TOWARDS THE DEVELOPMENT AND VALIDATION OF AN ISIXHOSA TOOL FOR THE ASSESSMENT OF APRAXIA OF SPEECH IN ADULTS: A DESCRIPTIVE STUDY

By

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Towards the Development and Validation of an IsiXhosa Tool for the Assessment of Apraxia of Speech in Adults: A Descriptive Study

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Glossary

This is a list of all the abbreviations used in this thesis from this point forward.

AOS – Apraxia of speech

CVA – Cerebro-vascular accident/stroke

SLP – Speech-Language Pathologist

TBI – traumatic brain injury

UCT – University of Cape Town

This is a list of terminology which do not have universally agreed upon definitions. These terms are listed with the definition used by the researcher for this thesis.

Addition – refers to the addition of one or more phonetically accurate non-target phonemes which is not distorted and which do not occur in the original speech stimulus (ASHA, 2019; Bislick et al., 2017).

Articulatory groping in AOS refers to articulatory searching an individual displays prior to phonating. It is seen as difficulty the participant displays with articulatory movements and can present as trial-and-error patterns in the articulation of phonemes (Galluzzi, 2015).

Broca's Aphasia – is a "classical non-fluent, and most generally recognised, form of aphasia. It is defined as a disturbance in or loss of speech, but with good comprehension of spoken language" (Schoeman & Van Der Merwe, 2010, p310).

Cognitive communicative disorder – is defined as a communication disorder in which the cognitive processes (attention, concentration and memory) are impaired and impact negatively on the individual's communication ability (ASHA, 2017).

Cultural appropriateness – refers to the acceptability and suitability of use of items/words in a specific culture

Distortion – refers to a change or alteration in the production of a phoneme in the target stimulus resulting in an unclear production of the target speech stimulus (ASHA, 2019). Distortion errors are defined as an attempt at the target phoneme that did not cross the phoneme boundary, produced with perceptible place, timing, manner or voice deviation from accurate production (Van Der Merwe, 2009). The target

phoneme is still recognizable (Den Ouden et al., 2018). Distortion errors may include sound distortions and distorted substitutions (Haley, Jacks, Richardson & Wambaugh 2017). Segment distortions give the impression that the sound production is phonetically incorrect, whereas distorted substitutions is recognized as phoneme errors that are also phonetically distorted (Haley et al., 2017).

Effortful speech – refers to the difficulty individuals have with finding and producing words and sentences. The speech is slow, hesitant, and laboured.

Impaired repetition – indicates that the individual's repetition of the target speech stimulus was poor.

Intonation: changes in pitch at the word level to indicate changes in meaning at the level of discourse. These changes indicate the speaker's attitude or emotion (Anderson, 2018).

Length: or length of sound is a suprasegmental feature. Vowels in words may be shortened or lengthened. The change in length of the vowel indicates changes in the meaning of the word at discourse level. Some languages use length contrastively to change the meaning of the words (Anderson, 2018).

Omission – refers to omitting or deleting a phoneme which is in the original speech stimulus (ASHA, 2019). Bislick and Hula (2019) used the definition for omission errors from Buchwald and Miozzo (2012); Buckingham (1986); and Dell (1988) who defined omission errors as deleted phonemes that may result from breakdown at the level of phonological retrieval (i.e. aphasic error) or motor planning (AOS error).

Perceived difficulty – refers to the isiXhosa speakers' perceptions of how difficult an isiXhosa word/phrase is to say (Yzer, et al., 2004).

Perceived frequency – refers to the isiXhosa speakers' perceptions on how frequently an isiXhosa word/phrase is used (Yzer, et al., 2004; Leroy & Kauchak, 2014).

Pitch: The pitch of a sound refers to how low or high frequency it is. High pitched sounds are produced when our vocal folds have a high-frequency vibration. Low pitched sounds are produced when our vocal folds vibrate more slowly

(Anderson, 2018). Pitch differences allow one to convey intent and emotion when speaking.

Prosody: also called suprasegmental information is the sounds beyond the level of the segments. Prosody makes up the rhythm, timing, meter, and stress of the words and sentences when spoken. The primary features of suprasegmental information are the pitch of sounds, the loudness, and the length of sounds (Anderson, 2018).

Substitution – indicates that an individual has substituted a phoneme for a different phoneme which differs from the original speech stimulus (ASHA, 2019). Substitution errors are defined as an inserted non-target phoneme that is phonetically accurate and include phonemic perseveration, anticipation, and transpositions errors (Van Der Merwe, 2009). Den Ouden et al. (2018) suggested that a substitution occurs when it is no longer possible to recognize the target phoneme or where the change of one or more features leads to the production of another phoneme (Den Ouden et al., 2018).

Tone: refers to the use of pitch to convey the meaning of a word (Yip, 2002). Some languages use varying pitch to change the meaning of words i.e. when the words are narrowly transcribed they look the same except where the tonal inflections are marked – indicating high tone, low tone or mid-tone (Anderson, 2018).

Abstract

South Africa is a culturally and linguistically diverse country. Serving isiXhosa speakers is a challenge for many Speech-Language Pathologists as there is a lack of appropriate assessment tools for this population. Current methods of adapting existing English tools are not appropriate as this does not allow the isiXhosa linguistic features to be assessed. Changing the method of scoring renders the tool invalid and unreliable. This project consisted of 3 sequential studies based in an exploratory quantitative framework. Each study has its own methodology and sub-aims with the overall aim to develop and determine the validity and reliability of isiXhosa speech stimuli for the assessment of Apraxia of Speech (AOS) in adults.

Study 1 aimed to describe and generate criteria and corresponding speech stimuli for an assessment of AOS in isiXhosa. IsiXhosa has distinguishing linguistic features – such as additional phonemes, alternate places and manners of articulation (e.g. ejectives), as well as phonetic features unique to the language (e.g. prenasalised consonants and tonal contrasts). Inclusion of these features were considered to be important in the creation of the tool.

Study 2 aimed to determine the face, content and construct validity of the generated criteria and speech stimuli. The speech stimuli which consisted of words, phrases and sentences were found to be culturally appropriate and to have face, content and construct validity as judged by a group of isiXhosa speakers and a Delphi panel. The speech stimuli met the criteria for an assessment of AOS as set out in Study 1.

Study 3 assessed the theoretical constructs outlined in Study 1 and Study 2 determined whether the revised criteria, which generated the newly devised speech stimuli, was valid and reliable in diagnosing AOS. The speech stimuli were based on criteria for the assessment of AOS and considered the isiXhosa linguistic features. There was high inter-rater reliability (79.2 – 98.4%) for determining the presence of features of AOS. Many of the error patterns displayed were similar to that documented in the literature for AOS, such as a higher number of errors were present on less frequently used speech stimuli and stimuli with an increasing number of syllables. It was it was hypothesized that the differences in the language such as clicks and tonal contrasts may add to complexity. Clicks presented with a higher number of errors whereas tonal contrasts had fewer errors suggesting tone was less affected by AOS.

Results further suggested that the first consonant of the stimulus rather than the initial phoneme in words add to complexity in isiXhosa. Further research in this area and refinement of the speech stimuli are required to create a comprehensive tool for assessment of AOS in adults.

Key words: *apraxia of speech; isiXhosa; assessment tool; adults; reliability; validity*

Chapter 1: Introduction

Overview of Chapter

Chapter one provides an introduction to the project. The rationale and research aims are briefly described. An overview of all chapters within this thesis is described.

This chapter describes the layout of the project as it consisted of three sequential studies, each presented separately. Due to the sequential design each study is presented as a chapter on its own. The literature pertaining to each study is presented within each chapter and therefore there is no overarching literature review chapter. Each chapter (2, 3, and 4) contains its own methodology with aims and objectives for each study. The results for each study are presented along with considerations for the subsequent study. Each study's findings are then discussed. The clinical implications and significance of this study within a South African context are presented.

Rationale for the Project

The number of valid and reliable speech assessment tools in the indigenous languages of South Africa is limited (Pascoe et al., 2010). To date there is no known published resource for the assessment of Apraxia of Speech in isiXhosa for adults. Assessment tools are required by SLPs to make accurate diagnoses about patients' speech and language disorders. Assessment in an unfamiliar language places additional cognitive demands on the neurological/linguistic processing system making it more challenging to determine the nature and severity of the presenting symptoms (Carter et al., 2005; Theron, Van der Merwe, Robin & Groenewald, 2009; Van der Merwe & Tesner, 2000). It is therefore necessary that appropriate assessment tools be developed (Carter et al., 2005). Adults presenting with AOS experience greater difficulty with volitional speech (Duffy, 2013). SLPs often adapt existing tools in English (e.g. translation of English words into isiXhosa) to assess patients who speak isiXhosa (Pascoe et al., 2010) including those with AOS. Adapted tools created through the process of translation may yield inaccurate results as translation will not assess the features of isiXhosa speech (Barrat, et al., 2012; Bornman, Sevcik, Romski & Pae, 2010; Niesler, Louw & Roux, 2005; Van der Merwe & Le Roux, 2014). In addition, there are problems with translated materials such as lack of congruence between the word and meaning in the languages concerned. Interlingual ambiguity may occur when translating words from one language to another (Raj & Rajendran,

2018). Translating English words into isiXhosa pose challenges as to whether the translated speech stimuli include all relevant linguistic features particular to the isiXhosa language. While some linguistic characteristics of languages may be shared between English and isiXhosa, many other features are not (Abrahams et al., 2011). It is therefore necessary to develop appropriate assessment tools (Carter et al., 2005) in isiXhosa that include features of the language (e.g. phonetics and morphology). The validity and reliability of the tool to make an accurate diagnosis will need to be established.

It may also make it difficult to determine whether the symptoms displayed by the individual are features of AOS if the assessment tool does not allow for elicitation of specific motor speech features of AOS (e.g. more errors on longer utterances; Patel et al., 2013). Failure to identify the features of AOS may result in an inaccurate diagnosis which would be detrimental to the management of the individual (Carter et al., 2005; Pahl & Kara, 1992; Van der Merwe & Tesner, 2000).

The lack of indigenous tools for the assessment of isiXhosa speech in adults, challenges with assessment in a language other than English and concerns with the validity and reliability of translated assessment materials led to this project which aimed to 1) determine the criteria for an assessment of AOS through reviewing existing assessment practices, 2) develop appropriate criteria for an assessment of AOS in isiXhosa, 3) generate speech stimuli that meet the novel criteria and 4) determine the validity and reliability of the newly devised criteria and generated speech stimuli in diagnosing AOS. These aims were realised in separate studies presented in this thesis.

Study Design

An exploratory sequential descriptive cross-sectional design was used. This study design was judged to be appropriate as it 1) typically allows for multiple steps and phases in order to complete the study (Durrheim, 2008), 2) allows the researcher to describe the process of creating valid and reliable assessment tools, and 3) allows the researcher to create a tool to assess isiXhosa speech (Durrheim, 2008; McNabb, 2007). Through the use of an exploratory sequential descriptive cross-sectional design and with reference to AOS in adult speakers, the aims and objectives of the project were as follows:

Study 1

1. To determine and describe the criteria for the speech stimuli in the assessment of AOS through synthesis of information from different sources
    a) To describe the linguistic criteria for speech stimuli to assess AOS
    b) To describe the linguistic features of isiXhosa
    c) To describe the implications the linguistic features have for the assessment of AOS in isiXhosa
    d) To generate and describe the criteria for an assessment of AOS in isiXhosa
    e) To generate isiXhosa speech stimuli that meet the criteria for the assessment of AOS in isiXhosa

Study 2

1. To determine face, content and, construct validity of the list of isiXhosa speech stimuli generated to meet the criteria for the assessment of AOS in adult speakers of isiXhosa.

Study 3

1. To determine the construct validity of the proposed criteria and the associated speech stimuli generated for the assessment of AOS in speakers of isiXhosa. Specifically, the proposal, that the speech stimuli associated with the following criteria (relating to complexity of speech productions) would generate AOS error patterns, was assessed:

    a) IsiXhosa adults with AOS would demonstrate errors on the first phoneme of the 2nd syllable in the word

    b) Increased number of syllables (i.e. increased length of utterance) adds to complexity resulting in more errors on these speech stimuli

    c) Repeated consonants within the speech stimuli are more complex and may result in more errors

    d) Words increasing in length with the same stem are more complex resulting in more errors

e) IsiXhosa words, phrases and sentences containing prenasalised consonants and clicks are more complex resulting in more errors on these speech stimuli

f) Tonal contrasts add to complexity in isiXhosa therefore these speech stimuli will result in more errors

g) More errors on infrequently used words

h) More errors on difficult words

2. To determine the clinical validity of the assessment tool to identify features of AOS

3. To determine inter-rater reliability of the list of isiXhosa speech stimuli generated to meet the criteria specified in Aim 1 of study 1.

4. To describe the performance of participants on the assessment tool.

A perceptual analysis of participants' speech was used to determine whether the revised criteria, which generated the newly devised speech stimuli, was valid and reliable in identifying features of AOS.

Significance, Implications, and Clinical Application

The study determined the pertinent methods of assessing AOS in adults with a neurological insult, whether these methods of assessment can be used in isiXhosa and how the language (i.e. isiXhosa phonetics, semantics and language structure) may influence assessment practices. It has shown that there are distinctions in language and these need to be considered when creating new assessment tools.

The project further intended to generate valid and reliable speech stimuli (words, phrases and sentences) which may aid SLPs in identifying features of AOS in isiXhosa speaking patients. Valid speech stimuli were created but further refinement is requirement.

This project is one way in which SLPs may overcome the challenge of limited indigenous assessment tools. It shows how novel ways of addressing the needs of the country may yield positive outcomes and asks yet more important questions which require further research.

Overview of Chapters

Chapter 2 presents Study 1 in detail. Literature pertaining to the South African context and provision of health care in the official languages of the Western Cape (a province within South Africa) is presented. The chapter also describes the current challenges faced by SLPs when assessing individuals who do not speak English as their home language. It outlines the methodological framework utilised and procedures followed in order to achieve the aim of generating the criteria for isiXhosa speech stimuli. The results of Study 1 are presented – criteria for an assessment of AOS, isiXhosa language features and implications for criteria in isiXhosa and speech stimuli that theoretically meet these criteria. A brief discussion of the results which influence Study 2 follows.

Chapter 3 describes Study 2 which aimed to determine the face, content and construct validity of the generated isiXhosa speech stimuli. It outlines all pertinent literature for the study and explains why validation of new assessment material is necessary. The methodology is described in detail as it differs from Study 1. The ethical considerations relevant to the study are presented. Study 2 involved data collection from 2 groups of participants – isiXhosa speakers and a Delphi panel. The results obtained from these two groups are presented and discussed.

Chapter 4 presents Study 3 of this project. A cross-sectional design was used to determine whether the revised criteria and associated speech stimuli proposed for the assessment of AOS in isiXhosa generates error patterns consistent with a diagnosis of AOS. It presents literature pertaining to the clinical validity, and reliability of the speech stimuli for the assessment of AOS in speakers of isiXhosa. There are many challenges with obtaining reliability when creating new assessment tools – these challenges are discussed. The study involved assessment of individuals using the isiXhosa speech stimuli. The results of the cross-sectional study and participants' performance are presented. The significant results of the project are discussed, the limitations of the study and the clinical implications presented. The chapter describes the usability of the tool within a South African context. Future research ideas are outlined as this is the first project which aimed to create valid and reliable isiXhosa speech stimuli for the assessment of AOS in adults.

Chapter 2: Study 1

Literature Review

Introduction

The literature review describes the context and adds to the rationale of why this research is important in South Africa. Currently, no isiXhosa speech assessment tool exists for adults with apraxia of speech (AOS) in South Africa. The importance of research on speech assessment tools for adults in the local languages in South Africa is discussed. The assessment and practice challenges faced by South African SLPs (Southwood & Van Dulm, 2015) are described. Possible solutions such as the generation of material for the assessment of speech in adults are explored and critiqued. The nature and assessment of AOS is described. Finally, the chapter makes an argument for the importance of test development particularly in African languages.

South African Context

South Africa is a multilingual, multicultural country with 12 official languages. IsiXhosa is the second most spoken language in the country (spoken by 16.3% of the population), after isiZulu (which is spoken by 24.4%; Statistics South Africa, Census 2022). According to Statistics South Africa (Census 2022) isiXhosa is also a dominant language of the Western Cape with 31.4% of individuals in the province who speak isiXhosa as their first language.

Since the inception of the new democratic constitution, all 12 languages (i.e. Afrikaans, English, isiNdebele, isiXhosa, isiZulu, Sesotho sa Leboa, Sesotho, Setswana, siSwati, Tshivenda, Xitsonga and South African Sign Language) have been given equal status (i.e. individuals should be able to access services and use any of the official languages to communicate in government institutions). In the Western Cape measures have been taken to support multilingualism. The Western Cape Language Act (1998) supports promotion of multilingualism through the provision of government services (e.g. public health care services) in the individual's home language. The Act states that individuals should be served (e.g. receive health care provided by a health worker) in any of the three official languages (i.e. English, Afrikaans and isiXhosa) of the province (Western Cape Language Act, 1998). There is however a discrepancy between the principle embedded in the constitution, and the Western Cape Language Act (1998); and the practical implementation of this law

(Barrat et al., 2012). The area of service provision that this study is concerned with is health care and speech language pathology in an official language of the Western Cape.

Provision of Health Care in the Official Languages of the Western Cape

A common feature of health care provision in the South African context is the mismatch between the language and culture of the health care professional and patient (Barrat et al., 2012; Kathard, 1998; Levin, 2006; Williams & Bekker, 2009). Williams and Bekker (2009) investigated the application of the language policy in the public sector in Cape Town. Their study found that health care services provided to isiXhosa speaking patients were not equal to those provided to English or Afrikaans speaking patients. They reported that isiXhosa speaking individuals' needs are not adequately recognized, the standard of care provided is lower than that provided to English or Afrikaans speaking individuals, the health care professionals treatment of the isiXhosa speaker is different, and patients are less satisfied with the services they receive as the management does not meet their needs.

Levin (2006) further explored the perceptions of isiXhosa speaking parents about barriers to health care provided to their children. He found that a main barrier to health care was language and cultural differences between the health care professional and the patient. In his study participants indicated that they felt dissatisfied with the communication which occurred between them and the health care professional and some (45%) were concerned that poor communication would have a negative effect on their care.

The language barrier which exists between health care professionals and patients is seen to "impede the provision of equitable and effective health care" (Deumert, 2010, p.53). Deumert (2010) summarised the effects of the language barrier on healthcare into three categories namely, 1) avoidance behaviour, 2) errors in diagnosis and treatment, and 3) health education and adherence. Errors in diagnosis and treatment may result from inadequate communication as the health care professional is unable to ask appropriate and important questions as well as administer relevant tests to acquire an accurate diagnosis (Deumert, 2010).

When specifically considering the profession of Speech-Language Pathology the same applies – as services provided to isiXhosa speaking patients may not be equal

to the services provided to English speaking patients (Williams & Bekker, 2009). The discrepancy in healthcare provision to isiXhosa speaking patients may be due to many SLPs speaking English or Afrikaans as a first language and treating patients in the respective languages which are not the patients' home languages (Penn, Frankel, Watermeyer, & Muller, 2009). The mismatch in home language between the health care professional and patient is also evident in the Western Cape as Pascoe et al. (2010) found that a large number of SLPs are only able to offer services in English or Afrikaans even though this may not be the first language of their patient. For example: isiXhosa speaking patients may not receive comprehensive assessment and treatment in their home language and the assessment may be unable to identify all speech sound errors, or language errors and subsequently the patient may receive limited therapy as the therapist is unfamiliar with patient's home language.

The provision of services in the Western Cape may not be in accordance with the language policy of the province (Levin, 2006; Pascoe et al., 2010; Williams & Bekker, 2009). It is also evident that the language barrier which exists between health care professionals and patients may negatively impact the quality of the services that patients receive at every level of intervention (Deumert, 2010; Southwood & Van Dulm, 2015).

Current Issues with Assessment in the South African Context

SLPs screen individuals, conduct comprehensive assessments, diagnose, manage, and counsel patients and families about speech, language and swallowing disorders. The wide range of activities (including assessment) all involve speaking and use of language in different forms (e.g. verbal or written). South African SLPs face many challenges with regards to the assessment of patients who speak a language other than English. One of the difficulties is that of limited assessment tools available in the indigenous languages of South Africa (Southwood & Van Dulm, 2015). In order to manage this situation SLPs may assess in the patient's second or third language, use standardised tests created for English speakers outside of South Africa (i.e. assessment tools standardised on American, British or Australian populations) or make adaptations to the available English assessment tools (Pascoe et al., 2010; Pascoe & Norman, 2011). Each of these practices however can have a negative impact on patients as results obtained using these measures may not be accurate (Gould, 2008;

Pahl & Kara, 1992). The following section further describes why these solutions may hinder rather than assist SLPs in making an accurate diagnosis.

Assessment of Speech Using Materials Not Standardised in South Africa

A limitation of using assessment materials which are not designed for and standardised on the South African population is that the assessment may yield results which are not a true reflection of the individual's performance (Gould, 2008; Pahl & Kara, 1992). As early as 1992, Pahl and Kara's research on the use of an English assessment standardized on the British population with typically developing South African English-speaking children indicated that even though the children spoke the same language (i.e. English) their test scores indicated that they had expressive language difficulties. Similarly, in Gould's (2008) study exploring assessment practices of Speech Therapists in Australia when working with Aboriginal children, she found that the standardized assessments (for Standard Australian English speakers) administered on the Aboriginal children did not benefit them but rather did more harm. The inaccurate results obtained may be due to various factors including the material being culturally inappropriate (Carter et al., 2005; Gould, 2008).

Assessment materials need to be designed, developed and standardised on the particular population with which it will be utilised (SASLHA, 2011). South Africa has a number of language groups and speech assessment materials need to be developed and standardised for each group. Assessments of speech ought to be in the speaker's home language, taking into account the culture regardless of the dominant language and culture of the country (SASLHA, 2011). Standardisation of tests on the South African population may be challenging due to the large number of subgroups with different languages, dialects and cultures.

To improve the accuracy of internationally developed and standardised assessment tools, Wilson and Moodley (2000) suggested that tools in English be re-standardised for the South African population. This process would include consideration of the culture of the population being tested (Carter et al., 2005). Re-standardization of English tools will not be appropriate for the assessment of isiXhosa speakers' speech as it will not allow specific speech sounds in isiXhosa to be assessed. Assessment of individuals require the creation of appropriate assessment tools in the individual's first language (Carter et al., 2005) to prevent inaccurate results and under

or over diagnosis of a disorder (Gould, 2008; Pahl & Kara, 1992). This study focuses on developing isiXhosa speech stimuli which takes into consideration the specific language features and culture of isiXhosa speakers.

The Problem with Translation of Assessment Material

SLPs often adapt materials to address the lack of culturally and linguistically appropriate assessment and therapy resources for the South African population (Pascoe et al., 2010). They may translate standardised assessment materials into the individual's home language, change the method of administration and/or qualitatively interpret and analyse results (Pascoe et al., 2010).

Translating materials into the individual's home language, as suggested by Gladstone et al. (2008) would not be appropriate for an assessment of AOS in isiXhosa. Translation of English speech assessment tools will not allow the phonetic features of isiXhosa to be assessed (Bornman, Sevcik, Romski & Pae, 2010) as there are differences in the phonetics of isiXhosa and English (Niesler, Louw & Roux, 2005; Van der Merwe & Le Roux, 2014). For example, when the English word 'teeth' – assessing the production of /t/ and /O/ – is translated to isiXhosa it is 'amazinyo' and thus the articulation of /t/ and /O/ cannot be assessed. Furthermore, the isiXhosa language structure is different to that of English and a single word in isiXhosa may be a sentence in English (e.g. ndiphilile – I am fine) thus adding linguistic and syntactic complexity to the speech stimulus being assessed. Additionally, isiXhosa is a tonal language and stress and intonation patterns impact on the syntax and semantics of the language. Thus, when translating from English to isiXhosa, the translated speech stimulus may not contain the same stress and intonation pattern, and the tonal patterns of isiXhosa may influence the response obtained (Barrat, et al., 2012).

The issue of interlingual ambiguity may also arise when translating (Raj & Rajendran, 2018) as context allows the correct translation to be selected, but when the context is less understood the incorrect translation may be selected resulting in a speech stimulus which does not assess what it was intended to assess.

In a study by Barrat et al. (2012) education levels of the translators used also influenced the sentence structure and vocabulary of the translations which impacted on the participant's ability to comprehend the stimulus. Barret et al. (2012) found that

translators with tertiary level education used more formal translations, whereas the translators with lower levels of education used more colloquial terms which were often borrowed words from other languages such as Afrikaans.

Face and content validity of the speech assessment tool will be compromised when translated (Hilton & Skrutkowski, 2002) as the test will not be able to assess what it was designed to assess (i.e. speech sounds in isiXhosa) thus making translation inappropriate.

Assessment in a Second or Third Language

According to Theron et al. (2009) speech production in an individual's second language is more challenging than the first language. This difficulty may be due to the individual being less familiar with a second language and that language being less automatic than the first language, thus increasing the demands on processing (Broos, Duyck & Hartsuiker, 2018; Theron et al., 2009). Van der Merwe and Tesner (2000) investigated bilingual speakers with AOS and reported that the participants exhibited a greater number of errors in their second language than in the first language. The errors that were produced in the first and second language were similar types of errors (e.g. voicing, consonant substitution, consonant distortion and vowel errors). More conscious processing is required to produce speech in the second language and assessment in an individual's second language may result in more errors with a possibility of misdiagnosis and mismanagement (Carter et al., 2005; Van der Merwe & Tesner, 2000). It is thus important to note that SLPs may make an inaccurate diagnosis (e.g. diagnosing a pathology when it is a difference linked to the first language's linguistic, phonological or phonetic system when assessing patients in a language other than in their home language; Carter et al., 2005; Van der Merwe & Tesner, 2000). This misdiagnosis would negatively impact treatment planning and management of the individual and may result in poorer treatment outcomes. Therefore, it is necessary to assess patients in their first language.

Acquired Motor Speech Disorders

Acquired motor speech disorders are defined by Lowit, Miller and Kuschmann (2014) as an impairment of speech that occurs after the period of normal speech development. It includes the structural (anatomy) and functioning (planning and execution) aspects of speech in both motor and sensory components. Motor speech

disorders include the dysarthria and apraxia of speech (AOS). The motor speech disorder that this study is concerned with is that of AOS.

