on closed-ended questions. Questions which included an option for "other" were also provided with a follow-up question to specify and further elaborate if required.

Main study

The main study involved the dissemination of the survey through various professional platforms and personal messaging. Once the responses were obtained, the data underwent descriptive statistical analysis. Potential focus group participants were identified and invited to participate. The focus group transcripts were analysed using content analysis.

3.2.4 Participants

Sampling strategy and size

Purposive sampling, a non-probability sampling strategy, was employed to recruit participants for this study. Non-probability sampling is a type of sampling where the choice of elements is not established by the statistical principle of randomness (Durrheim & Painter, 2006). Purposive sampling implies that sampling depended on availability, willingness to partake, and that the cases selected were typical of the population (Durrheim & Painter, 2006). A weakness of a purposive sampling strategy is that the researchers' error in judgment in selecting the sample may impact on the results obtained (McBurney, 2001).

Two participant groups were included in this study. Group one (n_1) included 107 participants who completed the online survey. Group two (n_2) included 12 participants who were involved in two focus group discussions with six participants each. With a population size of 2 243 (personal communication with the HPCSA, October 2019) and sample size of 107 at a 95% confidence level, a 9% margin of error was calculated. The response rate was 4.77%. Previous survey research conducted in South Africa with a population size of 1 802, sample size of 156, yielded an 8% margin of error (Fouché-Copley, Govender, & Khan, 2016) which was similar to the present study.

In order to produce meaningful results, there must be a representative sample of participants (Govender, Mabuza, Ogunbanjo, & Mash, 2014). There was limited information on the demographics of audiologists and speech therapists registered with the HPCSA. Conclusive information could not be found on the current distribution of professionals across the nine South African provinces. Various sources were accessed to gather this information which was compared to the province of the participants' academic training (Table 3-1). The highest distribution of professionals and the highest number of participants were both from the Gauteng province. The Western Cape and Kwa-Zulu Natal similarly had a high number of professionals and compromised most of the remainder of the participants. The distribution of participants in the current study was therefore considered a fair representation of the total population in terms of geographical location.

Table 3-1 Speech Therapists and/or Audiologists registered with various associations and the number of survey participants who graduated from institutes in the various provinces in South Africa (n_1 = 107).

Province	Registered with the HPCSA (n=2243)	Number registered on SAAA (2019) (n = 574)	Number registered on SASLHA (2019) (n = 644)	Number survey participants graduated in South Africa (n = 107)
Eastern Cape	78	20	28	0
Free State	80	16	10	0
Gauteng	1148	299	338	70
Kwa-Zulu Natal	348	104	93	14
Limpopo	92	13	16	1
Mpumalanga	107	15	18	0
Northwest	46	11	13	0
Northern Cape	21	6	6	0
Western Cape	302	90	122	20
Unknown/Other	21	0	0	2
Total	2243	574	644	107

Inclusionary criteria participant group 1: Survey

A primary concern with all methods of administering surveys was the response rate, which can vary based on the method of administration (McBurney, 2001). Participants had to meet certain inclusionary criteria to be included in the study (Table 3-2). In order to obtain the desired response rate, all participants who met the criteria were included in the study.

Table 3-2 Inclusionary criteria for the survey participants

Inclusionary criteria	Rationale
Audiologists or dual qualified speech-language therapists and audiologists registered with the HPCSA	Ensured that only practitioners who were trained and registered to work with adults hearing difficulties in South Africa would complete the survey
Clinicians who practiced in the private and/or public health sector of South Africa as audiologists;	Inclusion of private and public healthcare sectors provided a fair representation of speech audiometry practices across clinical settings
A minimum of six months of clinical work experience with adults with hearing difficulties;	Survey participants had clinical experience with which to provide their input and perspectives
Clinically involved in the assessment and management of hearing difficulties in the adult population.	Ruling out audiologists who only work with paediatrics or who were not clinically involved in adult hearing assessments

Individuals were excluded from the study if they were exclusively practicing speech therapy regardless of registration as a speech therapists and audiologist, or they were audiologists who worked with paediatric patients only as the focus of the research was on adults.

Inclusionary criteria participant group 2: Focus group

Participants were purposively selected for the focus group discussions in order to explore factors influencing the implementation of SIN testing in the South African context. Individuals willing to participate in the focus groups fulfilled certain criteria (Table 3-3)

Table 3-3 Inclusionary criteria for the focus group discussions

Inclusionary criteria	Rationale
Completed the online survey	Ensured that the participant had some context to the focus group discussion.
Provided their email addresses in the survey as consent to be contacted for an invitation to the focus group	In order to ensure that consent was obtained to contact the participant and to invite them to participate
Were available at the proposed date and time set for the focus groups	In order to participate in the online focus group
Had access to Skype or WhatsApp video calling to log in to the focus groups.	These were the platforms used to facilitate the focus group discussions

Participant description

All participants who met the inclusionary criteria were included in the study. Section A of the survey provided a detailed understanding of the demographic information of the survey participants which is tabulated below (Table 3-4)

Table 3-4 Describing the demographic information of the survey participants (n_1=107)

Description			*n*	%
Age range	Mean	31.28		
	Range	22-67		
	SD	7.56		
Gender	Female		97	91
	Male		10	9
HPCSA registration	Audiologist		53	50
	Speech Therapist and Audiologist		54	50
Highest qualification obtained	Undergraduate		81	75
	Masters		22	21
	AuD		2	2
	PhD		1	1
	Other		1	1
University of qualification	Wits		23	22
	UKZN		14	13
	UP		37	35
	UCT		18	17
	Medunsa		10	9
	Other		5	4
Place of work (multiple options n_1=115)	Private Practice		60	52
	State Hospital		36	31
	State Clinic		3	3
	NGO		4	4
	Other		12	10

Most audiologists in South Africa are female and consequently most of the participants in the present study were female (91%; n_1 = 97) therefore providing an appropriate representation of the population. The mean age of participants was 31.28 years (± 7.57; range: 22 - 67 years) with the majority (92%; n_1 = 98) ≤ 40 years of age (Figure 3-1).

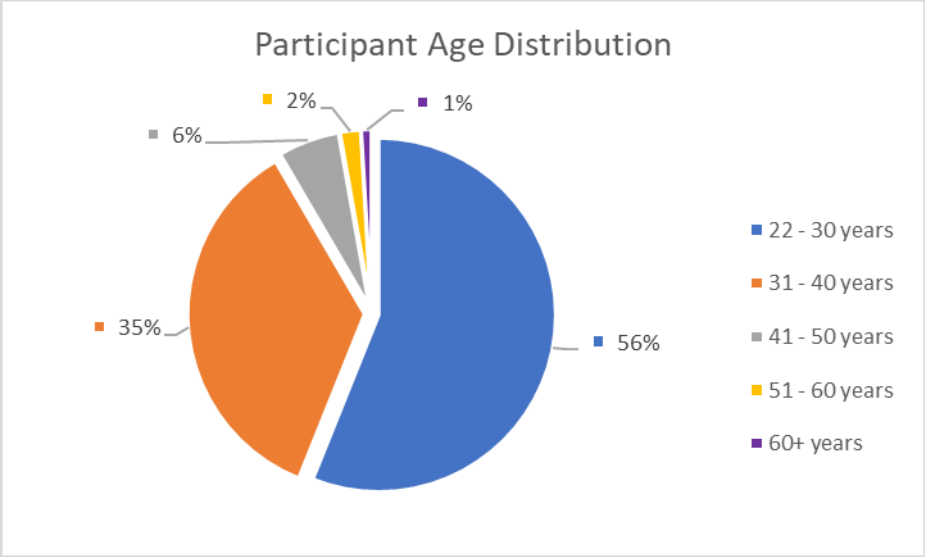


Figure 3-1. Participants age distribution (n_1 = 107).

There was an equal representation of single (n_1 = 53) and dual qualified (n_1 = 54) participants. Most participants had a bachelors degree (76%; n_1 = 81) whilst some had obtained their masters degree (21%; n_1 = 22) (Table 3-4). There was a fair representation of participants who qualified from various universities, with the greatest representation of participants being those who qualified in Gauteng (66%; n_1 = 70) (Table 3-4).

Seventy percent of participants (n_1 = 75) had 10 years of work experience or less (mean = 4.46; 1 to 10; ± 2.89). Whilst most participants worked with a caseload of paediatric and adult patients (84%; n_1 = 90), some participants worked with adult patients only (16%; n_1 = 17). Seventy-one percent of participants (n_1 = 76) consulted with between 1 - 15 adult patients a month for a diagnostic hearing assessment (Mean: 8.11; ± 4.43). The remainder 29% (n_1 = 31) consulted with between 16 and 35 adults per week.

Participants either worked in one clinical setting or multiple clinical settings. More than half of the participants (52%; n_1 = 60) worked in the private sector; either exclusively or in conjunction with other clinical settings such as public healthcare sector or NGO's (Table 3-4). The participants from the survey were a fair representation of the population in terms of geographical location. Various age ranges, clinical settings and universities of qualification were represented in the sample.

Participant group 2: Focus Groups

An online invitation was sent out to all willing participants who met the criteria. Many potential participants were invited to participate, however could not be available due to logistics, commitments and other arrangements. A total of 12 participants were purposively selected from the initial survey group to participate in the two focus group discussions (six participants per focus group) (Table 3-5).

Table 3-5 Demographic description of the two focus group participants (n_2 = 12)

		FG 1 n_2 = 6	FG 2 n_2 = 6	Total n_2 = 12
Age (in years)	Mean	31,67	44,67	38,17
	Range	26 to 42	32 to 67	26 to 67
	SD	7	12,26	11,69
Gender	Female	6	5	11
	Male	0	1	1
Work experience (in years)	Mean	8,67	14,33	11,5
	Range	2 to 18	8 to 27	2 to 27
	SD	6,65	7,12	7,2
Clinical work setting	Private	4	3	7
	Academia	0	1	1
	Public healthcare sector	2	2	4
Qualification	Bachelors	6	5	11
	Masters	0	1	1
University of qualification	Wits	3	3	6
	UP	2	2	4
	UKZN	1	1	2
Administered speech audiometry	SRT	5	6	11
	WR	6	6	12
	SIN	1	4	5

FG: Focus group

The mean age and years of work experience of the participants in the focus groups were higher than that of the participants in the survey. Each focus group represented participants who graduated from 3 different universities. Most of the participants (92%) had a bachelors degree and there was a fair representation of private and public clinical work environments. Eleven of the 12 participants (92%) worked with paediatrics and adults whilst one participant

(8%) worked with adults only. Majority of participants in focus group one (83%; $n_2 = 5$) did not administer SIN testing whilst focus group two had a more balanced representation of participants who did and did not administer SIN testing.

3.3 Measures and Equipment

3.3.1 Measures

Two data collection tools were developed for use in the current study, an online survey and a schedule for the focus group.

Online survey

A semi-structured online survey was developed to gather information on South African audiologists' speech audiometry practices on adults with hearing difficulties. It was disseminated using a multipronged approach to begin the main study. Surveys are commonly used quantitative techniques as they can collect data about a specific phenomenon, by developing questions that aim to identify the opinions, perceptions and behaviours of a group of individuals (Almeida, Faria, & Queirós 2017).

An online survey had many advantages in that it was more cost effective and could be adapted based on the participants responses (Leedy & Ormrod, 2013). It alleviated geographical constraints consequently generating a sample which was a greater representation of national practices. The survey was self-transcribing as the responses obtained was the medium in which the respondents expressed themselves; and it was therefore already prepared for further analysis (Kvale & Brinkmann, 2009). In the semi-structured survey, standard questions were followed by individually tailored questions to gain clarification (Leedy & Ormrod, 2013). The reliability of survey data depended highly on its structure and the accuracy with which the respondents answered (Almeida et al., 2017). This is further elaborated under reliability and validity section of this dissertation.

The survey was used to collect data from participants regarding their demographic information, clinical setting, clinical practices and their management of adult hearing difficulties (Appendix A). The survey was designed using GoogleDocs which permitted

convenient online dissemination. The raw data was easily transferred into an Excel spreadsheet for further analysis. The questionnaire included four sections with a total of 39 questions (Table 3-6). Each section generated insight into the sub-aims of this study research.

Table 3-6 Description of the online survey

Section of survey	No of questions	Rationale	Number of questions	
			Open-ended	Closed-ended
A: Demographic information	7	Identified age, gender, and information in relation to qualification and work experience.	3	4
B: Description of practice and services	5	Described information relating to working environment, patient load and presenting patient difficulties.	1	4
C: Speech audiometry	18	Identified and described speech audiometry practices for assessment of adult patients.	0	18
D: Managing hearing difficulties	6	Quantified participants' fitting of amplification devices and patient satisfaction thereof	4	2
E: Other	3	Provided further comments, obtained email address and offered to participate in the focus group	3	0
Total	39		11	28

The items pertaining to participants perception of patients' main listening complaints in section B were adapted from the Client Oriented Scale of Improvement (COSI) developed by National Acoustic Laboratories (NAL) (Appendix G). The COSI consists of a list of sixteen standardised listening situations which are categorised according to priority (Dillon, Guest, & Lovegrove, 1999), and is commonly used as a pre- and post-fitting questionnaire to determine improvement from hearing devices.

The questionnaire for the present study was designed with predominantly closed-ended questions where choices were presented so the respondents were not expected to think as hard and not required to be as articulate to provide their responses (McBurney, 2001). Scaled

questions were used for many of the closed-ended questions as they measured the attitudes and personality of participants by capturing subtle gradations of opinion or perception (Kanjee, 2006). The Likert scale is a commonly used rating scale (Kanjee, 2006) and was useful in measuring the direction and magnitude of the participants opinions in this survey (McBurney, 2001).

Closed-ended questions however limited the respondents to options provided in the questionnaires and had complementary advantages and disadvantages to open-ended questions (McBurney, 2001). The disadvantages of closed-ended questions are that the elements being investigated may be too intricate to reduce to a set of options, or the participants may not agree with any of the options presented leading to simplistic responses (McBurney, 2001). Consequently, 62% of the questions provided the participant with the option to provide an open-ended response. Probing phrases such as "please elaborate", "please explain why" and "if other, please specify" were used for this purpose.

Focus group script

The aim during the focus group discussions was not to achieve a consensus or identify solutions, but rather to generate different perspectives on the topic (Kvale & Brinkmann, 2009). Focus groups usually consist of six to ten participants led by a moderator (Kvale & Brinkmann, 2009). The researcher served as the moderator and each focus group consisted of six participants. Two focus groups were held because more than 80% of all themes are discovered within two to three focus groups (Guest, Namey, & McKenna, 2016). A non-directive style of moderating was utilised where the objective was to promote a diversity of viewpoints on the topic (Kvale & Brinkmann, 2009). Both focus groups comprised of a mix of participants who never administered SIN testing and those who did administer SIN testing.

The researcher was aware of limitations posed by a focus group approach. Even a skilled moderator may not be able to appropriately manage group dynamics therefore a comprehensive range of respondents perceptions are not always divulged (Ryan, Gandha, Culbertson, & Carlson, 2014). Hence a flexible approach was adopted to create a

democratising environment which encouraged participants to address topics that might not be elaborated on in a more structured focus group design (Ryan et al., 2014).

A schedule was developed based on the analysis of the survey and used during the focus group (Appendix H). The schedule was used to structure the direction of the focus group more or less tightly (Kvale & Brinkmann, 2009). The researcher used introductory, follow-up, probing, specifying, indirect structuring and interpreting questions during the focus group in order to target the topics to be covered (Kvale & Brinkmann, 2009). Participants were encouraged to share their thoughts and opinions on their input in the survey. They were invited to elaborate on ideas drawn from the online survey which they felt required further discussion and provided input on factors influencing SIN testing.

3.3.2 Equipment

Focus group discussions were video recorded onto a personal, password protected iPad with the verbal permission of the participants. Verbal data needed to be transcribed into a written version for the content analysis to be conducted (Braun & Clarke, 2006). The focus groups took place via Skype and WhatsApp video calling therefore video-recording was the most convenient.

3.4 Data collection procedures

3.4.1 Ethical clearance

A research protocol was submitted for consideration, comment, guidance and approval to the research ethics committee before the data collection commenced (WMA, 2013). Ethical clearance to conduct the study was thus obtained from the Human Research Ethics Committee (HREC): Non-medical of the University of the Witwatersrand. (Appendix I).

3.4.2 Participant recruitment

A multipronged approach was followed to recruit participants by distributing the online survey on multiple platforms. Permission was obtained from South African Association of Audiologists (SAAA) (Appendix B) who distributed the survey via their Facebook page. South

African Speech-, Language-, and Hearing Association (SASLHA) recognised the request for assistance with data collection (Appendix C) but was unable to assist with distributing the survey. The Deputy Director: Rehabilitation the Gauteng province was contacted and distributed the survey to professionals in the employment of the public healthcare sector via email (Appendix D). The Private Practitioner Group (PPG) for speech therapists and audiologists had also agreed to distribute the survey to its members via email (Appendix E).

A financial incentive to participate in the survey was made available to one randomly selected participant. Incentives improve questionnaire response rates and shows respect and appreciation for the time spent and effort taken in completing the questions (Department of Health and Human Services, 2010). The researcher bared in mind that offering a large incentive may be coercive and may skew the data results (Department of Health and Human Services, 2010). Accordingly, a minimal incentive of a R500 gift voucher was awarded to one selected participant. The participant was chosen by performing a RANDBETWEEN formula in Microsoft Excel and contacted via email with notification of their winning.

A two-month period was allocated for data collection. As the participants completed the survey through GoogleDocs, their responses were exported to a Microsoft Excel spreadsheet that was accessed by the researcher. The researcher monitored the responses on an ongoing basis throughout the data collection phase. Based on the low response rate one month into the data collection, it was established that further strategies would need to be employed to increase the response rate. As a result, the researcher personally sent private messages via social media platforms, WhatsApp and emails to potential participants who were found through their association with profession specific social media groups and websites. This strategy assisted to increase the response rate.

After the responses from the survey were part-analysed and trends identified, select participants who agreed to be contacted for the focus group were contacted via email. They were sent a follow-up participant information sheet inviting them to participate in the focus group discussion (Appendix J). Email communication commenced with potential participants to determine availability of dates and times. Participants who met the inclusionary criteria were then included in the group.

3.5 Ethical considerations

The primary purpose of research ethics is to guard the welfare of individuals partaking in the research (Wassenaar, 2006). The primary purpose of the present research was to produce new knowledge but protecting the rights and interests of the research participants was a priority (WMA, 2013). It was crucial to ensure that the research would be performed ethically (WMA, 2013) and therefore the Declaration of Helsinki was used as a guideline. Ethical considerations made during this study included, but were not limited to, informed consent, confidentiality, anonymity, safekeeping of data, non-maleficence and beneficence. Ethical clearance was thus obtained (Appendix I).

3.5.1 Informed consent

A participant information letter informed potential participants about the research topic (Appendix K). If they wished to participate, they agreed to all the informed consent questions as the first question of the survey. Participants invited for the focus groups were provided with a follow-up participant information sheet which included all the consent information related to the focus group (Appendix J). Verbal consent for video recording was obtained at the beginning of the focus groups.

3.5.2 Confidentiality

Protecting the confidentiality of individuals was an important component of the principles of autonomy and respect for the dignity of persons (Wassenaar, 2006) therefore precautions were taken which aimed to protect the privacy of research participants (WMA, 2013).

Participants from the survey were explained that confidentiality will be maintained throughout the study by allocating a participant number. Participants in the focus group were informed (through participant information sheets and verbally at the beginning of the focus group) that confidentiality cannot be guaranteed due to the nature of an online focus group. The researcher however ensured the safe-keeping of this video-recording and participant numbers were assigned to focus group participants.

