



**The phonological development of typically  
developing first language Zulu-speaking children  
aged 2;6–6;5 years:  
a descriptive cross-sectional study**

by

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## Abstract

**Background:** Zulu, one of the eleven official languages in South Africa, is the most spoken language in the country. However, research on children's phonological development in Zulu is minimal. To date there are no published Zulu speech assessments and associated normative data that speech-language pathologists (SLPs) can use to identify children with speech sound disorders who speak this language.

**Method:** This descriptive, cross-sectional study aimed to document the phonological development of thirty-two typically developing first language Zulu-speaking children between 2;6 and 6;5 years. Participants attended school or crèche in Manguzi, KwaZulu-Natal, and were grouped into six month age categories. A single-word Zulu phonology assessment was developed and used to assess the participants. Assessments were audio recorded, and field transcriptions made using the International Phonetic Alphabet (IPA). Speech development was described in terms of phoneme acquisition, word shape, phonological processes and percentage of vowels (PVC) / consonants correct (PCC). Consonant acquisition was assessed in the penultimate syllable only, according to the structure of Zulu.

**Results:** Findings suggest that many phonemes are acquired before the age of 2;6, as plosives, nasals, affricates, the implosive and vowels had already been mastered by the youngest group. The click /!g/, approximant /l/ and fricative /h/ were amongst the last to develop, as they had not yet been mastered by the oldest group at 6;5. In terms of word shape development, two-syllable structures were mastered by the age of 2;6. Structures consisting of four and five syllables were still developing at the age of 6;5. Across the age groups, simplification of co-articulated phonemes and vowel substitution were common phonological processes. Participants in the older age groups were able to produce target words more accurately and used fewer phonological processes.

**Discussion:** Findings of this study are discussed in relation to theories of phonological development in general, and specifically as they relate to normative data in other languages. Similarities and differences between Zulu and Xhosa speech sound development are noted. Knowledge of Zulu speech sound development will assist SLPs working with first language Zulu-speaking children to assess and manage their speech difficulties. Further development of this work may lead to the standardization of a Zulu speech assessment which would be an important step towards ensuring that SLP services are available and relevant to all children in South Africa.

Keywords: Zulu, phonology, speech sound development, word shape development, phonological processes, speech-language pathologist.

## Glossary

**Affricate** – A phoneme containing a stop and a fricative, produced using the same place of articulation (Brinton & Brinton, 2010).

**Approximant** – a consonant produced with minimal airflow obstruction; these can be separated into liquids and glides (Roach, 2009).

**Aspiration** – a puff of air released when producing a consonant (Brinton & Brinton, 2010).

**Coalescence** – phonemes occurring in sequence are co-produced as if they occur at one time (Roach, 2009).

**Dental** – a phoneme which is produced as a result of approximation or contact between the teeth and another oral articulator (Roach, 2009).

**Elision** – a phoneme is considered to have elided if it is present in slow speech, but not audible in conversational speech (Roach, 2009).

**Fricative** – a phoneme which is produced when air is forced through a narrow opening (Brinton & Brinton, 2010).

**IPA** – (International phonetic alphabet) a standard set of symbols used to transcribe speech (Roach, 2009).

**Nasal** – a phoneme which is produced with complete closure of two articulators (velum lowered and closure within oral cavity), thus air escapes through the nasal cavity (Brinton & Brinton, 2010).

**Palatal** – a consonant which is produced when the tongue is in contact with the highest part of the palate (Roach, 2009).

**Phoneme** – A phoneme is the smallest linguistic unit which contrasts with another and can alter the meaning of a word (de Lacy, 2007; Owens, 2008).

**Phonological processes** – speech processes which occur, resulting in the difference between a child's production of speech and the adult target (Dodd, Holm, Hua, & Crosbie, 2003).