What is AOS and when does it occur?

AOS is an acquired speech impairment that can occur in the absence of any linguistic and muscle weakness. Articulation and prosody are the two subsystems of speech which are impaired, which is unlike dysarthria in which any or all of the subsystems may be impaired. Conceptualisation of AOS is based on behavioural, computational, and imaging studies with a focus on the dynamic nature of the disorder and the interaction between linguistic and motor processes (Allison et al., 2020). AOS occurs because of impaired motor planning resulting in a breakdown in articulation and prosody of speech. It typically occurs after a stroke or brain injury, as well as in neurodegenerative diseases (Duffy et al., 2021; Wong, Wong & Velleman, 2022). AOS frequently co-occurs with aphasia and dysarthria (Allison et al., 2020; Ballard et al., 2016; Duffy et al., 2014; McNeil et al., 2017). It is clinically difficult to determine whether the breakdown in speech may be attributed to a breakdown in linguistic encoding (Aphasia), motor planning (AOS) or execution (Dysarthria; Allison et al., 2020; Ballard et al., 2016; McNeil et al., 2017) as the typical signs for these disorders overlap (Allison et al., 2020).

Theoretical models of AOS

Several theories have been proposed to explain the nature of the breakdown that results in AOS. These theories include those from a linguistic perspective (Levelt, 1989), neurolinguistics (Van Der Merwe, 2021), neural networks of the acquisition of speech motor skills and production of speech [i.e. Directions into Velocities of Articulators (DIVA); Gradient Order Directions into Velocities of Articulators (GODIVA)] Guenther et al., 2006; Miller & Guenther, 2021) and non-linear gestural models (Ziegler et al, 2021).

Theories generally propose multiple stages in speech production. Conceptualization (Levelt, 1989) occurs first. In this initial stage the idea is generated. Thereafter, grammatical and phonological encoding occurs. In this linguistic stage the appropriate abstract phonology, semantics and syntax is encoded (Levelt, 1989; Van Der Merwe, 2021). Motor planning and programming then occurs. Van Der Merwe (2021) proposes a distinction between “motor planning” and “motor programming”

whereas other theories propose and use “planning” and “programming” interchangeably. In the motor planning stage, the phonological representation is translated into specific phonetic motor plans/commands for articulation of the phoneme (Allison et al., 2020; Ballard et al., 2016; Van Der Merwe, 2021). After motor planning, motor programming then (Van Der Merwe, 2021), specifies muscles tone, range and rate of movement which are modified in response to spatio-temporal feedback with motor adjustments being made for a phoneme depending on where the phoneme occurs in the word (Van Der Merwe, 2021). Van Der Merwe’s (2021) distinction between motor planning and motor programming distinguishes between AOS and other motor speech disorders such as ataxic dysarthria. AOS is proposed to occur at the motor planning stage with difficulty in translating the phonological information into specific motor commands (Allison et al., 2020; Ballard et al., 2016; Van Der Merwe, 2021). Ataxic, hyperkinetic, hypokinetic and spastic dysarthria occur at the motor programming stage (Aradi & Cucchiara, 2021; Van Der Merwe, 2021). Execution of motor commands is the final stage in speech production and impairments at this level result in flaccid dysarthria (Van der Merwe, 2021).

Approaches to assessment and diagnosis of AOS

In developing appropriate material for the assessment of AOS, a review of current assessment practices to diagnose AOS may be helpful in determining critical/key elements to include in an AOS assessment tool. The Apraxia Battery for Adults (Dabul, 2000) and the Apraxia of Speech Rating Scale (ASRS, Strand et al., 2014) are tools which have been used by clinicians and researchers in addition to an oral motor evaluation, speech assessments and language assessment tools.

The ABA (Dabul, 2000) assesses speech in automatic speech, repetition tasks which include (1) AMRs (2) SMRs (3) monosyllabic and multisyllabic words (4) words of increasing length with the same stem and (5) sentences; connected speech; and reading. The ABA measures the presence and severity of AOS and has high reliability (Dabul, 2000). The ASRS is a descriptive tool, which is reported be valid and reliable in identifying the presence of AOS, its main features and its severity (Duffy et el., 2023) The scale is reported to have high sensitivity to AOS and high specificity to aphasia and dysarthria in neurodegenerative disorders (Duffy et al, 2023). To determine the presence of the primary features of AOS, the Western Aphasia

Battery-Revised (WAB-R), AMRs and SMRs, as well as tasks to elicit conversation and repetition of words and sentences are administered. The individual's performance is scored using the ASRS (Strand et al., 2014).

The oral motor examination evaluates the structure and function of the muscles involved in speech and is able to identify weakness in the oral musculature which contributes to a diagnosis of dysarthria (Duffy, 2013; Duffy et al., 2021). The evaluation of non-verbal tasks includes sequencing of oral movements of the lips, jaw and tongue, to identify impairments in sequencing of oral movements for a diagnosis of non-verbal apraxia (Duffy et al., 2021). There has been debate about the need to include the non-verbal tasks but the main reason for inclusion is to allow for a more comprehensive description of the individual's impairment profile as well as for differential diagnosis (Duffy et al., 2021).

Diadochokinesis tasks are included, and these are the alternating motion rates (AMRs; Dabul, 2000; Haley et al., 2012; Jonkers et al., 2017; Ogar et al., 2006)) and sequential motion rates (SMRs; Ballard et al., 2016; Jonkers et al., 2017; Ogar et al., 2006). These tasks assess rapid repetition and alternating movements for motor speech production.

A speech assessment includes a range of formal and informal tasks which are used to identify features of AOS and differentiate it from dysarthria and aphasia (Ballard et al., 2016; Duffy, 2013; McNeil et al., 2017). The tasks included in an assessment to elicit speech are: automatic speech (Dabul, 2000; Duffy, 2005; Ballard et al., 2016); repetition tasks (Ballard et al., 2016; Cunningham et al., 2016; Dabul, 2000; Duffy, 2013; Haley et al., 2012; Laganaro, 2012; McNeil et al., 2017; Ogar et al., 2006; Staiger et al., 2012; Strand & McNeil, 1996;) connected speech (Ballard et al., 2016; Cunningham et al., 2016; Dabul, 2000); and reading (Ballard et al., 2016; Dabul, 2000; Laganaro, 2012; Ogar et al., 2006; Patel et al., 2013).

The repetition tasks which are a relatively easy way for clinicians who are unfamiliar with a language to identify a speech disorder (Gagiano, 2013) include repetition of: 1) monosyllabic words (Duffy, 2013; McNeil et al., 2017), 2) multisyllabic words with stressed and unstressed syllables (Ballard et al., 2016; Cunningham et al., 2016; Dabul, 2000; Haley et al., 2012; Laganaro, 2012; McNeil et al., 2017; Ogar et al., 2006; Staiger et al., 2012; Strand & McNeil, 1996;); 3) words

of increasing length with the same stem, and 4) sentences (Ogar et al., 2006; Strand & McNeil, 1996). Repetition tasks place less demands on language production – especially in cases with associated Broca's aphasia – particularly in individuals with word finding difficulties. These tasks are able to elicit typical features of AOS (Ogar et al., 2006).

Language assessment tools include standardised assessments such as the WAB-R. The subtests which evaluate expressive language and verbal output include naming, picture description (Bailey et al., 2017; Den Ouden et al., 2018), repetition and reading and writing subtests. These assist with differential diagnosis between AOS and aphasia (Ballard et al., 2016; McNeil et al., 2017). Individuals who have aphasia display difficulties with word retrieval seen as slowed responses, they may produce more nouns rather than verbs (Zingeser & Berndt, 1990); and their speech is non-fluent and agrammatic (Hillis, 2007; Marshall & Wright, 2007; Webb & Adler, 2008). The subtests of reading and writing assists with identification of language impairments as individuals with pure AOS do not have difficulties with writing (Ballard et al., 2016, McNeil et el., 2017).

As this study's aim is to develop an isiXhosa tool for the assessment of AOS, the specific features of the stimuli to elicit speech need to be understood and these are reviewed in the next section.

Contextual Variables which Influence Breakdown in AOS

The research literature suggests contextual variables may influence error rates in speakers with AOS. The literature findings provide insight into contextual variables of speech stimuli that elicit more errors in individuals with AOS which may suggest that inclusion of these variables in the speech stimuli may be helpful in an assessment tool for AOS.

Segment variables

Phoneme and syllable position and consonants and vowels:

Research on phoneme position has been either at the word (Rosenbek et al., 1973; Ogar et al., 2006; Aichert & Ziegler, 2012) or syllable level (Bislick & Hula, 2019). Early research (Canter et al., 1985; Rosenbek et al., 1973; Trost & Canter, 1974) suggested AOS errors are more likely to occur in phonemes in word initial

position than in the medial and final positions (on a repetition task of monosyllabic words). Later studies by Aichert and Ziegler (2012) and Jonkers et al. (2017) had similar findings. In the study by Bislick and Hula (2019) it was suggested that there was an increase in errors in the initial syllable or phoneme of the word which reflected the complexity of starting a motor program and therefore increased the chance of error in individuals with AOS who had an impaired motor speech system. Bislick and Hula (2019) also suggested that phonemes in the initial position in words were more likely to be in error as there was more variety in the phonemes in the initial position in words in English. They reported that participants with aphasia+AOS produced more errors on syllable-initial than syllable-medial or syllable-final sounds than participants with aphasia only, suggesting the increase in errors was due to AOS. When considering the phoneme in the initial position in words Jonkers et al. (2017) and Ziegler et al. (2020) reported more errors on consonants than vowels in participants with AOS and they suggested that this feature is diagnostic of AOS. As difficulties with phonemes in the word initial position also occur in aphasia (Bislick & Hula, 2019; Stark, 2015) and dysarthria (Whitehill, 2010) this context does not necessarily differentiate between AOS, aphasia or dysarthria. From these studies, consonants are more likely than vowels to elicit errors in patients with AOS. Additionally, consonants in the initial position in words may elicit more errors in those with AOS than consonants in other positions in words. Although not diagnostic of AOS, as errors on consonants occur in aphasia as well (Bislick & Hula, 2019), there is a pattern of more errors in those with AOS than those with aphasia only.

Manner of articulation and Voicing

Early research by Rosenbek et al. (1973) and confirmed by later studies (Bislick & Hula, 2019; Ziegler et al., 2020) suggested that nasals, plosives and vowels were less likely to be in error than fricatives and affricates in those with AOS. The studies also suggested that fricatives are more likely to be in error than plosives (Ziegler et al., 2020) and plosives are more likely to be in error than nasals (Bislick & Hula, 2019). Fricatives, affricates and plosives, although not diagnostic of AOS, as errors occur on these phonemes in aphasia as well, may elicit more errors in those with AOS than other manners of articulation (Bislick & Hula, 2019; Rosenbek, et al., 1973; Ziegler et al., 2020).

Voicing has also been reported to influence error rates in AOS (Bislick & Hula, 2019). Voiceless oral consonants and nasals were reported to be less in error in patients with AOS than voiced consonants. Bislick and Hula (2019) however found that participants with Aphasia+AOS had more errors on voiceless rather than voiced consonants when compared to participants with aphasia only, suggesting that the difficulty may be due to the AOS.

Place of articulation

Place of articulation is a contextual variable that has been reported to influence error rates in AOS (McNeil et al., 2009; Romani et al., 2017; Ziegler et al., 2012). Bilabial and alveolar places of articulation were found to have fewer errors and were considered easier than other places of articulation in participants with AOS (McNeil et al., 2009; Romani et al., 2017; Ziegler et al., 2012). Palatal, postalveolar and dental consonants had the highest percentage of error in AOS (Chang et al., 2020). Participants with Aphasia+AOS had more errors on dental consonants than other places of articulation when compared to participants with aphasia only suggesting dental consonants are more difficult for those with AOS (Bislick & Hula, 2019).

Syllable

Syllable frequency, syllable structure, syllable position, length of utterance and syllabic stress have been considered as contextual factors that influence error rates in individuals with AOS.

Syllable frequency

Syllable frequency refers to how frequently a syllable occurs in words in a language (Laganaro, 2012; Staiger & Ziegler, 2008). High-frequency syllables were relatively spared in those with AOS (as they presented with less errors on high frequency syllables) when compared to low-frequency syllables (Staiger & Ziegler, 2008, Laganaro, 2012). A similar trend towards more errors on low frequency syllables than high frequency syllable words was found in those with AOS and conduction aphasia (Laganaro, 2012).

There is a trend towards more errors in low frequency syllables in AOS and conduction aphasia (Laganaro, 2012). It may not be helpful to include this feature in the stimuli as it elicits errors in both AOS and conduction aphasia making it less useful for identifying the presence of AOS.

Syllable structure

Syllable structure has been reported to contribute to the articulatory complexity of words (Staiger & Ziegler, 2008). Complex syllables were referred to as a speech stimulus with at least one consonant cluster (i.e. consonants occurring consecutively in a word) present (Staiger and Ziegler, 2008). Individuals with AOS have difficulty with transitions between syllables (Van Lieshout, Bose, Square & Steele, 2007). Therefore, syllables which contain consonant clusters are more difficult than single consonants for individuals with AOS and error rates are higher (Aichert & Ziegler, 2004). Complex syllables occurred more in low frequency syllables than high frequency syllables which has led some authors to suggest that complex syllables are more difficult (Aichert & Ziegler, 2008; Staiger & Ziegler, 2008). An earlier study by Aichert and Ziegler (2004) suggested that constant clusters were more complex and susceptible to errors depending on position within a syllable (i.e. the initial position being more difficult than medial and final, Aichert & Ziegler, 2004) whereas a later study by Staiger and Ziegler (2008) reported that consonants occurring consecutively (i.e., consonant clusters) were considered complex irrespective of the position within a syllable (Staiger & Ziegler, 2008). The impact of syllable structure was only found in low-frequency syllables where low frequency words with consonant clusters had more errors than high frequency words with consonant clusters (Staiger and Ziegler, 2008). They therefore concluded that syllable structure influences error rates in patients with AOS. The distance between consecutive phonemes' points of articulation was reported to add to complexity as the greater the distance, the greater the likelihood of an error (Rosenbek et al., 1973; Van Lieshout et al., 2007). For example, errors are more likely with /sk/ (alveolar to velar) than /st/ (both alveolar). There is however debate about this issue as studies by Aichert and Ziegler (2004) and Staiger and Ziegler (2008) showed that failure is determined more by frequency than complexity.

For the speech criteria for an assessment of AOS it is suggested that the speech stimulus should contain syllables with and without consonant clusters. Clusters should occur in different word positions. Consonant clusters selected, should reflect varying distances between consecutive points of articulation. As there is debate about articulatory distance adding to complexity it is not a universal criterion for the assessment of apraxia of speech.

Increased length: Multisyllabic words

Increased length of utterance is defined as speech stimuli (i.e. words and sentences) that increase in length by increasing the number of syllables in the word or sentence (Duffy et al., 2017). In a study by Bislick and Hula (2019) participants with AOS demonstrated more errors on words of increased length – specifically more errors were noted on words of three and five syllables when compared to disyllabic words.

Imitation of multisyllabic words: (3+ syllables) may assist with differential diagnosis between AOS and aphasia as the participant may display more errors on words with three or more syllables. More errors on words of increasing length however is a feature not distinct to AOS (Josephs et al., 2012; McNeil et al., 2017), but also occurs in aphasia (McNeil et al., 2017). This feature was however identified in a study by Duncan, Donovan and Sajjadi (2020) as a speech characteristic predictive of AOS and should therefore be included as a feature necessary for a differential diagnosis of AOS. This task also enables elicitation of metrical patterns (discussed under suprasegmental features) and allows syllabic stress to be evaluated (Duffy et al., 2017; Ziegler et al., 2020).

Suprasegmental Features:

Metrical Pattern/Syllabic Stress:

In individuals with normal speech, syllabic stress patterns conform to an unstressed vowel in the first syllable and a stressed vowel in the second syllable (e.g., catastrophe). In the study by Duffy et al. (2017) individuals with AOS produced equal stress across vowels in the first and second syllable. The study by Ziegler et al. (2020) reported that weak syllables were less likely to be in error in patients with AOS (Ziegler et al., 2020). Iambic words were more likely to be in error than single syllable words as the incorrect stress pattern was produced (Ziegler et al., 2020).

Equalized stress should be included as a diagnostic feature of AOS. It is therefore recommended that the speech stimuli contain iambic and multisyllabic words (Duffy et al., 2017).

Tone

IsiXhosa is considered a tonal language and uses tone (i.e. varying pitch) to convey or change the lexical and grammatical meaning of orthographically identical words (Anderson, 2018; Yip, 2002; Zerbian & Barnard, 2008a). Pitch changes can occur for every syllable in the word in a tonal language (Zerbian & Barnard, 2008a).

Tone is indicated on words using narrow phonetic transcription and diacritics which mark the tonal inflections of high tone, low-tone, or mid-tone (Anderson, 2018). Lexical tone was found to be intact in speakers of Cantonese with dysarthria with 87% of stimuli being produced accurately (Whitehill, 2010). Syllabic tone variation (in the Bantu languages isiZulu and Setswana) is omitted in both AOS and dysarthria (Coetzee, et al. 2011; Mahwayi, Uys and Van der Merwe, 2011) and is therefore not useful is assisting with differentiating motor speech disorders.

From the review, the contextual variables which appear to be useful in identifying AOS, as they elicit a pattern of more errors include:

Segmental features:

1. Consonants which elicit more errors are fricatives, affricates and plosives, palatal, post-alveolar, and dental (highest percentage of errors in those with AOS)

2. More errors in individuals with AOS on speech stimuli containing low frequency syllables with clusters in initial position in stimuli;

3. Length of utterance – iambic words and speech stimuli with three or more syllables are more likely to elicit errors in those with AOS

Suprasegmental features:

1. Metrical pattern: speech stimuli should contain words with an unstressed vowel in the first syllable and a stressed vowel in the second syllable (e.g., catastrophe; Ballard et al., 2016; Duffy et al., 2017) to elicit a pattern of equalised stress in participants with AOS.

The speech stimuli generated should therefore include these contextual features.

Nature of Errors:

As there is considerable variability within the literature defining diagnostic features of AOS, the nature of errors is reviewed. Perceptual analysis is the method predominantly used for diagnosis of speech disorders (Basilakos et al., 2017; Ballard et al., 2016) and is considered the gold standard for assessment of motor speech

disorders (Basilakos, 2018). Perceptual analysis is however vulnerable to inconsistency amongst raters and errors in judgement (Strand et al., 2014).

Perceptual Characteristics of AOS

Miller and Guenther (2021) reported a set of perceptual features which are considered key for a diagnosis of AOS. These are: slow rate of speech (as a result of longer segment and intersegment durations, pauses between sounds and sound prolongations); equal stress across syllables and consistent error types. The types of errors are largely phonetic distortions and distorted substitutions (Duffy, 2013; McNeil et al., 2009; Wambaugh et al., 2006). McNeil et al. (2009) reported that when speakers with AOS attempted to increase their rate of speech they produced more errors. Kent & Rosenbek (1983) reported difficulties transitioning between sounds and syllables which resulted in poor co-articulation and syllable segregation.

Additional features reported in the literature that appear to be non-discriminatory of AOS and may not assist with differential diagnosis include difficulties initiating speech, groping, phonemic perseveration, transposition errors, non-distorted phonemic substitutions, increasing errors with increasing complexity of words, awareness of errors and periods of error free speech (McNeil et al., 2009; Strand et al., 2014; Wambaugh et al., 2006). Normal speech rate and prosody were reported to exclude a diagnosis of AOS (Wambaugh et al., 2006).

The co-occurrence of AOS, dysarthria and aphasia has made differential diagnosis difficult as it has been challenging to identify the speech signs specific to AOS (McNeil, 2009). One of the main challenges when AOS co-occurs with aphasia is that of differentiating impaired motor planning/programming in AOS from phonemic paraphasias in aphasia (Croot et al., 2012; Bislick & Hula, 2019). AOS is characterised by difficulties with articulation and prosody which results from impaired temporal and spatial parameters of speech (McNeil et al., 2009). The speaker has intact linguistic processing (i.e. phonological lexical encoding and retrieval) but has an impairment in phonetic processing (i.e. speech planning of speech motor control). Phonological errors in aphasia occur because of an impairment in the linguistic processing and result in errors described as additions, omissions, and substitutions of phonemes (Croot et el., 2012; Ogar et al., 2006). Although the theoretical description

of AOS characteristics is distinct from aphasia, differentiating between phonological and prosodic features is challenging as damage to phonetic processing may result in errors that sound like phonemic errors; mild phonetic errors is reported in patients with aphasia (Croot et al., 2012; Ogar et al., 2006); and speech initiation difficulties in AOS, present similar to word finding difficulties in aphasia and impair the prosody and fluency of speech (Croot et al., 2012).

Perceptual Signs of AOS reported in the literature

The signs reported for AOS are described with the aim of identifying errors which are distinct to AOS and to determine whether they contribute to differentially diagnosing between AOS, dysarthria and aphasia. Furthermore, the speech stimuli which elicit the AOS errors will also be described with the aim of determining which speech stimuli to include in an assessment tool for AOS.

Across studies perceptual analysis of the speech stimuli using auditory and visual information and narrow as well as broad phonetic transcription were used (Haley et al., 2017; Staiger et al., 2012; Bislick et al., 2017; Bislick & Hula, 2019).

Phonemic Errors**:**

Across studies phonemic errors include distortions, substitutions, omissions, additions and transposition errors (Laganoro, 2012; Romani et al., 2017; Staiger et al., 2012). Phonemic errors occur in AOS (Laganaro, 2012) and aphasia (Laganaro, 2012; Romani et al., 2017; Staiger, Finger-Berg, Aichert, & Ziegler; 2012) therefore making differential diagnosis based on phonemic errors alone challenging.

Distortion Errors:

Distortion errors are defined as an attempt at the target phoneme that did not cross the phoneme boundary, produced with perceptible place, timing, manner or voice deviation from accurate production (Van Der Merwe, 2009). The target phoneme is still recognizable (den Ouden, 2002). Distortion errors may include sound distortions and distorted substitutions (Haley, Jacks, Richardson & Wambaugh 2017). Segment distortions give the impression that the sound production is phonetically incorrect, whereas distorted substitutions is recognized as phoneme errors that are also phonetically distorted (Haley et al., 2017). As early as 1984, distortion errors were seen to be a diagnostic feature of AOS (Rosenbek et al., 1984). Later studies also supported distortion errors as a feature of AOS (Coetzee, De Jager & Van Der Merwe,

2011; Ziegler et al., 2012; Haley et al., 2012; Bislick et al., 2017; McNeil et al., 2017). Distortion errors also occur in dysarthria which poses a challenge to differential diagnosis between AOS and dysarthria (Rosenbek, 1984; Bislick et al., 2017). Distortion errors also occur in aphasia (Cunningham et al., 2016; Bislick et al., 2017) although Romani et al. (2012) reported an absence of distortion errors in aphasia. Distortion errors in isolation do not constitute a diagnosis of AOS (Bislick et al., 2017). When the speech of speakers with AOS is compared to the speech of speakers with aphasia, Bislick and Hula (2019) found that there was a high proportion of distortion errors in the speech of speakers with AOS.

Conclusion: The occurrence of distortions in AOS, dysarthria, and aphasia suggests that this feature may not be helpful to differentially diagnose these conditions. There is however a high proportion of distortion errors in those with AOS.

Substitution Errors:

Substitution errors are defined as an inserted non-target phoneme that is phonetically accurate and include phonemic perseveration, anticipation, and transpositions errors (Van Der Merwe, 2009). Den Ouden (2002) suggested that a substitution occurs when it is no longer possible to recognize the target phoneme or where the change of one or more features leads to the production of another phoneme (den Ouden, 2002). Substitution errors are reported to occur both in AOS (Johns & Darley 1970; Halpern, 1976; Wertz et al., 1984; Josephs et al., 2012; Ziegler et al., 2012; Bislick et al., 2017; Bislick & Hula, 2019) and in aphasia (Ziegler et al., 2012, Bislick & Hula, 2019).

Conclusion: In essence, the occurrence of substitution errors would not be sufficient for a diagnosis of AOS.

Omission Errors:

Bislick and Hula (2019) used the definition for omission errors from Buchwald and Miozzo (2012); Buckingham (1986); and Dell (1988) who defined omission errors as deleted phonemes that may result from breakdown at the level of phonological retrieval (i.e. aphasic error) or motor planning (AOS error). In cross-linguistic studies, it was found that deletion of clicks occurs in isiZulu and Setswana (Coetzee, De Jager & Van Der Merwe, 2011). Furthermore, omission of syllabic tone variation was found

to be the most frequently occurring error in speakers of Bantu languages (isiZulu and Setswana) with AOS (Coetzee, De Jager & Van Der Merwe, 2011). Omission errors occur in AOS (Ziegler et al., 2012, Coetzee, De Jager and Van Der Merwe, 2011), dysarthria (Mahwayi, Uys & Van der Merwe, 2011) and aphasia (Ziegler et al., 2012), making differential diagnosis between the three disorders challenging. Bislick and Hula (2019) identified omission errors as the most prominent error in speakers with aphasia.

Conclusion: As omission errors occur in AOS, dysarthria and aphasia, these errors may not assist with differential diagnosis of AOS.

Addition Errors:

Addition errors are described by Bislick et al. (2017) as a phonetically accurate non-target phoneme which is inserted. The phoneme is not distorted. Bislick et al. (2017) found no significant difference in the occurrence of additions between those with AOS+aphasia and aphasia only, indicating that additions occur in both AOS and aphasia (Ziegler et al., 2012; Bislick et al., 2017).

Conclusion: The research suggests that the presence of addition errors may not distinguish between AOS and aphasia.