3.5.3 Anonymity

The survey treated sensitive topics for which it was important to protect the participants (Kvale & Brinkmann, 2009). Research aimed for anonymity and used strategies for the secure storage of transcripts, participant numbers were used in transcripts and where possible, other identifying details were altered (Richards & Schwartz, 2002). Each participant who completed the survey was allocated a participant number and thereby maintained anonymity. The participants who opted to include an email address for the financial incentive draw or invitation to the focus group would not remain anonymous. For this reason, the data was maintained in a password protected personal computer which could only be accessed by the researcher.

Participants in the focus group were made aware through the participant information sheet and verbally at the beginning of the focus group that due to the nature of focus groups, they could not remain anonymous. They were however made aware that no identifying information would be used and that participant numbers would be utilised to reflect their responses in the transcript of the focus group. The transcription masked the identities of the interviewed subjects as well as events and persons in the interview that could be easily recognised (Kvale & Brinkmann, 2009). No identifying information had been published in this dissertation.

3.5.4 Safe keeping of data

All responses obtained from the survey were saved securely in an excel spreadsheet on a password protected personal laptop which could only be accessed by the researcher. The video recordings of the two focus groups was done on an iPad which also belonged to the researcher and was password protected. The focus group transcription was done by the researcher and participant numbers were immediately assigned to remove any identifying information. The transcripts were also securely stored on the researchers' personal laptop.

3.5.5 Non-maleficence

The philosophical principle of non-maleficence ensured that no harm occurred as a direct or indirect result of the research (Wassenaar, 2006). The researcher endeavored that there were no direct or indirect harmful consequences to the participants of the research.

Participants were made aware that they had the right to withdraw or discontinue the survey or focus group discussion at any point without any negative consequences. None of the participants chose to withdraw from either the survey or the focus group. The researcher also took great care that the questions in the survey and discussions around the focus groups caused no harm or discomfort to the participants. In order to ensure that no inconvenience was placed on the participants, the focus group was held at a time, and manner most convenient to the participants.

3.5.6 Beneficence

This philosophical principle encouraged that the maximum benefits be afforded to the participants in the research study (Wassenaar, 2006). In addressing the primary aims of the research project, the researcher attempted to benefit the participants by beginning to raise curiosity on a topic which would be of clinical benefit to them. Future research would also be able to use this as a basis for developing a guideline and resources for speech audiometry in the South African context.

3.6 Reliability, Validity and Trustworthiness

For a measurement to be useful, both reliability and validity must be considered (Leedy & Ormrod, 2013; McBurney, 2001). The validity and reliability of measurement instruments influence (i) the extent to which the phenomenon under investigation can be better understood, (ii) the probability that the data analysis will yield statistically significant information and, (iii) the extent to which meaningful conclusions can be drawn from the data (Leedy & Ormrod, 2013). The findings must also be trustworthy suggesting that practitioners can act upon them with confidence (Raines, 2011). Reliability, validity and trustworthiness were hence all considered during this study.

3.6.1 Reliability

Reliability is described as the property of consistency of a measurement that gives the same result on different occasions (Durrheim & Painter, 2006; Leedy & Ormrod, 2013; McBurney, 2001). Internal consistency reliability identifies the extent to which all of the items within an instrument would generate similar results (Leedy & Ormrod, 2013). Considerations

made for reliability during the survey and focus groups, was the Hawthorne effect and social desirability tendency.

The Hawthorne effect was an important factor which could have potentially affected the generalisability of clinical findings to actual practice (McCarney, Warner, Iliffe, van Haselen, Griffin, & Fisher, 2007). The Hawthorne effect was concerned with participation in the research, the subsequent awareness of being studied and the potential influence it may have on behavior (McCambridge, Witton, & Elbourne, 2014). It was important to consider the effect this could have had on the responses obtained from the participants during the survey and the focus group discussions. The social desirability tendency is a phenomenon where bias may enter when respondents perceive one alternative as more socially acceptable than the other (McBurney, 2001).

An attempt was made to minimise the Hawthorne effect and the social desirability tendency during the study. The confidential nature of the online survey aimed to encouraged participants to respond honestly and the researcher strived to word questions so that all the options appeared equally socially desirable (McBurney, 2001). In order to minimise the possible impact of this during the focus group discussion, the researcher implemented two strategies. Firstly, the schedule and topics for discussion were carefully prepared and rehearsed to reduce any participant feelings of discomfort or social desirability during responding. Secondly, before commencing the focus groups, the researcher discussed that honest and realistic responses obtained from the discussion served to benefit the profession. This aimed to generate a more comfortable mood for the participants to respond openly and honestly, ultimately improving the reliability of the results.

3.6.2 Validity

The validity of the questionnaire is the extent to which it measured what it was developed and intended to measure (Durrheim & Painter, 2006; Leedy & Ormrod, 2013). Face validity and content validity were considered for this research and form part of construct validity (Drost, 2011).

Face validity is the extent to which the questionnaire looked like it was evaluating a particular characteristic and was helpful with encouraging cooperation from the participants (Leedy & Ormrod, 2013). Content validity is the extent to which the questionnaire was a representative sample of the speech audiometry content area being evaluated (Leedy & Ormrod, 2013).

The researcher took great care in developing a survey that would link directly to the sub-aim of the research and explored all elements and possibilities necessary for this purpose. The pilot study tested the reliability and validity of the survey tool that was used for collection of data in the main study. The tool was amended based on feedback to establish this aim. The responses obtained from the pilot study demonstrated that the questions in the survey evaluated content which the sub-aims of the study directed. The schedule developed for the focus groups assisted in keeping the discussion on topic and encouraged, without any pressure, participation from all participants. The responses obtained from the two focus groups revealed similar factors thus advocating that the schedule developed controlled for validity of the study.

3.6.3 Trustworthiness

Qualitative researchers have identified a number of factors to consider to improve the believability of research finding (Coleman & Unrau, 2011). These include (i) establishing one's own credibility which can be done by keeping meticulous records in a journal; (ii) documenting what has been done to ensure consistency by specifying the context of the data collection, triangulation and member checking and; (iii) documenting what has been done to control biases and preconceptions (Coleman & Unrau, 2011). The researcher used triangulation and documenting for consistency and controlling biases. The data obtained from the focus group was compared to the data obtained from the survey and identified similarities which existed. The researcher also documented the process of data collection, preparation and analysis. The raw data of the survey and focus groups has been kept intact. Data analysis was done on a duplicate version of the raw data. It can be concluded that the researcher made every attempt to ensure that the research findings were trustworthy.

3.7 Data Analysis

Descriptive statistics was used to analyse data obtained from the survey. The descriptive statistics used for the current study aimed to describe the body of data using elements (Leedy & Ormrod, 2013) which are described below (Table 3-7).

Table 3-7: Description of Data Analysis Procedures

Statistical procedure	Type of analysis	Rationale
Points of central tendency	Mean, mode and medium	Used to describe the demographic information of the participants, their patient description and hearing complaints, speech audiometry practices and management strategies implemented.
Amount of variability	Range and standard deviation	

The focus group transcription structured the conversation in a form amenable to a more in-depth analysis (Kvale & Brinkmann, 2009). The transcript underwent content analysis which involved a detailed and systematic evaluation of the responses obtained from the focus group in order to identify patterns, themes or biases (Leedy & Ormrod, 2013). The data analysis process involved reading through the transcript repeatedly and breaking it down through thematizing and categorising; and building it up again in different ways through elaboration and interpretation (Blanche, Durrheim, & Kelly, 2006).

There were 6 steps used in the process of content analysis (Braun & Clarke, 2006). These included (i) familiarisation with the data; (ii) generating initial codes; (iii) searching for themes; (iv) reviewing themes; (v) defining and naming themes and; (vi) producing the report (Braun & Clarke, 2006). These six steps were used for the content analysis and a total of 36 themes emerged from the transcript. The themes were then further categorised to identify the seven main themes.

3.8 Summary

This chapter described the aims of the research study. It explained the process and instruments employed in this study to achieve the aims. The research design, measures, participants and data collection methods were described. Ethical considerations and factors influencing reliability, validity and trustworthiness of the study were explored. Lastly, the data analysis process was explained.

Chapter 4: Results

This chapter presents the results of the study in response to the aims of the research. Speech audiometry practices reported by the participants in the survey are presented using descriptive statistics. The factors influencing SIN testing are presented through the seven themes identified through the content analysis of two focus group discussions. The quantitative and qualitative results obtained are integrated. Tables are used to visually represent the data where appropriate.

4.1 Main research aim: Describing South African audiologists' use of SIN testing in the assessment of adults with hearing difficulties

The main aim of this study was established through the two sub-aims namely (i) describing South African audiologists speech audiometry practices in the assessment of adults with hearing difficulties and (ii) exploring factors which influenced South African audiologists application of SIN testing for adults with hearing difficulties. The results presented describe participants reports of their patients' main listening complaints. Participants further provided explanations for the implementation and disuse of certain speech audiometry tests.

The frequency of speech audiometry testing is presented in relation to the demographic information of the participants. The languages used to administer the tests as well as the method of test presentation is outlined. Factors influencing test selection were detailed and participants confidence levels in the tests results obtained are also explored. Content analysis of the focus group discussions revealed seven factors influencing SIN testing which were integrated with the survey results. These themes were (i) participants reports of patients hearing complaints, (ii) participants' perceptions of SIN testing, (iii) patient counselling, (iv) availability of resources, (v) test validity, (vi) ideal test description and (vii) training and knowledge (Table 4-1).

Table 4-1 Describing the seven themes which emerged from the content analysis of the focus group discussions (n_2 = 12)

Theme label	Theme	Sub-Theme	Comments in Focus Group 1	Comments in Focus Group 2	Total
A	Hearing complaints	Main listening complaint	6	12	18
		Functional impact of hearing loss	2	3	5
			8	15	23
B	Participants perceptions of the need for SIN testing	Role of FM systems	3	7	10
		Is there a need for the test	3	6	9
		Does it add value	7	3	10
		Auditory processing	1	9	10
		SIN should be but is not being done	4	29	33
		Role in medico-legal assessments	2	0	2
			20	54	74
C	Patient counselling	Patients un/realistic expectations	3	6	9
		HA counselling tool	6	1	7
		Patient counselling	0	20	20
		Results used for management	0	9	9
			9	36	45
D	Availability of resources	Equipment	10	5	15
		Time considerations	4	16	20
		Languages	19	4	23
		Standardised tests	5	11	16
		HA SIN tests	1	3	4
		Financial considerations	11	11	22
		Space	2	0	2
			52	50	102
E	Testing validity	Practicality	5	4	9
		Validity	2	0	2
		Replicability/application	4	2	6
			11	6	17
F	Ideal test description		15	5	20
G	Training and knowledge	Knowledge	1	12	13
		Training	5	11	16
		Exposure	1	5	6
		Experience	1	3	4
		Knowledge of SIN tests	3	3	6
		Un/familiar with SIN	1	7	8
		Suitable tests	3	0	3
			15	41	56

4.2 Main listening complaint

Most survey participants (98%; n_1=105) confirmed that their patients' most commonly reported listening complaint was SIN. The focus group content analysis revealed that all focus group participants (n_2 = 12) also expressed difficulty with SIN as the main listening complaint reported by patients. They went on to elaborate that the difficulty was exacerbated in complex listening environments such as restaurants or crowds, and social interactions in personal and professional (occupational) environments (Table 4-2).

Table 4-2 Describing focus group participants responses of patients hearing difficulties and its impact (n_2 = 12)

Description	Participant response
Hearing difficulties in complex listening environments	"I would say that when a person is in a restaurant with their family or when there is more than one person talking. In background noise obviously the problem is exacerbated, they can't make out what the person is saying, because of the background noise, it just gets all mixed up" P2
Functional impact of listening difficulties on social interactions and occupations demands	"But for me it's a fact that people have a problem when there's a conversation around the table it's quick, there are children there are men there are women people don't know how to focus." P9 "I find people tend to avoid social situations because they are afraid that they will be embarrassed, or they feel excluded, so they just stay at home" P3 "You know what I think is a big factor, just occurring to me if I'm thinking of the patients that are struggling, these are the patients who are better educated, that have been very involved in the world who have been very powerful, who have been the center of lots of things, and because they are not coping as well as they could I think they experience the loss more." P9

4.3 Frequency of administering speech audiometry

The frequency at which various speech audiometry assessments were administered by the participants is displayed in Table 4-3. SRT (87%; n_1 = 93) and WR (85%; n_1 = 91) were more routinely administered by participants whilst only 36% (n_1 = 37) of participants administered SIN testing. Eighty-one percent of participants (n_1 = 87) administered both SRT and WR testing in various percentage of cases which was higher than 33% of participants (n_1

= 35) who administered all three tests. Nine percent of all participants (n_1 = 10) never administered any of the three speech audiometry assessments.

Table 4-3 Frequency with which speech audiometry was administered (n_1 = 107)

Frequency of administering	SRT		WR		SIN	
	n	%	*n*	%	*n*	%
Never include	14	13	16	15	70	64
Rarely include (in less than10% of cases)	8	7	6	6	7	7
Occasionally include (in about 30% of cases)	5	5	3	3	12	11
Sometimes include (in about 50% of cases)	7	7	8	7	7	7
Frequently include (in about 70% of cases)	10	9	11	10	1	1
Usually include (in about 90% of cases)	13	12	13	12	4	4
Always include	50	47	50	47	6	6
Total	107	100	107	100	107	100

4.4 Speech recognition threshold testing

Speech recognition threshold testing was administered by 87% of the participants (n_1 = 93). The three most common reasons for administering and not administering SRT will be presented.

4.4.1 Reasons for administering and not administering SRT testing

The three most common reasons that participants reported for administering SRT testing was (i) for reliability by calculating the correlation with the PTA (62%; n_1 = 48); (ii) part of departmental/practice assessment protocol (14%; n_1 = 11); and (iii) to obtain a level from which to calculate the presentation level for other speech tests (10%; n_1 = 8). Some participants reported that SRT could be used to determine the functional impact of the hearing loss (9%; n_1 = 7) whilst others felt that it could be used as a counselling tool for hearing devices (9%; n_1 = 7).

The three main reasons reported by participants for not conducting SRT testing were issues related to language differences that would affect the reliability and validity of the test

(n_1 = 9), equipment that was either not available or not working properly (n_1 = 5), and time constraints (n_1 = 4). One participant reported that it did not add value to the test battery and therefore did not administer it routinely.

No noteworthy differences were found between frequency of administering SRT testing and age of participants, years of work experience, gender, type of qualification obtained and place of work.

4.4.2 Language and presentation method used to administer SRT testing

The three languages that SRT was most commonly administered in were English, Afrikaans and isiZulu (Table 4-4). SRT testing was most commonly administered using live voice as the presentation method for all three languages (Table 4-4).

Table 4-4 Presentation method and the three most common languages that SRT was administered in (n_1 = 93)

Language of test	Total	Live voice		Pre-recorded		Combination of live voice and pre-recorded tests	
	n_1	n_1	%	n_1	%	n_1	%
English	90	74	82	7	8	9	10
Afrikaans	49	38	78	5	10	6	12
isiZulu	24	23	96	0	0	1	4

Many participants reported that the reason for administering SRT using live voice was because the test was readily available at the practice (n_1 = 26) or the equipment only allowed for presentation using live voice (n_1 = 17). Some participants reported that live voice was preferred because it could allow for language or dialect differences (n_1 = 8) and two participants reported that they chose this method due to time constraints. Six participants reported that it improved the validity of the testing whilst six other participants reported that was the way they were trained to administer it and it was how they were experienced in administering it.

4.4.3 Tests used for SRT testing

The most commonly used SRT tests were the CID W1 spondaic wordlist (40%; n_1 = 51) and the South African spondaic wordlist (52%; n_1 = 67). The rest of the tests used (8%; n_1 = 11) are described below (Table 4-5). The main reason for the test chosen was availability (19%; n_1 = 65)

Table 4-5 Tests used by the survey participants for SRT testing (n_1 = 129)

Test used	n_1	%
CID W1 spondaic wordlist	51	40
South African Spondaic wordlist	67	52
NU 6 wordlist	2	1.5
NAL – AB	1	0.7
NAL for ESL speakers	1	0.7
Digits	2	1.5
isiZulu wordlist	2	1.5
UP Afrikaans spondaic wordlist	1	0.7
Kuduwave wordlist	1	0.7
Tygerberg hospital wordlist	1	0.7
Total	129	100

4.4.4 Confidence in administering SRT testing

More than 50% of the participants (55%; n_1 = 51) were very confident about the results obtained from SRT testing whilst only 13% (n_1 = 12) were extremely confident. The most common reason that participants were confident about the test results was because it confirmed the reliability of the assessment by calculating the SRT-PTA correlation (83%; n_1 = 40). Eight participants were confident with their test results because the test was administered in a language appropriate for the patients.

4.5 Word recognition testing

Word recognition testing was administered by 85% of the participants (n_1 = 91).

4.5.1 Reasons for administering and not administering WR testing

There were many reasons reported for the use of WR testing. The main reason mentioned by the participants was that the test would guide patient management. Participants explained that the results would be useful to determine the next step in the management process (49%; n_1 = 34) or to determine if, and how successful the patient would be with hearing devices (50%; n_1 = 35).

Participants also explained that WR testing was important in order to determine if there was any roll-over (a decrease in WR ability with an increase in intensity) (39%; n_1 = 27) which could be indicative of retro-cochlear pathology. Eight participants (11%) reflected that it was a good indication of the patients' functional hearing abilities. Participants felt that it could also be used as a counselling tool for explaining the hearing loss (4%; n_1 = 3), to manage the patients' expectations (5%; n_1 = 4) and to counsel the patient for hearing devices (13%; n_1 = 9).

The three main reasons that WR testing was not administered were the same as for SRT testing. These were (i) language differences that would affect the reliability and validity of the test (n_1 = 3); (ii) equipment that was either not available or not working properly (n_1 = 3), and time constraints (n_1 = 3).

Similar to SRT testing, no noteworthy differences were found between frequency of administering WR testing and age of participants, years of work experience, gender, type of qualification obtained or place of work.

4.5.2 Language and presentation method used to administer WR testing

Similar to SRT testing, the three languages that WR testing was most commonly administered in were English, Afrikaans and isiZulu (Table 4-6). WR testing was most commonly administered using live voice as the presentation method for all three languages (Table 4-6).

Table 4-6 Presentation method and the three most common languages that WR was administered in *(n_1 = 91)*

	Total	Live voice		Pre-recorded		Combination of live voice and pre-recorded tests	
Language of test	n_1	n_1	%	n_1	%	n_1	%
English	48	62	68	14	16	14	16
Afrikaans	26	25	52	13	27	10	21
isiZulu	12	18	78	2	9	3	13

The reasons reported for using live voice to administer WR were the same as those for SRT testing. Participants reported that only that method of presentation was available at the practice (n_1 = 19) or the equipment only allowed for presentation using live voice (n_1 = 9). Some participants reported that live voice was preferred because it could allow for language or dialect differences (n_1 = 4) and two participants reported that they chose this method due to time constraints. Six participants reported that it improved the validity of the test results whilst six other participants reported that was how they were trained to administer it and it was how they were experienced in administering it.

4.5.3 Tests used for WR testing

The most commonly used tests were the CID W22 wordlist (36%; n_1 = 49) and the NU – 6 wordlist (29%; n_1 = 40). The remainder of the tests used are described in the table below (Table 4-7). The main reason for the test chosen was availability (22%; n_1 = 66).