**Syllable** – a basic unit of speech consisting of a vowel with or without surrounding consonants (Roach, 2009).

**Transcription** – spoken language written using specific symbols to denote pronunciation (Roach, 2009).

## Conventions Used

1. 1;6 years = 1 year and 6 months
2. Zulu target word '*ipeni*'
3. IPA transcription of a word /ip'eni/
4. English translation of word (pen)

## **Outline of dissertation**

### **Chapter One – Introduction**

The role of SLPs and challenges faced in the context of the South African workplace are discussed. Speech acquisition is discussed in relation to theoretical frameworks and theories of phoneme acquisition. Zulu is introduced in this chapter.

### **Chapter Two – Literature review**

Phoneme acquisition across languages is discussed, initially broadly across and then more specifically in relation to Bantu language development. Zulu phonology and studies documenting phoneme acquisition are discussed.

### **Chapter Three – Methods**

The study design, data collection and data analysis are discussed within this section. Ethical considerations guiding this study are discussed.

### **Chapter Four – Results**

Findings of the current study are discussed. This section is divided into three main sections, in accordance with the aims of the study, these sections include: phoneme acquisition, word shape development and relational analysis.

### **Chapter Five – Discussion**

The findings of the study are discussed in relation to research carried out with other Bantu languages. Findings are analysed in relation to theories and frameworks introduced in Chapter 1. Trends are discussed for each of the three objectives: phoneme acquisition, word shape development and relational analysis. A tentative version of a developmental phase model for Zulu is presented.

### **Chapter Six – Clinical implications and conclusion**

The clinical implications of the study are discussed to guide the use of the findings from the current study. The limitations of the study are discussed in detail and suggestions for future research are presented.

## Chapter One – Introduction

This chapter aims to describe the context in which Speech Language Pathologists (SLPs) work in South Africa, in particular, highlighting challenges associated with typical caseloads and the multilingual environment. Theories of speech and language acquisition are introduced to contextualise the specific research undertaken in this study. General information about the Zulu language and its characteristics are presented to assist with providing a background for the setting of the current study.

### 1.1 Background and challenges of SLPs working in South Africa

South Africa is a culturally and linguistically diverse country. The constitution recognizes eleven official languages: two Germanic (viz. English and Afrikaans) and nine indigenous Bantu languages (viz. Ndebele, Northern Sotho, Sotho, Swati, Tsonga, Tswana, Venda, Xhosa and Zulu). Despite this linguistic diversity, to date the majority of qualified SLPs working in South Africa speak English or Afrikaans as their first language (Pascoe et al., 2010). This results in many speakers of the remaining nine official languages receiving therapy through an interpreter, which is often sub-standard (Penn, Frankel, Watermeyer, & Müller, 2009), being treated in a language which is not their first language, or perhaps not being treated at all. As discussed by Southwood and Van Dulm (2015), although more therapists who are able to assess patients in an African language are entering the field of speech language pathology, most speakers of the indigenous Bantu languages will still be assessed in a language which is not their first language. This results in difficulty with identifying a language impairment. Universities in South Africa offer training to SLPs in English and Afrikaans, but there are no undergraduate Speech Language Pathology degree programmes offered in Bantu languages. In order to start to address this need, most universities have included an additional official South African language as a compulsory course within the curriculum to expose students to more languages. However these courses are typically not comprehensive or intensive enough for students to become confident in the assessment and treatment of patients in these languages. As the specific languages spoken vary from region to region, being trained in one of the indigenous languages does not assist therapists when they move between different provinces.

A survey found that although SLPs in South Africa are currently not well-equipped to offer intervention to the multilingual population, they are aware of the limitations surrounding this (Southwood & van Dulm, 2015). It was also found that more recently qualified SLPs are better equipped than more experienced SLPs to treat patients in Zulu (although, this was not the case for any of the other Bantu languages). This finding may indicate a more diverse population being trained in the profession or that newly trained

SLPs have had exposure to an additional language at school or during their training. Although newly trained therapists may be linguistically more prepared to assess in additional languages, Southwood and Van Dulm (2015) cautioned that they may not possess the cultural understanding to effectively interpret assessment results. Although it is encouraging to note the increasing linguistic diversity of newly qualified SLPs, further transformation is needed so that the diversity of the profession more closely resembles the diversity of the South African population (Pascoe & Norman, 2013).