Inconsistency of error location and variability of error type

Inconsistency of errors refer to inconsistency in the error location as well as inconsistency of the type of error which occurs. Inconsistent errors include articulatory errors across productions and repetitions of the same word (Darley et al., 1975; Hardcastle, 1987; Wertz et al., 1984; Rosenbek et al., 1984; Josephs et al., 2006; McNeil et al., 2009; Staiger et al., 2012; Jonkers et al., 2017; Haley et al., 2012). Studies have shown conflicting results which poses a challenge to using the error for differential diagnosis of AOS as some have. Studies indicated that errors are variable in AOS (Mauszycki & Wambaugh, 2006; Staiger et al., 2012) and others indicated that errors are consistent in AOS (Wambaugh, Nessler, Bennett, & Mauszycki, 2004; Mauszycki, Dromey, & Wambaugh, 2007; Mauszycki et al., 2010a, 2010b, 2012). Furthermore, inconsistent errors not only occur in AOS (Jonkers et al., 2017; McNeil et al., 2017), but also in ataxic dysarthria (Ziegler et al., 2012) and in aphasia (McNeil

et al., 2017). Error consistency or error inconsistency therefore cannot be considered a primary characteristic of AOS (Bislick et al., 2017).

Conclusion: Inconsistency of error occurrence and inconsistency of error type – are two important clinical markers that indicate instability in articulation. These however also occur in aphasia when phonemic paraphasias are produced (McNeil et al., 1997) and ataxic or hyperkinetic dysarthria (Ziegler et al., 2012) – thus making it less reliable as a primary diagnostic feature of AOS.

Extended Segment Durations (i.e. slow speech with lengthened consonants and vowels)

Slow Rate

Slow rate was defined as longer durations and reduced rate of syllable production for most words and sentences (Duffy et al., 2017). The duration was measured from the initial voicing, release of the stop or onset of noise energy to the point where there was a reduction in the acoustic energy or at the end of the response (Duffy et al, 2017). A discriminatory characteristic of AOS was slow rate (Bislick et al., 2017; Duffy et al., 2017; McNeil, Robin & Schmidt, 2009; Ziegler, 2008). Slow rate cannot be used in isolation as a diagnostic feature of AOS as this feature also occurs in dysarthria (Duffy et al., 2017; Josephs et al., 2012; Mefferd, 2020, Strand et al., 2014) and aphasia (Josephs et al. 2006).

Slow rate occurs in AOS, dysarthria and aphasia making it less reliable as a diagnostic feature of AOS.

Extended Intersegment Durations

According to McNeil et al. (2017) prosodic deficits may be a result of extended segment and intersegment durations which are realised as sound, syllable and words segregation. Prosodic errors occur in AOS (Josephs et al., 2006; McNeil, Robin & Schmidt, 2009; Ziegler, 2008; Bislick et al., 2017), dysarthria and aphasia. Prosodic errors are a feature of Broca's aphasia (Hillis, 2007) but not of conduction aphasia (Ziegler et al., 2012).

Ballard et al. (2016) investigated lexical stress changes in AOS. They found that lexical stress is the strongest predictor of AOS and participants with AOS have equalised lexical stress on multisyllabic words.

The occurrence of abnormal prosody in AOS, dysarthria and aphasia make it less reliable as a diagnostic feature of AOS.

Phonetic Errors

Phonetic errors are errors of articulation. The findings of Bislick et al. (2017) support the use of phonetic errors to diagnose and characterise AOS. Phonetic errors were used as a diagnostic feature of AOS.

Differentiating between phonetic errors (apraxic errors) and phonological errors is challenging (Croot et al., 2012). In AOS, phonetic errors can sound like phonemic errors, apraxic errors were reported in people who had a phonological disorder and initiation difficulties in AOS and word retrieval difficulties in aphasia can both result in abnormal fluency and prosody.

Bislick et al. (2017) suggests that a diagnosis of AOS should not be made on the presence of one sign alone but should be made when a combination of speech errors is present such as sound distortions, slow rate of speech, abnormal prosody, and extended segment and intersegment durations.

Articulatory groping/trial and error movements

Articulatory groping refers to trial and error articulatory movements that are audible or visible. It includes difficulties initiating speech or false starts (Josephs et al., 2012). Articulatory trial and error groping is reported as one of the earliest identifying features of AOS which was also used as a diagnostic feature in later studies (Johns & Darley, 1970; Halpern, 1976, Wertz et al., 1984; McNeil, 1997, 2004, 2009; Ziegler, 2008; Josephs et al., 2012; Staiger et al., 2012; Jonkers et al., 2017; McNeil et al., 2017, Duncan et al., 2020). It is also suggested to be a characteristic predictive of AOS (Duncan et al., 2020).

Trial and error groping was also reported to occur in aphasia (Josephs et al., 2012; Stark, 2015). It is reported to occur as a result of linguistic impairment and not just a motor speech impairment (Bailey et al., 2017) thus making in less useful in

making a differential diagnosis of AOS (McNeil et al., 2017). Inclusion of trial-and-error movements/articulatory groping as a diagnostic feature remains controversial.

The nature of errors reported in the literature for AOS include distortions, substitutions, additions, omissions, inconsistency of errors, slow rate, extended segment durations, and trial-and error groping. These types of errors however are not distinctive to AOS and occur in dysarthria and aphasia (Allison et al., 2020).

Identifying key features for a diagnosis of AOS has been challenging. The challenges and differences within the literature has made drawing a conclusion about the contextual variables, nature of errors and tasks to include in an assessment tool problematic. Many of the contextual variables, nature of errors and assessment tasks from the early research studies are still used in studies and clinical practice today.

In making a diagnosis of AOS, the clinical decision should and is based on more than key features, and includes a taking detailed case history, conducting an oral motor examination evaluation, reviewing the CT Brain or MRI reports as well as analysing and interpreting the finding from language assessments (Allison et al., 2020, Ballard et al., 2016).

Analysis of Errors:

The ability of clinicians and researchers to identify features of AOS have not routinely been reported on in the research literature with methods of analysis varying between studies. In the studies clinicians have identified participants for inclusion in the study based on clinical assessments (Molloy & Jagoe, 2019). Both broad phonetic transcription (Staiger & Ziegler, 2008) and narrow phonetic transcription (Basilakos et al., 2017; Bislick & Hula, 2019; Haley et al., 2012) of the speech tasks have been used in the research literature. Perceptual analysis, although reported as the gold standard for assessment (Basilakos, 2018) has not been used consistently across studies. It was however the predominant method of analysis used across studies (Staiger & Ziegler, 2008; Bislick & Hula, 2019), with varying inter-rater reliability. Some studies reported good inter-rater reliability (Bislick & Hula, 2019) while others reported low inter-rater reliability (Haley et al., 2012). Acoustic measures showed promising results in assisting with the differential diagnosis of AOS but required further study (Haley et al., 2012; Basilakos et al., 2017).

Perceptual analysis occurs across the range of assessment tasks. Analysis of errors may include transcribing speech samples from single word production to connected speech using narrow and broad transcription (McNeil et al., 2017).

For a diagnosis of AOS, analysis and integration of the information using different levels of analysis is necessary to understand how the clinical symptoms present (Allison et al., 2020; Ballard et al., 2014) and diagnosis is not just based on one task in isolation (Molloy & Jagoe, 2019).

Purpose of study

Based on the literature there is a clear need for improved service delivery for isiXhosa speaking patients. One way in which to improve the services is to develop assessment material in the language. This study specifically addresses the need for tools in isiXhosa for the assessment of AOS as currently no tools exist in the language.

Steps to Follow When Creating Assessment Tools

According to Langdon and Wiig (2009) the important steps in creating speech and language assessment tools are 1) to identify and include words and word structures that differentiate between normal speech and language, and disordered speech and language 2) to validate which words and word structures best differentiate between typical and atypical language, 3) to consult with experts of the language as research literature may be limited and 4) to consider differences in dialects across geographical regions. While this study focused on a tool to assess speech, it was decided to follow a similar process to the one recommended by Langdon and Wiig (2009).

In order to address the challenge of errors in diagnosis and treatment which arise out of the language mismatch between SLPs and patients and the lack of locally relevant assessment tools, this study aims to answer the research questions – what are: 1) the criteria for the assessment of AOS, and 2) the features of isiXhosa that must be included in a tool for evaluating AOS?

Methodology

Aims and Objectives

With reference to AOS in adult speakers, the aims and objectives of Study 1 were as follows:

1) To determine and describe the criteria for the speech stimuli in the assessment of AOS in isiXhosa through synthesis of information from different sources
    a. To describe the linguistic (i.e. phonetics, language structure) criteria for speech stimuli to assess AOS
    b. To describe the linguistic features of isiXhosa which were unique
    c. To describe the implications the linguistic features have for the assessment of AOS in isiXhosa
    d. To generate and describe the criteria for an assessment of AOS in isiXhosa
    e. To generate the isiXhosa speech stimuli that meet the criteria for the assessment of AOS in isiXhosa.

Research Design

The design for this study was an exploratory, sequential, descriptive design. The exploratory approach is often used for studies of areas which have not been previously researched (Durrheim, 2008). The process of creating assessment tools in South Africa for AOS has not been widely studied and therefore the exploratory approach was appropriate. The exploratory approach may also be applied to studies which require numerous steps due to the unknown nature of the topic being studied which may be complex (McNabb, 2007). A descriptive design was used as descriptive studies aim to provide detail regarding participants' ways of thinking and responding given their environment (Durrheim, 2008; Irwin, Panbacker & Lass, 2008). The purpose was to describe experiences without providing an explanation for the cause of the experience (Cozby, 2007).

Procedures.

Ethics approval was obtained from the University of Cape Town's Faculty of Health Sciences Human Research Ethics Committee (See Appendix A; HREC REF 647/2013). After approval of the project, Study 1 began.

Data collection and analysis.

A literature review was conducted to determine the criteria for the speech stimuli in an assessment of adults with AOS. The isiXhosa language was reviewed to determine the linguistic features of the language (i.e. phonetics, morphology and word structure) and the implications these had for the speech stimuli in isiXhosa and thereafter a list of speech stimuli was generated (Langdon & Wiig, 2009).

Literature on AOS and isiXhosa was searched using the databases: Academic Search Premier, EBSCOhost, Africa Bibliography, SAGE Research Methods Online, ScienceDirect, speechBITE, SpringerLink Journals & Books, Taylor & Francis Online, Wiley Online Library, Google Scholar and the UCT Library Catalogue (ALEPH). Search terms included: *isiXhosa, phonetics, morphology, syntax, isiXhosa language structure, tone in isiXhosa, isiXhosa tonology, apraxia of speech, criteria for speech assessments, creating speech assessments, validity and reliability.*

Existing literature and assessments for apraxia of speech were reviewed. The criteria for the speech stimuli were derived through evaluating the information for – areas of assessment, types of errors displayed by patients with AOS, key features of AOS, and methods of assessment. The information is presented in the results section. Consistent patterns across authors and tests were identified and compiled. From the types of errors displayed, tasks with associated speech stimuli to elicit those features were generated and the criteria derived for English.

Thereafter the isiXhosa language structure was reviewed to determine the features of the language. Those features which are unique to Nguni languages, the influence of tone on semantics, and the language shift and differences in the language, due to rural and urban contexts, were considered. After this review the criteria were adapted through including additional features which occur in isiXhosa.

The speech stimuli were then generated by the researcher using existing isiXhosa texts for adults (Langdon & Wiig, 2009). The list of texts included: *The English-Xhosa/Xhosa-English Dictionary* (2011), *The English Afrikaans Xhosa Zulu Aid* (Uys, 2010), and the *Pharos Multilingual Illustrated Dictionary* (Bennet & Tsoeu, 2008). Two to three words/speech stimuli were selected for each criterion.

Results

This section presents the results pertaining to objectives 1a – e. The results for objectives 1a – d are presented in Table 1. The results present a summary of the findings of the review of the literature for ease of reading. The full review of the literature linked to objective c can be found in Appendix B.

Table 1 includes the criteria for the speech stimuli in an assessment of AOS. It presents the main research finding, relevant references, the implication the research findings have for isiXhosa speech stimuli and the researcher's decision to include or exclude the criteria. Seven criteria were identified, namely, consonants in initial position in words, monosyllabic words, iambic words, multisyllabic words and sentences, metrical pattern, syllable frequency and tone. Only one of the listed criteria was excluded (i.e. monosyllabic words) as it was a criteria in which the difficulty with initial phonemes were not exclusive to a diagnosis of AOS, but also occurred in participants with aphasia (Haley et al., 2012; Ogar et al., 2006). Exclusion of this criterion did not have any implication for the generation of speech stimuli in isiXhosa.

Table 1

The Criteria for the Speech Stimuli in an Assessment of AOS (Results for Objectives a – d Summarised)

Criteria	Main research finding	References for finding	Decision to Include/Exclude	Implication for isiXhosa stimuli
Consonants in initial position in words	More errors produced on consonants than vowels in participants with AOS vs those with aphasia. Errors on initial consonants also occur in dysarthria.	Bislick & Hula, 2019; Duffy, 2005; Stark, 2015; Whitehill, 2010	As the speech stimulus will contain words with consonants and vowels this will be included. Whether the participant has more difficulty on the additional manners of articulation will need to be tested.	Include additional isiXhosa manners of articulation a. Clicks; b. Implosives; and c. Ejectives. (Dogil & Mayer, 1998)

Table 1 ***(continued)***

The Criteria for the Speech Stimuli in an Assessment of AOS (Results for Objectives a – d Summarised)

Criteria	Main research finding	References for finding	Decision to Include/Exclude	Implication for isiXhosa stimuli
Monosyllabic words	Difficulty with the initial phoneme is not distinctive to AOS as participants with aphasia also had difficulty with this task.	Haley et al. (2012); Ogar et al. (2006)	Exclude	None
Iambic words	In participants with AOS, equalised stress occurs on iambic words.	Duffy et al., 2017; Ziegler et al., 2020	Include as the stimulus will elicit a feature diagnostic of AOS.	None as isiXhosa has iambic words.
Multisyllabic words and sentences	More difficulty is displayed with longer words – not exclusive to AOS. Inconsistent productions of the word – not exclusive to AOS. However more errors are elicited in participants with AOS than those with aphasia.	Ballard et al., 2016; Duffy et al., 2017; Josephs et al., 2012; McNeil et al., 2017; Ogar et al. (2006); Strand & McNeil (1996)	Include as more errors are elicited in participants with AOS.	None as isiXhosa has multisyllabic words and sentences.

Table 1 ***(continued)***

The Criteria for the Speech Stimuli in an Assessment of AOS (Results for Objectives a – d Summarised)

Criteria	Main research finding	References for finding	Decision to Include/Exclude	Implication for isiXhosa stimuli
Metrical Pattern	In participants with AOS, in words with a pattern of the first syllable being unstressed and the second syllable being stressed, equalized stress occurs on multisyllabic words.	Ballard et al., 2016; Duffy et al., 2017; Ziegler et al., 2020	Include	Consideration of metrical patterns for isiXhosa to be included. Speech stimuli should contain words with an unstressed vowel in the first syllable and a stressed vowel in the second syllable
Syllable frequency	More errors occur in low frequency syllables with clusters in the initial position in words than high frequency syllables with clusters. This however occurs in AOS and aphasia.	Aichert & Ziegler, 2004; Laganaro, 2012; Staiger & Ziegler, 2008	Include as there is still debate regarding this variable and further research is needed.	List will include low and high frequency syllables in isiXhosa.
Tone	Syllabic tone is omitted in AOS and dysarthria.	Coetzee, et al. 2011; Uys and Van der Merwe, 2011; Van Der Merwe & LeRoux, 2014; Mahwayi,	Include as further research on this is required.	Include items with lexical and syllabic tone.

Objective e: IsiXhosa Speech Stimuli that meet the Criteria for the Assessment of AOS in IsiXhosa

Table 2

List of 85 generated isiXhosa speech stimuli that meet criteria in isiXhosa

Criteria	Speech Stimuli
Voiced alveolar	Idada
	Udade
Voiced velar	Igwegwe
	Igugu
Voiceless bilabial	Iphepha
	Iphupha
Voiceless alveolar	Utata
	Uthuthu
Voiceless Velar	Ikalika
Nasal, bilabial	Umama
Nasal	Umni
	Nini
	Inani
	Nina
Voiced affricate	Ijaji
Voiceless fricative	Usisi
	Isisu
	Kushushu
	Utsotsi
Prenasalised velar	Inkwenkwe
Prenasalised alveolar	Iindondo
Central click	Icici
Prenasalised central click	incinci
Palatal click	Iqaqa
Prenasalised bilabial	Impempe
Prenasalised velar	Ingongoma

Table 2 ***(continued)***

List of 85 generated isiXhosa speech stimuli that meet criteria in isiXhosa

Criteria	Speech Stimuli
Words and phrases with the same stem, increasing in length	Ixesha; amxesha onyaka; Ivenkile; ivenkilana; Uqhekezo; Umqhekezi; Iculo; umculi; ukucula Ndiphilile; andiphilanga Ukosulela; usuleleko; isibulala ntsholongwane Intlungu; kubuhlunga; alabuhlungwana Ifama; umfama; umzi womlimi; intendelezo yefama
Multisyllabic words (number of syllables)	Indlu (2) Imbewu (3) Intyatyambo (4) Intshonalanga (5) Umgca (2) Ingcongconi (4) Unxantathu (4) Ungquzulwano (5) Uninazala (5) Iliwa (3) Ihlonyelwa (4) Ishumi elinesithandathu (10) Ukubebezela (6) Iphephandaba (5) Itishala (4) Ikawusi (4) Ubukrelekrele (6) Bhala (2) Yhu! (1) Hlala (2) Sala (2)

Table 2 ***(continued)***

List of 85 generated isiXhosa speech stimuli that meet criteria in isiXhosa

Criteria	Speech Stimuli
Multisyllabic words (number of syllables)	Gula (2) Impi (2) Isithsaba (4)
Increasing length – sentences (number of syllables)	Indawo ikude. (6) Ndithanda isoka. (6) Ifoni iyakhala. (7) Nam ndiyavuya ukuwazi. (9) Sisitulu sikatitshalakazi. (11) Nditshixele izitshixo zam emotweni. (13) Nceda ngamatikiti amabini eshowu yasebusuku. (19) Ufuna ukufunda isiXhosa kodwa iincwadi zakhe azikho. (21)
Tonal contrasts	Gcoba - be happy Imithi - its pregnant Imizi - houses Gcoba - put lotion on Imithi - tress Imizi - a type of grass

Discussion

The discussion reflects an interpretation of the study results and highlights the important outcomes which impact Study 2.

The aim of Study 1 was to determine and describe the key criteria for an assessment of AOS, determine the linguistic features of isiXhosa and describe the implications these features have for the assessment of AOS in isiXhosa.

From the literature reviewed it is clear that the diagnosis of AOS is challenging for SLPs. There are confounding views on the primary features of AOS. Wertz et al. (1984) identified four salient features of AOS (i.e. articulatory groping, inconsistent articulatory errors, substitutions and abnormal prosody). These four salient features were included in later studies and Dabul's (2000) AOS battery. In the more recent research (Dronkers, 2004 and Richardson, Fillmore, Rorden, LaPointe & Fridrickson, 2012) these diagnostic criteria were still used to identify AOS – despite research indicating and calling for exclusion of the overlapping features of AOS, aphasia and dysarthria (Staiger, et al., 2012). Many of the earlier studies conducted included participants with AOS and aphasia and not only AOS thereby confounding the findings obtained – and the key diagnostic features (McNeil et al., 2017). Furthermore, the tasks used in the assessment of AOS varied although most studies relied on repetition tasks to elicit features of AOS. There was no consistency across studies in the type of stimulus. Studies included disyllabic and three syllable words, words of increasing length, sentences and a reading passage. The words were matched for psycholinguistic properties.

Articulatory complexity was identified as a criterion for an assessment of AOS. Furthermore, place and manner of articulation; the position of phonemes in a word; frequency of word use and the length of words were all elements identified as adding to complexity. When examining the linguistic features and structure of isiXhosa, many of these features were present which made it possible to assess these elements.

IsiXhosa has additional manners of articulation including ejectives and implosives which do not occur in English. These additional features were considered and added to the novel criteria for isiXhosa so that the speech stimuli would reflect the linguistic structure of the language (Van der Merwe & Le Roux, 2014). There is however uncertainty as to the hierarchy of complexity in isiXhosa and further research

is required to determine what constitutes complexity in isiXhosa and whether the proposed hierarchy is valid. For the purposes of this study it is hypothesized that the hierarchy of complexity from easiest to most difficult is as follows:

1) Monosyllabic words
2) Voiceless disyllabic words (bilabials easier than alveolar and velar)
3) Voiced disyllabic words (bilabials easier than alveolar and velar)
4) Voiceless fricative and affricates
5) Voiced fricatives and affricates
6) Increasing number of syllables
7) Speech stimuli with the same stem increasing in length
8) Prenasalised consonants and clicks
9) Tonal contrasts

For the criteria for the novel speech stimuli the following were included:

1) Iambic words
2) Multisyllabic words
3) Words with metrical patterns of unstressed and stressed syllables
4) Words with frequently occurring and infrequently occurring syllables
5) Words with lexical and syllabic tone.

A list of 85 speech stimuli was generated that met the criteria. Words were sourced from isiXhosa dictionaries and phrase books as well as isiXhosa reading material. Words were selected as they matched the criteria ensuring that multiple options were available for inclusion per criteria. As there were no published standard frequency ratings for isiXhosa it was assumed that the list generated had frequent and infrequently occurring stimuli. The frequency of occurrence will need to be determined. The generated speech stimuli was evaluated for validity and reliability in the subsequent studies. The list will need to be refined to include fewer items.

Chapter 3 – Study 2

Face, Content and Construct Validity of the Generated IsiXhosa Speech Stimuli

Literature Review

Validity

When creating new assessment materials – the developer has to ensure that the test meets the requirements in order to be a valid tool. Validity refers to the ability and extent of a test to measure what it was created to measure (Boslaugh & Watters, 2008; Kaplan & Saccuzzo, 2008). There are different types of validity that a tool should have before being considered "valid".

Face validity refers to the extent of a test to measure what it appears to measure (Salkind, 2010). The process of establishing face validity that has been used extensively in the literature (Ashcroft, Morecroft, Parker & Noyce, 2004; Gladstone et al., 2008; Miller et al., 2012) is one that entails an iterative review and revision process. The tool is typically sent to twenty individuals who are knowledgeable about the topic under study and are asked to comment on whether it assesses the construct under study. Changes are made to the tool and further review is sought until there are no further recommendations. If face validity is not obtained the items in a tool may not measure all the constructs under study. Furthermore, there are no strict guidelines for retaining or discarding items in a tool (Hardesty & Bearden, 2004). The research will therefore have to decide on rules for discarding and retaining items. In a similar manner to that mentioned in the literature (Ashcroft et al., 2004; Gladstone et al., 2008; Miller et al., 2012) face validity of the generated speech material can be obtained in this study through consulting with isiXhosa speakers.

There are no standard published frequency ratings for isiXhosa in either written or oral forms. These frequency ratings will need to be established. What would be valuable for this study are the oral frequency norms. Alonso, Fernandez and Diez (2011) used a basic counting procedure to obtain oral norms in Spanish. The sampled records for written norms were works of fictions, newspapers and magazines whereas transcripts of interviews, telephone conversations and talks were used for the oral norms. To calculate the frequency, the total number of times each word appeared within the text or conversation was counted. This method was not used in this study

as frequency of use and determining frequency ratings were not the aim of the study. The perceived frequency of use as judged by isiXhosa first language speakers was obtained to determine if the list contained frequently and infrequently occurring speech stimuli. Whether these perceived ratings match with actual occurrence is uncertain and should be further researched in a follow-up study.

Construct validity refers to the theoretical and empirical underpinnings of a measure. It is the extent to which research findings relate to theoretical knowledge (Durrheim & Painter, 2008). There are three steps involved in establishing construct validity: 1) specifying the set of theoretical constructs – in this study that was to identify the criteria for assessment of speech in isiXhosa for the diagnosis of AOS in adults; 2) testing these theoretical constructs through research, and 3) interpreting the findings (Durrheim & Painter, 2008).

Content validity is the ability of the test to assess all areas of the construct and ensure that the test is representative of these constructs (Woo, 2002). When developing a measure, researchers should aim to ensure that the measure (i.e. test/assessment tool) has content validity (Durrheim & Painter, 2008). This study aimed to determine the content validity of the generated speech stimuli. In order to ensure that the generated speech stimuli met the requirements for content validity, the following constructs were identified as being important: 1) the criteria for assessment of speech; 2) the linguistic features of isiXhosa and 3) the diagnostic features of speech and language disorders (Durrheim & Painter, 2008). An assessment is considered to have content validity after it has been reviewed, judged and revised by experts in the field (Shrock & Coscarelli, 2007). As suggested by Gladstone et al. (2008) and Maphalala et al. (2014) content validity in this study will be established through consulting with various groups of people (isiXhosa speakers and experts in linguistics and isiXhosa).

According to Kanjee (2008) newly developed tools should be evaluated to determine the validity of the tool before it can be used with a given population. One way in which the validity of a tool can be determined is through correlating the results obtained on the new tool with scores obtained on existing tools. This is referred to as criterion-related validity (Durrheim & Painter, 2008). In a study conducted by Maphalala et al. (2014) in which an isiXhosa assessment for speech in children was created, criterion-related validity was determined through reviewing studies

conducted in Bantu languages. In this study, achieving criterion-related validity was not possible as there are no validated AOS assessments for adult speakers of isiXhosa or any of the official languages in South Africa.

From the literature review in Study 1 on the diagnostic features of AOS, there were many features listed. Some studies indicated that not all features need to be present in an individual for a diagnosis of AOS (McNeil et al, 2017). Four salient features were proposed as the key diagnostic features of AOS with some aphasia features included. The criterion related validity for these diagnostic features of AOS in isiXhosa could be obtained through a consensus or Delphi panel. This was however not done within this study and could be done in a follow-up study. This study focused on obtaining face, construct and content validity.

Miller et al. (2012) developed a Swahili screening test for the assessment of speech in neurological disorders in adults. The authors argued that when assessing motor speech control, variables specific to the language being assessed must be included for the screening test to be valid. In their study face and content validity was obtained. Face validity was determined when the screening test was judged by workers in the community where the test would be utilised. They also judged the test on its cultural appropriateness. Content validity was determined by a review panel consisting of SLPs who assessed whether the test met key criteria when assessing individuals with neurological disorders.

Rationale for Validation of New Test Material for the Assessment of Apraxia of Speech in IsiXhosa

Determining the validity of a tool is a necessary step before it can be used with the specific population and in this case by SLPs with isiXhosa speaking patients (Van der Merwe & Le Roux, 2014). Generation of the speech stimuli in Study 1 allowed the cultural and linguistic properties of isiXhosa to be included in the assessment material. For a diagnosis of AOS to be determined the speech stimuli have to reflect differing levels of articulatory complexity (Duffy, 2005) in order to elicit features of AOS. To determine certain types of complexity (i.e. frequency of use, and perceived difficulty) isiXhosa speakers should be consulted as a measure of face validity (Miller et al., 2012).