Table 4-7 Tests used by the survey participants for WR testing *(n_1 = 136)*

Test used	n_1	%
CID W22	49	36
NU 6	40	29
PB 50	17	13.5
FVEWA	12	9
Digit pairs	4	3
Non-sense material	1	0.5
Sentences	2	1.5
NAL AB	4	3
isiZulu wordlist	2	1.5
Tygerberg Afrikaans wordlist	1	0.5
UP Afrikaans wordlist	2	1.5
Non-standardised, non-English wordlist	1	0.5
Company provided	1	0.5
Total	136	100

4.5.4 Confidence in administering WR testing

Majority of the participants (53%; n_1 = 48) were very confident about the results obtained from WR testing whilst only 19% (n_1 = 17) were extremely confident. The most common reason that participants were confident about the test results was because it correlated with their pure tone audiometry and SRT results (n_1 = 12). Some participants felt confident about the results because they were experienced in administering it (n_1 = 5).

4.6 Speech-in-noise testing

The administration of SIN testing is presented in much greater detail than SRT or WR testing. There was a detailed analysis on the frequency of test administration together with the reasons provided for use and disuse of the test. Factors influencing the implementation of SIN testing from the content analysis of the focus group discussions are integrated with the descriptive survey results. A description of the participants who administer the tests and their preferred language and method of presentation is documented. The tests used for SIN testing are presented and participant confidence levels in results obtained are provided.

4.6.1 Frequency of administering SIN testing

Speech-in-noise testing was administered by 36% of the participants (n_1 = 37). Limited input was provided in the survey as to why participants did or did not administer SIN testing. However, content analysis of the focus group discussion explored this in greater detail where various factors emerged.

4.6.2 Reasons for administering and not administering SIN testing

Factors which influenced the implementation of SIN testing was participants perceptions of the need for the test (content analysis theme B), its use in patient counselling (content analysis theme C), and resource availability for the test (content analysis theme D). These themes are all discussed in detail below.

4.6.3 Participants perception of the need for SIN testing (Focus group theme B)

Some participants were in favour of SIN testing and understood the importance of the results obtained, whilst other participants questioned its value as part of the assessment battery for adults with hearing difficulties (Table 4-8).

Argument against SIN testing

Some focus group participants questioned the need for SIN testing. Participants expressed that if an experienced audiologist engaged in a detailed case history and statement of complaint from the patient, that would be sufficient to determine the degree of difficulty with SIN, and counsel the patient appropriately (Table 4-8). Other participants echoed this sentiment suggesting that assessment and management of patients' SIN complaints can be done without a SIN test. A participant shared that SIN was a common and expected complaint. Testing SIN was therefore not considered valuable in the assessment or management plan. They expressed that there was a place for SIN testing only if other pathology was suspected, or test results did not correlate. There were multiple reasons presented suggesting that SIN was a redundant test that added little or no value to the assessment or management of patients with known hearing difficulties.

Argument for SIN testing

An opposing view was held by other participants who suggested that SIN testing added valuable information to the test battery for a variety of reasons (Table 4-8). Their input suggested that there was value in quantifying SIN difficulties and using a more evidence-based, scientific approach to understanding the patients' difficulties. A participant reflected that SIN testing was part of best practice and should be standardly administered on patients. There was further value identified in the assessment as it investigates central listening abilities and provides some insight into auditory processing skills. It was expressed that it was important to understand the patients processing abilities in trying to successfully assess a patient and provide an appropriate management plan.

The management plan could direct one to the role of assistive devices, such as FM systems, in the management of auditory processing difficulties. These would be valuable for patients with a hearing loss or with patients with hearing within normal limits. Participants identified the value of SIN testing to counsel patients about hearing devices which could assist with hearing difficulties. They identified its' role in determining which hearing devices would be most appropriate (e.g. hearing aids versus a cochlear implant). It could also guide the decision of the level of hearing device technology required to meet their lifestyle and communication needs. A participant pointed out that SIN would be a good resource to assess the functional impact of hearing loss, in the work environment and for medico-legal assessments.

Table 4-8 Describing focus group participants argument for and against the need for SIN testing (n_2 = 12)

Description	Participants response
Argument against SIN testing	"I think the main barrier to implementing it in your practice is that most audiologists weigh up the potential benefit. When most people make that decision, they find that they could kind of get similar benefit from maybe spending time on case history and assessment." P2 "You just assume that with the speech in noise complaint that we get, (SIN) would be an expected complaint if with the pure tone findings, that is the usual kind of pattern that we would expect. So is it so wrong to not include that unless the patient is showing signs of maybe a possible auditory neuropathy or something like that?" P7 "You also know the patients going to perform more poorly in (SIN)." P1 "I think of the relatively few times I've the done (SIN) over the eleven years that I've been practicing, it was mostly for people who presented with pure tones within normal limits with SRT's and SDT's that didn't match the picture." P7
Argument for SIN testing	"It is obviously golden standard to kind of implement it as part of the test battery." P8 "I think the question of auditory processing is absolutely critical." P9 "I think that the only thing that it would probably either help with, or work against with, is when you're doing your hearing aid discussion, is that of course by including that you could obviously discuss with the patient, well this is how you performed in noise without hearing aids um, knowing the noise algorithms hearing aids have in place, this is what we could expect." P1 "It gives us an idea where the patient is struggling, then it will inform us what type of technology we could use for this patient." P4 "I think actually we are going to have to add the speech testing into our battery because how are we also going to decide if the patient has a processing problem. And for some of the patients, that is actually how you are going to decide whether they are a hearing aid candidate or a cochlear implant candidate." P12 "We don't have a lot of tests available to test the functional impact of hearing loss on a person's life so I think that could potentially be a good test to do taking hearing aids out of the equation. It could potentially be a good way of assessing functional impact of hearing loss and also in the workplace." P3

	"In my experience the real use for SIN testing comes, more often than not, post fitting in trying to, trying to motivate for FM or whether it's trying to motivate for hearing aid fittings for persons with normal hearing." P2
	"So, if somebody has normal hearing and they struggle with SIN you can maybe do a more targeted SIN assessment, and then that may be more useful to um motivate them and the medical aid, maybe for trialing at least with the hearing aids." P2

With the advancements in technology in general, as well as hearing device technology, it was expressed that the SIN test should be more standardly administered. Using SIN test results for purposes of patient counselling was identified as a common advantage for the test.

4.6.4 Patient counselling (Focus group theme C)

Participants reflected that SIN testing could be used as a tool to assess an individuals' functional hearing abilities and skills (Table 4-9). The results of SIN testing would provide the audiologist with more information to counsel the patients about their test results, hearing difficulties and expectations. Participants expressed that SIN testing could be used as a tool to counsel patients regarding the benefits of hearing devices. They elaborated that the results of the test could also be used to assist them and the patient to determine the level of hearing device technology which would be most appropriate for their difficulties and needs. Some participants explained that the results of the test could be used to inform prognosis and management.

Participants further shared that the test results could be used to manage patient expectations from hearing devices. Participants found that patients expected to hear speech perfectly in noise with hearing devices. Therefore, the results of SIN tests explained to the patient pre- or post-hearing device fitting, could assist in managing expectations from the devices. Patients who had more realistic expectations were more satisfied with their hearing device performance. Participants were aware of the importance of appropriate patient counselling and acknowledged the role of SIN testing in the selection of hearing devices and managing patients' expectations pre- and post-fitting of hearing devices. Consequently, this may improve patient satisfaction (Table 4-9).

Table 4-9 Focus group participants use for SIN test results in patient counselling (n_2 = 12)

Description	Participant response
General counselling	"The main point being that the counselling is the hugest factor." P7
	"Because you know you mentioned about the counselling and (patient) expectations, and I think that is why the SIN testing is so important as a test battery" P8
	"Your counselling as well as your explanation of your test battery and if you've got more information to share with them, the chances are they better able to understand and cope." P8
Counselling for hearing devices	"Maybe if you discuss different levels of technology with them, that if you feel they would benefit from a higher level of technology you could use that as a demonstration of why more basic technology won't be sufficient for them." P3
	". . affordability (of hearing devices) all those kinds of things also come in, but I think the huge thing is the counselling." P11
	"So, it's probably just a route to use for convincing them, especially if they're on the edge of whether they should go that (hearing device) route or not." P1
	"It gives us an idea where the patient is struggling then it will inform us what type of technology we could use for this patient." P4
Informing prognosis or management	"I think it comes with, in terms of when you are actually doing your assessment, in your speech testing results also play such part in understanding what this patient is going to actually be, or what benefits they are actually going to get." P8
	"And for some of the patients, that is actually how you are going to decide whether they are a hearing aid candidate or a cochlear implant candidate." P12
	"I think that counselling becomes vital, it may not cost us anything in terms of equipment wise but in terms of that time, might be vital in terms of just listening to them and hearing what they saying and then make appropriate, if possible, technical adjustments." P11
Managing patients' expectations	"I can see where you coming from P9, because you do get those patients who unfortunately have extremely high expectations" P8
	"I think you could use it (SIN testing) to reiterate what you can expect from the aids, but you've got to be very, very careful about that because you not gonna solve all the issues." P1
	"So, they come back more satisfied because they had realistic expectations to begin with." P10

4.6.5 Availability of resources (Focus group theme D)

A lack of various resources was highlighted by the focus group participants. Many of these resource constraints were also mentioned in the comments section of the survey. Same as for SRT testing and WR testing, the main reasons SIN testing was not implemented was due to the lack of standardised tests for the languages spoken in South Africa, equipment limitations and time constraints. However, an additional reason provided for the disuse of SIN testing was financial considerations. These factors were all explored in detail during the focus group discussions and are presented below (Table 4-10).

Table 4-10 Resource limitations and considerations influencing the implementation of SIN testing

Description	Participant response
Lack of standardized tests available	"Okay what I wanted to say is that what bothered me a lot in the past, I don't know to what extent that has changed, is that the available tests are not standardised for the South African context." P3 "So, we are working with live voice and live voice always makes it difficult to do a standardised test and I think for us that is the biggest barrier that we have." P10 "So maybe the challenge with speech testing actually in South Africa, is the fact that we actually don't have standardised tests that we can all use" P12 "Because let's say I'm using a test in a language that I'm familiar, with sometimes a person repeats the word correctly, but they have a slight accent, but I still take it as correct. Whereas if I wasn't familiar with the language, let's say I had to do a Greek test, even if it's pre-recorded, and I don't have to pronounce it I don't think I would accurately be able to judge whether the person's response is correct. I think that the person that administers it has to be, you know, able to understand that language as well." P3 "So I think, and yes obviously it's important that it's done in different languages, but if the person's workplace for instance would be English, then also if we do the tests in English then maybe it would be more representative of his daily life, yeah that's just my opinion." P3 "Often what also helps is when we do the hearing aid fitting is some of the companies would have their own in the software certain noises etc., just to kind of simulate a situation. That also helps in terms of adjusting the hearing aids etc. to just give us an idea using a live, or typical noisy environment, a restaurant environment etc." P11
Equipment limitations	"I know some of these audiometers you can use a USB stick, or you can connect a CD player up to it." P2 "But of course, realistically again if we don't have CD players or things like that then we've got to use live speech." P1 "Because a lot of the time we don't know that our machines have the capability to do (SIN) because it kind of falls off the primary battery that we've all been taught. Then I had to contact the company whose audiometer we had had at the time for them to guide me on how to do the testing for the patient." P7
Time constrains	"Where our testing already takes an hour or so you going to add on an extra amount of time. It becomes quite a lot to actually fit into a

	test battery I think as a whole, which might become a bit unrealistic." P1 "Yes, I think basically a difficulty is that we should be doing a lot of the tests and sometimes we, I mean more than often, we don't due to time constraints." P11 "Time maybe but like P11 said if I really have a person struggling in noise then you can make the time to test them in noise." P10 "On that point there was a conference a couple of years ago where they timed, and they said speech in noise testing is much quicker than the speech discrimination (WR) testing that we'd actually do." P9 "And therefore, it is necessary that you take that into account and maybe do (SIN testing) at a follow-up session rather than in your main diagnostic session." P10 "I don't know if it's me or my patients, but I find that patients generally want it all done in the one session." P9
Financial considerations	"It would give you valuable enough information, but people are very, I don't know about the sectors that you are dealing in, but people are very, very stretched, things are very difficult economically now." P9 "I think also when which most of us are in the private world, I think when you're billing somebody for every single test although um, that's what we have to do, um we've got to look at what more information it's giving us. But you also know the patients going to perform more poorly in (SIN)." P1 "And I think it is economically, things are tough out there, but I think in terms of our kind of responsibility to the patients in terms of what they are paying for hearing aids, etc., SIN testing should be done" P11 "I know those are quite expensive tools, because we use them here at, well we distribute them here from where I work. I guess that's one barrier, is the cost." P2 "(When audiologists) weigh up the pros and cons, the pros they don't outweigh the cons enough for them to make the step to invest in speech in noise testing." P2

Lack of standardised tests available for the South African population

Participants expressed the lack of appropriate standardised tests for the South African population. This consequently questioned the reliability and validity of test results obtained. Participants from both focus groups shed light on the impact that language plays on the

administration of SIN tests in the South African context. SIN tests were not standardised in South African English or in the other 10 official languages of the country. This posed a challenge in administering and scoring the SIN tests. Another challenge posed due to the lack of standardised tests was that speech audiometry was administered using live voice which, in itself impacts on the validity and reliability of the test results. Furthermore, participants felt uncomfortable administering a test in a language they were not fluent in, as it would affect the scoring.

With 11 official languages in South Africa, this poses a unique challenge. Participant P3 also raised an interesting point about the test being administered in the language used at work/school to determine true functional communication difficulties, even if it was not the patients' first language. A participant from each group explained that some of the hearing aid companies software allowed the simulation of noisy environments. This feature was used as an informal tool to determine that patients' performance in noise with the devices. Participants appeared to prefer to use this as a method of addressing the patients SIN difficulties post-fitting instead of standardised SIN tests pre-fitting.

Equipment considerations for SIN testing

Participants expressed the lack of equipment to appropriately administer SIN tests. One participant was also not aware that her existing equipment had the facility to administer SIN testing and required guidance on how to use the equipment for the test. Equipment constraints were therefore highlighted as a considerable contributing factor to the implementation of SIN testing.

Time constraints related to SIN testing

Some participants expressed the lack of time to add an additional test into the basic test battery for adults with hearing difficulties. Although some participants reflected that time constraints were a substantial factor to consider in the implementation of SIN tests, one participant suggested that time constraints should not be an excuse for not assessing the primary

difficulties reported by a patient. Another participant also had a different view suggesting that SIN may be quicker to administer than WR testing.

Participants had opposing views regarding when the tests should be administered due to time considerations. Some participants reflected that it should be done in a follow-up session as the initial assessment session may become too lengthy, whilst another participant reflected that patients generally prefer the entire assessment completed in the same session. There are therefore varied opinions about when SIN should be done, however a patient-centered approach would encourage that it is done when it is in the best interest of the patient. Hence, some patients may require a follow-up session whilst others may benefit from it all being done in one session.

Financial limitations

Financial considerations were also discussed. Participants believed the current economic climate of the country encouraged people to be careful about how to spend their money. A patient will need to pay more for a hearing assessment if SIN testing was added onto the existing assessment protocol, which was already considered expensive. The reliability and validity of the test results would be queried when administered with a test that was not standardised for the South African population. Consequently, justifying the cost of the test would be challenging, especially if there was already an expectation that the patient was going to perform poorly, based on other tests administered. The feedback was that participants would rather conserve that money in the medical aid to have more funds available for a better level of amplification technology.

One of the participants however explained that despite the financial constraints faced by patients, the responsibility to the patient should take priority, especially considering the prices they are being charged for hearing devices. Participants were also concerned about the finances required to invest in SIN tests, or the equipment required to administer the tests. The various constraints and limitations faced by participants in the private and public sectors of healthcare play an important role in the implementation of SIN testing. Whilst some of the

challenges may be easier overcome, others are more complex and may not be in the immediate control of the audiologists.

4.6.6 Description of participants administering SIN testing

As with SRT and WR testing, no notable differences were found between frequency of administering SIN testing and age of participant, years of work experience, gender or type of qualification obtained.

4.6.7 Language and presentation method used to administer SIN testing

Similar to SRT and WR testing, the three languages that SIN testing was most commonly administered in were English, Afrikaans and isiZulu (Table 4-11). SIN testing was administered using live voice, pre-recorded tests or a combination of both as the presentation method (Table 4-11). Pre-recorded tests were more often used for SIN testing in English and Afrikaans whilst live-voice was more often used for SIN testing in isiZulu. Limited insight was provided in the survey as to why these presentation methods were chosen however the focus group discussions provided more detail on this point.

Table 4-11 Presentation method and the three most common languages that SIN testing was administered in *(n_1 =37)*

	Total	Live voice		Pre-recorded		Combination of live voice and pre-recorded tests	
Language of test	n_1	n_1	%	n_1	%	n_1	%
English	37	12	32	21	57	4	11
Afrikaans	18	6	33	9	50	3	17
isiZulu	3	2	67	0	0	1	33

4.6.8 Tests used for SIN testing

The most commonly used SIN test was the QuickSIN (23%; n_1 = 13), closely followed by the South African digits-in-noise test (20%; n_1 = 11) (Table 4-12). The main reason for the test selection was again availability (29%; n_1 = 24).

Table 4-12 Test used by the survey participants for SIN testing *($n_1 = 56$)*

Test used	n_1	%
QuickSIN	13	23
South African digits in noise	11	20
Arthur Boothroyd wordlist	9	16
HINT	4	7
WIN	0	0
SPIN	4	7
CST	0	0
BKB-SIN	3	5
SPIN	1	2
NU 6	2	4
SCAN	2	4
FVEWA	3	5
Acoustic pioneer	1	2
Controlled babble	3	5
Total	56	100

4.6.9 Test validity (Focus group theme E)

The focus group participants also raised the issue of validity and reliability of the tests used for SIN assessment. Participants expressed that it would be difficult to defend the validity of SIN tests results when the tests are not standardised on the South African population. One participant reflected that it would be similar to CAPD assessments she administered on children, using American standardised assessment tools. “A lot of the parents have said to me well where does your validity come in, and of course you say well it's an American accent how much does it really affect the testing. You've got to factor those in to say well then, your reliability your validity.” P1

Participants also questioned the real-life application of SIN assessment tools. They suggested that the tests are not a true reflection of a real-world noisy environment and therefore question the generalisability of the information provided by the test results. In the words of participant 1 “Because, of course how do you really replicate the outside world in here and what the aids are really doing? But I think to do real SIN tests and testing when you’re doing the actual hearing test, not all noise is the same.”

A participant shared that she felt that the results obtained from SIN tests would be inadequate. She explained that the best way to assess a patient's performance in noise with hearing devices, was to fit the devices and send the patient into a noisy environment. "I just feel its inadequate, it might be a better indication to SIN testing but it's not really the real world. I find that the only realistic assessment comes when the person is in a crowd." P9

The lack of standardised South African SIN tests appeared to play a substantial role in the implementation of SIN testing. Participants were reluctant to administer a test where reliability and validity cannot be guaranteed.

4.6.10 Ideal SIN test description (Focus group theme F)

The focus group participants were also asked about the ideal SIN test that would overcome some of the barriers to implementation. Participants reflected that the ideal test would need to be pre-recorded and standardised in the various official languages in South Africa. Some elaborated that it should take under 5 minutes to administer. It should be easy to administer in terms of the existing equipment set-up required, and it would be advantageous if it could be mobile. Due to equipment limitations in various clinical settings, the test should be compatible with a 1-channel audiometer or available for use via a CD player.