The inclusion of a community service year after qualifying as an SLP has effectively increased the number of newly trained therapists working in rural areas. These SLPs are likely to be treating a linguistically diverse population and are often running their own departments, having no guidance on how to adapt assessments in order to reliably assess their clients. This typical community service scenario further highlights the importance of learning additional languages whilst studying at university, as well as exposure to assessment adaptation within the curriculum at university. Many studies have highlighted the challenges and complexities of translating existing English assessments into other languages (Pascoe & Norman, 2013; Southwood & van Dulm, 2015; van der Merwe & Le Roux, 2014; van Dulm & Southwood, 2013), e.g., the language structure and cultural relevance needs to be considered, and a new set of norms should be developed with the relevant population before it is used (Southwood & van Dulm, 2015).

In a survey by van Dulm and Southwood (2013), it was found that although only 6% of the SLP respondents reported being able to provide intervention for children in Zulu, 11.9% requested therapy material in Zulu. This figure was similar for other Bantu languages. Although this appears to be a small percentage, in comparison to the 22,7% of South African's who speak Zulu as a first language (Brand South Africa, 2015), this highlights the mismatch between first language speakers and therapists who can assess in Zulu. When considering this, the difference between therapists who can assess in Zulu and those requesting resources appears significant. This indicates a need for therapists, even those who are not fluent in the languages in question, to have access to more linguistic and culturally relevant materials (van Dulm & Southwood, 2013). There is little published material available for SLPs working in the local Bantu languages (as well as in Afrikaans and South African English); this is linked to a lack of research being undertaken in South Africa that focuses specifically on the development of the official languages and difficulties that may be experienced by children and adults with speech and language difficulties across these languages (Spinner, 2011; Pascoe & Norman, 2013). Van der Merwe and Le Roux

(2014) discuss the creation and piloting of language and articulation assessments in Bantu languages as a positive step towards expanding research in this field.

Ninety-nine percent of SLPs taking part in van Dulm and Southwood's (2013) survey were confident in assessing children in English, 67% in Afrikaans and only 15% in a Bantu language (of those only 9% in Zulu); whereas only 13% felt comfortable providing intervention in a Bantu language. This suggests that a limited number of African language speakers are being treated in their first language. The participants reported that very few assessments (both formal and informal) were available in Bantu languages (van Dulm & Southwood, 2013). Pascoe et al. (2010) report that only a few assessments have been developed and standardized for South Africa. To adequately assess a child's phonology, normative data in their first language has to be available (Dodd et al., 2003).

## **1.2 The role of the SLP and consequences of a speech sound disorder**

Research by Pascoe et al. (2010) carried out in one region of South Africa, found that for SLPs working with children, an estimated 40–70% of their caseload is made up of children with communication (speech and/or language) difficulties. This is in agreement with other studies that suggest that children with speech sound disorders (SSDs) make up the majority of an SLP's caseload (McLeod & Harrison, 2009; Mullen & Schooling, 2010; Oliveira, Lousada, & Jesus, 2015; Waring & Knight, 2013), with very few of these cases presenting due to an underlying diagnosis (Waring & Knight, 2013). Pascoe et al. (2015) estimated that 6.6% of 3;0 year old children in Cape Town have an SSD. This is comparable with other sources, e.g., Mckinnon and Reilly (2007) reported the prevalence of SSDs in Australian school children as 1.06%, and a systematic review by Law, Boyle, Harris, Harkness and Nye (2000) estimated prevalence of speech disorders in children to be between 2.3–24.6%. When comparing the prevalence reported by each study, the various age ranges must be considered as some looked at a wide range of ages (e.g., Law et al., 2000; Mckinnon & Reilly, 2007), whilst others focused on one particular age group (e.g., Pascoe et al., 2015).