This study set out to explore the validity of the isiXhosa speech stimuli generated to meet both sets of criteria, i.e. articulatory complexity and isiXhosa linguistic properties as well as cultural validity and the criteria for an assessment of AOS in isiXhosa.

Methodology

Aims and Objectives

The aims of Study 2 were as follows:

2. To determine a) face, b) content and c) construct validity of the list of isiXhosa words, phrases and sentences generated to meet the criteria for the assessment of AOS in adult speakers of isiXhosa.

Research Design

A descriptive design was used to determine face, content and construct validity. Descriptive studies allow for data collection through the use of surveys or questionnaires of the topic under study (Irwin et al., 2008; Kelley, Clark, Brown & Sitzia, 2003) which may be written or oral (Cozby, 2007). According to William (2006) survey research is an important aspect of social research. The advantages of survey research are that data can be gathered from the population in an economical way and the participants may complete the survey in their own time (Irwin et al., 2008; William, 2006). Surveys are also less costly and participants may remain anonymous (Cozby, 2007). Questionnaires were used as the method of data collection in this study. There are however disadvantages of survey methods which were raised. Surveys may 1), be time consuming (William, 2006); 2), not allow for cause and effect relationships to be studied (Irwin et al., 2008); and 3), have a low response rate (Cozby, 2007). In order to address these disadvantages the questionnaire was kept short with a dichotomous response option; cause and effect was not the purpose of this study, and response rate was not an issue as the researcher was present when the isiXhosa speakers completed the questionnaire. The researcher did not interfere with the participants' completion of the questionnaire.

The Delphi method was used to determine the content and construct validity of the speech material generated (Langdon & Wiig, 2009; Okoli & Pawlowski, 2004). The advantage of a Delphi method is that it allows a panel of experts to contribute to the study without having to meet (Okoli & Pawlowski, 2004). It also allows for more than one round of analysis to be conducted. This approach was an appropriate design for this study, as experts in the field of linguistics and isiXhosa judged whether the speech stimuli reflected the linguistic features of the isiXhosa language, including the

phonetics, morphology, sound classifications, word structure, and number of syllables; and met the requirements for articulatory complexity in an assessment of AOS. A disadvantage of this approach is that it may be time consuming and lengthy (Osbourne, Collins, Ratcliffe, Millar & Duschl, 2003). This disadvantage was addressed through setting a deadline for responding (Hsu & Sandford, 2007).

Participants.

Study 2 included two groups of participants who aided in determining the face, content and construct validity of the speech stimuli generated.

Group 1 (isiXhosa speakers).

Inclusion criteria.

Participants were required to meet the following criteria:

- Speak isiXhosa as a first language
- Be able to communicate in English
- Be literate in English
- Be over the age of 18 years

Exclusion criteria.

Participants were excluded if they had a self-reported history of a speech or language disorder, hearing loss, or cognitive difficulties.

Group 2 (Delphi panel).

Inclusion criteria.

Participants were included in the study if they met the following criteria

- Studied the isiXhosa language/linguistics at a tertiary level
- Willing to commit to three rounds (Hsu & Sandford, 2007) of data collection so as to reach consensus regarding the speech stimuli for inclusion in the assessment of AOS in isiXhosa.

Exclusion criteria.

- There were no exclusion criteria

Recruitment method.

The group 1 (isiXhosa speakers) participants were recruited from UCT and Groote Schuur Hospital via notices on the Health Sciences campus and hospital premises. Participants from the isiXhosa community who wished to volunteer to take part in the study contacted the researcher personally or via email. Participants were provided with information about the study and informed consent was obtained (refer to Appendix C and D).

The Delphi panel (Group 2) was recruited via email. Potential participants were identified through a review of key authors publishing on the topic of isiXhosa as a language as well as a review of university staff databases for members who worked within the African languages department. Participants were also recruited through snowball sampling which is a method in which the participants are identified and recruited by other participants or a key informant (Durrheim & Painter, 2008).

Sampling method.

Purposive sampling is a non-probability sampling method in which the researcher is able to include willing participants who meet specific criteria (Laskin, 2007; Oliver, 2006). This sampling method was used for Groups 1 and 2 as the study required participants with particular characteristics (Durrheim & Painter, 2008).

The sample generated for the isiXhosa speakers may however not be representative of the larger isiXhosa population, as all isiXhosa speakers do not reside in Cape Town. Generalisability of the results obtained for the face validity of the speech stimuli may be compromised (Durrheim & Painter, 2008). The researcher attempted to include equal numbers of male and female participants of varying ages in the sample (i.e. participants 18 years and older). This was done by recruiting both male and female isiXhosa speakers to participate in the study.

For the Delphi panel, the number of experts in the field of linguistics and isiXhosa is limited and therefore purposive sampling was deemed appropriate (Durrheim & Painter, 2008). An advantage of this type of sampling is that it is convenient and economical.

Sample size.

Group 1 (isiXhosa speakers).

Based on the study by Gladstone et al. (2008) a sample size of 20 participants was judged to be appropriate given the exploratory nature of the study.

Group 2 (Delphi panel).

According to Okoli and Pawlowski (2004) and Pollard and Pollard (2004) a Delphi panel typically consists of 10 – 20 experts. This sample size was difficult to obtain given the limited number of isiXhosa linguists in the South African context (Trembath, Wales & Balandin, 2005). African linguists have used four (Gladstone et al., 2008) and five (Maphalala et al., 2014) participants to constitute a Delphi Panel.

Tools.

The initial list of isiXhosa Speech Stimuli consisted of 85 words, phrases, and sentences.

Questionnaire: Cultural appropriateness, perceived frequency and ease of use of the isiXhosa speech stimuli.

A questionnaire (Appendix E) was designed to collect information on the 1) cultural appropriateness, 2) perceived frequency of occurrence in the language, and 3) perceived difficulty of producing the generated isiXhosa speech stimuli orally. The questionnaire was created for self-administration. Information about the cultural appropriateness of the speech stimuli, perceived ease and frequency of use was obtained through a dichotomous (yes/no) format. The dichotomous format allowed for ease of data capturing and analysis (Kanjee, 2008). It however does not allow for sensitivity to be evaluated. The questionnaire allowed for recording of participants' perceptions about the frequency of use and perceived difficulty of saying the speech stimuli. Inclusion of these aspects was essential as an assessment tool for AOS requires words, phrases and sentences that are easy and difficult to say, frequently and infrequently used and culturally appropriate for isiXhosa speakers. An open-ended question was included for participants to provide suggestions of other words for those which were deemed culturally inappropriate. The dichotomous format was deemed appropriate as the previous study conducted by Abrahams et al. (2011) utilized a questionnaire containing a Likert scale which resulted in a response set. A response set decreases the reliability of the results obtained. A Likert scale format was not used in this study to avoid a response set.

Questionnaire: Validity of a list of isiXhosa Words, Phrases and Sentences used to Assess Speech in Adults.

A self-administered questionnaire (Appendix F) was designed for use by the Delphi panel. The questionnaire contained the criteria for an assessment of AOS, the features of isiXhosa and the implications for generating the speech stimuli. A dichotomous (yes/no) question was included for the participants to agree or disagree 1) that the criteria generated for the isiXhosa speech stimuli were consistent with the language and 2) that the speech stimuli generated met the criteria for assessing AOS in isiXhosa. There were six tables which included criteria relating to parameters that need to be assessed in AOS in isiXhosa which will allow the features of AOS to be systematically elicited in a way that can be quantified. The tables were organised in terms of increasing articulatory complexity: a) place of articulation; b) manner of articulation; c) consonant clusters, pre-nasalised consonants or clicks; d) words of increasing length with the same stem; e) multisyllabic words; and f) sentences with increasing length. Length was measured in number of syllables in each stimulus. An open ended question for additional comments was included which would allow the Delphi panel to make comments, provide a rationale for their responses, and raise questions (Okoli & Pawlowski, 2004).

Procedures.

Data collection.

Ethics approval for the project was obtained from the Human Research Ethics Council at UCT (HREC Ref 647/2013 – Appendix A). Permission was obtained from the Director of Human Resources (UCT) and the Chief Executive Officer of Groote Schuur Hospital to recruit participants (Recruitment Letter - Appendix G).

Face validity and cultural appropriateness.

The isiXhosa speakers met with the researcher in her office at the hospital, at a time convenient to both parties. The researcher explained the nature of the study and obtained consent. The participants were asked to complete a questionnaire indicating their perceptions of the cultural appropriateness, frequency of use, and difficulty of the words, phrases and sentences generated by the researcher (Kelley et al., 2003). The questionnaire was self-administered with the researcher present while participants

completed the questionnaire. The researcher was able to address any questions or clarifications that the participants had when completing the questionnaire (Kelley et al., 2003).

Data analysis.

Participants' responses were collated and recorded in an Excel spreadsheet. The data were analysed using descriptive statistics. Frequency counts and percentages were obtained to determine whether the speech stimuli were 1) culturally appropriate, 2) frequently used, and 3) difficult to say. Any word indicated as being culturally inappropriate by even one participant was excluded.

Based on the percentages obtained, the researcher could determine whether there was a range of perceived difficulty and perceived frequency of use of the speech stimuli. (Both easy and difficult words, and frequently and infrequently used words were required for the assessment of AOS).

Speech stimuli were considered easy and frequently used when 75% or more of the participants indicated the word as "easy to say" and "used often". The speech stimuli were ranked according to the percentage of participants who rated them as "easy to use" and "used often".

Content and construct validity.

The Delphi panel participants were emailed an information letter (Appendix H) about the study and written consent was obtained. The proposed criteria for an assessment of AOS in isiXhosa and the revised list of speech stimuli (i.e. words, phrases and sentences generated by the researcher which met the criteria and judged to be culturally appropriate) were sent to them electronically. The panel was asked to review the criteria for assessing AOS and to provide feedback regarding the decisions made to adjust the criteria for the isiXhosa language. In addition, the panel was required to comment on each of the speech stimuli and to indicate if the stimuli met the specified criteria. Participants were given a date by which they had to return the questionnaires.

Once the completed questionnaires were returned to the researcher, the responses were reviewed and summarised (Hsu & Sandford, 2007). Words that did not meet the criteria were removed from the list of speech stimuli. A summary of the Panel's responses and a list of stimuli removed from the original set of speech stimuli was sent to the Panel for further review (Round 2). As suggested by Hsu and Sandford (2007) more than one round of analysis is required to reach consensus. The researcher contacted the participants via email to remind them to respond to the revised questionnaire. There were however no further responses from the second round of engagement with the Delphi Panel as none of the panel members responded. Responses from each participant were considered and included based on motivation provided by the expert. The speech stimuli were finalised based on rationale and recommendations from the first round of consultations and analysis.

Ethical Considerations

The ethical principles as stipulated in the Declaration of Helsinki (World Medical Association, 2013) guided the considerations taken into account in this project. Research participants' dignity and wellbeing were held to be more important than the research and therefore participants had the right to decline participation in the study (Durrheim & Painter, 2008). All potential participants were provided with an information letter detailing the project and written informed consent was obtained. Provision was made for participants who could not read by having the information verbally explained to him/her in English or isiXhosa (via an interpreter).

The following ethical principles were incorporated in this study (Helsinki, World Medical Association, 2013):

Autonomy and respect for the dignity of research participants.

Participants were respected as individuals who are capable of making their own choices. Individuals were invited to participate and their participation was voluntary. Individuals were provided with an information letter detailing the nature of the project and what was required of them as participants. They were informed that they were not obliged to participate and could withdraw at any time without an explanation or any negative consequences.

Confidentiality.

The confidentiality of participants was upheld through assigning each participant a number. No participant was identified in any way in any publication related to this project. Where identifying data were collected these were stored securely and separately from the data used in this project.

Beneficence.

The research participants did not benefit from the study. Their participation contributed to the generation and validation of an assessment tool for AOS in adults who speak isiXhosa.

Non-maleficence.

The participants were not exposed to any direct or indirect harm. They were informed of the research process and no deception was employed. The burden of the study was that the participants were expected to contribute their time in order to complete the questionnaire or to participate in a Delphi Panel. Where isiXhosa speaking participants had to travel to participate in the study, they were reimbursed for their transport costs.

Justice – participants treated in a fair and impartial manner.

The participants were treated with fairness. The researcher has ensured that all the results, either positive or negative, were accurately published in this final document. A copy of this report will be available to the research participants should they so wish (Hedge & Pomaville, 2012).

Results

The results pertaining to face, construct and content validity of the speech stimuli are reported. Face validity which comprises the participants' perceptions of cultural appropriateness, frequency of use and difficulty of the speech stimuli are presented first. Thereafter the results obtained from the Delphi panel (construct and content validity) are presented followed by the final list to be used in Study 3 (i.e. the words, phrases and sentences that meet the requirements for an assessment of AOS in isiXhosa).

Sample Size

Group 1 (IsiXhosa speakers).

Twenty participants were recruited.

Group 2 (Delphi panel).

Of the 33 possible experts identified and contacted (via email) to participate, two declined participation (reasons provided were - unable to participate due to time constraints and not areas of expertise); 25 did not respond to the email; and five indicated their willingness and provided consent to participate. Of the five, only four returned the questionnaire following the first round of analysis.

Participant Description

Group 1 (isiXhosa speakers).

There were 20 isiXhosa-speaking participants (seven males; 13 females). Participants' ages ranged from 20 to 48 years (M = 33.05; SD = 8.95).

Group 2 (Delphi panel).

Four experts from South African universities constituted the Delphi Panel. The first expert had a PhD in linguistics and specialises in morphology, morpho-syntax and language development. The second participant had more than 20 years teaching experience in Phonetics and Linguistics at a University. The third taught isiXhosa at

University level. The fourth has a degree in Speech-Language Pathology and has conducted research in African languages.

a) Face Validity

Perceived cultural appropriateness.

Of the 85 speech stimuli 100% of them were perceived to be culturally appropriate by all the isiXhosa speakers.

Perceived frequency of use.

Thirty percent of the speech stimuli were perceived to be frequently used. Table 3 lists the stimuli (words, phrases and sentences) and the percentage of participants in parentheses who rated the speech stimulus as frequently used.

Table 3

IsiXhosa Speakers' Perceptions of Frequency of Use of the Speech Stimuli (n=20)

IsiXhosa Speech Stimuli (%) from most to least frequent			
Iphepha (100)	Iphephandaba (80)	Inani (45)	Uqhekezo (30)
Utata (100)	Umculi (75)	Isisu (45)	Umfama (30)
Nini (100)	Andiphilanga (75)	Ivenkilana (45)	Unxantathu (25)
Usisi (100)	Nithanda isoka (75)	Idada (40)	Ubukrelekrele (25)
Kushushu (100)	Ungquzulwano (70)	Iqaqa (40)	Impi (25)
Iindondo (100)	Amazesha onyaka (70)	Ikalika (35)	Ukosulela (25)
Yhu! (100)	Ifamu (65)	Ingongoma (35)	Usuleleko (25)
Hlala (100)	Ifoni iyakhala (65)	Umgca (35)	Isibulala ntsholongwane (25)
Ivenkile (100)	Udade (60)	Uninazala (35)	Alabuhlungwanga (25)
Ndiphilile (100)	Intyatyambo (60)	Umni (35)	Ihlonyelwa (20)
Umama (95)	Itishala (60)	Sala (35)	Ishumi elinesithandathu (20)
Icici (95)	Ikawusi (55)	Umzi womlimi (35)	Intendelezo yefama (20)
Incinci (95)	Nina (50)	Igwegwe (30)	Nceda ngamatikiti amabini eshowu yasebusuku (10)
Bhala (95)	Iphupha (50)	Igugu (30)	Nditshixele izitshixo zam emotweni (10)
Utsotsi (90)	Impempe (50)	Uthuthu (30)	Indawo ikude (5)
Inkwenkwe (90)	Ijaji (50)	Imbewu (30)	Sisitulu sikatitshalakazi (5)
Indlu (90)	Ukubebezela (50)	Intshonalanga (30)	Ufuna ukufunda isiXhosa kodwa iincwadi zakhe azikho (5)
Ixesha (90)	Gula (50)	Ingcongconi (30)	
Kubuhlunga (90)	Ukucula (50)	Iliwa (30)	
Umni (85)	Intlungu (50)	Isithsaba (30)	
Iculo (85)	Nam ndiyavuya ukuwazi (50)	Umqhekezi (30)	

Note: % indicates number of participants who indicated the speech stimuli was "used often"

Perceived difficulty of speech stimuli.

Twenty seven percent of the speech stimuli were perceived to be difficult to say. Table 4 lists the speech stimuli and their perceived difficulty as rated by the isiXhosa speakers.

Table 4

IsiXhosa speakers' perceptions of difficulty of the speech stimuli (n=20)

IsiXhosa Speech Stimuli (%) from easiest to most difficult			
Iphepha (100)	Bhala (95)	Iindondo (90)	Umqhekezi (70)
Uthuthu (100)	Umni (95)	Yhu! (90)	Impempe (65)
Idada (95)	Hlala (95)	Amaxesha onyaka (90)	Isibulala ntsholongwane (65)
Udade (95)	Sala (95)	Ivenkile (90)	Sisitulu sikatitshalakazi (65)
Iphupha (95)	Gula (95)	Iculo (90)	Umculi (60)
Umama (95)	Impi (95)	Intendelezo yefama (90)	Uqhekezo (55)
Umni (95)	Isithsaba (95)	Indawo ikude (90)	Unxantathu (50)
Nini (95)	Ivenkilana (95)	Ndithanda isoka (90)	Ishumi elinesithandathu (50)
Inani (95)	Ndiphilile (95)	Ifoni iyakhala (90)	Igwegwe (45)
Ijaji (95)	Andiphilanga (95)	Indlu (90)	Ufuna ukufunda isiXhosa kodwa iincwadi zakhe azikho (45)
Usisi (95)	Usuleleko (95)	Ixesha (85)	Intshonalanga (40)
Isisu (95)	Intlungu (95)	Nam ndiyavuya ukuwazi (85)	Ungquzulwano (40)
Kushushu (95)	Kubuhlunga (95)	Ukubebezela (80)	Umzi womlimi (40)
Utsotsi (95)	Ifamu (95)	Ukucula (80)	Ingongoma (35)
Imbewu (95)	Umfama (95)	Ukosulela (80)	Ingcongconi (35)
Uninazala (95)	Igugu (90)	Iqaqa (75)	Ubukrelekrele (25)
Iliwa (95)	Utata (90)	Intyatyambo (75)	Incinci (20)
Iphephandaba (95)	Ikalika (90)	Icici (70)	Alabuhlungwanga (20)
Itishala (95)	Nina (90)	Umgca (70)	Nceda ngamatikiti amabini eshowu yasebusuku (15)
Ikawusi (95)	Inkwenkwe (90)	Ihlonyelwa (70)	Nditshixele izitshixo zam emotweni (15)

Note: % indicates number of participants who indicated the speech stimuli was "easy to say"

The words *icici* and *incinci* were perceived to be both frequently used and difficult suggesting that not all frequently used words are easy to produce.

Words containing tonal contrasts and Hlonipha.

The word *'gcoba' – be happy* – was less familiar to the isiXhosa participants and it was suggested that it is a form of Hlonipha as generally the word *'vuya'* will be used to express '*be happy'* (Kamnandi, personal communication, 2014). The word *'gcoba'* was retained in the assessment tool as it was not deemed culturally inappropriate.

None of the speech stimuli were excluded based on cultural inappropriateness; nine were excluded as there were too many speech stimuli per criteria. Two of the words containing tonal contrasts – *ndiyazi – I know it/ knowing it* were discarded as they were understood to have the same meaning (Kamnandi, personal communication, 2014).

b) Content and c) Construct Validity

Seventy three words, phrases and sentences were included in the stimuli sent to the Delphi panel (Appendix F).

All members of the panel agreed that the changes made to the criteria to generate isiXhosa speech stimuli, for the assessment of AOS, had merit and were valid.

Arising out of Study 1, there was a suggestion relating to a hierarchy of complexity in isiXhosa. The panel raised the issue of articulatory complexity in isiXhosa (i.e. whether there is: 1) articulatory complexity in isiXhosa, 2) levels of complexity in isiXhosa, and 3) similar levels of articulatory complexity in isiXhosa as there is for English) as little literature is available on whether the complexity for isiXhosa can be judged to be similar to the articulatory complexity in English. This will need to be further researched in future studies.

A member of the Delphi panel suggested excluding criteria that do not exist in isiXhosa such as consonant clusters. Consonant clusters in English contribute to complexity and elicit more errors in patients with AOS. Consonant clusters do not occur in isiXhosa and were therefore excluded as a criterion.

Table 5 provides a summary of the criteria arising out of Study 1 and the corresponding speech stimuli. The criteria were judged by the Delphi Panel to meet the constructs set out in the questionnaire. The list of speech stimuli for each criterion as evaluated by the Delphi panel (for content and construct validity) and the isiXhosa speakers (for face validity) is also presented in the table.

Table 5

Proposed criteria and speech stimuli approved by the isiXhosa speakers and Delphi Panel for an assessment of AOS in isiXhosa

Criteria	IsiXhosa Implication and Novel Criteria	Speech Stimuli				
Place of articulation	IsiXhosa has all the places of articulation listed for English – words therefore reflect complexity in this order - bilabial; alveolar, velar. The initial consonant of the second syllable reflects the various places of articulation.	Bilabial (voiceless) Iphepha, Iphupha	Alveolar (voiceless + voiced) Utata, Uthuthu, Idada, Udade	Velar (voiceless + voiced) Ikalika, Igugu,, Igwegwe	Velar + nasal Nini, Inani, Nina	Bilabial + nasal Umama, Umni
Phoneme Position and Initial Phoneme Difficulty	Errors are more likely in initial position in words – due to the nominal classification system of isiXhosa it is suggested that the 1st phoneme of the 2nd syllable contain the target phoneme.	Refer to speech stimuli listed under place of articulation, manner of articulation, syllable structure and length of utterance.				
Manner of Articulation	The order below reflects complexity: 1. Nasals and plosives; 2. Fricatives and affricates IsiXhosa has additional manners of articulation which were included: clicks, implosives and ejectives.	Voiced affricate Ijaji	Voiceless fricative Usisi, Isisu Kushushu Utsotsi	Central click icici	Palatal click iqaqa	
Syllable structure - Consonant Clusters	No consonant clusters exists in isiXhosa therefore this was excluded. IsiXhosa however has prenasalised consonants which were included.	inkwenkwe, iindondo, incinci, impempe, ingongoma				

Table 5 ***(continued)***

Proposed Criteria and speech stimuli approved by the isiXhosa speakers and Delphi Panel for an assessment of AOS in isiXhosa

Criteria	IsiXhosa Implication and Novel Criteria	Speech Stimuli
Length of Utterance	Monosyllabic words are rarely found in isiXhosa; therefore disyllabic words were the smallest unit. Multisyllabic words; words of increasing length with the same stem; and sentences were included.	Yhu! (1) Multisyllabic Words (number of syllables) Indlu (2), Umgca (2), Bhala (2), Hlala (2), Sala (2) Gula (2), Impi (2) Imbewu (3), Iliwa (3), Intyatyambo (4), Isithsaba (4), Itishala (4), Ikawusi (4), Ingcongconi (4) Unxantathu (4) Ihlonyelwa (4) Intshonalanga (5) Ungquzulwano (5) Uninazala (5) Iphephandaba (5) Ukubebezela (6) Ubukrelekrele (6) Ishumi elinesithandathu (10)
Frequency of Use	Frequent and infrequently used words included.	Refer to Table 3 for speech stimuli perceived as frequently used.
Difficulty	Easy and difficult words included.	Refer to Table 4 for speech stimuli ranked from easiest to most difficult.

Discussion

This part of the study concerned itself with the face validity of the speech stimuli for an isiXhosa tool for the assessment of AOS in adults. Face validity in this study referred to the cultural appropriateness of the speech stimuli, perceived frequency of use and perceived difficulty of the words, phrases and sentences. The speech stimuli included in the tool were judged to be culturally appropriate. In addition, the speech stimuli were judged to include both frequent and infrequently used words, as well as easy and difficult words which meet the requirements for an assessment of AOS.

With regards to the frequency rating of the stimuli included – the method for obtaining standard frequency ratings of occurrence was not used within this study. The perceived frequency of occurrence of the stimuli were obtained. Whether these perceived ratings match with actual occurrence is uncertain and should be further researched in a follow-up study.

The Delphi Panel provided feedback on the proposed criteria and speech stimuli which contributed to establishing content and construct validity. Consideration of the linguistic features of isiXhosa, necessitated changes to the criteria for an assessment of AOS. The Delphi panel supported the proposed revisions to the criteria as the revisions aligned with isiXhosa (see Table 5 in the results section). Specifically, the Delphi panel were in agreement with the suggestion that in words containing a prefix, to evaluate the first phoneme of the second syllable as it contained the target phoneme.

There was also consensus that there should be inclusion of isiXhosa specific criteria (which do not exist in English) such as the additional manners of articulation i.e. clicks, implosives and ejectives. These additional manners of articulation were included in the speech stimuli. There was recognition and agreement that prenasalised consonants contributed to complexity of syllable structure in isiXhosa. It was proposed by the researcher that prenasalised consonants in isiXhosa are as complex in terms of articulation as consonant clusters are in English. This proposal however requires further research in order to prove its validity. Furthermore, as identified in the literature and confirmed by the Delphi panel, consonant clusters – a feature of complexity in English, do not exist in isiXhosa (Abrahams et al., 2011; Childs, 2003;

R. Bailey, personal communication, 2011). There was also agreement that this feature not be included as a criteria for the assessment of AOS in isiXhosa.

With regards to the nominal classification system which results in a vowel occupying the initial phoneme of the speech stimulus – the criteria proposed by the researcher arising out of the literature review was to ensure that the first phoneme of the second syllable of the speech stimulus contained the target phoneme. This proposed change to the criteria was supported by all members of the panel. It is not known if this change in criteria will result in an error i.e. elicit an error on the second syllable of the word. The results of this proposed change to the criteria will be evaluated in Study 3.