4.6.11 Confidence in administering SIN testing

Participants were less confident about the results they obtained from SIN testing compared to SRT or WR testing. Thirty-five percent of participants (n_1 = 13) were very confident about the results obtained from SIN testing whilst 13% (n_1 = 5) were extremely confident. Three participants reported that the results of the test were a representation of the patients functional hearing difficulties. Participants lacked confidence in SIN testing and results which may be attributed to their training and knowledge on the topic as discovered through the focus group discussions.

4.6.12 Training and knowledge (Focus group theme G)

Limitations in knowledge were expressed by many participants across the two focus groups. There appeared to be a general lack of knowledge, training, exposure, experience and familiarity around the topic of SIN testing. The lack of knowledge and familiarity with SIN testing also affected participants confidence levels in the results obtained. "There's like a lack of information about what's available and what can be used, and also in terms of implementing it." P8

The responses from the survey suggested that majority of the participants were very confident with the results obtained from SRT (55%; n_1 = 51) and WR (53%; n_1 = 48) testing, however only 35% (n_1 = 13) of participants felt the same level of confidence regarding results obtained from SIN testing.

Participants also explained that SIN testing was not administered due to habit, lack of familiarisation, and because they were not comfortable with the test. Participants expressed the lack of training at their respective institution of qualification. The focus group participants were from three different universities and many participants reflected a lack of training on the topic of SIN testing during their undergraduate studies (Table 4-13). Some participants could not recall whether it was taught at undergraduate level and identified it as a barrier to the implementation of SIN testing. Some participants felt that there should be more emphasis placed on the topic during profession specific conferences or continuing professional development (CPD) activities.

Participants felt they had limited-to-no experience or exposure in the area of SIN testing and that was a barrier to implementation. Furthermore, if the place of work did not include it in the testing protocol then it was not implemented. A participant had been on a cochlear implant course where SIN testing was mentioned. She reflected that to be the first time she was exposed to SIN testing, and the value of the information obtained from the results. There also appeared to be a general lack of awareness regarding the tests available for SIN testing internationally and in the South African context. Many participants reflected on the importance

of educating themselves on SIN tests which were available in South Africa, and which locally developed tests may be better suited for their patient population (Table 4-13).

Table 4-13 Focus group participants training and knowledge on SIN testing (n_2 = 12)

Description	Participant response
Lack of under-graduate and post-graduate training	"We were also not taught at university to, or I stand under correction, but I don't remember being taught at university to include (SIN) in the battery." P7 "We haven't actually been taught (SIN) from university." P5 "I mean every year I attend the congress but often these things are not addressed. I think the congress or maybe the courses need to ensure that we get the latest information and the latest way of doing things." P12 "I've never once heard about snr (signal-to-noise ratio) or any SIN testing in all the CPD events that I have been to in the last eleven years." P7
Lack of exposure to SIN testing	"So, it's not something I was exposed to." P4 "I just wanted to say that because I am a junior, as an audiologist, and I'm still new to the field. I rely on protocols that are set by the practice and what is available at the practice. So, if a particular practice doesn't have the materials, or it is not actually part of the test protocol then it is not implemented." P6 "That for me was an eye-opener and that's where I actually, for the first time, saw how speech testing in noise is done, the way you place the patient." P12
Lack of awareness of available tests	"I think that some of the tests that Rene and them have done, I think we need to educate ourselves a little bit." P11 "Just (a) lack of understanding in terms of what's available I think is the main sort of thing" P8 "Perhaps to start off and see what is available in South Africa." P11 "I think a lot of people, I mean I'm guilty of this, you get into a routine for yourself when you testing somebody, for your test battery; and if you've been doing that for years then it kind of becomes, you know not in a bad way but sort of in a bad way, becomes routine." P8

4.7 Language used to administer speech audiometry

The three main languages used for speech audiometry testing was English, Afrikaans and isiZulu. These three languages comprised of 85% (n_1 = 163) of the SRT testing, 86% (n_1 = 161) of WR testing and 91% (n_1 = 58) of SIN testing (Table 4-14). The remainder of the eight official languages of South Africa were seldom used in speech audiometry testing and are represented in the table below (Table 4-14).

Table 4-14 Different languages that were used to administer SRT (n_1 = 192), WR (n_1 = 187) and SIN (n_1 = 64) testing

	SRT (n_1=192)		WR (n_1=187)		SIN (n_1=64)	
Language	*n*	%	*n*	%	*n*	%
English	90	47	90	48	37	58
Afrikaans	49	26	48	26	18	28
Ndebele	1	0.5	0	0	0	0
Northern Sotho	8	4	7	4	2	3
Southern Sotho	4	2	4	2	0	0
Swati	2	1	3	1.5	1	1.5
Tsonga	1	0.5	2	1	1	1.5
Tswana	2	1	4	2	1	1.5
Venda	0	0	0	0	0	0
Xhosa	9	5	5	3	0	0
isiZulu	24	12	23	12	3	5
Other	2	1	1	0.5	1	1.5

4.8 Factors which influenced the test selected for speech audiometry

Participants used different tests for various reasons and the mean was used to describe the details thereof (Table 4-15). Availability was the most common reason for the tests used for SRT (19%; n_1 = 65), WR (22%; n_1 = 66) and SIN (29%; n_1 = 24) (Table 4-15). Confidence in administrating the test was the second most common reason for the test selected for speech audiometry. The factor that least influenced the test selected for SRT (3%; n_1 = 10), WR (2%; n_1 = 7) and SIN (5%; n_1 = 4) was equipment requirements. Appropriateness for use for the patients, reliability and validity, speed and appropriateness for use in the South African context were not priority factors considered for speech audiometry test selection.

Table 4-15 Reason participants selected the tests they used for speech audiometry (SRT n_1 = 93, WR n_1 = 91 and SIN n_1 = 37)

Reason for test selection	SRT		WR		SIN		Mean
	n_1	%	n_1	%	n_1	%	%
Accuracy	38	11	32	11	10	12	11.3
Availability	65	19	66	22	24	29	23.3
Confidence in administrating it through constant use	41	13	41	14	8	10	12
Ease of interpretation	35	10	35	10	7	8	10
Ease of use and scoring	41	13	37	12	8	10	11.3
Equipment requirements	10	3	7	2	4	5	3.3
Most appropriate for the patients at the practice	27	8	18	6	4	5	6.3
Reliability and validity	34	10	32	11	6	7	9.3
Speed	14	4	14	5	6	7	5.3
Most appropriate for use in the South African context	31	9	17	6	4	5	6.7
Other	1	0	3	1	2	2	1.2
Total	337	100	302	100	83	100	100

4.9 Confidence in speech audiometry administered

Participants reflected different levels of confidence in speech audiometry tests (Table 4-16). More than half of the participants felt very confident about administering SRT (55%; n_1 = 51) and WR (53%; n_1 = 48) whilst 35% (n_1 = 13) of participants felt equally confident about administering SIN tests.

Table 4-16 Level of confidence participants had in administering speech audiometry tests (SRT n_1 = 93, WR n_1 = 91 and SIN n_1 = 37)

Level of confidence in administering test	SRT		WR		SIN	
	n_1	%	n_1	%	n_1	%
Not at all confident	2	2	1	1	1	3
Slightly confident	2	2	3	3	8	22
Somewhat confident	26	28	22	24	10	27
Very confident	51	55	48	53	13	35
Extremely confident	12	13	17	19	5	13
Total	93	100	91	100	37	100

Less than 20% of participants felt extremely confident about administering SRT (13%; n_1 = 12), WR (19%; n_1 = 17) or SIN (13%; n_1 = 5) tests (Table 4-16). Confidence in test results differed depending on whether the tests were administered using live-voice or pre-recorded test stimuli (Table 4-17). Participants felt more confident about administering SRT and WR using live voice as the presentation method. On the contrary, participants felt more confident about their results when they used pre-recorded stimuli for SIN testing.

Table 4-17 Level of confidence in speech audiometry compared to the presentation method

Level of confidence	SRT			WR			SIN		
	PR	Combo	LV	PR	Combo	LV	PR	Combo	LV
Extremely	14%	12%	13%	29%	36%	13%	24%		
Very	43%	44%	57%	50%	36%	57%	42%	25%	25%
Somewhat	43%	44%	24%	21%	21%	25%	24%	75%	17%
Slightly			3%		7%	3%	10%		50%
Not at all			3%			2%			8%

PR: Pre-recorded
LV: Live voice
Combo: Combination method

4.10 Clinical setting

The participants worked in a variety of clinical settings. Some participants worked in only one setting whilst other participants were involved in more than one setting. The highest number of participants who administered SRT (93%; n_1 = 56), WR (95%; n_1 = 57) and SIN (48%; n_1 = 29) testing were in private practice. The second highest number of participants (31%; n_1 = 36) who administered all three tests were based in public hospitals (Table 4-18).

Table 4-18 Speech audiometry practices of participants across clinical settings (n_1 = 115)

Clinical setting	Population		SRT		WR		SIN	
	n_1	%	n_1	%	n_1	%	n_1	%
Private	60	52	56	93	57	95	29	48
Public hospital	36	31	29	81	28	78	4	11
Public clinic	3	3	2	67	2	67	0	0
NGO	4	4	4	100	4	100	2	50
Other	12	10	10	83	8	67	3	25
Total (mean)	115	100	101	(84.8%)	99	(81.4)	38	(26.8)

4.11 Summary

This chapter presented the results of the study in relation to the sub-aims of the research. Responses obtained from the survey described current speech audiometry practices of South African audiologists' and were presented using descriptive statistics. The results revealed that the participants in this study administered SRT and WR testing more routinely than SIN testing. Seven themes emerged from the content analysis of the two focus groups and were integrated with the survey results. These themes, together with quotations from the participants, provided insight into factors influencing the implementation of SIN testing for adult patients in South Africa. Overall, the results provided further insight into the use of SIN testing in the assessment of adults with hearing difficulties.

Chapter 5: Discussion

The purpose of this chapter is to discuss the results of the research study and the significance thereof. It intends to discuss the results in relation to the aims of the study outlined in the methodology, as well as the literature outlined in the literature review. This chapter integrates the discussion of the survey results and content analysis to describe current speech audiometry practices, and factors influencing SIN testing in the assessment of adults with hearing difficulties.

5.1 Main research aim: Describing South African audiologists use of SIN testing in the assessment of adults with hearing difficulties

Results from the descriptive analysis of the survey explored speech audiometry practices and is discussed in detail below. The discussion involves participants' demographic information and its' impact on speech audiometry practices, language use and presentation method of tests utilized. The focus group transcript provided unique information and insight into the factors influencing SIN testing in the South African context and is discussed and integrated with the survey results. The themes identified from the content analysis are (i) participants reports of patients hearing complaints, (ii) participants' perceptions of SIN testing (iii) patient counselling, (iv) availability of resources, (v) test validity, (vi) ideal test description and (vii) training and knowledge.

5.2 Main listening complaint

The current study revealed that 98% of survey participants and 100% of the focus group participants identified SIN as the primary listening complaint of their adult patients. The main listening complaint reported by their patients was either difficulty with conversations with one or two people in noise, or difficulty with conversations with groups in noise. These findings support international research which also found SIN to be the main listening complaint of adults with hearing difficulties (Beck & Nilsson, 2013; Evans et al., 2016; Kochkin, 2010; Moore et al., 2014; Mueller, 2016; Paglialonga et al., 2013; Spyridakou & Bamiou, 2015; Taylor, 2003, 2010, 2011; Wilson, 2004). The finding in this study was in keeping with

international findings and can be used to tailor the assessment protocol for best practices in the South African context.

5.3 Frequency of administering speech audiometry

Speech-in-noise is a well-known common complaint of patients with hearing difficulties, and therefore clinicians need to identify methods to carefully evaluate these difficulties during the hearing device pre-fit stages (Taylor, 2011). The HPCSA (2009) draft guideline described in the literature review section of this dissertation also recommended the inclusion of SIN tests, although limitations in terms of the availability of contextually relevant South African standardised tests were acknowledged.

This study found that SRT (87%; n_1 = 93) and WR (85%; n_1 = 91) testing was more routinely administered by the participants. Although 98% of participants reported SIN as their patients primary listening complaint, it was interesting to note that 36% of participants administered SIN testing in varied degrees of frequency, whilst only 6% of participants always administered SIN testing. South African audiologists should consider SIN testing more routinely in order to keep up with international and HPCSA best practice for speech audiometry testing.

5.4 Speech recognition threshold testing

Speech recognition threshold testing was the most commonly administered speech audiometry test in this study and was administered by 87% (n_1 = 93) of participants. The test was administered for test reliability, as a practice protocol and/or to obtain a starting level for further speech testing. Previous research suggested that clinically SRT was used to quantify a patients threshold for speech material and used as a check on pure-tone thresholds (Wilson et al., 1973).

The demographics of participants did not influence the administration of the test. English was the primary language of test administration and participants preferred to

administer it using live voice, largely due to equipment limitations. It was inspiring to see that the majority of participants (52%) were using the locally developed South African spondaic wordlist, which was found to include words most appropriate in the South African context (Hanekom et al., 2015). It was a test that participants were mostly confident in administering.

Previous literature suggested that SRT testing provided valuable information on older patients where there may be a concern regarding cognitive function or when test validity was at question (Hall, 2017). Aside from these instances, SRT testing may not add significant value to the assessment or management of the patient and time may be better spent on tests such as SIN which are more value-adding (Hall, 2017). Therefore, South African audiologists should also consider the need for the test and administer it when they are able to justify that it adds value to a specific case.

5.5 Word recognition testing

Word recognition is an estimate of the maximum ability of a patient to recognise a wordlist in isolation, with no background noise (Beck & Repovsch, 2013) and was administered by 85% of participants, almost as often as SRT testing. WR was largely administered because it was used to inform patient management, as a potential predictor for hearing device fitting, and to determine the presence of roll-over as a predictor for the site of lesion. However, recent literature suggested that WR results may not be a reflection of type or degree of disability, nor predict the expected success of rehabilitative options (CASLPO, 2018; Hall, 2017).

Similar to SRT testing, the demographics of the participants did not impact on the administration of WR testing. Participants mostly used English as the language of testing. Participants largely used live voice as the presentation method, although the draft guideline for audiologists in South Africa recommended the use of pre-recorded material (HPCSA, 2009). Participants were also largely confident about results obtained. The CID W22 wordlist, an English based test, was most commonly used due to availability. Interestingly, locally

developed wordlists such as the FVEWA, isiZulu wordlist and other Afrikaans wordlists were not commonly used.

Literature suggested that patients seldom complain of difficulties hearing speech-in-quiet, and therefore questions the value of routinely administering WR testing (Hall, 2017). South African audiologists were however routinely administering WR testing due to training, familiarity, and habit as suggested from the survey and focus group responses. Audiologists should look more critically at the speech audiometry tests available to them and administer tests which are value-adding to each individual patient. In doing so, patients and audiologists may find more value in administering SIN tests.

5.6 Speech-in-noise testing

The results obtained regarding SIN testing is discussed in more detail. The descriptive survey results and focus group content analysis are integrated in order to provide a detailed discussion around the factors influencing the implementation of SIN testing.

5.6.1 Frequency of administering SIN testing

SIN testing should be part of the standard test battery administered on adult patients (Taylor, 2011; Wilson, 2004). The South African draft guideline recommended that SIN testing be administered, but that the development and standardisation of SIN tests for the South African population be given research attention (HPCSA, 2009). Speech-in-noise testing was administered in varied degrees of frequency by 36% of participants, and always administered by 6% of participants. This was less than the percentage who always administered SRT and WR testing. Research confirms that it is judicious to incorporate a SIN test to evaluate one's baseline ability to understand speech in the presence of background noise (Beck & Nilsson, 2013). The routine administration of SIN tests would be expected considering that SIN was the most commonly reported complaint of patients.

Participants in this study administered SIN testing more often than a previous study where 19% of participants administered some sort of SIN testing pre-fitting (Mueller, 2003). More recently however, a study in the United States found that 84% of participants administered SIN at varied degrees of frequency and 15% of participants always administered SIN testing (Clark, Huff, & Earl, 2017). The findings in the current study are meaningful as they show that South African audiologists are lagging in comparison to international best practices. Practitioner's assessment protocols should be guided by their patients' primary listening concerns. It is widely agreed that background noise is a practical, daily challenge for hearing device users, and clinicians selecting appropriate amplification for the patients would find the results beneficial if they implemented test measures to determine the degree of difficulty (Taylor, 2011). With many potential benefits from SIN testing, routine administration should be considered.

5.6.2 Reasons for administering and not administering SIN testing

Factors which influenced the implementation of SIN testing was discussed in detail by the focus group participants. They revealed that participants' perceptions of the need for the test (contest analysis theme B), its use in patient counselling (content analysis theme C), and resource availability for the test (content analysis theme D) were factors which determined the administration or disuse of SIN testing. These themes are all discussed in detail below.

5.6.3 Participants' perception of the need for SIN testing (Focus group theme B)

There was a healthy debate in focus group one about whether SIN testing would add value to the test battery in the South African context. It was viewed as a time consuming and expensive procedure which was open to critique regarding validity and reliability due to the lack of standardised tests for the South African context. Furthermore, participants suggested that it would provide redundant information about a patient struggling with a hearing loss because SIN difficulties were expected. Previous studies have however shown that pure tone results and speech-in-quiet tests, such as SRT and WR, were not predictors for SIN abilities as the two tasks reflect different aspects of auditory abilities (Wilson, 2011). SIN testing thus provides unique information to the assessment of an adult with hearing difficulties and it was

therefore recommended that it be included as part of every audiologic diagnostic assessment (Wilson, 2011).

Focus group two was largely unanimous about the need to administer the test as it was part of best practice, even though some of the participants admitted to not yet administering it. There was an agreement that the results would assist in counselling, hearing device selection, managing patients' expectations and choosing the appropriate level of technology (Mueller, 2016). Many participants further agreed that a more scientific and quantifiable approach needed to be considered for SIN difficulties. Adults find it important to improve speech understanding in noise and therefore there is a need for outcome measures that assess SIN capabilities (Duncan & Aarts, 2006). The survey results reflected a similar sentiment, that the results of the test could be used to better counsel the patients regarding expectations, as well as the level of hearing device technology that should be considered. However only 6% of survey participants always administered SIN testing.

This finding was important as it suggested that there was a split view regarding the need for, and the role of, SIN testing within the South African context. Although there was a general consensus in the literature that SIN testing should be part of the standard audiological test battery for patients with hearing difficulties. (Spyridakou & Bamiou, 2015), some participants felt that SIN testing added little value and the advantages of administrating it did not outweigh the disadvantages. On the other hand, it was believed that the role of SIN tests in the South African context was to counsel the patient appropriately and it was necessary in order to determine the most appropriate management plan going forward. There was insight from the participants who felt that SIN testing was important and an awareness that they should be administering it. Therefore, one of the factors which influenced the implementation of SIN testing was participants' perception of whether it added value or not in the South African context.

5.6.4 Patient counselling (Focus group theme C)

Patient counselling was visited by focus group participants on many occasions as an advantage of SIN testing. Similar to the findings of the survey responses, participants in the focus group found that the results of SIN testing may play an important role in counselling the patient about their SIN difficulties. It would also assist in counselling the patient with regards to the most appropriate management plan for them. SIN test results could further guide audiologists and patients in terms of what technology was required from a hearing device in order for them to be most successful with it. Responses from the survey as well as the focus group highlighted the importance of SIN testing in counselling the patient toward more realistic hearing expectations pre- and post-fitting.

The present study established the role of SIN testing in the South African context and the findings were similar to previous international studies. Previous research has also suggested that results acquired from SIN tests can be used to design an appropriate management plan (Wilson et al., 2007) and assist with counselling (Mueller, 2016; Taylor, 2011). Considering that the value of SIN in the South African context has been established, a greater emphasis should be placed on implementation in clinical practice.