In order to assess a child's speech and language fairly and reliably, assessment should be carried out in the child's first language. Children are entitled to receive treatment in their first language (Pascoe et al., 2010), and as discussed in SASLHA's code of ethics (South African Speech-Language-Hearing Association, 2011) treatment should be appropriate to both individual and community needs. One cannot discriminate against patients based on their language (SASLHA, 2011). Monolingualism in South Africa is rare (Brand South Africa, 2015; Pascoe et al., 2010) and treatment of bi-/multilingual children is less than optimal, due to a lack of bilingual therapists and a lack of appropriate resources in

each language (van Dulm & Southwood, 2013). When considering bi-/multilingual children, this becomes more complex as these children are at risk of being misdiagnosed. For this reason it is important that children are assessed in every language which they use in order to provide an accurate representation of their strengths and weaknesses (International Expert Panel on Multilingual Children's Speech, 2012), paying close attention to language differences as opposed to language disorders (De Lamo White & Jin, 2011). When considering the linguistic diversity of South Africa and the population which is being served, it becomes apparent that this is disproportionate to the few practising SLPs who have a Bantu home language (Pascoe et al., 2010; Southwood & van Dulm, 2015).

Many studies of children's speech development have focused on one language with an assumption that the children are monolingual, when in fact this may very well not be the case (Gangji, Pascoe, & Smouse, 2014; Mahura, 2014; Pascoe & Maphalala, 2012). In cases where bi-/multilingualism is acknowledged, the nature of the languages and the children's exposure to them are not always well detailed making the results (and resulting normative data) hard to interpret and use in practice. This language complexity then poses a further complication to the treatment of children in South Africa. De Lamo White and Jin (2011) discuss how socio-cultural and linguistic differences of bilingual children increase the complexity of the assessment. They suggest that a socio-cultural approach to assessment and treatment be used, which includes consideration of values, traditions, lifestyle, gender, age and socio-economic status.

SSDs can differ significantly from child to child in terms of the underlying cause, the severity of the disorder, the phonemes involved and whether additional areas of the linguistic system are affected (Waring & Knight, 2013). Therapy is imperative when a child presents with an SSD. Left untreated it can result in adverse communication, academic (often related to literacy) and psychosocial sequelae in later life (Bird, Bishop, & Freeman, 1995; Lewis, Freebairn, & Taylor, 2000; McCormack, McLeod, McAllister, & Harrison, 2009; McLeod & Harrison, 2009; Pascoe et al., 2010; Rvachew, 2007).

According to Baker and McLeod (2011) evidence-based practice (EBP) should be the basic framework in the management of SSDs. To use EBP one cannot simply choose a method that has been researched; clinical expertise and a patient's individual environment and beliefs need to be considered alongside current evidence-based research (Kamhi, 2006). Although it is well known and understood that EBP is effective, many barriers to using this approach exist which include time constraints for the critical review and analysis of research linked to every clinical decision (Baker & McLeod, 2011b). Many studies have been conducted to assist with determining best practice with regards to intervention of

SSDs. These have compared treatment methods as well as treatment intensity and duration (e.g., Allen, 2013; Brumbaugh & Smit, 2013; Crosbie, Holm, & Dodd, 2005; Kamhi, 2006). In contrast, no documented studies to date have analysed intervention in Bantu languages or intervention in a rural setting, thus making EBP difficult to carry out in our local context. Furthermore there is no evidence-base discussing intervention for multilingual South African children and the effects of intervention across languages. Interaction between languages can cause various changes, dependent on the language itself, and the degree of contact between languages (Gildersleeve-Neumann, Kester, Davis, & Peña, 2008). Due to the unique characteristics of SSDs, it is important that therapy techniques and goals are chosen to suit the patient within their own environment. Therapy can include phonological awareness activities (Gillon, 2005; Hesketh, Adams, Nightingale, & Hall, 2000), auditory discrimination tasks (Rvachew, Nowak, & Cloutier, 2004) and/or activities centred around minimal pairs (where only one phoneme is different e.g., **bet/pet**) (Dodd et al., 2008; Oliveira et al., 2015; Pascoe et al., 2010). Cutting across all these different therapy approaches it is acknowledged that parental involvement is key to success in intervention (Bowen & Cupples, 2006; Oliveira et al., 2015; Pascoe et al., 2010).