The words *icici* and *incinci* were perceived to be both frequently used and difficult which are contradictory to what is known for words in English. Words that are frequently used are considered easier to say (Ballard, Granier, & Robin, 2000; Ziegler, Aichert & Staiger, 2012) than those which are less frequently used due to the programming capacity required for novel constructions (Ballard et al., 2000). Despite the words being frequently used, the perceived difficulty may be due to the words containing a central click (*icici*) and a prenasalised central click (*incinci*) as suggested in the hierarchy of complexity. The perceived frequency of occurrence may also not match the actual occurrence in the language thus resulting in a confounding finding.

Words in isiXhosa and Hlonipha are dependent on an individual's geographical location (e.g. urban vs. rural) and family name. Hlonipha may result in words being more or less familiar to one depending on one's area of residence and family. Words presented in the section on tone were judged as less familiar to the isiXhosa speakers. *'Imithi' – it's pregnant* – was suggested to be a word used more in rural settings by farmers as this word refers to an animal being pregnant. It is therefore not often used by those in the city or urban areas. Furthermore *'imizi' – a type of grass* was also suggested to be a word which is commonly used in the Eastern Cape (Kamnandi & Landie, personal communication, 2014). These stimuli were retained in the list as they were not culturally inappropriate and the list required frequent and infrequently used words.

There was only one round of consultation with the Delphi panel. A challenge was obtaining further participation of the panel due to poor response rate in the second

round. Despite the lack of responses to the second round of questionnaires, there was generally high agreement in the first round that the criteria for the assessment of AOS in isiXhosa and the speech stimuli generated were appropriate and met the specified criteria.

An area not considered within this study is that of the diagnostic features of AOS for inclusion in the assessment tool. Future research may need to evaluate the criterion related validity of the four salient diagnostic features of AOS (i.e. sound distortions, extended intersegment durations, extended segment durations and prosody errors; McNeil et al., 2017) in isiXhosa. Furthermore, the inclusion of shared aphasic error patterns (i.e. error variability across productions, increased errors on increased length of utterance, and articulatory groping; McNeil et al., 2017) may also need further evaluation.

The cultural appropriateness, frequency of use and difficulty of the speech stimuli was judged by the native/first language speakers of isiXhosa. The judgements obtained were from a small sample (n=20) and generalisability may be limited. There may also be differences in the perceived cultural appropriateness of the words when using the speech stimuli across different geographical locations (i.e. Western Cape and Eastern Cape, Kamnandi, 2014). The study however did not explore this and further research within this area can be conducted.

The words, phrases and sentences included in the list of speech stimuli have face, construct and content validity as judged by the isiXhosa speakers and the Delphi panel. The speech stimuli meet the criteria for an assessment of AOS in isiXhosa as set out in Study 1. The speech stimuli are also culturally appropriate. The isiXhosa speech stimuli can be used with isiXhosa speakers and the proposed criteria can be tested.

The merits of the revised criteria were tested with participants who spoke isiXhosa in Study 3. The outcomes may differ from what is known in English which would suggest that there are language specific features for AOS in isiXhosa.

Chapter 4 – Study 3

Literature Review

Construct Validity

In this chapter construct validity is further evaluated through testing the theoretical hypothesis (by assessing patients who speak isiXhosa) and interpreting the findings.

Clinical Validity

Clinical validity refers to the ability of an assessment tool to measure, compare, and make a distinction between clinically different subgroups (Brown, 1996). For this study clinical validity refers to the ability of the isiXhosa speech stimuli to determine the presence of AOS in isiXhosa speakers who may have AOS, dysarthria, and/or Broca's Aphasia as a result of a CVA, TBI or another neurological cause. In order for the isiXhosa speech stimuli to have clinical validity participants from each subgroup need to be included in the study.

Reliability

Reliability is defined by William's (2006) as the ability of test material to produce the same results over repeated measures should the attribute being measured not change. There are various types of reliability. Test/retest reliability and inter-rater reliability are both measures of reliability which are important when developing new assessment tools. Test/retest reliability ensures that the same results are obtained when the same assessment is used with the same individual when the test is repeated (William, 2006). Inter-rater reliability ensures that the same results are obtained when two or more clinicians use the same tool to assess the same individual. In this study, test/retest reliability was not feasible as a key feature of AOS is that the errors are inconsistent and it may therefore not be possible to elicit the same feature on a measure which is repeated later. As with AOS, individuals who initially exhibit signs of the disorder may not display those same behaviours later due to the inconsistency in their errors. Spontaneous recovery may also occur. Additionally, learning may occur making test/retest reliability unfeasible and inappropriate. This study is therefore concerned with inter-rater reliability which is the consistency among two or more

raters (SLPs) who are assessing the same behaviour (features of speech or language disorder displayed by patients; Kaplan & Saccuzzo, 2008).

Studies conducted on speech often use transcription as a way of determining the presence and type of errors. There is however concerns about the reliability of the methods used for transcription (McNeil et al., 2017). Furthermore transcription requires considerable time to complete and collect from multiple raters.

In a study conducted on AOS inter-rater reliability was obtained for the perceptual features that differentiate AOS (Haley et al., 2012). A high agreement was found for judging prolongations (0.87), distortions (0.89) and inconsistency (0.98). The high reliability was achieved through raters scoring the number of sounds perceived to be in error rather than narrowly transcribing the errors (McNeil et al., 1997). Further evidence for the use of broad transcription and perceptual analysis is the finding of Haley & Martin (2011) that perceptual judgments correlate highly with broad transcription of phoneme errors in AOS.

Challenges with reliability.

As there is a lack of standardised assessment tools in the official languages of South Africa – SLPs have developed their own tools for use with patients. These self-developed tools (either translated assessments or adapted assessments) should be used with caution as inter-rater reliability has not been determined. Furthermore, there is no standardised procedure for setting intervention aims based on the results obtained from the self-devised assessment (Van Dulm & Southwood, 2013).

Sensitivity of an assessment tool refers to the ability of the assessment to correctly identify all the individuals who have a ‘disease’ or particular disorder such as AOS. Specificity of an assessment tool refers to the ability of the assessment to correctly identify all the individuals tested without the ‘disease’ or disorder (Lalkhen & McCluskey, 2008; Parikh, Mathai, Parikh, Sekhar & Thomas, 2008).

The sensitivity and specificity of the assessment tool were not evaluated in this study as the aim of the study was not to diagnose patients using the tool but rather to evaluate the ability of the tool to identify features of AOS present in a given population.

Methodology

Aims and Objectives

With reference to AOS in adult speakers, the aim and objectives of this study were:

1. To determine the construct validity of the proposed criteria and the associated speech stimuli generated for the assessment of AOS in speakers of isiXhosa. Specifically, the proposal, that the speech stimuli associated with the following criteria (relating to complexity of speech productions) would generate AOS error patterns, was assessed:
    a) The target phoneme (to elicit an error in AOS) will be the first phoneme of the 2nd syllable in the words
    b) Increased number of syllables (i.e. increased length of utterance) adds to complexity resulting in more errors on these speech stimuli
    c) Repeated consonants within the speech stimuli are more complex and may result in more errors
    d) Words of increasing length with the same stem are more complex resulting in more errors
    e) isiXhosa words, phrases and sentences containing prenasalised consonants and clicks are more complex resulting in more errors on these speech stimuli
    f) Tonal contrasts add to complexity in isiXhosa therefore these speech stimuli will result in more errors
    g) More errors on infrequently used words
    h) More errors on difficult words (difficulty as judged by participants in Study 2)
2. To determine the clinical validity of the assessment tool to identify features of AOS.
3. To determine inter-rater reliability of the list of isiXhosa words, phrases and sentences generated to meet the criteria specified in Aim 1 of study 1.
4. To describe the performance of participants on the assessment tool across diagnoses (AOS, dysarthria, and Broca's aphasia).

Research Design

A cross-sectional design was used for Study 3 (Hall, 2008). This was the most appropriate design method for this part of the study as it allowed for a snapshot of observations to be made at one point in time (Hall, 2008). The advantages of a cross-sectional design were that it allowed the researchers to prove or disprove the assumptions that were made in the previous parts of this study and it allowed for multiple variables to be measured within this study. The design also allowed for a detailed analysis and description of the outcomes of the assessment tool (Rivers, 2016). The disadvantages of this design were that behaviour over time could not be measured, it did not help determine a cause and effect relationship with any of the results obtained, and the timing of the snapshot could not guarantee a representative sample (Rivers, 2016). In this study however, behaviour over time was not an aspect that required study as the goal was not to evaluate the effectiveness of a treatment protocol but rather the validity of the assessment tool created. The study also did not aim to determine a cause and effect relationship. Furthermore the researcher aimed to include a representative sample in the study.

Participants: IsiXhosa patients.

Inclusion criteria.

Participants were eligible for inclusion in the study if they met the following criteria

- Spoke isiXhosa as a first language
- Over the age of 18 years
- Healthy individuals with no neurological deficits
- Or individual who had a neurological deficit (such as a left CVA or TBI) with resultant speech and/or expressive language difficulties
- Able to follow simple commands in isiXhosa as determined by the treating SLP
- Able to provide consent
- No reported and/or documented hearing loss as reported by the patient and/or treating health care professional

Exclusion criteria.

Participants were excluded if they had:

- Severe receptive aphasia as determined by the treating SLP
- Dementia – as determined by the treating physician

Recruitment method.

A key informant technique was used to recruit participants as they were identified by SLPs (key informants) working at two large hospitals in Cape Town (Durrheim & Painter, 2008). The SLPs working at each site assessed her patients and informed the researcher of any patients who met the inclusion criteria. The individuals who did not have any neurological damage were recruited by the researcher.

Sampling method.

Convenience sampling was employed as the participants selected for inclusion were patients who were available to the researcher (William, 2006). The advantages of this method are that is it easy, efficient, and cost effective. This type of sampling method may not be representative of the broader isiXhosa speaking population (William, 2006).

Sample size.

According to Durrheim and Painter (2008) a sample needs to be large enough to generalise the results obtained to the wider population. Patel et al., (2013) conducted a study in which they aimed to determine the feasibility of using a novel reading passage to assess motor speech disorders. The sample size used in their study was 22 participants. Leedy and Ormrod (2005) suggest that 30 is the minimum number of participants for a sample in a quantitative study. In the study of isiXhosa speech acquisition in children (Maphalala et al., 2014) 24 children participated. The small number of participants was preferred in this study as it allowed for in depth analysis of the results and it yielded rich data (Maphalala et al., 2014). Due to the exploratory nature of this study, the aim was to include between 22 and 30 participants across diagnoses (i.e. AOS, dysarthria, Broca's aphasia, cognitive communicative disorder and normal speech).

Compilation of speech stimuli into a tool.

The speech stimuli generated and refined in studies 1 and 2 were compiled into the isiXhosa Speech Assessment tool for AOS. This tool was used to assess participants' speech. The tool consisted of a response form (Appendix I) which listed

the speech stimuli (with IPA transcriptions) as well as a video recording of a native speaker of isiXhosa verbally producing each of the words, phrases and sentences. The nature and purpose of the study was explained to the individual by the researcher and clearance for his image to be used in this study and subsequently for assessments with patients was obtained.

The video recording of the isiXhosa speaker was created over two sessions totalling two and a half hours. The total recording time being about 12 – 15 minutes. The isiXhosa speaker was instructed by the researcher to produce the words one at a time while the researcher video recorded his production of each speech stimulus. Each word/speech stimulus was recorded individually (single video clips) for ease of administration when conducting the assessment. A continuous stream of video requires the administrator to pause it in order to score the response (through ticking the description listed and transcribing where necessary) whereas single video clips allowed time in between speech stimuli for the administrator to score a response on the response form. After the recording of each speech stimulus, the production was then listened to and viewed by the researcher and isiXhosa speaker to ensure that it was audible, intelligible and visible. When the production was unclear the speech stimulus was re-recorded.

Figure: 1

Images of the video clips in the assessment tool

Each subset of stimuli was preceded by the IsiXhosa speaker giving the instruction in isiXhosa for the section (i.e. repeat these words, repeat these words three times, repeat these sentences). The video clips were stored on an iPad which was used for presenting the tool to participants.

The response form was a table which listed the 66 speech stimuli and characteristics of AOS and Broca's aphasia to assist with making a differential diagnosis. A section listing the features of dysarthria was included as well as a section to document any other comments or specific comments on tone.

Study Personnel

The study consisted of the following personnel: the principal researcher, a qualified SLP with a BSc – SLP, with more than three years' experience; five SLPs working at the selected institutions who helped to identify participants for Study 3; an isiXhosa speaker – educated and employed as an interpreter at a hospital who was also the model for video recordings; interpreters (professional and ad hoc) – were employed to explain the purpose of the research to the participants in the study; and two research assistants were trained to administer the assessment tool to participants identified by the SLPs. The two research assistants were qualified SLPs and had more than 3 years' experience. Prior to using the IsiXhosa Speech Assessment tool with patients, the research assistants were trained. The training session lasted for two hours. Both research assistants attended a training session. Training entailed becoming

familiar with the speech stimuli and scoring methods of the tool– understanding how it was constructed and what it is intended to assess, how to use and administer the tool, recording responses and scoring the tool by ticking on the response form to indicate whether the feature under study was present or not. The research assistants were encouraged to add in comments to assist with making a decision of the type of error the participant displayed. They were also given an opportunity to practice administering and scoring the tool. Other pertinent information regarding apraxia of speech, and aphasia were also discussed with the research assistants (see Appendix J). The researcher and research assistants were blind to the treating SLPs diagnosis of the participants.

Pilot study.

The administration was then trialled on one individual to check how comfortable each assistant was with administering and scoring the tool. From that session further refinements to administering the tool was made. It was decided that a sound check would be done prior to administering the tool to ensure the participant could adequately hear the speech stimulus, the recording of the participant would also be checked to ensure that the reproduction was not impaired in any way, and the researchers would pause the recording after each speech stimulus when additional time for transcribing the participants responses were required.

Procedures.

Data collection.

The Medical Superintendent/Chief Executive Officers at Groote Schuur Hospital and Life Esidemeni were emailed to request permission to conduct the research at the respective sites (Appendix G). After obtaining permission the SLPs were asked to identify possible participants for inclusion in the study. Once participants were identified they were invited (telephonically or face to face) by the researcher or research assistants, to participate in the study. The participants were provided with information about the study (Appendix K) and provided informed consent to participate. The information was provided in English (where participants understood English) and in isiXhosa via a translator to the participants who only spoke isiXhosa. For participants who were unable to read, information was provided to them verbally.

To protect participants' confidentiality their names were not used. Each participant was assigned a number (Ajita, 2008; World Medical Association, 2013). As many of the participants were known to the researcher, the research assistants recruited, obtained consent and administered the IsiXhosa Speech Assessment for Adults (list of words, phrases and sentences) in order to avoid conflict and minimize the power dynamic between the therapist and the patient. The participants were made comfortable with the research assistants and were free to indicate their desire to stop participating which was respected by the research assistants. The participants were assessed in a quiet office or in their ward cubicle either seated on their bed or in a chair at the bedside. Where assessments were conducted at the bedside, the ward staff were asked to reduce background noise. The iPad with the assessment was placed in front of the participants on a table. The research assistant explained what was expected of the participant and determined whether the sound was loud enough and visually clear enough for the participant to hear and see the screen. The participant was initially instructed to watch the screen and listen to the video. The instructions were also included in the assessment tool in isiXhosa. A video camera was set up to record the participants' responses. The researcher and research assistants independently wrote down the participants responses during the test administration. A response form was used by the research assistants to document participants' responses. The researcher and research assistants were blind to each other's scoring. A video recording was made of the participants' responses to assist with perceptual analysis (Haley et al., 2012). Responses were documented at the time of administration and the video recording was available when the researcher or research assistant required it for a reliability check and for detailed analysis of responses. At the end of the assessment the video camera was turned off and participants thanked for their participation.

Equipment.

A Kodak digital video camera was used to record participants' responses. Responses were video recorded so that the researcher and/or assistants could review participants' responses if they were uncertain about how to score the response. It also allowed for behavioural aspects of AOS to be seen (e.g. articulatory groping) which would be missed on an audio recording.

The Assessment Tool was on an iPad.

Data analysis.

Construct validity.

To determine the construct validity of the proposed criteria and the speech stimuli, the responses of the participants were analysed. The frequency of errors for each construct was calculated.

Inter-rater reliability.

To determine the reliability of the speech material to assist with a diagnosis of AOS, perceptual analysis of the participants' responses was done. The participants' responses were analysed for types of errors (i.e. diagnostic features of AOS, dysarthria and Broca's aphasia) to assist the researcher in making a diagnosis of AOS (Haley et al., 2012). Table 1 of the tool describes the features that patients with AOS may display. The scoring tool listed the diagnostic features of speech disorders (AOS, dysarthria and Broca's aphasia which commonly co-occur with AOS) and the researcher and research assistants had to score the tool (by indicating with a tick the feature displayed by the participant). Additional information regarding patient's performance was documented in the comments column.

The data collected from the research assistants was analysed for inter-rater reliability. Inter-rater reliability is a reliability measure which describes the agreement or consistency between different judges (two or more) who are judging the same behaviour (Kaplan & Saccuzzo, 2008). This was done through comparing the data obtained (two sets of scores from the two research assistants) for each participant and calculating the error rate obtained (Walizer and Wiener, 1990). Error rate was calculated using the following formula:

$$Frequency\ of\ errors = \frac{number\ of\ errors}{total\ number\ of\ stimuli\ containing\ the\ construct\ \times\ N\ participants\ with\ AOS}$$

Ethical Considerations

The ethical principles as stipulated in the Declaration of Helsinki (World Medical Association, 2013) guided this study. Research participants' dignity and wellbeing were held to be more important than the research and therefore participants

had the right to decline participation in the study (Durrheim & Painter, 2008). All potential participants were provided with an information letter detailing the project and a consent form to sign. Provision was made for participants who could not read by having the information verbally explained to him/her in English or isiXhosa (via a translator).

The following ethical principles were incorporated in this study (Helsinki, World Medical Association, 2013):

Autonomy and respect for the dignity of research participants.

Participants were respected as individuals who are capable of making their own choices. Individuals were invited to participate and their participation was voluntary. Individuals were provided with an information letter detailing the nature of the project and what was required of them as participants. They were informed that they were not obliged to participate and could withdraw at any time without an explanation or any negative consequences. An interpreter was available to convey the information to the isiXhosa speaking participants.

Confidentiality.

The confidentiality of participants was upheld through assigning each participant a number. No participant was identified in any way in any publication related to this project. Where identifying data was collected these were stored securely and separately from the data used in this project. Video recordings of the participants were securely stored and will be destroyed after publication of the data. The professional and ad-hoc interpreters signed confidentiality agreements to maintain confidentiality of the participants.

Beneficence.

The research did not benefit the participants directly; however their participation contributed to the generation and validation of an assessment tool for apraxia of speech in adults who speak isiXhosa.

Non-maleficence.

The participants in the project were not exposed to any direct or indirect harm. They were informed of the research process and no deception was employed. The burden of the study was that the participants were expected to contribute their time in

order to be assessed by the researcher. In cases where the participants were required to meet the researcher at an arranged destination, the participants were reimbursed for their travelling expenses.

Justice – participants treated in a fair and impartial manner.

The participants were treated with fairness. The researchers ensured that all the results, either positive or negative, were accurately published in this final document. A copy of this report will be available to the research participants should they so wish (Hedge & Pomaville, 2012).

Results

This study presents the construct validity, clinical validity and reliability of the speech stimuli when using the isiXhosa speech stimuli with isiXhosa patients or healthy individuals in order to make a diagnosis of AOS. It also describes the performance of the participants on the isiXhosa speech stimuli across diagnoses. The results which speak to the construct validity of the tool are presented first. Thereafter the results pertaining to clinical validity and inter-rater reliability are presented. The results for participants with each speech diagnoses (i.e. AOS, Dysarthria. Broca's aphasia and cognitive communicative disorder are presented separately for ease of reading. Appendix L presents a comprehensive view of all the participants' performance and description of errors displayed.

Sample Size

A final sample size of 26 participants was obtained.

Participant Description

There were 26 participants in this phase of the study (15 male; 11 female). Their ages ranged from 20 to 89 years (*M = 51.05; SD =21.73*). Participants were diagnosed by the treating SLP. Research assistants were blind to the diagnosis of the treating SLP. Seven participants had AOS (which is the main focus of this study), six had dysarthria, three participants had expressive aphasia, one had a cognitive communicative disorder (as diagnosed by the treating SLP) and eight participants had no medical diagnosis with normal speech. The small sample size across disorders allowed for more detailed analysis of responses (Maphalala et al., 2014).

Construct Validity

Table 6 displays a summary of the frequency of errors across constructs (i.e. objectives a – h) for participants with AOS. With regard to the construct evaluating the initial phoneme, the first consonant of the second syllable had a higher error rate than initial phonemes which were vowels or consonants for participants with AOS (Refer to Table 6). Error rates were higher on words containing three and four syllables and on sentences, than on two syllable words. Words with the same stem increasing in length also had higher error rates. When comparing the elements of complexity, speakers with AOS demonstrated a higher number of errors on stimuli

containing clicks and a low number of errors on prenasalised consonants. Errors in tone were not influenced by the length of the utterance/number of syllables. There was a higher error rate on words which were rated as less frequently used and words rated as difficult to say (Refer to Table 6).

Table 6

Summary of the Frequency of errors across constructs for participants with AOS (Objectives a – h)

Objective	Error position		Total stimuli containing construct	N errors[3]	Frequency of error
a	First phoneme	Vowel	59	51	12,3
		Consonant	12	6	7,1
		First consonant of second syllable	59	75	18,2
b	Increasing length of utterance	2 syllables	8	14	25,0
		3 syllables	27	84	44,4
		4+ syllables	28	98	50,0
		Sentences	8	30	53,6
c		Stem	21	49	33,3
d	Complexity	Repeated phoneme	22	8	5,2
e		Clicks	9	29	46,0
		Prenasalised consonants	5	4	11,4
f	Tone	Tonal error	6	1	2,4
		Articulation error	6	2	4,8
		2 syllables	2	4	28,6
		3 syllables	4	8	28,6
g	Perceived frequency of use[1]	76-100%	21	56	38,1
		51-75%	9	32	50,8
		26-50%	27	75	39,7
		0-25%	15	58	55,2
h	Perceived difficulty[2]	76-100%	55	132	34,3
		51-75%	11	43	55,8
		26-50%	7	25	51,0
		0-25%	5	18	51,4

Note. 1. % use as rated by participants in study 2 (isiXhosa speakers); 2. % easy as rated by participants in study 2 (isiXhosa speakers); 3. Average of errors across two raters.

Inter-Rater Reliability and Description of Responses (Errors) and Comparison with SLP Diagnosis

The types of errors were compared with the primary diagnosis of the SLP and the following was found:

Participants with AOS

The seven participants with a diagnosis of AOS (as diagnosed by the treating SLP) displayed errors which were consistent with AOS. The following errors were noted on the isiXhosa Speech Assessment: substitution, groping, omissions, inconsistent errors, and more errors noted on words which had increasing complexity. See Appendix L for the list of speech stimuli as well as types of errors displayed across participants.

The percentage of speech stimuli found to be in error ranged from 25% to 97% indicating a range of severity of AOS. Participants classified by the treating SLP as having severe AOS had the highest percentage of errors and participants classified as having mild AOS making the least errors (25%).

The inter-rater agreement based on presence of an error ranged from 79.2% to 98.4%. Inter-rater agreement for classification of error types ranged between 69.7% and 89.4%.

Table 7 displays the speech stimuli found to have the highest error rate for participants with AOS.

Table 7

Speech stimuli found to have the highest error rate (70+ %) for participants with AOS

Speech Stimuli	**% in error (n=7)**
iphepha	71.4 (5)
ijaji	85.7 (6)
utsotsi	71.4 (5)
ixesha, amaxesha onyaka	85.7 (6)
uqhekezo, umqhekezi	85.7 (6)
iculo, umculi, ukucula	85.7 (6)
ukosulela, usuleleko, isibulala ntsholongwane	85.7 (6)
intlungu, kubuhlunga, alabuhlungwana	85.7 (6)
ifama, umfama, umzi womlimi, intendelezo yefama	85.7 (6)
intyatyambo	100
unxantathu	100
itishala	71.4 (5)
isithsaba	71.4 (5)
ihlonyelwa	85.7 (5)
ikawusi	71.4 (5)
ingcongconi	85.7 (6)
iphephandaba	71.4 (5)
ubukrelekrele	71.4 (5)
ukubebezela	85.7 (6)
ishumi elinesithandathu	85.7 (6)
ndithanda isoka	71.4 (5)
nam ndiyavuya ukuwazi	85.7 (6)
sisitulu sikatitshalakazi	85.7 (6)
nditshixele izitshiko zam emotweni	85.7 (6)
nceda ngamatikiti amabini eshowu yasebusuku	100
ufuna ukufunda isiXhosa kodwa iincwadi zakhe azikho	85.7 (6)

Participants with Dysarthria

The six participants with a diagnosis of dysarthria displayed errors which were consistent with the diagnosis. Errors of articulatory precision, respiration and phonation were those which were most commonly identified. The percentage of stimuli found to be in error ranged from 0% - 100%. Table 8 displays the speech stimuli with the highest percentage of errors.

Table 8

Speech stimuli with highest error rate for participants with dysarthria

Speech Stimuli (% in error)	**% in error (n = 6)**
iphupha	83.3
nini	83.3
ijaji	83.3
usisi	83.3
iqaqa	83.3
ixesha, amaxesha onyaka	100
uqhekezo, umqhekezi	80
iculo, umculi, ukucula	80
ukosulela, usuleleko, isibulala ntsholongwane	80
intlungu, kubuhlunga, alabuhlungwana	100
ifama, umfama, umzi womlimi, intendelezo yefama	100
unxantathu	80
ihlonyelwa	80
ikawusi	100
ingcongconi	80
iphephandaba	80
ubukrelekrele	100
ukubebezela	80
ishumi elinesithandathu	80
nam ndiyavuya ukuwazi	80

The inter-rater agreement based on presence of an error ranged from 43.2% to 81.34%. The low inter-rater reliability may have been due to the subjective nature of scoring the tool – stimuli judged as "normal" were those which the research assistant perceived as the target response.

When comparing Table 7 and Table 8 majority of the speech stimuli with the highest error rate occur in both groups of participants (i.e. participants with AOS and participants with dysarthria).