5.6.5 Availability of resources (Focus group theme D)

Resources in the form of standardised tests, equipment limitations, time constraints and financial considerations were discussed during the focus group discussions. Responses obtained from the survey revealed that resources varied greatly across clinical settings.

Lack of standardised tests available for the South African population

It was known that standardised and normed SIN tests for the South African population were not readily available. From the survey it was evident that availability was the most common factor participants considered for all speech audiometry tests used, including SIN tests. The challenge of availability of standardised tests for the South African population was exacerbated by the unique richness of languages spoken in the country. Standardised speech

audiometry material is essential for the reliability of test results (Mendel & Owen, 2011). Participants reflected that if the tester did not speak, nor was fluent in the language of the patient, scoring the test and interpreting the results became challenging.

There has been research focusing on locally developed SIN tests. Non-native English listeners with limited English language speaking abilities were recently found to be able to complete the locally developed DIN test (Potgieter, et al., 2018). It was found to be useful as a counselling tool for hearing aid selection and to manage patients' expectations (Potgieter et al, 2018). Other SIN tests were also locally developed to alleviate some of the challenges faced by the language differences in the country. These include the *Sinslyste in Afrikaans vir Volwassenes in Lawaai* [Sentence lists in Afrikaans for Adults in Noise] (SAV-L) (Scourfield, 2011) and the South African English SIN test using the Arthur Boothroyd (AB) wordlists. Perhaps further awareness and training is required amongst South African audiologists regarding locally developed and available tests for SIN testing. However, research priority should be given to the standardisation of these locally developed tests so that audiologists are more confident in the interpretation of their results.

Equipment considerations for SIN testing

Equipment challenges were also identified during the focus group similar to the survey responses. One of the main reasons SRT and WR was not administered by some of the participants was because of a lack of equipment or, working equipment. Although pre-recorded tests can be administered through a CD/USB player, calibration and presentation levels can be ensured when it is connected via an audiometer which is compatible. Therefore, without the appropriate equipment, administering SIN testing was a challenge.

Time constraints related to SIN testing

Time constraints were also considered by focus group participants as some reflected that the assessment would become too lengthy for the patient to manage, and for the practitioner to accommodate in the same session. On the other hand, a participant reflected that if SIN was

the patients' primary complaint, time should be made to appropriately assess it. Some participants from the survey were unable to administer SRT and WR testing due to time constraints, therefore including SIN testing may be challenging. There is greater value in administering SIN testing over speech-in-quiet testing, such as SRT and WR, because word recognition scores are not able to evaluate or imitator the everyday difficulties of listening to SIN (Taylor, 2003) . SIN also assesses the patients' primary listening complaint therefore it is more similar to real life situation and the information provided is more valuable for management purposes (Spyridakou & Bamiou, 2015; Taylor, 2003). Therefore, the new school of thought suggested that if time constraints were a concern, SIN testing could be administered instead of WR testing (Hall, 2017).

Financial limitations

Financial limitations were also mentioned by focus group participants. Participants considered the cost to the practitioner to invest in SIN tests and equipment which would be compatible with it. They further considered the additional cost to the patient to administer an additional test that needed to be charged for. However, if SIN was the patients' primary complaint but was not being assessed, it puts into question the value of the assessment battery in assessing the patients' primary complaint, and in providing the practitioner with the necessary information to inform a management plan. Similar to the argument of time constraints, some may argue that if there are financial limitation for the practitioner and/or the patient, SIN could be considered instead of WR testing for the same reasons mentioned under time constraints.

The challenges faced in terms of resources which have influenced the implementation of SIN testing appear to be manageable. Perhaps the only challenge which does not have a simple solution was the largest challenge, the diversity of languages in South Africa which may impact on the ability of audiologists to administer the tests. Hence there is a need for future research to focus on the development and standardisation of SIN tests more appropriate for the South African context.

5.6.6 Description of participants administering SIN testing

As with SRT and WR testing, no notable differences were found between the demographic details of participants and the implementation of SIN testing. The clinical setting of the participants did however appear to impact on the administration of SIN testing. The highest percentage of participants who administered SRT (93%, n_1 = 56), WR (95%, n_1 = 57), and SIN (48%, n_1 = 29) testing, were based in private practice. Hence, clinical setting may have influenced resource availability, and thus the implementation of SIN testing.

5.6.7 Language and presentation method for SIN testing

Pre-recorded tests were used more routinely than live voice as the presentation method for SIN testing, which is encouraging as it is the recommended method (Mendel & Owen, 2011). Despite this, participants were less confident about results obtained from SIN testing than other speech audiometry tests. Similar to WR testing, locally developed pre-recorded SIN tests were not routinely used by participants. Test validity was discussed in detail as a theme during the focus group discussions which influenced the implementation of SIN testing and is detailed below.

5.6.8 Tests used for SIN testing

Three SIN tests developed in South Africa were described in the literature review section of this dissertation. Although these tests were developed for use among the South African population, few participants used these tests. It was interesting to note that despite the availability of locally developed SIN tests, the most commonly used test was the internationally developed QuickSIN (Killion et al., 2004). It is encouraging however that the second most commonly used SIN test was the locally adapted AB SIN test. The main reason provided by survey participants for test selection was availability. However, focus group discussions elaborated that test validity played an important role in the selection of a test for speech audiometry purposes.

5.6.9 Test validity (Focus group theme E)

Testing validity was commonly discussed during the focus group discussions. Participants reflected their concerns regarding the use of SIN tests that were not standardised or normed on the South African population. Participants explained that if tests were not standardised, they could not be used as the reliability and validity of the test would be compromised. Test sensitivity is compromised by poor test reliability thereby making it difficult to distinguish differences between scores under different listening conditions (Mackersie, Boothroyd, & Minniear, 2001). However, this was contradictory to the survey findings that reliability and validity were not factors which were highly considered in the selection of any of the speech audiometry tests chosen, availability was the primary factor considered.

The results of the survey reflected that the majority of SRT and WR testing was administered using live voice. Previous research has considered the impact of live-voice on reliability and validity of test results (Mendel & Owen, 2011). However, the participants in this study were more confident about the results obtained when administering the tests using live voice. These findings are important for three reasons. Firstly, clinicians need to understand the importance of evaluating the reliability and validity of a test that they are using for speech audiometry purposes. Secondly, because the availability of tests was the primary factor considered in test selection, perhaps greater emphasis needs to be placed on increasing access to locally developed test material. Lastly, the findings of the present study further emphasises previous recommendations made that the standardisation of locally developed tests must be given research priority (HPCSA, 2009).

5.6.10 Ideal test description (Focus group theme F)

As a result of the limitations of existing SIN tests, focus group participants provided insight into the ideal test description. The participants touched on the characteristics of an ideal SIN test that would be most appropriate for the South African clinical context. Participants believed a standardised test would be ideal however it would need to be developed in all official languages in order to meet the needs of the population. One participant however argued that if the tester is not comfortable with the language of testing, the scoring and results may be skewed

and therefore unreliable. Again, it should be noted that SRT and WR tests were selected based on availability and not on standardisation, validity or reliability of results. Based on that finding, the ideal test would be a test that is appropriate and easily available to the practitioners.

In terms of test time, participants agreed that it should not take longer than 5 minutes to administer but at the same time needs to be able to provide the practitioners with sufficient information to inform management and recommendations going forward. Due to equipment challenges which were identified through the survey and the focus group, the ideal test should be pre-recorded to improve reliability (Mendel & Owen, 2011) and easily administered through a 1-channel audiometer or a CD/DVD player. This would allow it to be portable which is another factor of convenience for testing.

5.6.11 Training and knowledge (Focus group theme G)

Participants were less confident about results obtained during SIN testing compared to other speech audiometry assessments. One of the reasons for the lack of confidence was the limitations in knowledge and experience with SIN testing which was part of the focus group discussion content analysis.

Similar to all tests, SIN testing for some can be part of routine practice, but for others it can be daunting because it is an unknown (Taylor, 2011). This study found that participants were unanimous regarding the dearth of knowledge of, and familiarity with, SIN testing and thus played an important role in the limited implementation of SIN testing in the South African context. There was limited training reported at undergraduate level across various institutions. Conferences and other CPD activities did not appear to engage participants on the topic of SIN testing, or other advances in audiology.

It can be argued that it was the responsibility of the practitioner to abide by evidence-based practice and take ownership for the advancement of their own professional knowledge. Participants however felt that more emphasis needed to be placed on SIN testing during training

events. To use, and continue to use, a test as part of an assessment protocol, there needs to be an understanding of how it fits into clinical practice (Taylor, 2011). The feedback from the focus group suggested the participants lacked insight into SIN test availability and how the results could impact on clinical practice. This was corroborated by responses from the survey which suggested that participants lacked confidence with the results obtained from SIN testing compared to other speech audiometry tests administered.

These findings are important because they form the basis of SIN testing in South Africa. Further research needs to explore the extent to which SIN testing is emphasised at an undergraduate level at all training institutions and a national plan of action is encouraged to increase theoretical and clinical training on the procedure. Furthermore, profession specific associations should acknowledge that SIN testing may be a gap in current clinical practice and provide greater emphasis at professional development events. These finding provide greater motivation for the development and finalisation of a national guideline emphasising the inclusion of SIN testing as part of speech audiometry practices.

5.7 Language used to administer speech audiometry

Whilst there are 11 official languages, a variety of other languages are spoken in South Africa (Department of Arts and Culture, 2003). Therefore, the impact of the language used for testing would naturally be considered as an important factor in the implementation of speech audiometry. The languages used for speech audiometry testing as reported by participants were predominantly English, Afrikaans and isiZulu. There were pre-recorded SRT and WR tests available in both English and Afrikaans. Participants however reflected that accent and dialect differences were the reason that live voice was preferred over pre-recorded tests. Contrary to current research findings, previous research suggested that speech audiometry administered using live voice limits the validity of the test results (Mendel & Owen, 2011). Some participants shared that administering the test using live voice improved the validity as it was spoken in a language, dialect and accent familiar to the patient as discussed under the presentation mode section of this dissertation. Reliability and validity however did not play a meaningful role in test selection for most participants in the current study.

Language is extrinsically redundant, in that one can use the rules of the language to fill in the blanks, as well as intrinsically redundant, which refers to the auditory systems ability to transport the message to the brains' language centers (Taylor, 2011). This skill assists with language related tasks and tests. The impact on speech audiometry results cannot be negated when tests are not administered in a language familiar to the patient. Language, accent and dialect differences pose a unique challenge in the administration of speech audiometry in South Africa. Therefore, research priority should be given to the development and standardisation of speech audiometry tests appropriate for use in the South African context.

5.8 Factors which influenced the test selected for speech audiometry

There were a variety of factors which influenced participants' test selection for speech audiometry. Most of the participants were influenced either by availability of tests and wordlists for speech audiometry or confidence in administering the tests through constant use. Interestingly only 6.7% of participants chose a specific speech audiometry test because it was most appropriate for use in the South African context, and only 6.3% of participants chose a specific test because it was appropriate to use for the patient. The South African guideline recommends the use of pre-recorded monosyllabic words in quiet (HPCSA, 2009), however no other considerations were recommended. Previous studies found that audiologists based their speech audiometry test selection on availability, ease of administration, time required for testing, age of patient, hearing status, type of hearing disorder and type of amplification device if applicable (Sharma, Tripathy, & Saxena, 2016). The finding in the present study was substantial because it shows that participants were making decisions regarding test selection based on availability and familiarity, rather than appropriateness for use.

These results suggested a great lack of availability of tests appropriate for speech audiometry in South Africa. It further suggested that participants were not familiar or confident with tests that may be more appropriate for use with their patient population. The HPCSA guideline recommendations for the use of pre-recorded material was also not routinely followed. This was a meaningful finding as increasing access to more appropriate tests, and training on the tests, would support audiologists in the use of tests which are more suitable for

the patients. This is a task that could be undertaken by profession specific associations such as SAAA or SASLHA.

5.9 Confidence in speech audiometry administered

Participants' confidence level in the results obtained from speech audiometry tests was low overall. Less than 20% of participants felt extremely confident about results obtained from speech audiometry tests. Participants were however still more confident about SRT and WR test results, than SIN test results. It is likely that the reason for this was that participants were more familiar with SRT tests and WR tests than SIN tests. Participants' limited confidence in speech audiometry results obtained would question the value it added to the patient, the assessment results and the management plan.

There was no relationship between which specific tests were used and confidence levels. The researcher was unable to locate any previous studies on the factors which may influence South African audiologists' confidence levels in administering speech audiometry. This was an important finding as it suggested that even though a test may be developed or recorded with a South African accent, it may not increase audiologists' confidence in test results obtained.

The presentation method of the tests did appear to influence confidence levels. Interestingly, 100% of participants who administered SIN using pre-recorded tests were extremely confident about the results they obtained. Participants who used live voice for SIN testing were less confident about results obtained. Conversely, a greater percentage of participants who administered SRT and WR using live voice were more confident about their test results compared to those who administered SRT and WR using pre-recorded tests.

A popular response was that live voice was used to present tests in a language, dialect and accent that was familiar to the patient, and therefore render the test more useful during scoring and interpretation. It was known that results obtained from tests that vary in dialect

and accent have a measurable impact on speech audiometry performance (Nissel et al., 2013). These findings suggest that although presenting SRT or WR using live voice has been known to affect the reliability of test results (Mendel & Owen, 2011; Wilson, 2004), the participants of this study appeared to be confident about results obtained using live voice. Participants however appear to still prefer pre-recorded tests for SIN testing. This provided important insight for the development of tests appropriate for the South African context.

5.10 Clinical setting

Participants who worked in the private sector represented more than half (52%) of the sample. They routinely administered speech audiometry tests and almost half of them (48%) administered SIN tests. The availability of time was a reported barrier in the public sector with a low practitioner-to-patient ratio. In private practice however, practitioners were more flexible with the amount of time they could spend with a patient. This may be one of the reasons that speech audiometry was more routinely administered in private practice compared to public facilities. A previous study however suggested that if time was limited, SIN testing should be done because it can be used as a predictor for WR testing but WR testing cannot be used as a predictor for SIN testing (Mueller, 2016).

Limitations in terms of equipment, or working equipment was also a barrier that was reported by many participants who worked in the public healthcare sectors, and was an explanation provided for the reason speech audiometry was not being administered. In the private sector however, the practitioner had greater control over equipment resources, and therefore could be another explanation as to why speech audiometry was more routinely administered in private practice compared to the public healthcare sector.

Some survey participants reported that when working in the public healthcare sector, assessment protocols were already set for the department and the protocols may not include speech audiometry testing. However, this did not appear to be a common challenge in private practice as the practitioners again had more control and flexibility over assessment protocols. This may be a further contributing factor for the higher percentage of practitioners in private

practice administering speech audiometry compared to the public healthcare sector. It was highly recommended that SIN testing be an essential part of the diagnostic protocol (Taylor, 2011; Wilson, 2004) but it appeared that South African audiologists were not yet utilising the test as routinely as it should be. This was a further motivating factor for developing more inclusive nationally recommended guidelines and protocols for the assessment of adults with hearing difficulties. This may assist in maintaining a certain level of evidence-based practice regardless of clinical setting. It may also assist the public healthcare sector to motivate for the equipment required in order to follow best practice guideline.

5.11 Summary

This chapter discussed the results of the research study presented in chapter four in response to the sub-aims of the research. Speech audiometry practices were described in relation to frequency of administration, languages used for testing, factors influencing test selection, confidence in results obtained and clinical settings. Content analysis of the two focus group discussions revealed factors influencing the implementation of SIN testing in the South African context through 7 main themes namely, (i) hearing difficulties, (ii) perception of the need for SIN testing, (iii) patient counselling, (iv) availability of resources, (v) test validity, (vi) ideal test description and, (vii) training and knowledge. The results from the survey and focus groups did overlap and were therefore integrated. Literature available on the topic was used to compare and contrast findings from the present study to other studies. The significance of the findings in the present study was discussed.

Chapter 6: Conclusion

This chapter presents a summary of the research aims and findings, and their significance. The strengths and limitations of the study are discussed. There are also recommendations provided in terms of future research, guideline development and training requirements based on these research findings. Lastly, the implications of the findings are presented.

6.1 Summary of findings

The two sub-aims of the research study provided insight into South African audiologists use of SIN testing in the assessment of adults with hearing difficulties. The results confirmed that the primary listening complaint of patients in South Africa is the ability to follow SIN. The findings suggested that majority of participants used SRT and WR testing as part of their assessment of adults with hearing difficulties. Audiologists were comfortable using live voice to administer SRT and WR testing and confident about their test results. SIN testing was not routinely administered due to a variety of reasons which emerged from the focus group discussions. The primary role of SIN tests as identified by the participants was to counsel patients with regards to realistic expectations.

There were many factors considered across various clinical settings that were unique to the South African context. These were identified largely through the focus group discussions but was corroborated from comments found in the survey responses as well. The seven main factors which emerged were (i) hearing difficulties, (ii) perception of the need for SIN testing, (iii) patient counselling, (iv) availability of resources, (v) test validity, (vi) ideal test description and, (vii) training and knowledge. Of these, the greatest influencing factor was the lack of standardised tests available in the various languages spoken in South Africa.

6.2 Critical evaluation of the study

The researcher was aware of the strengths and limitation of the present study.

6.2.1 Strengths

The strengths of the present study are described below in terms of the methodology and findings.

- This study provided information on speech audiometry practices, specifically SIN testing, in the South African context which was not previously available. This information can now be used for further research and development in the area of SIN testing.

- The study utilised a mixed methods approach which combined descriptive statistics for data analysis and content analysis for a more in depth understanding of the findings.

- The participants in this study were a fair representation of the population in terms of gender and geographical location. Audiologists from various academic institutions were represented and audiologists from the public healthcare sector and private facilities contributed to the survey and focus group discussions.

- As far as the researcher was aware, the information obtained from the present study, and the significance thereof, it the first of its kind in the South African context. It therefore provides a strong foundation for understanding speech audiometry practices in South Africa and highlights the need for more research required in the area of SIN testing.

6.2.2 Limitations

The researcher was also aware of the methodological limitations of the study.

- Despite the use of a multi-pronged approach to the recruitment of participants, the study yielded a response rate of 4.77% and a 9% margin of error. Therefore, the results of this study are not an absolute representation of the population of audiologists in South Africa.

- A further limitation of the study was that the social desirability tendency could have played a role in the responses obtained for the survey and the focus group. The survey was online and therefore confidential however the responses may have been skewed for this reason.

6.3 Recommendations

The reflected a need for further research, guideline development and training needs. These are discussed below.

6.3.1 Recommendations for further research

- Further research on a similar topic as the present study should endeavor to obtain a greater sample size which could be a better representation of the population.

- The nature of the online survey cannot negate the possibility that the results were skewed and therefore it is recommended that future research should include the observation of participants in actual performance of speech audiometry for a truer representation of clinical practice.

- The results of this research suggested that the primary listening complaint of patients is not being appropriately addressed by audiologists through their assessment. The reason for the lack of SIN assessment has been explored in depth in this study however there is a need for this to be explored in greater detail in the management plan. If this is better understood, it can be better addressed.

- One of the factors which influenced SIN testing was the lack of knowledge regarding SIN testing. This study did not provide a detailed description of the impact of undergraduate training and work experience on the implementation of SIN testing, or the knowledge, perceptions and attitudes of South African audiologists around the topic of SIN testing. Information obtained from research on this would be able to inform training institutes and CPD programs on the needs to bridge the gap.