Stackhouse, Pascoe and Gardner (2006) explain that speech delays occur as a result of one or a combination of speech input, speech production and/or stored lexical representations of phonemes (or words). These psycholinguistic processes are imperative for phonological awareness, and a delay in spoken language could result in difficulties with written language. In a study by Bird, Bishop and Freeman (1995) it was found that participants with SSDs found it challenging to identify the phonemes in a syllable. Therefore when children of the same age were learning the sounds that letters in the alphabet correspond to, children with SSDs were still having difficulty with phonological awareness (such as matching rhyming words), which resulted in challenges for reading (Bird et al., 1995). Due to the close relationship between phonological awareness, speech and literacy it is imperative that SSDs are identified and treated early, so that children starting to read and write at school are able to build their literacy development on a firm foundation of oral language.

### **1.3 Theoretical Frameworks: Speech development and difficulties**

SSDs can be described at a variety of different linguistic levels. A phoneme is the smallest linguistic unit which contrasts with another and can alter the meaning of a word (de Lacy, 2007). Every language consists of a variety of different phonemes, combined in specific ways to form the words of the language. One way in which an SLP can judge whether a child is developing appropriately is to compare a child's acquisition of phonemes

within his/her language (or languages) in relation to normative data that details the expected ages of acquisition of the consonants and vowels within the language. This type of information is readily available for some languages (e.g., English: Grunwell, 1987; Spanish: Bernthal & Bankson, 1994), emerging for other languages (e.g., Xhosa: Maphalala, Pascoe, & Smouse, 2014; Zulu: Naidoo, van der Merwe, Groenewald, & Naudé, 2005) and not yet available for other languages (e.g., Sepedi; Shangaan).

A communication disability is defined as difficulty in using verbal or written language in order to convey a message or to understand a message conveyed by another individual (Dodd, 2005b). Many children referred to SLPs have speech difficulties due to problems in the production of their speech sounds - known as an SSD. When classifying SSDs one needs to consider the typical development of the speech sounds of the language in question; the severity of the difficulties (mild, moderate or severe) and the underlying aetiology, if it is known. Although many classification systems have been proposed, few have been inclusive of all disorders. Dodd (2005a) describes a classification system for functional SSDs which separates them into four well defined diagnostic categories as described in Table 1.

Table 1

*Classification of speech sound disorders (Dodd, 2005b)*

<b>Classification</b>	<b>Description</b>
Articulation Disorder	<ul style="list-style-type: none"> <li>• Difficulty producing specific sounds</li> <li>• Same substitution used whether naming or copying a word</li> <li>• A phonetic disorder</li> </ul>
Phonological Delay	<ul style="list-style-type: none"> <li>• Error patterns are typical of normally developing speech, but are present until a later age <ul style="list-style-type: none"> <li>○ Normal developmental error patterns</li> </ul> </li> </ul>
Consistent phonological disorder	<ul style="list-style-type: none"> <li>• Same error patterns are used consistently, these error patterns are not typical of normally developing speech <ul style="list-style-type: none"> <li>○ Atypical error patterns</li> </ul> </li> </ul>
Inconsistent phonological disorder	<ul style="list-style-type: none"> <li>• Various error patterns noted for one target word, not typical of normally developing speech <ul style="list-style-type: none"> <li>○ Inconsistent error patterns</li> </ul> </li> </ul>