Patients with Expressive Aphasia

Participants with expressive aphasia were "unable to say" 47% of the speech stimuli. The type of errors displayed were: substitutions, an increase in errors with an increase in complexity, omissions, effortful speech, consistent errors, distortion of

consonants, semantic/phonemic paraphasias and other. Refer to Appendix L for distribution of types of errors.

The inter-rater agreement based on presence of an error ranged from 77.7% to 100%. Agreement based on classification of the types of errors displayed ranged between 45.5% and 96.5%. The agreement decreased due to difficulty classifying the type of error that was displayed.

Participant with a Cognitive Communicative Disorder

The inter-rater agreement for presence of an error was 100%. There was a 96% inter-rater agreement based on classification of the types of errors displayed. See Appendix L for nature of the errors displayed.

Tone

The performance of participants in Study 3 was compared across disorders. Those with no medical diagnosis or SLP diagnosis falling into the category of healthy individuals had no difficulty with the tonal contrasts.

Table 9 displays the percentage of difficulty with the words containing tonal contrasts across disorders.

Table 9

Percentage of difficulty with the words containing tonal contrasts across disorders

Words	Apraxia of Speech (n=3)	Expressive Aphasia (n=3)	Dysarthria (n=4)	Cognitive Communicative (n=1)
Gcoba *be happy*	66.6 (2)	100	No difficulty	No difficulty
Gcoba *put lotion on*	66.6 (2)	100	25 (1)	Difficulty
Imithi *It's pregnant*	33.3 (1)	100	No difficulty	No difficulty
Imithi *Tress*	100	100	No difficulty	No difficulty
Imizi *houses*	33.3 (1)	66.6 (2)	No difficulty	No difficulty
Imizi *a type of grass*	100	100	50 (2)	No difficulty

The participants with AOS had difficulty with the words containing tonal contrasts. The error however was not an error of tone. Participants with dysarthria and cognitive communicative disorders had little to no difficulty with the words containing

tonal contrasts. The participants with Expressive Aphasia were unable to produce the stimuli containing tonal contrasts.

Discussion

This project set out to develop valid speech stimuli for inclusion in an isiXhosa assessment for apraxia of speech in adults. The process of developing the tool considered and included the requirements for the speech assessment of AOS as well as the features of the isiXhosa language.

The speech stimuli, based on the revised criteria were determined to have cultural and linguistic acceptability. The speech stimuli contribute to an assessment of AOS as they may form part of the repetition tasks in a comprehensive assessment. It is likely that these speech stimuli will lead to a more accurate description of an isiXhosa speaker's speech. The isiXhosa speech stimuli generated and validated will allow for a more comprehensive assessment of isiXhosa speech especially as language specific features such as clicks, prenasalised consonants and ejectives have been included. The SLP clinician will be able to describe the speech impairment profile of the patient in more detail as the language specific features will have been assessed. For example, in this study participants with AOS had a high frequency of errors on stimuli containing clicks and more errors on less frequent words. As there will be more detail about the patient's impairment profile, SLPs will be better able to tailor an appropriate intervention plan for the patient who speaks isiXhosa.

The speech stimuli have not shown clinical validity. Although the researcher was able to distinguish the presence of some AOS features in the isiXhosa speakers (i.e. groping and inconsistent errors) there was an overlap of the following error types: substitutions, omissions and increase in errors with an increase in complexity; in participants with expressive aphasia thus making a differential diagnosis not possible. These findings brings into question the validity of the diagnostic features of AOS included in the assessment tool. As the diagnostic features were taken from previous research studies without validity testing in this study a further step may be required to evaluate their validity. A consensus panel may be able to assist with determining criterion related validity for the diagnostic features of AOS.

Many of the error patterns are similar to that documented in the literature describing AOS, for example substitution errors. Other errors patterns which are described as overlapping with aphasia were also noted in the participants with AOS (i.e. groping, omissions, inconsistent errors, and more errors noted on words which

had increasing complexity). However, there were differences, such as errors on the first (word initial) phoneme (i.e. consonant) did not transfer to the errors on the first (word initial) vowel. In fact, there were a higher number of errors on the first phoneme of the second syllable of the word – which may suggest that the first consonant rather than the word initial sound is a challenge in motor programming in AOS – based on the findings for isiXhosa. Similarly, the finding that ejectives/clicks present with more errors could be linked to greater complexity required for motor programming in producing these sounds. The hypothesis that prenasalised consonants could be considered to present with greater complexity was found not to be true – as there was a lower number of errors on prenasalised consonants than on other sounds – suggesting less motor/articulatory complexity. Tone also seemed not to be affected by AOS as there were few tone errors displayed.

Tonal contrasts, require further testing and refinement. In this study speech stimuli containing tonal contrasts were limited to two and three syllable words and from the results obtained it is not clear whether tone adds to complexity in isiXhosa. Further research is required to determine the complexity of tonal contrasts and whether this may be a language specific feature of isiXhosa for AOS. Lexical tone may however be a language specific feature for those with expressive aphasia as the participants with aphasia were unable to produce the words. Further research is needed as the sample size in this study was too small to make a generalization. It is suggested that the tool should include phrases and sentences that have tonal contrasts. Tone at a word level excludes context. Participants had difficulty with those words due to reasons other than tone (for example articulatory groping). Phrases and sentences are longer and will add a level of complexity thereby making phrases and sentence minimal pair tone contrasts a necessary feature of an assessment of AOS – as this may then be able to elicit an error.

Due to the limited number of participants generalisability of the results may be limited. Furthermore, research focusing on language specific errors is required to determine any additional features displayed by isiXhosa patients with AOS (Paradis, 2001). Due to the nature of isiXhosa and differing linguistic features when compared to English isiXhosa patients display motor planning errors which are unique to the language – such as errors on the first consonant in words which is often the second

syllable in the word and not the initial vowel. In this study tonal contrasts did not display errors which constitute a language specific feature.

The inter-rater reliability of the tool to assess patients with AOS ranged from 79.2 – 98.4%, which indicates a high inter-rater agreement for features of AOS. This indicates that the isiXhosa speech assessment may be used to identify features of AOS. It may also assist clinicians in determining specific targets for therapy as it allows additional isiXhosa features to be assessed such as the additional manners of articulation (i.e. clicks, ejectives). It however may not be useful in differentiating between disorders as it had lower reliability (43.2% - 81.34%) in determining the presence of dysarthric errors. This low agreement may have been due to the subjective nature of scoring the tool which required researchers to indicate the presence of an error in a general category rather than a specific error type. The low inter-rater reliability therefore necessitates further, more refined research into the specific errors displayed in isiXhosa patients with dysarthria.

To improve the reliability of the assessment tool training of research assistants/SLPs using the tool should be employed. The training should include a section about isiXhosa as pertinent information may be lost, misinterpreted and/or misunderstood due to lack of knowledge about specific language features. Clinicians need to have training in order to utilise the tool – additional training, familiarization with the salient features of isiXhosa is necessary in order to score the tool accurately. Alternately, clinicians may use the tool with an interpreter in order to analyse responses which differ from the speech stimuli.

Future Research

It is suggested that the study be replicated with the speech stimuli being used with a larger sample size to see if the findings regarding AOS error patterns hold true and to confirm the articulatory and motor complexity of the unique features of isiXhosa speech. Use in the clinical setting as well as in research studies will further develop and refine the isiXhosa speech stimuli for AOS. Refinement of the speech stimuli is needed to create a comprehensive tool (including an oral motor evaluation (OME), automatic speech tasks, reading task, and conversation subtest) as there is currently no standardized tool in isiXhosa. An application can be developed – one that is able to say the words and analyse responses are suggestions for areas of further research. The hierarchy of complexity in isiXhosa should be determined. The Delphi method is a research method which allows for vigorous comment and reworking of ideas. As there was only one round in this project, further analysis can be provided in a follow-up study. Differences in responses in terms of perceived cultural appropriateness across geographical locations can be further evaluated. Further research would be required to evaluate the sensitivity and specificity of the tool.

Conclusion

This project identified criteria for an assessment of AOS. Increasing complexity – although identified as a criterion in assessment may not be helpful in making a differential diagnosis as participants with AOS and those with aphasia displayed difficulties on items increasing in length. It determined novel isiXhosa criteria for an assessment of AOS in adults, which included linguistic features of isiXhosa (e.g. clicks, prenasalised consonants, and tonal contrasts). It generated isiXhosa words, phrases and sentences and demonstrated the face, content and construct validity of these speech stimuli. The isiXhosa speech stimuli has high inter-rater reliability (79.2 – 98.4%) in determining the presence of AOS features. There was however an overlap in the diagnostic features of AOS with those of aphasia – thus making a differential diagnosis difficult. Further work remains to be done as this research has highlighted many gaps in available literature.

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Appendices

Appendix A

UNIVERSITY OF CAPE TOWN

FACULTY OF HEALTH SCIENCES
Human Research Ethics Committee

FHS016: Annual Progress Report / Renewal

HREC office use only (FWA00001637; IRB00001938)			
This serves as notification of annual approval, including any documentation described below.			
☑ Approved	Annual progress report	Approved until/next renewal date	30/03/24
☐ Not approved	See attached comments		
Signature Chairperson of the HREC/ Designee		Date Signed	19/5/2023

Note: Please email this form and supporting documents (if applicable) in a combined pdf-file to hrec-enquiries@uct.ac.za.
Please clarify your plan for research-related activities during COVID-19 lockdown.
Please use the latest form found on our website:
http://www.health.uct.ac.za/fhs/research/humanethics/forms

Comments to PI from the HREC
Thank you and the HREC have agreed for the way forward. and much success Thank you for the deviation form

Principal Investigator to complete the following:

1. Protocol information

Date (when submitting this form)	23/03/2023		
HREC REF Number	647/2013	Current Ethics Approval was granted until	30.05.2015
Protocol title	Towards the development and validation of an isiXhosa tool for the assessment of apraxia of speech in adults		
Protocol number (if applicable)			
Are there any sub-studies linked to this study?	☐ Yes	☑No	
If yes, could you please provide the HREC Reference number for all sub-studies? **Note: A separate FHS016 must be submitted for each sub-study.**			
Principal Investigator	Shajila Singh		

HUMAN RESEARCH ETHICS COMMITTEE
- 3 APR 2023
HEALTH SCIENCES FACULTY
UNIVERSITY OF CAPE TOWN

(Note: Please complete the Closure form (FHS010) if the study is completed within the approval period)

Appendix B

Literature linked to Objective b – To describe the linguistic features of isiXhosa

There are differences between the linguistic, phonetic, phonological and phonotactic systems of English and isiXhosa (Gxilishe & Tuomi, 2001; Gxilishe, 2004; Mncube, n.d.; Owens, 2008; Van der Merwe & Le Roux, 2014). What follows is a description of the features of isiXhosa as they relate to this study with a focus on developing criteria for assessing AOS. The question that arises is whether the features of the language impact on how AOS presents.

IsiXhosa vowels and consonants.

IsiXhosa consists of five vowels which are contrastive [a], [ɛ~e], [i], [ɔ~o] and [u] (Gxilishe & Tuomi, 2001). Vowel length is not contrastive in most cases and is predictable due to the characteristics of isiXhosa prosody. A feature of isiXhosa is penultimate lengthening of the vowel – this is where the penultimate syllable of each word has a longer vowel than in other places in the word (e.g. *mnumzana* /mnumz**a:**na/ *"mister"*). Penultimate lengthening is also described as a fundamental feature of isiXhosa prosody (Van Der Stouwe, 2009). Vowel length is only contrastive within noun class markers e.g., with the singular and plural form where [i] represents the singular form and [ii] represents the plural (Van der Stouwe, 2009). All vowels in isiXhosa are voiced (Van der Stouwe, 2009).

There are differences in the consonants of isiXhosa as compared to English. IsiXhosa has an extensive consonant repertoire. The isiXhosa phonetic inventory contains phonemes such as clicks (c [kǀ']; x [kǁ']; and q [k!']), the implosive stop and ejectives (Dogil & Mayer, 1998; Finlayson et al., 1994; Gxilishe & Tuomi, 2001; Gxilishe, 2004; Maphalala et al., 2014; Van Der Stouwe, 2009).

All sounds in isiXhosa are produced with a pulmonic airstream except the ejectives, implosives and clicks. IsiXhosa also contains nasal compounds and nasalised click sounds (nc [ŋǀ], nq [ŋ!], nx [ŋǁ]). Breathy voiced plosives only occur in borrowed consonant clusters (Finlayson et al., 1994). The consonants in isiXhosa may be voiced, voiceless or breathy voiced.

Nasals, nasalization, and prenasalised consonants

In African languages such as isiXhosa, nasals and nasalization often take on suprasegmental or prosodic character (Yip, 2002). Many West African languages have nasalized vowels, and in many of these, nasal consonants are in total or near complementary distribution with voiced oral counterparts. Some African languages allow for N+C segments or clusters of some type and there has been discussion about whether they are one or two segments (Yip, 2002).

According to Childs (2003) prenasalised stops are derived from consonant clusters which consisted of a nasal and a voiced stop. These consonant clusters eventually merged to form a single segment in order to conform to the phonotactics of isiXhosa (Childs, 2003). When consonants appear consecutively in a word, the consonants do not form a cluster, but form a compound sound. Consider the example *nkq* in the word *inkqubo.* In this compound, *q* signifies that the sound is a click, whereas *n* serves to indicate that the click is nasalised and the *k* shows that the whole compound *nkq* is voiceless (Jessen & Roux, 2007). Thus, when a nasal appears alongside another consonant, the consonant becomes nasalized (Mncube, n.d.; Van Der Merwe & Le Roux, 2014), and pre-nasalisation is a common compound feature in isiXhosa (Childs, 2003).

Syllable structure in isiXhosa

IsiXhosa is an open syllable language (Mncube, n.d.) as it conforms to a /CV/ syllable structure (i.e. a consonant is always followed by a vowel or a glide, Nielser et al., 2005). There are occasions where a nasal, generally /m/, forms a syllable on its own. This can be attributed to the loss of a vowel, occurring when an /u/ or an /i/ is deleted from a syllable (Childs, 2003). In the example *umfula* (stream), /m/ is followed by another consonant /f/, however it is not considered a consonant cluster as /m/ forms its own syllable. Therefore, the word would be syllabified as follows: m/fu/la (Finlayson, Jones, Podile & Snyman, 1994; Mncube, n.d.). Furthermore, isiXhosa is governed by the nominal classification system and words require a prefixal morpheme to have meaning. Due to the nominal classification system, vowels occupy the initial position in words resulting in a /V-CV/ structure.

Reduplication in African Languages and isiXhosa

Most African languages (including isiXhosa) belong to the Niger-Congo family, and almost all these languages have partial reduplication as a morphological

process. In West African languages such as Akan (Kwa), reduplication consists of the CV structure for base verbs. When reduplication occurs, the vowel is produced as a high vowel. Examples of CV reduplication from the Nupe language are presented:

- /gí/ 'eat' → /ge/ 'be good' → /gà/ 'separate'
- /gú/ 'puncture' → /gò/ 'receive'
- /gi-gí/ 'eating' /gi-ge/ 'goodness' /gi-gà/ 'separating'
- /gu-gú/ 'puncturing' /gu-gò/ 'receiving'

Bantu CVCV verb stem-reduplication has also contributed to the development of prosodic morphology. The verb stem is a constituent consisting of a root plus one or more suffixes. In several Bantu languages, reduplication is most often two syllables in length (Hyman, 2003). For the speech stimuli in an assessment of AOS in isiXhosa it may therefore not be possible to assess single syllables.

Length.

Generally, an assessment of AOS would contain words differing in syllable length from monosyllabic words to sentences (Ballard et al., 2016; Cunningham et al., 2016; Dabul, 2000; Haley et al., 2012; Ogar et al., 2006; Strand & McNeil, 1996). When considering isiXhosa speech stimuli for assessment, the language is described as an agglutinating, morphologically rich language (Mncube, n.d.). IsiXhosa words consist of a series of morphs (Mncube, n.d.). A monosyllabic stem such as *-pha*, has no meaning unless it is accompanied by a prefixal morpheme such as i-, forming the word *ipha*, meaning give (Mncube, n.d.). IsiXhosa words therefore do not consist of single morphs, i.e. a minimal phonetic unit which has meaning (Syal & Jindal, 2007). The isiXhosa language is governed by the nominal classification system and the concordial agreement system which form the basis of the language structure (Pretorius & Bosch, 2009). These systems have to be considered as it influences the content selection (i.e. number of syllables in the words chosen). According to the nominal classification system, words are classified according to a prefixal morpheme and therefore a word, such as a noun or a verb, must contain a prefix and a stem (Mncube, n.d.). The nominal classification system determines which prefixal morpheme attaches to the noun stem (Mncube, n.d.). Word stems are usually disyllabic, with prefixes and suffixes added to indicate the noun class, female sex or tense and/or plurality of the word (Van der Merwe & Le Roux, 2014). As a result of the prefix requirement, there may typically be no monosyllabic words in the language and what

may appear to be a single word may instead be a description (Van der Merwe & Le Roux, 2014) as illustrated by this example, the single word *ndiphilile* is the sentence *I am fine.*

Tone in African Languages

In African languages there are words that differ only in tone, e.g. in the Nupe language, the word bá with rising tone means 'be sour', while the word ba with middle tone means 'cut', and the word bà with falling tone means 'count' (High, Mid and Low- tone, respectively). These words are as distinct from each other as words that have different vowels, e.g. bí 'crumble', bé 'come', bá 'be sour' (Hyman, 2003). Similarly, isiXhosa is described as a tonal language comprising of two basic tones (high tone and low tone sounds, Cassimjee, 1998; Van Der Stouwe, 2009). This variation in tone affects the meaning of speech as tone is contrastive with many examples of words differing only in tone (South Africa Info, 2012; Van Der Stouwe, 2009). According to Cassimjee (1998) isiXhosa tonology is complex and is not represented in the written form of the language. Grammatical tone is however predictable and based on the morphological structure. Phonological constraints also govern the isiXhosa tone pattern.

Van Der Merwe and LeRoux (2014) described lexical tone as word tone or syllable tone. Lexical tone differs from the prosodic feature intonation as it comprises of pitch variation at the syllable level. It also distinguishes meaning in words which are phonologically similar.

Van Der Stouwe (2009) described the two tonal features of isiXhosa – high tone and low tone. These can be combined to form three underlying tones – described by Van Der Stouwe (2009) as high, low, and high-low tone and five surface tones of high, low, high-low, low-high, low-high-low. Furthermore, Van der Merwe and Le Roux (2014) suggest that tone adds complexity to isiXhosa speech and that tonal errors may be a language-specific sign to indicate the presence of a motor speech disorder. An example of the language specific error is that of omitting syllabic tone variation which could result in decreased intelligibility as well as impair the meaning of the word (Van Der Merwe & LeRoux, 2014). Thus, it is important to include tone in any assessment of AOS in isiXhosa. Eight words differing in tone only were selected from Van Der Stouwe (2009) for inclusion in the assessment protocol.

Intonation

IsiXhosa also contains the prosodic feature of intonation (Van Der Merwe & LeRoux, 2014) which is the pitch changes at sentence level to indicate meaning. Intonation includes stress, speech rate and rhythm.

Hlonipha

Hlonipha – Women's language of respect is also known as isiHlonipha Sabafazi. Hlonipha is described by Finlayson (2002) as a specific sociolinguistic phenomenon. It is a language variety associated with respect and is practiced by certain Southern Bantu speaking people. More specifically it is spoken by Nguni (e.g. IsiXhosa speakers) and Southern Sotho speaking women. It is a custom known amongst Nguni people as *ukuhlonipha* which means *to respect* and it has been defined in a variety of ways.

Hlonipha most commonly describes a custom between relatives (more specifically in-laws) and is generally applied to women, who when married, are not allowed to say the names of their Chief's or husband's relations, especially the father-in-law. These women are also not allowed to use words which contain the primary syllable or any part of the names of their in-laws. In order to abide by these customs, the women must keep at a distance from their fathers-in-law and have adopted the habit of inventing new names for these persons. Although this custom is on the decline it is still practiced today (Finlayson, 2002). It is important to be aware of the phenomenon as it may impact participants responses in an assessment.

Appendix C

Information Letter for IsiXhosa Speakers

UNIVERSITY OF CAPE TOWN

School of Health &
Rehabilitation Sciences
Division of Communication Sciences & Disorders
F46 Old Main Building. Groote Schuur Hospital, Observatory, 7925
Telephone: 021 406 6402
Fax: 021 406 6323

Dear Sir/Madam

Re: Participation in a study addressing the suitability of isiXhosa words for inclusion in an assessment of speech

I am a postgraduate student conducting research in the Division of Communication Sciences and Disorders at the University of Cape Town. My research aims to create a suitable isiXhosa word list to assess apraxia of speech in adults.

You are hereby invited to participate in the study which requires you to attend a group session which I anticipate will last for an hour. You will be required to provide your opinion regarding the difficulty, cultural appropriateness and frequency of isiXhosa words, in writing. Your responses will be analysed and words found to be inappropriate will be discarded from the list. You will be reimbursed for your transport costs to the venue (TBC) and refreshments will be provided.

My research proposal has been approved by the Faculty of Health Sciences, Human Research Ethics Committee - study approval number is XXX.

Participation in this study will not benefit you directly nor cause you discomfort or harm in any way. The study aims to create an appropriate list of words, phrases and sentences which can be used to assess isiXhosa speaking adults' speech. As I will not be collecting any identifying information from you, your confidentiality will be respected at all times, and I will not identify you in any publication of the study.

Participation in this study is voluntary and you may withdraw from this study at any time, without penalty and without having to give a reason for doing so. A copy of the results will be made available should you so wish.

I thank you for your time and consideration.
Yours faithfully,

Nasreen Allie
allienasreen@gmail.com (c) 0736912617

Should you have any questions, please do not hesitate to contact me at the above contact details, or my supervisor Prof. Shajila Singh: Shajila.Singh@uct.ac.za (w) 021 406 6041 or Prof. Marc Blockman (Chairperson of Research Ethics Committee): (w) 021 406 6496 or at marc.blockman@uct.ac.za

Appendix D

Informed Consent

UNIVERSITY OF CAPE TOWN

School of Health & Rehabilitation Sciences
Division of Communication Sciences & Disorders
F46 Old Main Building. Groote Schuur Hospital, Observatory, 7925
Telephone: 021 406 6402
Fax: 021 406 6323

Informed Consent Form

I, _____ (*full name in print*) have read the information letter and understand my rights as a research participant. I understand what my participation in this study entails and have had an opportunity to ask questions and have these answered. I am aware that I may withdraw from the study at any time if I so wish, without having to provide an explanation. Withdrawal from the study will have no negative implications for me. I voluntarily consent to participate in this study.

Participant's Signature: ____ Date: _____

Researcher's Signature: _____ Date: _____

Should you have any questions please do not hesitate to contact me (see details on information letter) or my supervisor:

Prof. Shajila Singh: Shajila.Singh@uct.ac.za (w): (021) 4066041

Appendix E

Tool to gather data from isiXhosa Speakers

Participant No. _____ Age.: _____

Gender: _____

Read through the list of words and indicate with either 'Y' for yes or 'N' for No if the word is culturally appropriate, easy to say, and used often.

Word	Culturally Appropriate	If no, please provide another word	Easy to say	Used often
Idada				
Udade				
Igwegwe				
igugu				
iphepha				
iphupha				
utata				
uthuthu				
ikalika				
umama				
impempe				
umni				
nini				
inani				
nina				
ingongoma				
ijaji				
usisi				
isisu				
kushushu				
utsotsi				
inkwenkwe				
iindondo				
icici				

incinci				
iqaqa				
indlu				
imbewu				
intyatyambo				
intshonalanga				
umgca				
ingcongconi				
ixesha				
unxantathu				
ungquzulwano				
uninazala				
iliwa				
ihlonyelwa				
Ishumi elinesithandathu				
ukubebezela				
iphephandaba				
itishala				
ikawusi				
ubukrelekrele				
bhala				
umni				
Yhu!				
hlala				
sala				
gula				
impi				
isithsaba				
Amaxesha onyaka				
ivenkile				
ivenkilana				
umqhekezi				

uqhekezo				
iculo				
umculi				
ukucula				
ndiphilile				
andiphilanga				
ukosulela				
usuleleko				
Isibulala ntsholongwane				
intlungu				
kubuhlunga				
alabuhlungwanga				
ifamu				
umfama				
Umzi womlimi				
Intendelezo yefama				

Phrases and Sentences

Phrase/Sentence	**Culturally Appropriate**	**If no, please provide another phrase/sentence**	**Easy to say**	**Used often**
Indawo ikude				
Ndithanda isoka				
Ifoni iyakhala				
Nam ndiyavuya ukuwazi				
Sisitulu sikatitshalakazi				
Nceda ngamatikiti				

amabini eshowu yasebusuku				
Nditshixele izitshixo zam emotweni				
Ufuna ukufunda isiXhosa kodwa iincwadi zakhe azikho.				

Appendix F

Validity of a list of isiXhosa Words, Phrases and Sentences used to Assess Speech in Adults

Dear Sir/Madam

Thank you for agreeing to participate in this study. Instructions on how to complete the questionnaire follow below. The questionnaire begins on page 2.

What the study is about?

The aim of the study is to determine whether the isiXhosa words selected for inclusion in a protocol to assess apraxia of speech, meet the criteria detailed in the literature. These criteria are set out in the questionnaire together with the isiXhosa stimuli.

What is required of you?

1. I would like you to review the criteria and the adjustments made to them in terms of the isiXhosa language and state whether the adjustment made accommodates for the differences between the English language and isiXhosa.
2. Thereafter, I would like you to please review the words, phrases and sentences in the tables (2 – 7) and indicate whether, to your knowledge, the word, phrase or sentence meets the specified criteria.
3. If the word does not meet the criteria, it would be helpful if you could please provide
    a. a reason or comment that will assist me with selecting another word; or
    b. an alternative word, phrase or sentence that will meet the criteria.