- Availability of test material was the primary reason for tests selection amongst South African audiologists. There were tests available which could be used for the South African population that are locally and internationally developed and recorded. There is a need for research which will indicate which of these tests could be most appropriate for use in South Africa. Once this is determined, perhaps the HPCSA and profession specific bodies could increase availability of that specific test so that audiologists could use tests which are more appropriate for the population.

- The HPCSA guideline recommended research priority be given to SIN tests standardised for the South African population. Some South African SIN tests, such as the South African DIN test and the South African AB wordlist in noise, have been developed and recorded. Standardising and norming these tests for the South African population should therefore be given research priority.

- This research has suggested that the primary role of SIN testing was to counsel patients for various purposes, which resulted in more realistic expectations. Further research could look more specifically at the pre- and post-fitting outcomes with patients who had SIN testing administered and were counselled appropriately compared to those who did not.

- A large percentage of South African audiologists were more confident about the results they obtain using live voice for SRT and WR testing because they could match

language, accent and dialect much better using that presentation method. Although the use of live voice for speech audiometry is largely not recommended due to its influence on validity and reliability, more in-depth research on the topic is required to understand its place and role in a country, such as South Africa, where the richness of languages poses a challenge with pre-recorded tests.

- It was surprising to find that audiologists confidence levels with the results obtained from speech audiometry was low. Further research could evaluate the factors which influenced confidence levels and provide recommendations to increase these across practitioners in the country.

- Lack of training on SIN testing at an undergraduate level was a theme that emerged from the focus group discussions but was not explored further in the present study. This should be explored in greater detail and recommendations could be provided to institutes regarding implementation.

- Participants reflected some resource challenges faced in administering both WR and SIN tests, such as time and finances. There is literature which suggests that in such circumstances, SIN testing would yield more valuable information than WR results. Further research could explore if that would be the case in the South African setting as well. This could inform audiologists regarding the best evidence-based, value-adding practices for the South African context.

6.3.2 Implications

There were a variety of speech audiometry practices in the South African context. The results of the present study consequently propose certain policy and practice implications.

6.3.3 Policy implications

The findings of the present study suggested the lack of a comprehensive national guideline and/or protocol for the assessment of adult patients with hearing difficulties. The information from this study can be used by the Professional Board for Speech, Language and Hearing professions of the HPCSA to develop a national protocol or guideline for speech audiometry practices in the South African setting. It is therefore strongly recommended that a national speech audiometry guideline and protocol be developed which includes the latest evidence-based recommendations on clinical practice. The adoption of this should be encouraged by the HPCSA and profession specific associations across all clinical settings. It can also be used for motivation of the necessary resources and equipment in the public healthcare sector.

6.3.4 Practice implications

Literature available suggests that SIN testing should be implemented as part of best-practice and is being done so in other countries. The results of the present research suggested that South African audiologists should be implementing it more routinely. One of the factors that influenced the implementation of SIN testing was the reported lack of training and exposure.

Participants expressed the lack of post-graduate training on SIN testing at courses, conferences and other CPD events. It is the responsibility of all health care providers to keep up to date with the latest evidence-based practices. It is recommended that SIN training be made available through profession specific training opportunities in order to bridge the gap to clinical practice.

6.4 Summary

Hearing difficulties in adults is a growing international concern (World Health Organization, 2018a). Audiologists are trained and specialised in assessing and managing adults with hearing difficulties. This study provided a description of current speech audiometry practices of audiologists in the assessment of adults hearing complaints. In doing so, it has

uncovered meaningful information which can be used as a basis for the development of nationally agreed upon speech audiometry practices in the management of adults hearing difficulties.

The importance of SIN testing has been justified through the literature. There is significant value in the information gathered from the results of SIN tests. The present study identified and described the factors which influenced SIN testing among South African audiologists. With this information, further research and resource development can be considered, enabling audiologists in South Africa to administer SIN testing to all individuals it is deemed to benefit.

References

Almeida, F., Faria, D., & Queirós, A. (2017). Strengths and limitations of qualitative and quantitative research methods. *European Journal of Education Studies*, *3*, 369–387. https://doi.org/10.5281/zenodo.887089

American Speech-Language-Hearing Association. (2006). *Preferred practice patterns for the profession of audiology*. Retrieved February 7, 2018, from https://doi.org/10.1044/policy.PP2006-00274

Atieno, O. P. (2009). An analysis of the strengths and limitation of qualitative and quantitative research paradigms. *Problems of Education in the 21st Century*, *13*, 13–18. http://ezproxy.deakin.edu.au/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=eue&AN=43917788&site=ehost-live&scope=site

Basu, D. (2018). Disease of public health importance in South Africa. *South African Journal of Public Health*, *2*(3), 48. https://doi.org/10.7196/SHS.2018.v2.i3.72

Beck, D. L., & Nilsson, M. (2013). Speech-in-noise testing: A pragmatic addendum to hearing aid fittings. *The Hearing Review*, *20*(5), 24–26.

Beck, D. L., & Repovsch, J. (2013). Observations on speech, speech-in-noise and embedded tests. *The Hearing Review*, *7*. https://www.hearingreview.com/practice-building/practice-management/continuing-education/observations-on-speech-speech-in-noise-and-embedded-tests

Blanche, M., Durrheim, K., & Kelly, K. (2006). First steps in qualitative data analysis. In M. Blanche, K. Durrheim, & D. Painter (Eds.), *Research in practice: Applied methods for the social sciences* (2nd ed., pp. 320–344). Cape Town: UCT Press.

Boothroyd, A. (1968). Developments in speech audiometry. *Journal of Sound*, *2*, 3–10.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. http://eprints.uwe.ac.uk/11735

Cameron, S., & Dillon, H. (2007). Development of the Listening on Spatialized Noise-Sentences Test (LISN-S). *Ear and Hearing*, *28*(2), 196–211. https://doi.org/10.1097/AUD.0b013e318031267f

CASLPO. (2018). *Practice standards and guidelines for hearing assessment of adults by audiologists*. http://www.caslpo.com/sites/default/uploads/files/PSG_EN_Hearing_Assessment_of_Adults_by_Audiologists.pdf

Ciorba, A., Bianchini, C., Pelucchi, S., & Pastore, A. (2012). The impact of hearing loss on the quality of life of elderly adults. *Clinical Interventions in Aging*, *7*, 159–163. https://doi.org/10.2147/CIA.S26059

Clark, J. G., Huff, C., & Earl, B. (2017). Clinical practice report card: are we meeting best practice standards for adult hearing rehabilitation? *Audiology Today*, *29*(6), 15–25. https://www.audiology.org/sites/default/files/AT296_NovDec_17.pdf

Coleman, H., & Unrau, Y. A. (2011). Qualitative data analysis. In R. M. Grinnell, JR & Y. A. Unrau (Eds.), *Social work research and evaluation: Foundations of evidence-based practice* (9th ed.). New York: Oxford University Press.

Cox, R., Alexander, G., & Gilmore, C. (1987). Development of the connected speech test. *Ear and Hearing*, *8*(5), 119s–126s.

Creswell, J. W. (2007). *Qualitative inquiry & research design: Choosing among five approaches* (2nd ed.). Thousand Oaks, CA: SAGE Publications, Inc.

Department of Arts and Culture. (2003). *National language policy framework*. Retrieved July 31, 2018, from

http://www.dac.gov.za/sites/default/files/LPD_Language%20Policy%20Framework_English_0.pdf

Department of Health and Human Services. (2010). *Using incentives to boost response rates* (Evaluation Brief No. 22; p. 2). Retrieved from https://www.cdc.gov/healthyyouth/evaluation/pdf/brief22.pdf

Department of Health and NHS. (2012). *Any qualified provider adult hearing services implementation pack* (Best Practice Guideline No. 18570). https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/475660/DH_-__Adult_Hearing_Implementation_Pack.pdf

Dillon, H., Guest, G., & Lovegrove, R. (1999). Measuring the outcomes of a national rehabilitative program: normative data for the client oriented scale of improvement (COSI) and the hearing aid users questionnaire (HAUQ). *Journal of the American Academy of Audiology*, *10*, 67–79.

Drost, E. A. (2011). Validity and reliability in social science research. *Educational Research and Perspectives*, *38*(1), 105–123. https://pdfs.semanticscholar.org/0815/34bfe6cf8dd0da1f40704098366f368da3e8.pdf

Duncan, K. R., & Aarts, N. L. (2006). A comparison of the HINT and QuickSIN tests. *Journal of Speech-Language Pathology and Audiology*, *30*(2), 86–94.

Durrheim, K. (2006). Research design. In M. Blanche, K. Durrheim, & D. Painter (Eds.), *Research in practice: Applied methods for the social sciences* (2nd ed., pp. 33–59). Cape Town: UCT Press.

Durrheim, K., & Painter, D. (2006). Collecting quantitative data: Sampling and measuring. In M. Blanche, K. Durrheim, & D. Painter (Eds.), *Research in practice: Applied methods for the social sciences* (2nd ed., pp. 131–159). Cape Town: UCT Press.

Egan, J. P. (1948). Articulation testing methods. *Laryngoscope*, *58*, 955–991.

Evans, S., McGettigan, C., Agnew, Z. K., Rosen, S., & Scott, S. K. (2016). Getting the cocktail party started: Masking effects in speech perception. *Journal of Cognitive Neuroscience*, *28*(3), 483–500. https://doi.org/10.1162/jocn_a_00913

Fouché-Copley, C., Govender, S., & Khan, N. (2016). The practices, challenges and recommendations of South African audiologists regarding managing children with auditory processing disorders. *South African Journal of Communication Disorders*, *63*(1). https://doi.org/DO - 10.4102/sajcd.v63i1.132

Govender, I., Mabuza, L. H., Ogunbanjo, G. A., & Mash, B. (2014). African primary care research: performing surveys using questionnaires. *African Journal of Primary Health Care & Family Medicine*, *6*, 1–7.

Granberg, S., Swanepoel, D. W., Englund, U., Moller, C., & Danermark, B. (2014). The ICF core sets for hearing loss project: International expert survey in functioning and disability of adults with hearing loss using the international classification of functioning, disability, and health (ICF). *International Journal of Audiology*, *53*, 497–506. https://doi.org/10.3109/14992027.2014.900196

Guest, G., Namey, E., & McKenna, K. (2016). How many focus groups are enough? Building an evidence base for nonprobability sample sizes. *Field Methods*, *29*(1), 3–22. https://doi.org/10.1177/1525822X16639015

Hall, J. (2017). Rethinking your diagnostic audiology battery: Using value added tests. *Audiology Online*. https://www.audiologyonline.com/articles/rethinking-your-diagnostic-audiology-battery-20463

Hanekom, T., Soer, M., & Pottas, L. (2015). Comparison of the South African Spondaic and CID W-1 wordlists for measuring speech recognition threshold. *South African Journal of Communication Disorders*, *62*(1), 97. PMC. https://doi.org/10.4102/sajcd.v62i1.97

Harris, T., Bardien, S., Schaaf, H., Petersen, L., de Jong, G., & Fagan, J. (2012). Aminoglycoside-induced hearing loss in HIV-positive and HIV-negative multidrug-resistant tuberculosis patients. *South African Medical Journal*, *102*(6), 363–366. https://doi.org/10.7196/SAMJ.4964

Hirsh, I. J., Davis, H., Silverman, S. R., Reynolds, E. G., Eldert, E., & Benson, R. W. (1952). Development of materials for speech audiometry. *Journal of Speech and Hearing Disorders*, *17*(3), 321–327. http://dx.doi.org/10.1044/jshd.1703.321

HPCSA. (2009). *Guidelines for diagnostic audiology in adults* (V. de Andrade, Ed.). unpublished.

Joubert, K., & Botha, D. (2019). Contributing factors to high prevalence of hearing impairment in the Elias Motsoaledi local municipal area, South Africa: A rural perspective. *South African Journal of Communication Disorders*, *66*(1). https://doi.org/DO - 10.4102/sajcd.v66i1.611

Kalikow, D., Stevens, K., & Elliott, L. (1977). Development of a test of speech intelligibility in noise using sentence materials with controlled word predictability. *Journal of Acoustical Society of America*, *61*(5), 1337–1351. https://doi.org/10.1121/1.381436

Kanjee, A. (2006). Assessment research. In M. Blanche, K. Durrheim, & D. Painter (Eds.), *Research in Practice: Applied methods for the social sciences* (2nd ed. pp. 476-498). Cape Town: UCT Press.

Khoza-Shangase, K. (2017). Risk versus benefit: Who assesses this in the management of patients on ototoxicity drugs. *Journal of Pharmacy and Bioallied Sciences*, *9*(3), 171–177. https://doi.org/10.4103/jpbs.JPBS_17_17

Killion, M. C., Niquette, P. A., Gudmundsen, G. I., Revit, L. J., & Banerjee, S. (2004). Development of a quick speech-in-noise test for measuring signal-to-noise ratio loss

in normal-hearing and hearing-impaired listeners. *Journal of Acoustical Society of America*, *116*(4 Pt 1), 2395–2405. https://doi.org/10.1121/1.1784440

Kim, J., Lee, J., Lee, K. W., Bahng, J., Lee, J. H., Choi, C.-H., Cho, S. J., Shin, E. Y., & Park, J. (2015). Test-retest reliability of word recognition score using Korean standard monosyllabic wordlists for adults as a function of the number of test words. *Journal of Audiology & Otology*, *19*(2), 68–73. https://doi.org/10.7874/jao.2015.19.2.68

Kochkin, S. (2010). MarkeTrak VIII: Consumer satisfaction with hearing aids is slowly increasing. *The Hearing Journal*, *63*(1), 19–32.

Kredo, T., Bernhardsson, S., Machingaidze, S., Young, T., Louw, Q., Ochodo, E., & Grimmer, K. (2016). Guide to clinical practice guidelines: the current state of play. *International Journal for Quality in Health Care*, *28*(1), 122–128. https://doi.org/10.1093/intqhc/mzv115

Kvale, S., & Brinkmann, S. (2009). *Interviews: Learning the craft of qualitative research interviewing* (2nd ed.). California: SAGE Publications, Inc.

Leedy, P. D., & Ormrod, J. E. (2013). *Practical research planning and design* (10th ed.). Boston: Pearson.

Louw, C., Swanepoel, D. W., Eikelboom, R. H., & Hugo, J. (2018). Prevalence of hearing loss at primary health care clinics in South Africa. *African Health Sciences*, *18*(2), 313–320. https://doi.org/10.4314/ahs.v18i2.16

Macefield, R. C., Jacobs, M., Korfage, I. J., Nicklin, J., Whistance, R. N., Brookes, S. T., Sprangers, M. A., & Blazeby, J. M. (2014). Developing core outcomes sets: Methods for identifying and including patient-reported outcomes (PROs). *Trials*, *15*(49). https://doi.org/10.1186/1745-6215-15-49

Mackersie, C. L., Boothroyd, A., & Minniear, D. (2001). Evaluation of the Computer-Assisted Speech Perception Assessment (CASPA) Test. *Journal of the American Academy of Audiology*, *12*(8), 390–396.

Martin, F., & Clark, J. G. (2003). *Introduction to audiology* (8th ed.). Boston: Allyn and Bacon.

McBurney, D. H. (2001). *Research methods* (5th ed.). Belmont: Wadsworth, Thomson Learning.

McCambridge, J., Witton, J., & Elbourne, D. R. (2014). Systematic review of the Hawthorne effect: New concepts are needed to study research participation effects. *Journal of Clinical Epidemiology*, *67*, 267–277. http://dx.doi.org/10.1016/j.jclinepi.2013.08.015

McCarney, R., Warner, J., Iliffe, S., van Haselen, R., Griffin, M., & Fisher, P. (2007). The Hawthorne Effect: A randomised, controlled trial. *BMC Medical Research Methodology*, *7*(1), 30. https://doi.org/10.1186/1471-2288-7-30

McKim, C. A. (2015). The value of mixed methods research: A mixed methods study. *Journal of Mixed Methods Research*, *11*(2), 202–222. https://doi.org/10.1177/1558689815607096

Mendel, L., & Owen, S. (2011). A study of recorded versus live voice word recognition. *International Journal of Audiology*, *50*, 688–693. https://doi.org/10.3109/14992027.2011.588964

Moore, D. R., Edmondson-Jones, M., Dawes, P., Fortnum, H., McCormack, A., Pierzycki, R. H., & Munro, K. J. (2014). Relationship between speech-in-noise threshold, hearing loss and cognition from 40-69 years pf age. *PLoS ONE*, *9*(9), e107720. https://doi.org/10.1371/journal.pone.0107720

Mueller, H. G. (2003). Fitting test protocols are “more honored in the breach than the observance.” *The Hearing Journal*, *56*(10), 19–20, 22–24, 26.

Mueller, H. G. (2016). Signia Expert Series: Speech-in-noise testing for selection and fitting of hearing aids: Worth the effort? *Audiology Online, Article 18336*. http://0-search.ebscohost.com.innopac.wits.ac.za/login.aspx?direct=true&db=rzh&AN=124292366&site=eds-live&scope=site

Mulwafu, W., Kuper, H., & Ensink, R. J. H. (2016). Prevalence and causes of hearing impairment in Africa. *Tropical Medicine and International Health*, *21*(2), 158–165. https://doi.org/10.1111/tmi.12640

Naude, A. (2018). Statistical evaluation and prediction of word recognition test scores for the Foneties Verteenwoordigende Enkellettergrepige Woordlyste in Afrikaans (FVEWA). *Tydskrif Vir Geesteswetenskappe*, *58*(1), 124–136. https://doi.org/doi.10.17159/2224-7912/2018/v58n1a8

Nilsson, M., Soli, S., & Sullivan, J. (1994). Development of the Hearing in Noise Test for the measurement of speech reception thresholds in quiet and in noise. *Journal of the Acoustical Society of America*, *95*(2), 1085–1099.

Niquette, P., Arcaroli, J., Revit, L., Parkinson, A., Staller, S., Skinner, M., & Killion, M. (2003, March). *Development of the BKB-SIN Test*. annual meeting of the American Audiology Society, Scottsdale.

Nissel, S. L., Harris, R. W., Channell, R. W., Richardson, N. E., Garlick, J. A., & Eggett, D. L. (2013). The effects of dialect on speech audiometry testing. *American Academy of Audiology*, *22*(2), 233–240. https://doi.org/doi: 10.1044/1059-0889(2013/12-0077

Norman, R., Bradshaw, D., Schneider, M., Pieterse, D., & Groenewald, P. (2006). *Revised burden of disease estimates for the comparative risk factor assessment, South Africa 2000*. Methodological Note, Cape Town.

Paglialonga, A., Grandori, F., & Tognola, G. (2013). Using the speech understanding in noise (SUN) test for adult hearing screening. *American Journal of Audiology*, *22*(6), 171–174.

Panday, S., Kathard, H., Pillay, M., & Govender, C. (2007). Development of a Zulu speech reception threshold test for Zulu first language speakers in Kwa Zulu-Natal. *South African Journal of Communication Disorders*, *54*, 111–122.

Panday, S., Kathard, H., Pillay, M., & Wilson, W. (2018). First-language raters' opinions when validating word recordings for a newly developed speech reception threshold test. *South African Journal of Communication Disorders*, *65*(1), 555. PMC. https://doi.org/10.4102/sajcd.v65i1.555

Peer, S. (2013). Otorhinolaryngology—Not just tonsils and grommets: Insights into the ENT scene in South Africa. *South African Medical Journal*, *103*(7), 455–457.