Within the last three classifications (phonological delay, consistent phonological disorder and inconsistent phonological disorder) outlined in Table 1, phonological processes or error patterns exist. Phonological processes are a typical part of speech development (Grunwell, 1987), and the term 'phonological process' is used throughout the thesis to denote simplification patterns used by children. Dodd (2005b) uses the term 'error patterns' to denote phonological processes which (a) may be typical for the language in

question and occur in the correct sequence but should have been eliminated already (phonological delay category); (b) are atypical and not usually seen in children acquiring a given language (consistent phonological disorder category); and (c) inconsistent error patterns, where unusual / atypical processes are used in ways which are inconsistent and unpredictable (inconsistent phonological disorder category) (Dodd, 2005b). Phonological processes may include backing, velar fronting, stopping, affrication, deaffrication, gliding of liquids, voicing and vocalizations (Dodd, Holm, Crosbie, & Hua, 2005; Hawkins, 1984; Yavas & Goldstein, 1998). When considering the prevalence of SSDs, the phonological delay category has been shown to be the predominant category across a range of languages (e.g., German: Fox & Dodd, 2001; English: Dodd et al., 2003) . A study investigating SSDs in children aged 3;0–3;11 acquiring English, Afrikaans and/or Xhosa in Cape Town, also showed phonological delay to be the most prevalent category (Pascoe et al., 2015).

Moving beyond phonemes, syllables are described as an uninterrupted unit of pronunciation, which consists of a vowel with or without surrounding consonants. Some words consist of only one syllable. As the consonant-vowel (CV) syllable is used when babbling, and is one of the first units mastered by a child, words are often shortened or adapted to follow either CV or CVCV structures. Phonological processes used in altering word structure may include the deletion of final syllables (/wag/ for wagon), deleting unstressed syllables (/nana/ for banana), reducing clusters (/pider/ for spider) and reduplication (/wawa/ for water) (Dodd et al., 2005; Hawkins, 1984; Yavas & Goldstein, 1998). Phonological processes may be language specific, for example in a language with no consonant clusters, cluster reductions would not exist. Phonological processes present in English have been well documented and classified (Cohen & Anderson, 2011; Grunwell, 1987). Although studies have been carried out in other languages (e.g., Putonghua: Hua & Dodd, 2000; Tswana: Mahura, 2014; Xhosa: Maphalala et al., 2014; Swahili: Gangji et al., 2015), there is insufficient research to develop norms for many languages.

When considering a child's speech sound development, there are three broad perspectives which can be considered. These include the linguistic, medical and psycholinguistic approaches. Baker, Croot, Mcleod and Paul (2001) discuss the strengths and shortfalls of each approach. The linguistic approach, which is sometimes referred to as the descriptive approach, emerged between the 1960's and 1970's. It analyses speech in relation to norms for typically developing children at the same age (Waring & Knight, 2013). One of the positive aspects of this approach is that speech development can be categorized as typical, atypical or delayed. This approach has been criticized in that it focuses solely on speech production and does not consider breakdown at other levels of the communication

system (Waring & Knight, 2013). It therefore provides a good breakdown of the speech difficulty, however no cause of impairment is identified (Baker et al., 2001).

The medical perspective analyses a child's SSD by initially assuming an underlying medical diagnosis (Waring & Knight, 2013). This classification system is split between broad based classification systems (which diagnose the underlying condition, not specific to communication) and more specific SSD classification systems (Waring & Knight, 2013). Although this approach assists with diagnosing the cause when there is an underlying medical condition, it does not assist with the identification of SSDs in cases where the aetiology is unknown (Baker et al., 2001). Another shortfall of this approach is that it does not analyse the severity of the SSD. From this it can be deduced that the medical and linguistic approaches balance each other well, with the one focusing more on the underlying cause and the other describing the impairment (Baker et al., 2001).

Psycholinguistic approaches, in contrast, aim to describe how a speech impairment occurs by analysing human linguistic behaviour (Baker et al., 2001; Waring & Knight, 2013). Speech is analysed by considering auditory discrimination (input), lexical representation and speech output (Stackhouse et al., 2006; Waring & Knight, 2013). The approach uses speech processing models to assist with understanding where a breakdown is occurring and how this breakdown will affect other areas of development. An intervention plan tailored specifically to a patient's strengths and weaknesses can then be generated (Stackhouse et al., 2006). A basic breakdown of a speech processing model is depicted in Figure 1.