Thank you and kind regards,

Nasreen Allie

Please note – Due Date: I would appreciate it if you could return the completed questionnaire by **Friday 25 July 2014.**

Table 1: Factors Relating to Increasing Complexity of Speech Stimuli for an Assessment of Apraxia of Speech

	Research findings	Criteria for assessment of apraxia of speech	Features of isiXhosa	Implications for generating an isiXhosa word list	Do you agree with this implication? Yes/No	If no, please comment	Additional Comments
Place of articulation	Bilabial and alveolar places of articulation are easier than other places of articulation (Duffy, 2005). The following order reflects increasing complexity: a. Bilabial b. Alveolar c. Velar	Words used for the assessment of apraxia of speech must contain phonemes that reflect a range of complexity in terms of place of articulation.	IsiXhosa has all the places of articulation listed for English.	IsiXhosa words selected must include phonemes reflecting different levels of complexity in terms of place of articulation.			
Phoneme Position	Errors are more likely to occur in phonemes in the initial position of a word than in the medial and final positions (Freed, 2000; Rosenbek et al., 1973).	Phonemes should be assessed in the initial position of a word.	IsiXhosa has a nominal classification system which results in vowels occupying the initial position of words (Mncube, n.d.).	It will not be possible to assess all consonants in the word initial position in isiXhosa. IsiXhosa words selected for the word list should therefore contain a range of consonants in the second syllable of the word. The initial prefix (nominal			

				classification) will be ignored for analysis.			
Manner of Articulation	Nasals, plosives and vowels are less likely to be in error than fricatives and affricates (Freed, 2000; Rosenbek et al., 1973).	The order below reflects increasing complexity therefore increasing the likelihood of error: a. Nasals and plosives; and b. Fricatives and affricates	In isiXhosa, additional manners of articulation include (Dogil & Mayer, 1998): a. Clicks; b. Implosives; and c. Ejectives.	The word list needs to include words with the additional isiXhosa manners of articulation.			
Initial phoneme difficulty	An error is more likely to occur in a word, if the initial phoneme is fricative or affricate (Freed, 2000; Rosenbek et al., 1973).	Initial phonemes need to reflect a variety of manners of articulation.	Due to the nominal classification system, the initial phoneme is usually a vowel (Mncube, n.d.).	The first consonant of the second syllable would include fricatives and affricates.			
	Words which begin and end with the same phoneme could provide an indication of severity (Duffy, 2005; Freed, 2000) more errors in such words suggest increased severity of apraxia of speech (Freed, 2000).	The same phoneme should be repeated in the initial and final position of words.	IsiXhosa has an open syllable structure and therefore words generally end in vowels (Mncube, n.d.).	Repetition of a phoneme within a word, e.g. utata.			

Consonant Clusters	Error rates are higher for syllables containing consonant clusters than those containing single sounds (Aichert & Ziegler, 2004).	Words should contain syllables with and without consonant clusters	There is no evidence in the literature that clusters exist in isiXhosa (Child, 2003). There are however prenasalised consonants (Finlayson et al., 1994).	Prenasalised consonants would be substituted for consonant clusters.			
	Consonant clusters are more difficult at the beginning of the word than in the medial and final positions (Aichert & Ziegler, 2004).	Clusters should occur in different word positions.					
	The distance between consecutive phonemes' points of articulation adds to complexity. The greater the distance, the greater the likelihood of an error (Rosenbek et al., 1973; Van Lieshout et al., 2007). E.g. errors are more likely with /sk/ (alveolar to velar) than /st/ (both alveolar).	Consonant clusters selected, should reflect varying distances between consecutive points of articulation.					
Frequency of Word Use	High frequency words are easier to produce than low frequency words (Freed, 2000; Rosenbek et al., 1973).	The word list should comprise of both high and low frequency words.	As in any language, it is expected that there would be isiXhosa words that are more frequently used than others.	The word list should include both frequently and infrequently used isiXhosa words.			

Length of Utterance	As the length of an utterance increases, an individual with apraxia of speech will have more difficulty with speech production (Bartle et al., 2007; Haley & Overton, 2001).	The word list should include the following: a) Monosyllabic words; b) Multisyllabic words; c) Words of increasing length with the same stem. d) Sentences	There are no monosyllabic words in isiXhosa (Mncube, n.d.).	The word list should contain: a) Disyllabic words; b) Multisyllabic words; and c) Sentences.			
	Sentences containing multisyllabic and infrequent words are challenging for individuals with apraxia of speech (Freed, 2000).						
	Words of increasing length with the same stem are difficult for patients with apraxia of speech (Duffy, 2005; Freed, 2000; Strand & McNeil, 1996).						

The tables below (Table 2 – 7) contain the criteria and the words, phrases and sentences for you to review.

Table 2: The words in the table should assess increasing complexity in terms of place of articulation

Instruction: Please state (Yes/No) if the words contain the following:

1. Bilabial, alveolar or velar phoneme in the initial syllable
2. Plosives (voiced/voiceless) or nasals
3. Repetition of the same consonant in the word

Criteria	Word	Do you agree? (Yes/No)	Comment
Voiced alveolar	Idada Udade		
Voiced velar	Igwegwe Igugu		
Voiceless bilabial	Iphepha Iphupha		
Voiceless alveolar	Utata Uthuthu		
Voiceless Velar	Ikalika		
Nasal, bilabial	Umama		
Nasal	Umni Nini Inani Nina		

Table 3: The words in the table should assess increasing complexity in terms of manner of articulation

Instruction: Please state (Yes/No) if the words contain the following:

1. Fricatives or affricates
2. Voiced or Voiceless
3. Repetition of the same consonant in the word

Criteria	Word	Do you agree? (Yes/No)	Comment
Voiced affricate	Ijaji		
Voiceless fricative	Usisi Isisu Kushushu Utsotsi		

Table 4: Words should include consonant clusters, prenasalised consonants or clicks which contribute to complexity.

Instruction: Please state (Yes/No) if the words contain the following:

1. Consonant clusters or prenasalised consonants
2. Clicks with varying places of articulation
3. Repetition of the same consonant in the word

Criteria	Word	Do you agree? (Yes/No)	Comment
Prenasalised velar	inkwenkwe		
Prenasalised alveolar	iindondo		
Central click	icici		
Prenasalised central click	incinci		
Palatal click	iqaqa		
Prenasalised bilabial	Impempe		

Prenasalised velar	Ingongoma		

Table 5: Words should include the same stem, but must reflect an increase in length, adding to complexity.

Instruction: For each group of words/phrases please state (Yes/No) if they contain the following:

1. Each word in the group contains the same word stem
2. Increase in length

Criteria	Word	Do you agree? (Yes/No)	Comment
Words and phrases with the same stem, increasing in length	Ixesha; amxesha onyaka;		
	Ivenkile; ivenkilana;		
	Uqhekezo; Umqhekezi;		
	Iculo; umculi; ukucula		
	Ndiphilile; andiphilanga		
	Ukosulela; usuleleko; isibulala ntsholongwane		
	Intlungu; kubuhlunga; alabuhlungwana		
	Ifama; umfama; umzi womlimi; intendelezo yefama		

Table 6: Multisyllabic words should be included

Instruction: Please state (Yes/No) if the words contain the following:

1. Each word should contain more than 2 syllables. Number of syllables indicated in brackets.

Criteria	Word	Do you agree? (Yes/No)	Comment
Multisyllabic words	Indlu (2)		
	Imbewu (3)		
	Intyatyambo (4)		
	Intshonalanga (5)		
	Umgca (2)		
	Ingcongconi (4)		
	Unxantathu (4)		
	Ungquzulwano (5)		
	Uninazala (5)		
	Iliwa (3)		
	Ihlonyelwa (4)		
	Ishumi elinesithandathu (10)		
	Ukubebezela (6)		
	Iphephandaba (5)		
	Itishala (4)		
	Ikawusi (4)		
	Ubukrelekrele (6)		
	Bhala (2)		

	Yhu! (1)		
	Hlala (2)		
	Sala (2)		
	Gula (2)		
	Impi (2)		
	Isithsaba (4)		

Table 7: Sentences increasing in length should be included

Instruction: Please state (Yes/No) if the sentences contain the following:

1. Increase in length. Number of syllables indicated in brackets.

Criteria	Sentence	Do you agree? (Yes/No)	Comment
Increasing length	Indawo ikude. (6)		
	Ndithanda isoka. (6)		
	Ifoni iyakhala. (7)		
	Nam ndiyavuya ukuwazi. (9)		
	Sisitulu sikatitshalakazi. (11)		
	Nditshixele izitshixo zam emotweni. (13)		
	Nceda ngamatikiti amabini eshowu yasebusuku. (19)		

	Ufuna ukufunda isiXhosa kodwa iincwadi zakhe azikho. (21)		

~ END, THANK YOU ~

Appendix G

Permission Letter for Recruiting UCT/GSH/Life Esidemeni Staff and Patients as Participants

UNIVERSITY OF CAPE TOWN

School of Health & Rehabilitation Sciences
Division of Communication Sciences & Disorders
F46 Old Main Building. Groote Schuur Hospital, Observatory, 7925
Telephone: 021 406 6402
Fax: 021 406 6323

Dear Director of Human Resources(UCT)/Executive Director of the Department of Student Affairs (UCT)/Medical Superintendent(GSH)/Chief Executive Officer(GSH)

Re: Recruitment of UCT/GSH/Life Esidemeni staff and patients to participate in a study addressing the validity of an isiXhosa wordlist for the assessment of speech of adults following a stroke or traumatic brain injury

I am a postgraduate student conducting research in the Division of Communication Sciences and Disorders at UCT. My research aims to create an isiXhosa word list to assess apraxia of speech in adults.

I would like to invite members of the UCT/GSH staff and patients, who are speakers of isiXhosa as well as language experts in isiXhosa to participate in a study. The staff will be required to assess the difficulty, length, cultural appropriateness and frequency of isiXhosa words to determine their validity. Participation in the study will not interrupt work time. The patients who participate will be required to repeat a list of words, phrases and sentences. I would appreciate your permission to recruit UCT/GSH staff and patients to participate in my research. I will recruit by means of posters, flyers, email and personal contact.

My research proposal has been approved by the Faculty of Health Sciences, Human Research Ethics Committee - study approval number is XXX.

Participation in the research will not directly benefit or cause harm to the participants or the university/hospital.

I thank you for your time and consideration.
Yours faithfully,

Nasreen Allie, (allienasreen@gmail.com, 0736912617)

Should you have any questions, please do not hesitate to contact me at the above details or my supervisor Prof. Shajila Singh: Shajila.Singh@uct.ac.za (w) 021 406 6041
or

Prof. Marc Blockman (Chairperson of Research Ethics Committee): (w) 021 406 6496 or at marc.blockman@uct.ac.za

Response from GSH

Western Cape Government
Health

GROOTE SCHUUR HOSPITAL
Enquiries: Dr Bhavna Patel
E-mail : Bhavna.Patel@westerncape.gov.za

Associated Professor S. Singh
Health & Rehabilitation
F45 – Old Main Building

E-mail: allienasreen@gmail.com / shajila.singh@uct.ac.za

Dear A/Professor Singh

RESEARCH PROJECT: Towards the Development and Validation of an Isi-Xhosa Tool for the Assessment of Apraxia of Speech in Adults: A Descriptive Study

Your recent letter to the hospital refers.

You are hereby granted permission to proceed with your research.

Please note the following:

a) Your research may not interfere with normal patient care
b) Hospital staff may not be asked to assist with the research.
c) No hospital consumables and stationary may be used.
d) **No patient folders may be removed from the premises or be inaccessible.**
e) Please introduce yourself to the person in charge of an area before commencing.
f) Please provide the research assistant/field worker with a copy of this letter as verification of approval.
g) Confidentiality must be maintained at all times.

I would like to wish you every success with the project.

Yours sincerely

DR BHAVNA PATEL
CHIEF EXECUTIVE OFFICER
Date: 15th January 2014

C.C. Mr Lionel Naidoo

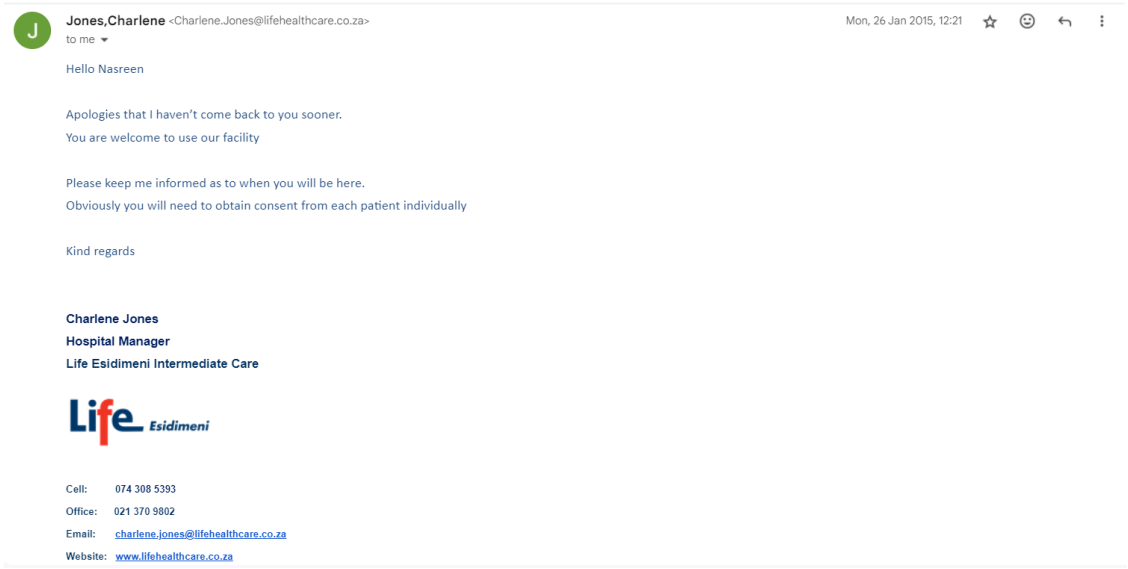
G46 Management Suite, Old Main Building,
Observatory 7925

Tel: +27 21 404 6288 fax: +27 21 404 6125

Private Bag X,
Observatory, 7935

www.capegateway.go.v.za

Response from Life Esidemeni



Jones,Charlene <Charlene.Jones@lifehealthcare.co.za> Mon, 26 Jan 2015, 12:21

to me

Hello Nasreen

Apologies that I haven't come back to you sooner.
You are welcome to use our facility

Please keep me informed as to when you will be here.
Obviously you will need to obtain consent from each patient individually

Kind regards

Charlene Jones
Hospital Manager
Life Esidimeni Intermediate Care

Life Esidimeni

Cell: 074 308 5393
Office: 021 370 9802
Email: charlene.jones@lifehealthcare.co.za
Website: www.lifehealthcare.co.za

Appendix H

Information Letter for Delphi Panel

UNIVERSITY OF CAPE TOWN

School of Health & Rehabilitation Sciences
Division of Communication Sciences & Disorders
F46 Old Main Building. Groote Schuur Hospital, Observatory, 7925
Telephone: 021 406 6402
Fax: 021 406 6323

Dear Sir/Madam

Re: Participation in a study addressing the validity of an isiXhosa word list to assess speech

I am a postgraduate student conducting research in the Division of Communication Sciences and Disorders at the University of Cape Town. My research aims to create an isiXhosa word list to assess apraxia of speech in adults. My research proposal has been approved by the Faculty of Health Sciences, Human Research Ethics Committee - study approval number is XXX.

As an expert on isiXhosa, you are hereby invited to participate on a Delphi panel. You will be required to review a list of isiXhosa words, phrases and sentences to determine whether they meet the criteria for an assessment of apraxia of speech (which will be shared with you) and the isiXhosa language. If you agree to participate, I will electronically send you the list of words. Your responses will be compared with those of other experts to arrive at a final list of words based on consensus. You will be given the opportunity to provide your opinion on at least three versions of the word list.

Participation in this study will not benefit you directly nor cause you discomfort or harm in any way. Your participation is voluntary and you may withdraw from this study at any time without penalty and without having to provide a reason for doing so. A copy of the research results will be made available to you should you so wish.

I thank you for your time and consideration.
Yours faithfully,

Nasreen Allie, (allienasreen@gmail.com , 0736912617)

Should you have any questions, please do not hesitate to contact me at the above details or my supervisor Shajila Singh: Shajila.Singh@uct.ac.za (w) 021 406 6041

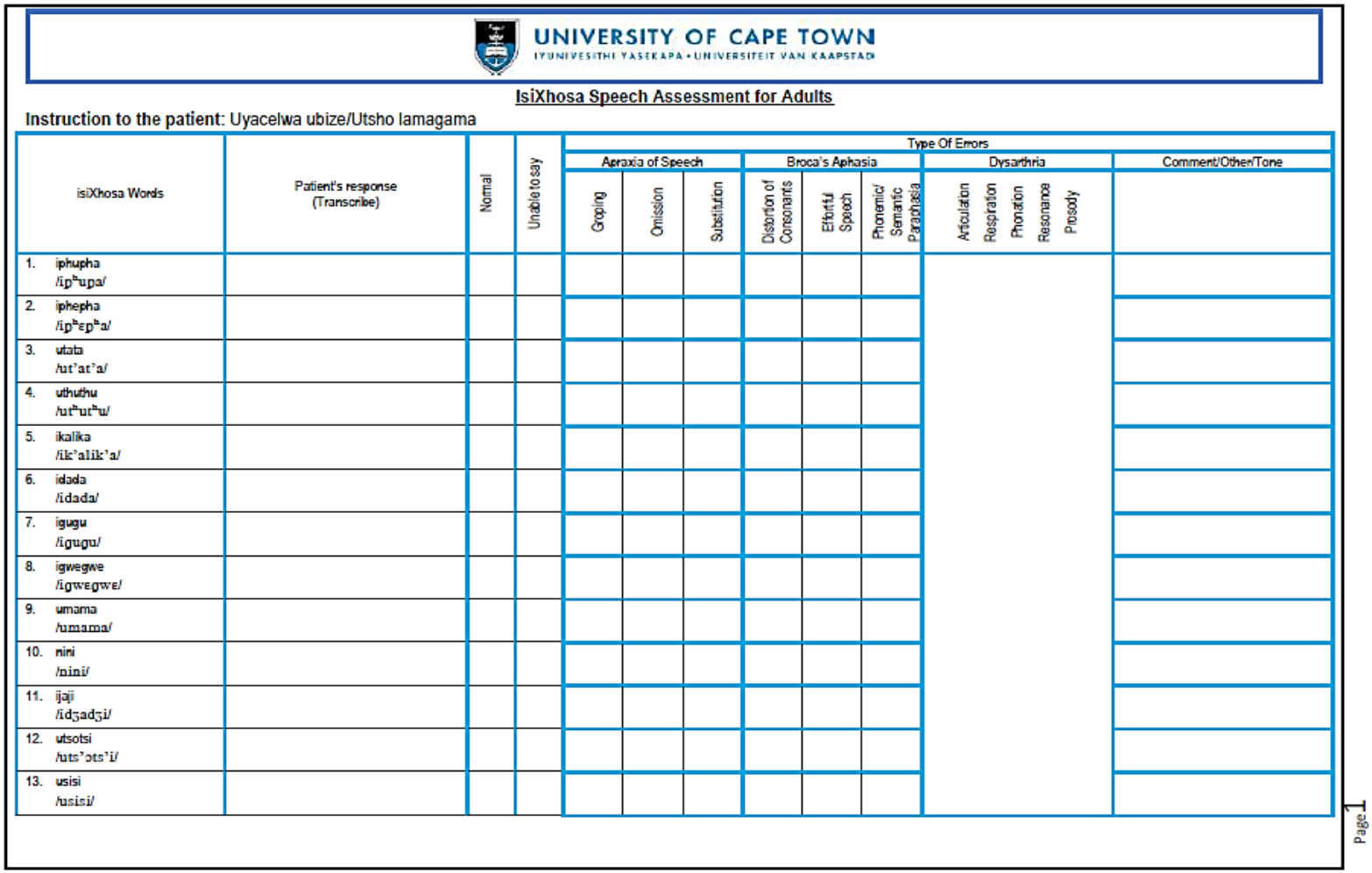
or

Prof. Marc Blockman (Chairperson of Research Ethics Committee): (w) 021 406 6496 or at marc.blockman@uct.ac.za

(Please find attached the consent letter should you wish to participate in the study).

Appendix I

IsiXhosa Speech Assessment Tool/Response Form for IsiXhosa Patients



UNIVERSITY OF CAPE TOWN
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

IsiXhosa Speech Assessment for Adults

Instruction to the patient: Uyacelwa ubize/Utsho lamagama

isiXhosa Words	Patient's response (Transcribe)	Normal	Unable to say	Type Of Errors											Comment/Other/Tone
				Apraxia of Speech			Broca's Aphasia			Dysarthria					
				Groping	Omission	Substitution	Distortion of Consonants	Effortful Speech	Phonemic/ Semantic Paraphasia	Articulation	Respiration	Phonation	Resonance	Prosody	
1. iphupha /ipʰupa/															
2. iphepha /ipʰɛpʰa/															
3. utata /utʼatʼa/															
4. uthuthu /utʰutʰu/															
5. ikalika /ikʼalikʼa/															
6. idada /idada/															
7. igugu /igugu/															
8. igwegwe /igwɛgwɛ/															
9. umama /umama/															
10. nini /nini/															
11. ijaji /idʒadʒi/															
12. utsotsi /utsʼotsʼi/															
13. usisi /usisi/															

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isiXhosa Words	Patient's response (Transcribe)	Normal	Unable to say	Type Of Errors: Apraxia of Speech – Groping	Apraxia of Speech – Omission	Apraxia of Speech – Substitution	Broca's Aphasia – Distortion of Consonants	Broca's Aphasia – Effortful Speech	Broca's Aphasia – Phonemic/ Semantic Paraphasia	Dysarthria – Articulation	Dysarthria – Respiration	Dysarthria – Phonation	Dysarthria – Resonance	Dysarthria – Prosody	Comment/Other/Tone
14. isisu /isisu/															
15. kushushu /kʼuʃuʃu/															
16. impempe /impʼɛmpʼɛ/															
17. indondo /indɔndɔ/															
18. inkwenkwe /inkʼwɛnkʼwɛ/															
19. ingongoma /ingɔngɔma/															
20. icici /i|i|i/															
21. incinci /in|in|i/															
22. iqaqa /iǃaǃa/															
General Comment				Do errors increase with phonemic complexity? Y / N Are errors inconsistent? Y / N Is the person aware of the errors? Y / N			Are errors consistent? Y / N			Effect on intelligibility:					

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Instruction to the patient: Uyacelwa ubize/Utsho lamagama

isiXhosa Words	Patient's response (Transcribe)	Normal	Unable to say	Type Of Errors												Comment/Other/Tone
				Apraxia of Speech				Broca's Aphasia			Dysarthria					
				Groping	Omission	Substitution	Errors increase with phonemic complexity	Distortion of Consonants	Effortful Speech	Phonemic/ Semantic Paraphasia	Articulation	Respiration	Phonation	Resonance	Prosody	
1. ixesha /i‖ɛʃa/; amxesha onyaka /ama‖ɛʃa ɔŋjakʼa/																
2. ivenkile /ivɛŋkʼilɛ/; ivenkilana /ivɛŋkʼilana/																
3. uqhekezo /u!ʰɛkʼɛzɔ/; umqhekezi /um!ʰɛkʼɛzi/																
4. iculo /i‖ula/; umculi /um‖uli/; ukucula /ukʼu‖ula/																
5. ndiphilile /ndipʰilileˈ; andiphilanga /andpʰilaŋga/																

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isiXhosa Words	Patient's response (Transcribe)	Normal	Unable to say	Type Of Errors											Comment/Other/Tone
				Apraxia of Speech				Broca's Aphasia			Dysarthria				
				Groping	Omission	Substitution	Errors increase with phonemic complexity	Distortion of Consonants	Effortful Speech	Phonemic/ Semantic Paraphasia	Articulation	Respiration	Phonation	Resonance	Prosody	
6. ukosulela /uk'ɔsulɛla/; usuleleko /usulɛlɛk'ɔ/; isibulala ntsholongwane /isiɓulala ntʃɔlɔŋgwanɛ/															
7. intlungu /int'lunggu/; kubuhlunga /k'uɓuɬunga/; alabuhlungwana /alaɓuɬunggwana/															
8. ifama /ifama/; umfama /umfama/; umzi womlimi /umzi wɔmlimi/; intendelezo yefama /intɛndelezɔ jɛfama/															
General Comments				Are errors inconsistent? Y / N Is the person aware of the errors? Y / N				Are errors consistent? Y / N			Effect on intelligibility:				

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IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

Instruction to the patient: Phinda lamagama kathathu

isiXhosa Words	Patient's response (Transcribe)	Normal	Unable to say	Type Of Errors: Apraxia of Speech – Groping	Apraxia of Speech – Inconsistent errors	Apraxia of Speech – Omission	Apraxia of Speech – Substitution	Broca's Aphasia – Distortion of Consonants	Broca's Aphasia – Effortful Speech	Broca's Aphasia – Consistent errors	Broca's Aphasia – Phonemic/ Semantic Paraphasia	Dysarthria – Articulation / Respiration / Phonation / Resonance / Prosody	Comment/Other/Tone
1. yhu /jʰu/													
2. bhala /bala/													
3. impi /imp'i/													
4. umgca /um‖gia/													
5. indlu /indu/													
6. sala /sala/													
7. hlala /ɬala/													
8. gula /gula/													
9. imbewu /imbɛwu/													
10. iliwa /iliwa/													
11. intyatyambo /inc'ac'ambɔ/													
12. unxantathu /un‖ant'atʰu/													
13. itishala /it'iʃala/													
14. isithsaba /isitʰsaɓa/													

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isiXhosa Words	Patient's response (Transcribe)	Normal	Unable to say	Type Of Errors: Apraxia of Speech: Groping	Apraxia of Speech: Inconsistent errors	Apraxia of Speech: Omission	Apraxia of Speech: Substitution	Broca's Aphasia: Distortion of Consonants	Broca's Aphasia: Effortful Speech	Broca's Aphasia: Consistent errors	Broca's Aphasia: Phonemic/ Semantic Paraphasia	Dysarthria: Articulation	Dysarthria: Respiration	Dysarthria: Phonation	Dysarthria: Resonance	Dysarthria: Prosody	Comment/Other/Tone
15. ihlonyelwa /iɬɔɲjɛlwa/																	
16. ikawusi /ikʼawusi/																	
17. ingcongconi /iŋǀgiɔŋǀgiɔni/																	
18. iphephandaba /ipʰɛpʰandaɓa/																	
19. intshonalanga /intʃʼɔnalaŋga/																	
20. ubukrelekrele /uɓukxʼɛlɛkxʼɛlɛ/																	
21. ukubeleezela /ukʼuɓɛɓɛzɛla/																	
22. ishumi elinesithandathu /iʃumi ɛlinɛsitʰandatʰu/																	
General Comments				Do errors increase with phonemic complexity? Y / N Is the person aware of the errors? Y / N								Effect on intelligibility:					