Potgieter, J., Swanepoel, D., Myburgh, H. C., & Smits, C. (2018). The South African smartphone digits-in-noise hearing test: Effect of age, hearing loss and speaking competence. *Ear and Hearing*, *39*(4), 656–663. https://doi.org/DOI: 10.1097/AUD.0000000000000522

Potgieter, J., Swanepoel, D., & Smits, C. (2018). Evaluating a smartphone digits-in-noise test as part of the audiometric test battery. *South African Journal of Communication Disorders*, *65*(1), 574. PMC. https://doi.org/10.4102/sajcd.v65i1.574

Rahman, M. (2016). The advantages and disadvantages of using qualitative and quantitative approaches and methods in language "testing and assessment" research: A literature review. *Journal of Education and Learning*, *6*, 102. https://doi.org/10.5539/jel.v6n1p102

Raines, J. C. (2011). Evaluating qualitative research studies. In R. M. Grinnell, JR & Y. A. Unrau (Eds.), *Social work research and evaluation* (9th ed.). New York: Oxford University Press.

Ramkissoon, I. (2001). Speech recognition thresholds for multilingual populations. *Communication Disorders Quarterly*, *22*(3), 158–162. https://doi.org/10.1177/152574010102200305

Ramkissoon, I., Proctor, A., Lansing, C., & Bilger, R. (2002). Digit speech recognition thresholds (SRT) for non-native speakers of English. *American Journal of Audiology*, *11*, 23–28. https://doi.org/10.1044/1059-0889(2002/005)

Ramma, L., & Sebothoma, B. (2016). The prevalence of hearing impairment within the Cape Town Metropolitan area. *South African Journal of Communication Disorders*, *63*, 1–10.

Richards, H. M., & Schwartz, L. J. (2002). Ethics of qualitative research: Are there special issues for health services research? *Family Practice*, *19*, 135–139.

Ryan, K. E., Gandha, T., Culbertson, M. J., & Carlson, C. (2014). Focus group evidence: Implications for design and analysis. *American Journal of Evaluation*, *35*(3), 328–345. https://doi.org/10.1177/1098214013508300

Samelli, A. G., de Andrade, C. Q., Pereira, M. B., & Matas, C. G. (2013). Hearing complaints and the audiological profile of the users of an academic health center in the western region of São Paulo. *International Archives of Otorhinolaryngology*, *17*(2), 125–130. PMC. https://doi.org/10.7162/S1809-97772013000200003

Scarinci, N., Worrall, L., & Hickson, L. (2009). The effect of hearing impairment in older people on the spouse: Development and psychometric testing of the Significant Other Scale of Hearing Disability (SOS-HEAR). *International Journal of Audiology*, *48*, 671–683. https://doi.org/10.1080/14992020902998409

Scarinci, N., Worrall, L., & Hickson, L. (2012). Factors associated with third-party disability in spouses of older people with hearing impairment. *Ear and Hearing, 33*, 698–708.

Schoepflin, J. (2012). Back to basics: Speech audiometry. *Audiology Online.* https://www.audiologyonline.com/articles/back-to-basics-speech-audiometry-6828

Scourfield, J. (2011). *Development of an Afrikaans sentence perception test based on the CUNY topic-related sentences—Phase 1: Sentence perception in noise* [Unpublished masters dissertation, University of Stellenbosch]. https://scholar.sun.ac.za/handle/10019.1/6584

Sharma, S., Tripathy, R., & Saxena, U. (2016). Critical appraisal of speech in noise tests: A systematic review and survey. *International Journal of Research in Medical Sciences*, *5*, 13. https://doi.org/10.18203/2320-6012.ijrms20164525

Singh, G., Barr, C., Montano, J., English, K., Russo, F., & Launer, S. (2017). Family-centered audiology care: Emotion and reason in hearing healthcare. *Hearing Review*, *24*(5), 30–32. https://www1.phonakpro.com/content/dam/phonakpro/gc_hq/en/resources/evidence/journal_articles/documents/singh_fcc_emotion_reason.pdf

Spyridakou, C., & Bamiou, D. (2015). Need of speech-in-noise testing to assess listening difficulties in older adults. *Hearing, Balance and Communication*, *13*, 65–76. https://doi.org/10.3109/15563650.2015.1015814

Statistics South Africa. (2012). *Census 2011 Census in brief* (No. 03-01–41). http://www.statssa.gov.za/census/census_2011/census_products/Census_2011_Census_in_brief.pdf

Statistics South Africa. (2014). *Census 2011: Profile of persons with disabilities in South Africa* (No. 03-01–59). https://www.statssa.gov.za/publications/Report-03-01-59/Report-03-01-592011.pdf

Statistics South Africa. (2017). *Stats in brief, 2017*. *Pretoria*. https://nationalgovernment.co.za/department_annual/203/2017-statistics-south-africa-(stats-sa)-annual-report.pdf

Swanepoel, D. (2006). Audiology in South Africa. *International Journal of Audiology, 45*, 262–266. https://doi.org/10.1080/14992020500485650

Taylor, B. (2003). Speech-in-noise tests: How and why to include them in your basic test battery. *The Hearing Journal*, *56*(1), 40–46.

Taylor, B. (2010). A proven strategy for addressing speech understanding in noise. *Hearing Review, 17*(4), 4.

Taylor, B. (2011). Using speech-in-noise tests to make better hearing aid selection decisions. *Audiology Online*. Retrieved March 19, 2018, from https://www.audiologyonline.com/articles/using-speech-in-noise-tests-832

Tillman, T. W., & Carhart, R. (1966). *A test for speech discrimination composed of CNC monosyllabic words, Northwestern University Auditory Test No. 4* (Technical Documentary Report SAM-TDR-62-135). Brooks Air Force Base. https://www.researchgate.net/publication/12503562_Word_recognition_performance_for_Northwestern_University_Auditory_Test_No_6_word_lists_in_quiet_and_in_competing_message

UNAIDS. (2017). Ending AIDS: Progress towards 90-90-90 targets. *Geneva*, *UNAIDS*. Retrieved March 19, 2018, from https://www.unaids.org/sites/default/files/media_asset/Global_AIDS_update_2017_en.pdf

Van der Riet, M., & Durrheim, K. (2006). Putting design into practice: Writing and evaluating research proposals. In M. Blanche, K. Durrheim, & D. Painter (Eds.),

Research in practice: Applied methods for the social sciences (2nd ed., pp. 80–111). Cape Town: UCT Press.

van Zyl, M., Swanepoel, D. W., & Myburgh, H. C. (2018). Modernising speech audiometry: Using a smartphone application to test word recognition. *International Journal of Audiology, 57*(3), 1–9. https://doi.org/10.1080/14992027.2018.1463465

Wassenaar, D. R. (2006). Ethical issues in social science research. In M. Blanche, K. Durrheim, & D. Painter (Eds.), *Research in practice: Applied methods for the social sciences* (2nd ed., pp. 60–79). Cape Town: UCT Press.

Wilson, R. (2003). Development of a speech in multitalker babble paradigm to assess word-recognition performance. *Journal of American Academy of Audiology, 14*, 453–470.

Wilson, R. (2004). Adding speech-in-noise testing to your clinical protocol: Why and how. *The Hearing Journal*, *57*(2), 10–19.

Wilson, R. (2011). Clinical experience with the words-in-noise test on 3430 veterans: Comparison with pure-tone thresholds and word recognition in quiet. *American Academy of Audiology*, *22*(7), 405–423. https://doi.org/10.3766/jaaa.22.7.3

Wilson, R., McArdle, R., & Smith, S. (2007). An evaluation of the BKB-SIN, HINT, QuickSIN, and WIN materials on listeners with normal hearing and listeners with hearing loss. *Journal of Speech, Language and Hearing Research*, *50*, 844–856.

Wilson, R., Morgan, D., & Dirks, D. (1973). A proposed SRT procedure and its statistical precedent. *Journal of Speech and Hearing Disorders*, *38*(2), 184–191. https://doi.org/10.1044/jshd.3802.184

Wilson, W., Jones, B., & Fridjhon, P. (1998). Use of the NAL AB wordlists as a South African English speech discrimination test. *South African Journal of Communication Disorders, 45*, 77–86.

Wilson, W., & Moodley, S. (2000). Use of the CID W22 as a South African English speech discrimination test. *South African Journal of Communication Disorders, 47*, 57–62.

WMA. (2013). World medical association declaration of Helsinki: Ethical principles for medical research involving human subjects. *Published Online, Special Communication*. https://doi.org/doi:10.1001/jama.2013.281053

World Health Organization. (2001). *International Classification of Functioning, Disability and Health, ICF*. Geneva. https://apps.who.int/iris/handle/10665/42407

World Health Organization. (2017). *World Health Assembly resolution on prevention of deafness and hearing loss. In: Seventh World Assembly,*. http://apps.who.int/gb/ebwha/pdf_files/WHA70/A70_R13-en.pdf

World Health Organization. (2018a). *Addressing the rising prevalence of hearing loss*. https://apps.who.int/iris/handle/10665/260336.

World Health Organization. (2018b). Deafness and hearing loss. *WHO Fact Sheet*, Geneva. http://www.who.int/mediacentre/factsheets/fs300/en/

Appendices

Appendix A: Online survey

SPEECH PATHOLOGY & AUDIOLOGY

SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT (SHCD)

Private Bag 3, Wits, 2050 • Tel: 011 717 4577 • Fax: 011 717 4572 • E-mail: hmthakor@gmail.com

Title of project: South African Audiologists' Use of Speech-in-Noise Testing for Adults with Hearing Difficulties

Participant No: _____

Date completed: _____

	Have you read and understood the participant information sheet, and do you provide consent for all items on the consent form? Yes No	 1 2
	Section A. Demographic information	
1	What gender are you? Female Male	 1 2
2	How old are you? (please specify in years; months)	
3	Which qualification do you have? (please select one) Audiologist Speech therapist and audiologist	 1 2
4	What is your highest qualification? (please select one) Undergraduate degree Master's degree AuD PhD Other (please specify):	 1 2 3 4 5
5	Which institute is your highest qualification from? (please select one)	

	University of the Witwatersrand University of Kwa-Zulu Natal University of Pretoria University of Cape Town Medunsa Sefako Makgato University Other (please specify):	1 2 3 4 5 6 7
6	What year did you complete your undergraduate degree? (please specify year)	
7	How long have you been working in audiology? (please specify in years; months)	
	Section B. Description of practice and services	
8	What is your current clinical setting/s? (please select all that apply) Private practice State hospital State clinic NGO Other (please specify): _____	 1 2 3 4 5
9	How would you describe your patient caseload (please select one) Adults only Paediatrics and adults	 1 2
10	How many adults, on average, do you see per week for a diagnostic hearing assessment?	
11	Do the adults you see complain of hearing difficulties in any of the following situations? (please select all that apply) Conversations with 1 or 2 in quiet Conversations with 1 or 2 in noise Conversations with group in quiet Conversations with group in noise Television/Radio at normal volume Familiar speaker on the phone Unfamiliar speaker on the phone Hearing the phone ring from another room Hearing the front doorbell or knock on the door Hearing in traffic During increased social contact Hearing at a place of worship Children voices Female voices Male voices Other (please specify):	 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
12	What would you describe as the primary hearing complaint of adults you see with hearing difficulties? (please select one) Conversations with 1 or 2 in quiet Conversations with 1 or 2 in noise Conversations with group in quiet Conversations with group in noise Television/Radio at normal volume	 1 2 3 4 5

	Familiar speaker on the phone	6
	Unfamiliar speaker on the phone	7
	Hearing the phone ring from another room	8
	Hearing the front doorbell or knock on the door	9
	Hearing in traffic	10
	During increased social contact	11
	Hearing at a place of worship	12
	Children voices	13
	Female voices	14
	Male voices	15
	Other (please specify):	16
	Section C. Speech audiometry	
13	Do you include speech reception threshold testing on adult patients? (please select one)	
	Never include (proceed to question 18)	1
	Rarely include (in less than10% of cases)	2
	Occasionally include (in about 30%of cases)	3
	Sometimes include (in about 50% of cases)	4
	Frequently include (in about 70% of cases)	5
	Usually include (in about 90% of cases)	6
	Always include	7
	Please elaborate why?	
14	What language/s do you perform speech reception threshold testing in? (please select all that apply)	
	English	1
	Afrikaans	2
	Ndebele	3
	Northern Sotho	4
	Southern Sotho	5
	Swati	6
	Tsonga	7
	Tswana	8
	Venda	9
	Xhosa	10
	Zulu	11
	Other (please specify):	12
15	Which speech reception threshold test/s do you use? (please select all that apply)	
	CID W-1 spondaic word list	1
	South African spondaic word list	2
	Other (please specify):	3
16	Why have you chosen to use this test? (please select all that apply)	
	Accuracy	1
	Availability	2
	Confidence in administrating it through constant use	3
	Ease of interpretation	4
	Ease of use and scoring	5
	Equipment requirements	6
	Most appropriate for the patients at the practice	7
	Reliability and validity	8

	Speed Other (Please elaborate the reason?):	9 10
17	What presentation method do you use for speech reception threshold testing and why? Live voice Pre-recorded A combination of both Please elaborate the reason?	 1 2 3
18	Do you feel confident about the results you obtain from your speech reception threshold test/s? Not at all confident Slightly confident Somewhat confident Very confident Extremely confident Please elaborate the reason?	 1 2 3 4 5
19	Do you include word recognition (speech discrimination) testing in your assessment protocol? Never include (proceed to question 25) Rarely include (in less than10% of cases) Occasionally include (in about 30%of cases) Sometimes include (in about 50% of cases) Frequently include (in about 70% of cases) Usually include (in about 90% of cases) Always include Please elaborate the reason?	 1 2 3 4 5 6 7
20	What language/s do you perform word recognition testing in? (please select all that apply) English Afrikaans Ndebele Northern Sotho Southern Sotho Swati Tsonga Tswana Venda Xhosa Zulu Other (please specify):	 1 2 3 4 5 6 7 8 9 10 11 12
21	Which word recognition test/s do you use? (please select all that apply) NU – 6 CIDW-22 PB 50 FVEWA Digit pair lists Nonsense material Sentence material Other (please elaborate):	 1 2 3 4 5 6 7 8
22	Why have you chosen to use this test? (please select all that apply) Accuracy	 1

	Availability	2
	Confidence in administrating it through constant use	3
	Ease of interpretation	4
	Ease of use and scoring	5
	Equipment requirements	6
	Most appropriate for the patients at the practice	7
	Reliability and validity	8
	Speed	9
	Other (please elaborate the reason):	10
23	What presentation method do you use for word recognition testing and why?	
	Live voice	
	Pre-recorded	1
	A combination of both	2
	Please elaborate the reason?	3
24	Do you feel confident about the results you obtain from your word recognition test/s?	
	Not at all confident	
	Slightly confident	1
	Somewhat confident	2
	Very confident	3
	Extremely confident	4
	Please elaborate the reason?	5
25	Do you include speech in noise testing in your assessment protocol?	
	Never include (proceed to question 31)	1
	Rarely include (in less than10% of cases)	2
	Occasionally include (in about 30%of cases)	3
	Sometimes include (in about 50% of cases)	4
	Frequently include (in about 70% of cases)	5
	Usually include (in about 90% of cases)	6
	Always include	7
	Please elaborate the reason?	
26	What language/s do you perform speech in noise tests in? (please select all that apply)	
	English	1
	Afrikaans	2
	Ndebele	3
	Northern Sotho	4
	Southern Sotho	5
	Swati	6
	Tsonga	7
	Tswana	8
	Venda	9
	Xhosa	10
	Zulu	11
	Other (please specify):	12
27	Which speech in noise test/s do you use? (please select all that apply)	
	South African Digits-in-Noise test	1
	Arthur Boothroyd word lists	2
	QuickSIN	3
	HINT	4
	WIN	5
	SPIN	6

	CST BKB-SIN Other (please specify):	7 8 9
28	Why have you chosen to use this test? (please select all that apply) Accuracy Availability Confidence in administrating it through constant use Ease of interpretation Ease of use and scoring Equipment requirements Most appropriate for the patients at the practice Reliability and validity Speed Other (Please elaborate):	 1 2 3 4 5 6 7 8 9 10
29	What presentation method do you use for speech in noise testing and why? Live voice Pre-recorded A combination of both Please elaborate the reason?	 1 2 3
30	Do you feel confident about the results you obtain from your speech in noise test/s? Not at all confident Slightly confident Somewhat confident Very confident Extremely confident Please elaborate the reason?	 1 2 3 4 5
	Section D. Managing hearing difficulties	
31	Do you fit amplification devices on adults? Yes No (proceed to question 36)	 1 2
32	How many amplification devices on average do you fit in a month?	
33	What percentage of patients fitted with amplification devices are completely satisfied with their performance in all situations?	
34	In your experience, what percentage of patients complains about difficulty hearing speech in a noisy environment with amplification devices?	
35	What percentage of patients fitted with amplification device/s choose not to continue wearing/using it due to unsatisfactory performance?	
36	What in your experience is the reason for unsatisfactory performance of understanding speech in noise with amplification devices? (please select all that apply) Budgetary constraints which do not support appropriate hearing aid technology level Poor speech in quiet discrimination scores Poor speech in noise scores Poor hearing aid performance Unrealistic expectations	 1 2 3 4 5

	Other (please specify):	6
	Section E. Other	
37	Further comments	
38	If you would like to be placed in a draw for a R500 Woolworths voucher, please provide your email address	
39	If you would like to be considered to participate in a focus group discussing the results of this survey and more on speech audiometry, please provide your email address below	

Thank you for your participation in the survey.

Appendix B: South African Association of Audiologist (SAAA) permission letter

SPEECH PATHOLOGY & AUDIOLOGY

SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT (SHCD)

Private Bag 3, Wits, 2050 • Tel: 011 717 4577 • Fax: 011 717 4572 • E-mail: hmthakor@gmail.com

Title of project: South African Audiologists' Use of Speech-in-Noise Testing for Adults with Hearing Difficulties

Gmail — Hema Thakor <hmthakor@gmail.com>

Research Survey
3 messages

Hema Thakor <hmthakor@gmail.com>
To: admin@audiologysa.co.za — Sat, Aug 11, 2018 at 5:38 PM

Good day

I am a speech and hearing therapist currently doing my masters in audiology. As part of my data collection, I have a short survey for practitioners to complete regarding adult diagnostic hearing assessments and management.

I am considering forums in which to distribute my survey and would like to inquire if the SAAA Facebook group and classifieds would be able to circulate my survey when I am ready for data collection and what the process may be?

I look forward to your response.

Thank you so much.

Hema Thakor
Speech Therapist and Audiologist

Cornelle Naude <admin@audiologysa.co.za>
To: Hema Thakor <hmthakor@gmail.com> — Tue, Aug 14, 2018 at 9:42 AM

Good day,

Thank you for your email.

You are more that welcome to post your survey on our Facebook page.

Kind regards

Cornelle Naude

SAAA – Administrative Officer

Tel: 082 727 5977

Fax: 086 543 6644

Web: www.audiologysa.co.za

South African Association of *Audiologists*
CARING FOR YOUR HEARING

+27 (0)82 727 5977 | admin@audiologysa.co.za | www.audiologysa.co.za

This email is intended only for the use of the individual or entity named above and may contain information that is confidential and privileged. If you are not the intended recipient, you are hereby notified that any dissemination, distribution or copying of this email is strictly prohibited. Opinions, conclusions and other information in this message that do not relate to the official business of our firm shall be understood as neither given nor endorsed by it.

Appendix C: South African Speech Language Hearing Association (SASLHA) permission letter

SPEECH PATHOLOGY & AUDIOLOGY

SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT (SHCD)

Private Bag 3, Wits, 2050 • Tel: 011 717 4577 • Fax: 011 717 4572 • E-mail: hmthakor@gmail.com

Title of project: South African Audiologists' Use of Speech-in-Noise Testing for Adults with Hearing Difficulties

Gmail Hema Thakor <hmthakor@gmail.com>

Survey research
4 messages

Hema Thakor <hmthakor@gmail.com> Sat, Aug 11, 2018 at 5:20 PM
To: admin@saslha.co.za

Good day

I trust you are well.

I am currently registered for my Masters in Audiology at the University of the Witwatersrand and in the process of submitting my proposal to the ethical committee for considerations.

As part of my research, I will conducting a survey on audiologists and speech therapists and audiologists in South Africa. I sent a Facebook message on 16th June, 2018 to inquire if SASLHA would be able to send it out to all its members and I was explained that it could be done at a minimal cost. I would like to confirm if this is indeed the case and would like to clarify what the cost may be?

I look forward to your response.

Thanks and regards
Hema Thakor
Speech Therapist and Audiologist .

Felicity <admin@saslha.co.za> Mon, Aug 13, 2018 at 9:49 AM
Reply-To: Felicity <admin@saslha.co.za>
To: hmthakor@gmail.com

Hi Hema Thakor,

Thank you for your email.
There is no cost involved to send out the survey. Kindly email the survey and letter from the Ethics Chairperson confirming your survey.

Regards,
SASLHA

Ticket: https://mymembership.freshdesk.com/helpdesk/tickets/3578
[Quoted text hidden]

hmthakor@gmail.com <hmthakor@gmail.com> Mon, Aug 13, 2018 at 2:18 PM
To: Felicity <admin@saslha.co.za>

Dear Felicity

Thank you kindly. I am in the process of ethics submission so will be in touch as soon as its cleared and ready for distribution.

Thanks again
Hema

Sent from my iPhone

Appendix D: Deputy Director of rehabilitation in Gauteng permission letter

SPEECH PATHOLOGY & AUDIOLOGY

SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT (SHCD)

Private Bag 3, Wits, 2050 • Tel: 011 717 4577 • Fax: 011 717 4572 • E-mail: hmthakor@gmail.com

Title of project: South African Audiologists' Use of Speech-in-Noise Testing for Adults with Hearing Difficulties

Gmail — Hema Thakor <hmthakor@gmail.com>

Research survey
2 messages

Hema Thakor <hmthakor@gmail.com> — Sat, Aug 11, 2018 at 5:58 PM
To: Elma.Burger@gauteng.gov.za

Dear Elma

I trust you are well

I am currently doing my Masters in Audiology. As part of my data collection, I have a short survey for practitioners in the private and state sector nationally to complete, regarding adult diagnostic hearing assessments and management.

I am considering ways in which to distribute my survey and would like to inquire if you would be able to circulate my survey when I am ready for data collection and what the process may be?

I look forward to your response.

Thank you so much.

Hema Thakor
Speech Therapist and Audiologist

Elma Burger <Elma.Burger@gauteng.gov.za> — Mon, Aug 13, 2018 at 4:34 PM
To: Hema Thakor <hmthakor@gmail.com>

Hema – I can certainly circulate – just send me the ethics number as well – did you get clearance from GHD as well.

From: Hema Thakor [mailto:hmthakor@gmail.com]
Sent: Saturday, August 11, 2018 5:58 PM
To: Elma Burger
Subject: Research survey

[Quoted text hidden]



Appendix E: Private practitioners group permission letter

SPEECH PATHOLOGY & AUDIOLOGY

SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT (SHCD)

Private Bag 3, Wits, 2050 • Tel: 011 717 4577 • Fax: 011 717 4572 • E-mail: hmthakor@gmail.com

Title of project: South African Audiologists' Use of Speech-in-Noise Testing for Adults with Hearing Difficulties

Gmail — Hema Thakor <hmthakor@gmail.com>

Research
3 messages

Hema Thakor <hmthakor@gmail.com> — Mon, Jun 18, 2018 at 11:37 AM
To: ppgrsa@gmail.com

Hello

I am a speech and hearing therapist currently doing my masters in audiology. As part of my data collection, I have a short survey for practitioners to complete regarding adult diagnostic hearing assessments and management.

I am considering forums in which to distribute my questionnaire and was wondering if the PPG meeting consists mostly of practitioners interested in speech therapy as I noticed the topics are mostly speech orientated?

If there are practitioners attending who do focus on audiology, would I be allowed to provide them with a paper-based questionnaire which would take approximately 10 minutes to complete should they wish to?

I look forward to your response.

Thank you so much.

Hema Thakor
Speech Therapist and Audiologist

PPGSA Private Practitioner <ppgrsa@gmail.com> — Tue, Jun 19, 2018 at 9:48 PM
To: Hema Thakor <hmthakor@gmail.com>

Good Evening Hema,

I hope this email finds you well.

so majority of the members of the PPG practice in speech, but if you would we can email out your survey to our data base - will reach alot more people then if you hand out in lectures, and hopefully you can get a few responses from there?

Let us know!

Warm regards,

PPG admin
[Quoted text hidden]

hmthakor@gmail.com <hmthakor@gmail.com> — Tue, Jun 19, 2018 at 10:10 PM
To: PPGSA Private Practitioner <ppgrsa@gmail.com>

Hello

Thank you so much. I appreciate your help and advice. I will be in touch once I am in my data collection phase.

Thanks again

Regards
Hema

Sent from my iPhone

Appendix F: Survey feedback sheet

Dear participant

Thank you for agreeing to pilot the research survey.
As part of the pilot project, I would like to invite you to complete the survey emailed to you.
I would highly appreciate feedback on the following topics once you have completed the survey.

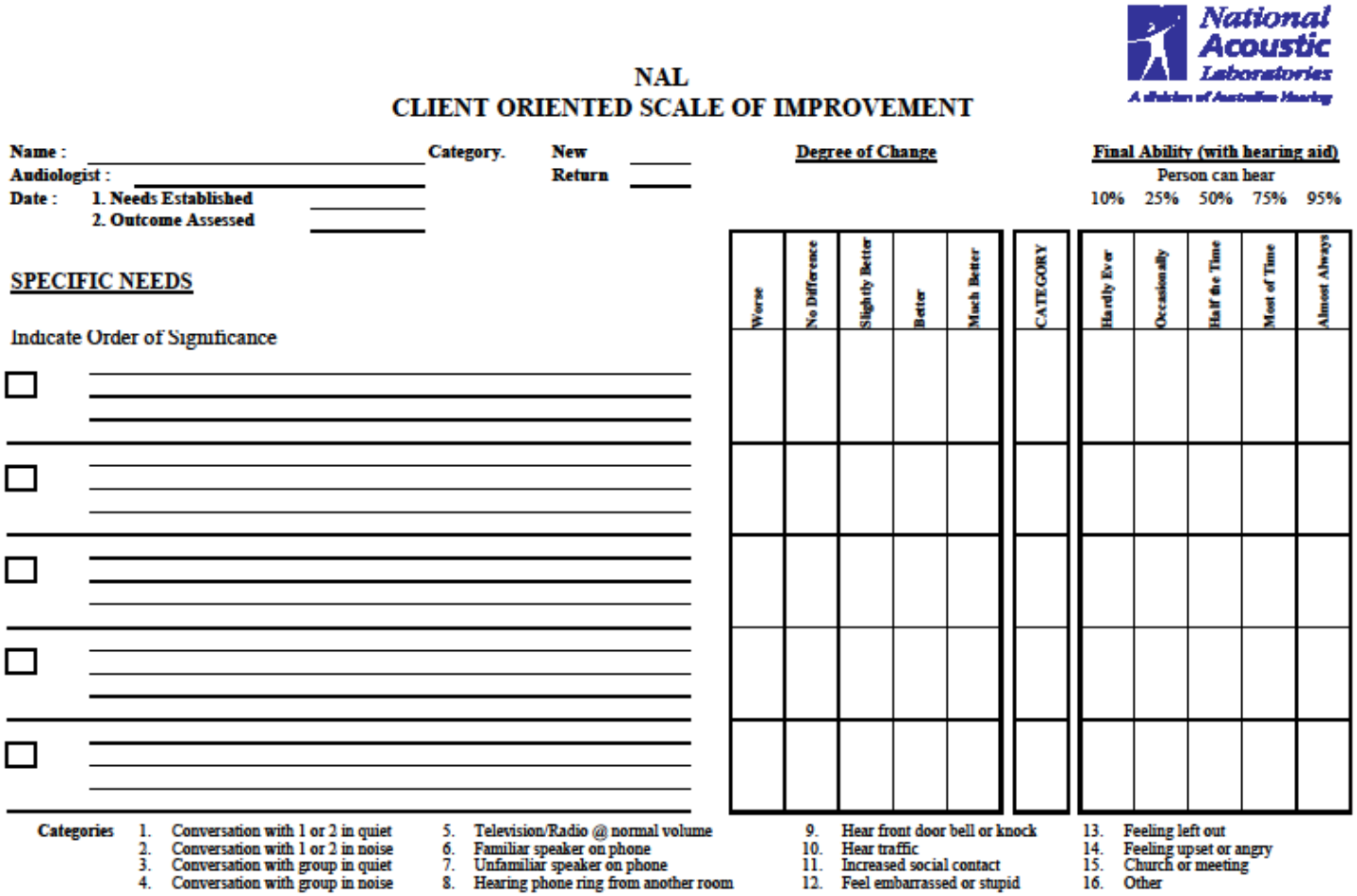
Topic	Description	Comments
Duration of survey	How long did it take to read the participant information sheet and complete the entire survey?	
Participant information sheet	Does the participant information sheet provide clarity on the purpose of the research and what is required from the participant?	
User-friendly	GoogleDocs has been used to create and distribute the survey, did you find it user-friendly? Is it easy to follow the link and access the survey?	
Format	Is the format of the survey easy to follow and interact with?	
Mobile friendly	If you completed the survey on a mobile phone, did you find the format mobile friendly?	
Flow of survey	Do the questions follow a logical flow within each section and as a whole	
Questions	Do you find the questions easy to understand and answer?	
Answering questions	Do you find the instructions on answering the questions helpful and straight-forward?	
Writing style	Do you find that the writing style is easy to understand?	
Changes	Are there any changes to the survey that you would recommend?	

I would be grateful if you can email the feedback to me by the 13th October 2018

Thank you kindly for agreeing to assist with this pilot project

Hema Thakor

Appendix G: Client Oriented Scale of Improvement (COSI)



NAL
CLIENT ORIENTED SCALE OF IMPROVEMENT

National Acoustic Laboratories
A division of Australian Hearing

Name : _____ **Category.** **New** _____
Audiologist : _____ **Return** _____
Date : **1. Needs Established** _____
2. Outcome Assessed _____

SPECIFIC NEEDS

Indicate Order of Significance

☐ _____
☐ _____
☐ _____
☐ _____
☐ _____

Degree of Change

Worse	No Difference	Slightly Better	Better	Much Better	CATEGORY

Final Ability (with hearing aid)
Person can hear

10%	25%	50%	75%	95%
Hardly Ever	Occasionally	Half the Time	Most of Time	Almost Always

Categories

1. Conversation with 1 or 2 in quiet
2. Conversation with 1 or 2 in noise
3. Conversation with group in quiet
4. Conversation with group in noise
5. Television/Radio @ normal volume
6. Familiar speaker on phone
7. Unfamiliar speaker on phone
8. Hearing phone ring from another room
9. Hear front door bell or knock
10. Hear traffic
11. Increased social contact
12. Feel embarrassed or stupid
13. Feeling left out
14. Feeling upset or angry
15. Church or meeting
16. Other

Appendix H: Focus group schedule

Focus Group Schedule

1. Invite all participants to skype group
2. Connect to speakers if possible
3. Send everyone a 5 minute pre-reminder via email/whatsapp.
4. Call everyone at 1, greet and welcome them.
5. Check that they have read the participant information sheet. States that it could be 60-90 minutes but many participants are time sensitive therefore we will aim for 45 minutes.
6. Read out consent requirements
    a. You have read the participant information sheet
    b. You agree to participate in the focus group
    c. You understand that due to the nature of the focus group, neither confidentiality nor anonymity can be guaranteed
    d. You provide consent to be audio and video recorded largely for transcription purposes
    e. You understand that the researcher may use quotes in her research report.

7. Few ground rules
    a. The purpose of this focus group is to identify and discuss factors influencing speech audiometry practices in SA, which is a country with a unique audiological stand-point.
    b. We would like to explore these factors as openly and as honestly as possible. Please feel very free to provide input wherever you feel fit without any obligation to contribute. It is only with this information that we can overcome or address challenges we may be facing in conducting speech audiometry to the best of our ability.
    c. Please share your thoughts, opinions, views, perspectives, experiences, etc to help us unpack this topic as much as possible.

8. Let's get started:
    a. Thank you all for completing the survey. In analysing the survey, it was found that there were many similarities amongst participant responses to questions.

b. One of the questions looked at patients main hearing complaints from a list provided. What would you describe as the most significant hearing complaint reported to you by your patients?
    i. Most audiologists reported that speech in noise was either a concern or the most significant concern for patients with a hearing loss. Do you find the same with your patients and how does that influence their ///activities of daily living?
c. How are you using this information to tailor your assessment and management plan specifically to the patient? EG: patient complains of discharge from the ear, we must do otoscopy, tymps, AC and BC for conductive components. How do we then tailor the assessment for a patient complaining of speech in noise?
d. A larger number of audiologists perform speech discrimination in quiet testing than speech in noise testing on adults. If we can all largely agree that speech in noise is the primary complaint, why are audiologists focusing more on speech in quiet testing and not on speech in noise testing?
e. What are the factors that may influence the administration of speech-in-noise testing on adults with hearing complaints in your context
f. What are the advantages and disadvantages to administering SIN testing?
g. If we were to standardly include speech-in-noise tests into our testing protocol, describe your most idea SIN test ito duration of test, method of administration, scoring, stimulus type
h. How would you describe adult hearing performance in noisy environments with and without hearing aids? What are the trends that you have picked up with your patients
i. Any further comments

9. I would like to thank you for your time and input.

Appendix I: Ethical clearance certificate

Research Office

HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)
R14/49 Thakor

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER: H18/09/30**
PROJECT TITLE	South African Audiologists' use of speech-in-noise testing for adults with hearing difficulties
INVESTIGATOR(S)	Miss H Thakor
SCHOOL/DEPARTMENT	Speech and Hearing Therapy/
DATE CONSIDERED	14 September 2018
DECISION OF THE COMMITTEE	Approved Permission letters required before data collection can commence
EXPIRY DATE	01 November 2021

DATE 02 November 2018 **CHAIRPERSON** _____
(Professor J Knight)

cc: Supervisor : Dr K Joubert

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University. Unreported changes to the application may invalidate the clearance given by the HREC (Non-Medical)

I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to completion of a yearly progress report.**

_____ _____/_____/_____
Signature Date

PLEASE QUOTE THE PROTOCOL NUMBER ON ALL ENQUIRIES

Appendix J: Focus group participant information letter

SPEECH PATHOLOGY & AUDIOLOGY

SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT (SHCD)

Private Bag 3, Wits, 2050 • Tel: 011 717 4577 • Fax: 011 717 4572 • E-mail: hmthakor@gmail.com

Title of project: South African Audiologists' Use of Speech-in-Noise Testing for Adults with Hearing Difficulties

Dear Audiologist

My name is Hema Thakor and I am an Audiology Masters student from the University of the Witwatersrand. As part of the requirements of the degree, I am required to complete a research dissertation. The aim of this study is to describe South African audiologists' use of speech audiometry in the assessment and management of adults with hearing difficulties.

As an audiologist who has completed the survey as part one of my research project, I would like to invite you to participate in phase two of the study. Phase two of the study involves two focus groups held in Gauteng to further discuss the results of the survey completed and gain deeper insight into factors influencing speech audiometry practices.

If you agree to participate in phase two of the study, you, together with five other participants, will be contacted to arrange a date and time that will best suit all six participants. The focus group will be done online and last approximately 60-90 minutes. There are no disadvantages or penalties for not participating. You may withdraw at any time or not answer any question if you do not want to without any negative consequences. It is hoped that the results of this study will assist with providing deeper insight into speech audiometry practices within the South African context than can benefit all audiologists.

All information obtained during the focus group will be used solely for research purposes. Personal information will be treated with the strictest confidentiality however due to the nature of focus groups, anonymity and confidentiality cannot be guaranteed. A participant number will be assigned to you to represent your participation in my final research dissertation. The focus group will be video-recorded and the recording will be stored electronically on a personal computer with a password protection.

All data collected in the course of the study will be securely retained for two (2) years, if a scientific publication arises from the study and six (6) years, if there is no publication. Thereafter, the data will be destroyed accordingly.

This study will be written up as a research report which will be available online through the university library website. If you wish to receive a summary of this report, I will be happy to send it to you upon request.

If you have any questions prior to your participation or at any time during the study, please do not hesitate to call me on 072 721 7536 or email me on hmthakor@gmail.com. You are

also welcome to contact my research supervisors (Dr Karin Joubert on 011 717 4561; email: Karin.joubert@wits.ac.za or Mrs Liepollo Ntlhakana on 011 717 4581; email Liepollo.ntlhakana@wits.ac.za).

If you have any queries, concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (non-medical), telephone +27(0)11 717 1408, email Shaun.Schoeman@wits.ac.za.

Warmest regards,
Hema Thakor

Appendix K: Survey participant information letter

SPEECH PATHOLOGY & AUDIOLOGY

SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT (SHCD)

Private Bag 3, Wits, 2050 • Tel: 011 717 4577 • Fax: 011 717 4572 • E-mail: hmthakor@gmail.com

Title of project: South African Audiologists' Use of Speech-in-Noise Testing for Adults with Hearing Difficulties

Dear Audiologist

My name is Hema Thakor and I am an Audiology Masters student from the University of the Witwatersrand. As part of the requirements of the degree, I am required to complete a research dissertation. The aim of this study is to describe South African audiologists' use of speech audiometry in the assessment and management of adults with hearing difficulties.

I would like to invite you, as an audiologist practicing in South Africa, to participate in phase one of this study. Phase one of the study the completion of an online survey and phase two involves a focus group discussion

If you agree to participate in phase one of the study, you may click on the link below which will redirect you to a survey regarding speech audiometry practices with adults with hearing difficulties. The survey will take approximately 10 minutes to complete. To acknowledge the time and effort taken, a R500 Woolworths gift voucher will be awarded to one participant completing the survey. The participant will be selected through a random draw and contacted via email to inform them of their winning. There are no disadvantages or penalties for not participating. You may withdraw at any time or not answer any question if you do not want to without any penalties. It is hoped that the results of this study will assist with providing deeper insight into speech audiometry practices within the South African context that can benefit all audiologists.

Phase two of the study involves two focus groups in Gauteng to provide greater insight into the results obtained from the survey. If you are willing to be invited to the focus group, please indicate this by providing your email address to the question pertaining to this in the survey. Please note that due to the limited number of participants who will be invited to the focus group, not all willing members may be able to participate.

All information obtained during the study will be used solely for research purposes. All data collected during the study will be securely retained for two (2) years, if a scientific publication arises from the study and six (6) years, if there is no publication. Thereafter, the data will be destroyed accordingly.

This study will be written up as a research report which will be available online through the university library website. If you wish to receive a summary of this report, I will be happy to send it to you upon request.

If you have any questions prior to your participation or at any time during the study, please do not hesitate to call me on 072 721 7536 or email me on hmthakor@gmail.com. You are also welcome to contact my research supervisors (Dr Karin Joubert on 011 717 4561; email: Karin.joubert@wits.ac.za or Mrs Liepollo Ntlhakana on 011 717 4581; email Liepollo.ntlhakana@wits.ac.za).

If you have any queries, concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (non-medical), telephone +27(0)11 717 1408, email Shaun.Schoeman@wits.ac.za.

Warmest regards,
Hema Thakor