UNIVERSITY OF CAPE TOWN
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

Instruction to the patient: Phinda lemibhala

isiXhosa Sentence	Patient's response (Transcribe)	Normal	Unable to say	Type Of Errors: Apraxia of Speech – Groping	Apraxia of Speech – Omission	Apraxia of Speech – Substitution	Broca's Aphasia – Distortion of Consonants	Broca's Aphasia – Effortful Speech	Broca's Aphasia – Phonemic/ Semantic Paraphasia	Dysarthria – Articulation	Dysarthria – Respiration	Dysarthria – Phonation	Dysarthria – Resonance	Dysarthria – Prosody	Comment/Other/Tone
1. Indawo ikude. /indawɔ ik'udɛ/															
2. Ndithanda isoka. /nditʰanda isɔk'a/															
3. Ifoni iyakhala. /ifɔni ijakʰala/															
4. Nam ndiyavuya ukuwazi. /nam ndijavuja uk'uwazi/															
5. Sisitulu sikatitshalakazi. /sisit'ulu sik'atitʃ'alak'azi/															
6. Nditshixele izitshixo zam emotweni. /nditʃʰiǁɛlɛ izitʃʰiǁɔ zam ɛmɔt'weni/															
7. Ncedа ngamatikiti amabini eshowu yasebusuku. /nǀɛda ŋgamat'ik'it'i amaɓini ɛʃɔwu jasɛɓusuk'u/															
8. Ufuna ukufunda isiXhosa kodwa iincwadi zakhe azikho. /ufuna uk'ufunda isiǁʰɔsa kɔdwa inǀwadi zakʰe azikʰɔ/															
General Comments				Do errors increase with phonemic complexity? Y / N Are errors inconsistent? Y / N Is the person aware of the errors? Y / N			Are errors consistent? Y / N			Effect on intelligibility:					

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UNIVERSITY OF CAPE TOWN
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

Instruction to the patient: Uyacelwa ubize/Utsho lamagama

isiXhosa Words	Patient's response (Transcribe)	Normal	Unable to say	Type Of Errors: Apraxia of Speech – Groping	Apraxia of Speech – Omission	Apraxia of Speech – Substitution	Broca's Aphasia – Distortion of Consonants	Broca's Aphasia – Effortful Speech	Broca's Aphasia – Phonemic/ Semantic Paraphasia	Dysarthria – Articulation	Dysarthria – Respiration	Dysarthria – Phonation	Dysarthria – Resonance	Dysarthria – Prosody	Comment/Other/Tone
1. Gcoba (be happy) /gʗɔ̃ ɓá/															
2. Gcoba (put lotion on) /gʗɔ̃ ɓa̋/															
3. Imithi (it's pregnant) /imiᵗʰ/															
4. Imithi (tress) /imîᵗʰ/															
5. Imizi (houses) /ímîz/															
6. Imizi (a type of grass) /ímîzi̋/															
General Comment				Do errors increase with phonemic complexity? Y / N Are errors inconsistent? Y / N Is the person aware of the errors? Y / N			Are errors consistent? Y / N			Effect on intelligibility:					

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Appendix J

Data Collection – IsiXhosa Speaking Patients Procedure

IsiXhosa Speech Assessment

1. Greet and Introduce Yourself
2. NA to explain procedure to patient and get consent form signed. A participant number will be allocated to each patient.
3. JW/KA to then administer the tool. Inform patient that some words will be easy and some more difficult. NA to record session.
    a. JW/KA to start playing video instructions
    b. Instruction - repeat each word, look at screen.
    c. Administer each section (4 sections). All words and sentences to be administered to all patients. All 65 video clips (includes instructions).
    d. For the section requiring repetition of words of increasing length – repetition of the video is allowed if you feel that difficulty may be as result of poor auditory memory. Alternately administer each word separately. Pause video after each word is presented. Record responses adequately. Play video for next word.
    e. Transcribe (write out) the patients response as accurately as possible.
    f. For the section requiring 3 repetitions, a prompt – gesture to repeat 3 times is allowed.
    g. Use own discretion when deciding to continue if patient is unable to repeat a word.
    h. Repetition of the video is only allowed when a patient may have difficulty with attention/been distracted/or if an unforeseen interruption has occurred.
4. Scoring the tool: tick which type of error is displayed, or if patient is unable to respond, or if the response was normal.
5. Should you be unsure of what error was displayed place a question mark {?} next to the word. The production of this word can then be reviewed on the recording and a decision about the error can then be made. The two raters will watch the video recording of the participant's response and make a decision regarding the scoring of the item.

6. Should an error that is not listed be displayed note this in the comments section
    a. Errors not listed on the tool:
        i. Perseveration (apraxia and aphasia)
        ii. Difficulty initiating (apraxia and aphasia)
        iii. Slow rate (dysarthria and aphasia)
    b. These are not included (listed) as they occur in more than one disorder – so these errors do not allow for a differential diagnosis (Mauszycki & Wambaugh, 2011).
    c. Errors relating to apraxia of speech not listed:
        i. Articulatory errors: prolongations, additions, transpositions
        ii. Consonants more difficult than vowels
        iii. Initial consonants more difficult than final consonants (note if this occurs in section 1)
        iv. Blends (prenasalised consonants) more difficult than single sounds
        v. Fricative and affricates – difficult consonants
        vi. Prosodic difficulties: stopping and re-starting, difficulty initiating phonation
7. Where discrepancies in scoring occurred between the two raters a review will be necessary.
8. Comments/Other/Tone: use this section to note if patient uses any self-cueing strategy (such as gesture, tapping, pacing, using hands to help count/syllabify the words). Also note any other features that the patient displays that you feel will assist with a differential diagnosis or add to a description of what the patient is displaying.

Appendix K

Information Letter for IsiXhosa Patients

UNIVERSITY OF CAPE TOWN

School of Health &
Rehabilitation Sciences
Division of Communication Sciences & Disorders
F46 Old Main Building. Groote Schuur Hospital, Observatory, 7925
Telephone: 021 406 6402
Fax: 021 406 6323

Dear Sir/Madam

Re: Participation in a study addressing the suitability of isiXhosa words for inclusion in an assessment of speech

I am a student conducting research in the Division of Communication Sciences and Disorders at the University of Cape Town. My research aims to create an isiXhosa word list to assess adult patients with apraxia of speech.

You are hereby invited to participate in the study which requires you to repeat a list of words in isiXhosa. I will audio record the session of you repeating the words. The recording will be used to help me analyse your responses and determine if the words are suitable or not.

My research proposal has been approved by the Faculty of Health Sciences, Human Research Ethics Committee - study approval number is XXX.

Participation in this study will not benefit you directly nor cause you discomfort or harm in any way. As I will not be collecting any identifying information from you, your confidentiality will be respected at all times, and I will not identify you in any publication of the study.

Participation in this study is voluntary and you may withdraw from this study at any time, without penalty and without having to give a reason for doing so. A copy of the results will be made available should you so wish.

I thank you for your time and consideration.
Yours faithfully,

Nasreen Allie
allienasreen@gmail.com (c) 0736912617

Should you have any questions, please do not hesitate to contact me at the above contact details, or my supervisor Prof. Shajila Singh: Shajila.Singh@uct.ac.za
(w) 021 406 6041.
or
Prof. Marc Blockman (Chairperson of Research Ethics Committee): (w) 021 406 6496 or at marc.blockman@uct.ac.za

Appendix L

Description of performance on the isiXhosa Stimuli

Tables L1 - L7 displays each word and corresponding criteria as well as the error percentage of participants (n=26). It also describes the types of errors that participants had across disorders. Under the errors of dysarthria – respiratory errors were not unpacked in this study. With regards to words marked as “Unable to say” – this was where the participant had no response. If the participant attempted the speech stimulus and there was no verbal response but groping was noted – G was then noted as the type of error. The data obtained from the healthy individuals was excluded from the table as no errors were present and therefore no further analysis was required.

Table L1

The Results from Participants as it Relates to the Place of Articulation in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
	Place of articulation					
	Voiceless bilabial	42.3	4/7	2/3	5/6	N
	Same sound repeated in the word		O	X	X	
iphupha	1st phoneme of 2nd syllable reflects target consonant		G	Re	Re	
			Re		O	
					S	
	Voiceless bilabial	46.2	5/7	2/3	4/6	1/1
	Same sound repeated in the word		X	X	DC	O
iphepha	1st phoneme of 2nd syllable reflects target consonant		G	S	Re	
			O		O	
			Re		S	

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L1 ***(continued)***

The Results from Participants as it Relates to the Place of Articulation in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
utata	Voiceless alveolar	34.6	4/7	3/3	2/6	N
	Same sound repeated in the word		G	X	S	
	1st phoneme of 2nd syllable reflects target consonant		O	O	A	
			DC	S	Re	
			Re	Re	P	
uthuthu	Voiceless aspirated alveolar	26.9	2/7	3/3	2/6	N
	Same sound repeated in the word		X	X	S	
	1st phoneme of 2nd syllable reflects target consonant		O	S	P	
				Oth	Pr	
ikalika	Voiceless velar	34.6	3/7	3/3	3/6	N
	Same sound repeated in the word		O	X	O	
	1st phoneme of 2nd syllable reflects target consonant		S	S	DC	
					A	

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L1 ***(continued)***

The Results from Participants as it Relates to the Place of Articulation in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
idada	Voiced alveolar	23.1	3/7	1/3	2/6	N
	Same sound repeated in the word		X	X	O	
	1st phoneme of 2nd syllable reflects target consonant		S		DC	
					A	
igugu	Voiced velar	23.1	2/7	2/3	2/6	N
	Same sound repeated in the word		X	X	DC	
	1st phoneme of 2nd syllable reflects target consonant		G		O	
			O			
igwegwe	Voiced velar	30.7	4/7	2/3	2/6	N
	Same sound repeated in the word		X	X	O	
	1st phoneme of 2nd syllable reflects target consonant		O		DC	
			S		Re	
			Re			

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L1 ***(continued)***

The Results from Participants as it Relates to the Place of Articulation in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
umama	Bilabial nasal	19.2	2/7	2/3	1/6	N
	Same sound repeated in the word		G	X	O	
	1st phoneme of 2nd syllable reflects target consonant		O			
nini	Alveolar nasal	30.7	2/7	1/3	5/6	N
	Same sound repeated in the word		X	X	X	
	1st phoneme of 2nd syllable reflects target consonant		S		S	
			DC		DC	
					A	
					U	

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L2

The Results from Participants as it Relates to the Manner of Articulation in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
ijaji	Manner of articulation					
	Voiced affricate	57.7	6/7	3/3	5/6	1/1
	Same sound repeated in the word		G	X	X	O
	1st phoneme of 2nd syllable reflects target consonant		O	O	O	
			S	S	S	
				A		
utsotsi	Voiceless fricative	42.3	5/7	3/3	3/6	N
	Same sound repeated in the word		X	X	O	
	1st phoneme of 2nd syllable reflects target consonant		G	O	S	
			O	A	DC	
			S			
			DC			

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L2 ***(continued)***

The Results from Participants as it Relates to the Manner of Articulation in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
usisi	Voiceless fricative Same sound repeated in the word 1st phoneme of 2nd syllable reflects target consonant	38.5	4/7 X G O	1/3 X	5/6 O S DC Re	N
isisu	Voiceless fricative Same sound repeated in the word 1st phoneme of 2nd syllable reflects target consonant	38.5	4/7 X S Re Pr	2/3 X	4/6 O DC A Re	N

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L2 ***(continued)***

The Results from Participants as it Relates to the Manner of Articulation in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
kushushu	Voiceless fricative Same sound repeated in the word 1st phoneme of 2nd syllable reflects target consonant	34.6	3/7 O S X DC A	2/3 X Oth	4/6 A O DC	N

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L3

The Results from Participants as it Relates to The Prenasalised Consonants and Clicks in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
	Prenasalised consonants/clicks					
impempe	Prenasalised bilabial	23.1	2/7	2/3	2/6	N
	Same sound repeated in the word		X	X	DC	
	1st phoneme of 2nd syllable reflects target consonant		O	Oth		
	Prenasalised voiced alveolar	23.1	3/7	2/3	1/6	N
indondo	Same sound repeated in the word		X	X	P	
	1st phoneme of 2nd syllable reflects target consonant		O	DC		
			S			
inkwenkwe	Prenasalised voiceless velar	19.2	2/7	2/3	1/6	N
	Same sound repeated in the word		O	X	DC	
	1st phoneme of 2nd syllable reflects target consonant		S	SP		

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L3 ***(continued)***

The Results from Participants as it Relates to The Prenasalised Consonants and Clicks in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
ingongoma	Prenasalised voiced velar Same sound repeated in the word 1st phoneme of 2nd syllable reflects target consonant	26.9	2/7 O S	3/3 X R	2/6 DC	N
icici	Central click Same sound repeated in the word 1st phoneme of 2nd syllable reflects target consonant	34.6	4/7 X G S DC A	3/3 X S U	2/6 O A	N

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L3 ***(continued)***

The Results from Participants as it Relates to The Prenasalised Consonants and Clicks in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
incinci	Prenasalised central click	30.8	3/7	2/3	3/6	N
	Same sound repeated in the word		X	X	O	
	1st phoneme of 2nd syllable reflects target consonant		DC		DC	
			A		A	
			Re			
iqaqa	Palatal click	42.3	3/7	3/3	4/6	1/1
	Same sound repeated in the word		X	X	O	DC
	1st phoneme of 2nd syllable reflects target consonant		O	O	S	
			S	DC	A	
			A			
			DC			

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L4

The Results from Participants as it Relates to the Same Stem Increasing in Length in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
	Same stem increasing in length					
	Same stem increasing in length	57.7	6/7	3/3	6/6	N
	Lateral click		X	X	S	
			G	O	DC	
ixesha;			O	DC	ES	
amxesha onyaka			S		A	
			M		Re	
			DC		P	
			A			

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L4 *(continued)*

The Results from Participants as it Relates to the Same Stem Increasing in Length in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
ivenkile; ivenkilana	Same stem increasing in length	42.3	4/7 X O S M Re U	3/3 X O S	4/6 O DC ES A U	N

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L4 *(continued)*

The Results from Participants as it Relates to the Same Stem Increasing in Length in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
	Same stem increasing in length	50	6/7	2/3	4/6	1/1
	Palatal click		X	X	O	DC
			O		S	
uqhekezo;			S		DC	
umqhekezi			M		A	
			DC			
			A			
			Re			

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L4 ***(continued)***

The Results from Participants as it Relates to the Same Stem Increasing in Length in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
	Same stem increasing in length	50	6/7	3/3	4/6	N
	Central click		X	X	O	
iculo;			G	S	S	
umculi;			S		DC	
ukucula			M		A	
			DC		Re	
			A			
	Same stem increasing in length	38.5	4/7	3/3	3/6	N
			X	X	O	
ndiphilile;			O	S	A	
andiphilanga			DC	DC	P	
			Pr			

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L4 ***(continued)***

The Results from Participants as it Relates to the Same Stem Increasing in Length in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
	Same stem increasing in length	57.7	6/7	3/3	5/6	1/1
			X	X	X	O
ukosulela;			G	O	O	DC
usuleleko;			O	S	S	Pr
isibulala ntsholongwane			S	M	M	
			M		DC	
			IE		U	

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L4 *(continued)*

The Results from Participants as it Relates to the Same Stem Increasing in Length in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
intlungu; kubuhlunga; alabuhlungwana	Same stem increasing in length	57.7	6/7 X G O S M A P	3/3 X O S	6/6 O S M DC A Re	N

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L4 *(continued)*

The Results from Participants as it Relates to the Same Stem Increasing in Length in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
	Same stem increasing in length	57.7	6/7	3/3	6/6	N
			X	X	X	
ifama;			G	S	S	
umfama;			O	U	DC	
umzi womlimi			S		A	
intendelezo yefama			M		Re	
			A		P	
			P		Pr	

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L5

The Results from Participants as it Relates to the Increasing Number of Syllables in the Speech Stimuli in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
yhu	Number of syllables increasing in length Multiple repetitions of the same word to elicit inconsistency across productions	34.6	3/7 X G S P	3/3 X S DC	3/6 Re P DC	N
bhala	Number of syllables increasing in length Multiple repetitions of the same word to elicit inconsistency across productions	30.8	2/7 X G	3/3 X S IE DC	3/6 DC Re P	N

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L5 ***(continued)***

The Results from Participants as it Relates to the Increasing Number of Syllables in the Speech Stimuli in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
impi	Number of syllables increasing in length	26.9	2/7	3/3	2/6	N
	Multiple repetitions of the same word to elicit inconsistency across productions		X O IE	X S	S	
umgca	Number of syllables increasing in length	38.5	4/7	3/3	3/6	N
	Multiple repetitions of the same word to elicit inconsistency across productions Central click		O S IE A	X S CE	S DC A CE	

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L5 ***(continued)***

The Results from Participants as it Relates to the Increasing Number of Syllables in the Speech Stimuli in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
indlu	Number of syllables increasing in length	30.8	2/7	3/3	3/6	N
			X	X	DC	
	Multiple repetitions of the same word to elicit inconsistency across productions		DC	S	CE	
				DC	U	
sala	Number of syllables increasing in length	26.9	2/7	3/3	2/6	N
			X	X	S	
	Multiple repetitions of the same word to elicit inconsistency across productions		G	S	DC	
				IE	CE	
				DC		

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L5 ***(continued)***

The Results from Participants as it Relates to the Increasing Number of Syllables in the Speech Stimuli in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
hlala	Number of syllables increasing in length Multiple repetitions of the same word to elicit inconsistency across productions	34.6	3/7 X S DC	3/3 X S DC ES CE	3/6 DC A U	N

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L5 ***(continued)***

The Results from Participants as it Relates to the Increasing Number of Syllables in the Speech Stimuli in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
gula	Number of syllables increasing in length Multiple repetitions of the same word to elicit inconsistency across productions	34.6	3/7 X G IE DC Unsure	3/3 X S DC	3/6 S DC CE Consistent errors	N
imbewu	Number of syllables increasing in length Multiple repetitions of the same word to elicit inconsistency across productions	34.6	4/7 X O S DC IE	2/3 X DC	2/6 S DC	1/1 S CE

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L5 *(continued)*

The Results from Participants as it Relates to the Increasing Number of Syllables in the Speech Stimuli in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
iliwa	Number of syllables increasing in length Multiple repetitions of the same word to elicit inconsistency across productions	34.6	4/7 X G O S DC IE	3/3 X O S DC ES CE	2/7 O DC A	N

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L5 ***(continued)***

The Results from Participants as it Relates to the Increasing Number of Syllables in the Speech Stimuli in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
intyatyambo	Number of syllables increasing in length	50	7/7	2/3	4/6	N
	Multiple repetitions of the same word to elicit inconsistency across productions		X G O S DC A	X S DC	O DC IE A	
unxantathu	Number of syllables increasing in length	57.7	7/7	3/3	5/6	N
	Multiple repetitions of the same word to elicit inconsistency across productions Lateral click		X O S CE A ES	X O S DC CE	O S DC CE CE A	

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L5 ***(continued)***

The Results from Participants as it Relates to the Increasing Number of Syllables in the Speech Stimuli in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
itishala	Number of syllables increasing in length Multiple repetitions of the same word to elicit inconsistency across productions	46.2	5/7 O S DC A Re Pr IE	3/3 X O S DC	4/6 O S DC A	N

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L5 ***(continued)***

The Results from Participants as it Relates to the Increasing Number of Syllables in the Speech Stimuli in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
isithsaba	Number of syllables increasing in length Multiple repetitions of the same word to elicit inconsistency across productions	46.2	5/7 G O S IE A DC	3/3 X O S DC CE	4/6 S DC A U	N

<u>Key</u>: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L5 ***(continued)***

The Results from Participants as it Relates to the Increasing Number of Syllables in the Speech Stimuli in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
ihlonyelwa	Number of syllables increasing in length Multiple repetitions of the same word to elicit inconsistency across productions	53.8	6/7 X O S IE Pr	3/3 X O S DC CE P	5/6 DC ES A Re U	N

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L5 ***(continued)***

The Results from Participants as it Relates to the Increasing Number of Syllables in the Speech Stimuli in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
ikawusi	Number of syllables increasing in length Multiple repetitions of the same word to elicit inconsistency across productions	57.7	5/7 X O S IE	3/3 X O S DC CE P	6/6 O DC ES A Re	1/1 O

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L5 ***(continued)***

The Results from Participants as it Relates to the Increasing Number of Syllables in the Speech Stimuli in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
ingcongconi	Number of syllables increasing in length Multiple repetitions of the same word to elicit inconsistency across productions Central click	53.8	6/7 X O S IE A DC Re	3/3 X O S DC CE P	5/6 O DC Pr A	N

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L5 ***(continued)***

The Results from Participants as it Relates to the Increasing Number of Syllables in the Speech Stimuli in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
iphephandaba	Number of syllables increasing in length Multiple repetitions of the same word to elicit inconsistency across productions	50	5/7 X G S DC CE Pr U	3/3 X O S DC ES CE P	5/6 O S DC CE A Re Pr U	N

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L5 ***(continued)***

The Results from Participants as it Relates to the Increasing Number of Syllables in the Speech Stimuli in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
intshonalanga	Number of syllables increasing in length Multiple repetitions of the same word to elicit inconsistency across productions	38.5	3/7 X S	3/3 X S DC ES CE P	4/6 O DC A Pr	N

<u>Key</u>: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L5 ***(continued)***

The Results from Participants as it Relates to the Increasing Number of Syllables in the Speech Stimuli in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
ubukrelekrele	Number of syllables increasing in length Multiple repetitions of the same word to elicit inconsistency across productions	57.7	5/7 X G O S DC A	3/3 X O CE	6/6 O IE DC ES CE Pr A U	1/1 DC

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L5 ***(continued)***

The Results from Participants as it Relates to the Increasing Number of Syllables in the Speech Stimuli in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
ukubebezela	Number of syllables increasing in length Multiple repetitions of the same word to elicit inconsistency across productions	53.8	6/7 X G O S IE Unsure	3/3 X O S DC ES Consistent errors	5/6 O DC A CE	N

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L5 ***(continued)***

The Results from Participants as it Relates to the Increasing Number of Syllables in the Speech Stimuli in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
ishumi elinesithandathu	Number of syllables increasing in length Multiple repetitions of the same word to elicit inconsistency across productions	50	6/7 X G O S IE	3/3 X O S DC ES CE	4/6 O DC ES A Pr U	N

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L6

The Results from Participants as it Relates to the Sentences Increasing in Length in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
	Sentences increasing in length	42.3	4/7	3/3	4/6	N
Indawo ikude.			X G O S ES	X	O DC ES A Re	
		46.2	5/7	3/3	4/6	N
Ndithanda isoka.			X G S ES A	X O S	O DC ES Re	

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L6 *(continued)*

The Results from Participants as it Relates to the Sentences Increasing in Length in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
Ifoni iyakhala.	Sentences of increasing length	38.5	4/7 X G O S	2/3 X O	3/6 DC A	1/1 O
Nam ndiyavuya ukuwazi.		53.8	6/7 G O S DC	3/3 X O	5/6 O DC Re	N

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L6 ***(continued)***

The Results from Participants as it Relates to the Sentences Increasing in Length in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
Sisitulu sikatitshalakazi.	Sentences of increasing length	53.8	6/7 X G O S ES Pr	3/3 X O	4/6 O S DC ES A	1/1 O

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L6 ***(continued)***

The Results from Participants as it Relates to the Sentences Increasing in Length in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
Nditshixele izitshixo zam emotweni.	Lateral click	57.7	6/7 X G O S DC A U	3/3 X O DC	5/6 O DC ES Pr	1/1 DC

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L6 ***(continued)***

The Results from Participants as it Relates to the Sentences Increasing in Length in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
Nceda ngamatikiti amabini eshowu yasebusuku.	Prenasalised central click	53.8	7/7 X G O A Re U	3/3 X	4/6 O DC A	N

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L6 *(continued)*

The Results from Participants as it Relates to the Sentences Increasing in Length in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
Ufuna ukufunda isiXhosa kodwa iincwadi zakhe azikho.	Lateral click Prenasalised central click	53.8	6/7 X G O S ES PS/S	3/3 X O S	4/6 O DC ES A	1/1 O S DC Pr

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L7

The Results from Participants as it Relates to the Varying Lexical Tone in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
	Varying lexical tone/ Tonal contrasts	n=18	n=3	n=3	n=4	n=1
Gcoba (be happy) /g|ɔ̄ bà/	Contains a click	38.9	2/3 X IE	3/3 X	2/4 S A	N
Gcoba (put lotion on) /g|ô bâ/	Contains a click	38.9	2/3 X U	3/3 X	1/4 U	1/1 T
Imithi (it's pregnant) /ímítʰ/		22.2	1/3 G IE	3/3 X	N	N
Imithi (tress) /ímîtʰ/		33.3	3/3 X T Oth	3/3 X U	N	N

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U

Table L7 ***(continued)***

The Results from Participants as it Relates to the Varying Lexical Tone in IsiXhosa and Types of Errors Displayed across Disorders

Speech stimuli (Word/phrase/sentence)	Criteria applicable to this word	% Error (n=26)	Type of error			
			AOS (n=7)	Aphasia (n=3)	Dysarthria (n=6)	Cognitive Communicative (n=1)
Imizi (houses) /ímîz/		16.7	1/3 X	2/3 X	N	N
Imizi (a type of grass) /îmîzï/		44.4	3/3 X G U	3/3 X U	2/4 T U	N

Key: Normal = N; Unable to say = X; Apraxia of speech: Groping = G; Omission = O; Substitution = S; Errors increase with phonemic complexity = M; Inconsistent errors = IE; Broca's Aphasia: Distortion of consonants = DC; Effortful speech = ES; Phonemic/semantic paraphasia = P/SP; Consistent errors = CE; Dysarthria: Articulation = A; Respiration = R; Phonation = P; Resonance = Re; Prosody = Pr; Other = Oth; Tone = T; Unsure = U