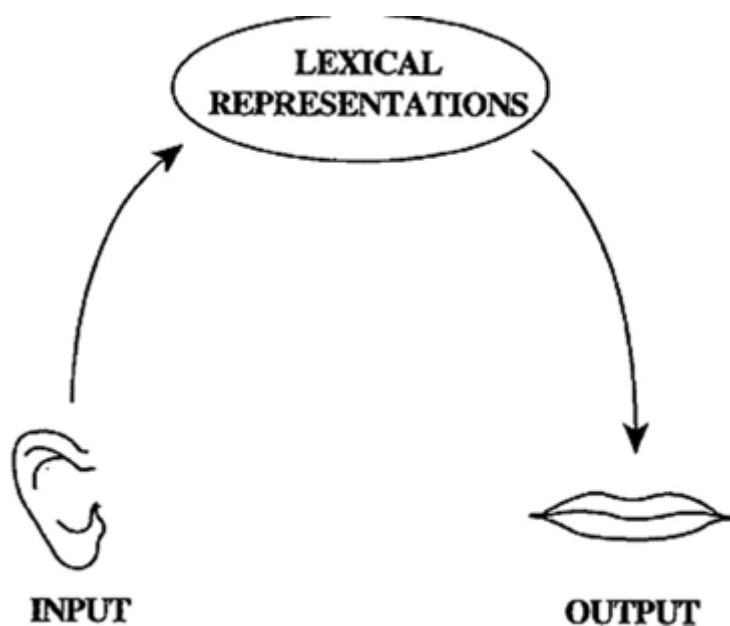
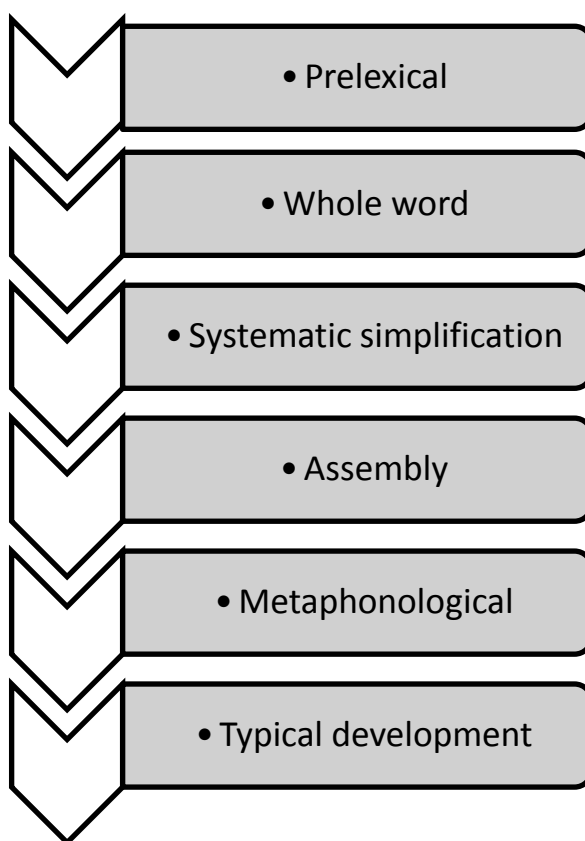


Figure 1. Speech processing model as described by Stackhouse and Wells (1997).

Image reproduced from (Stackhouse et al., 2006).

The current study is underpinned by the psycholinguistic approach. I will use Stackhouse and Wells' (1997, 2001) speech processing models; as well as Dodd's (2005a) diagnostic framework to interpret findings. Stackhouse et al. (2006) note that a breakdown at any level of the speech processing chain can account for impairments at both a spoken and, in older children, written language level. In order to understand at which level the difficulty arises speech processing models are used. In a study of typical development, their developmental phase model is useful (Mahura, 2014; Maphalala et al., 2014). It is depicted in Figure 2 and details the different levels of speech processing linked to different stages of development.



*Figure 2.* A representation of the stages of the developmental phase model as described by Stackhouse et al. (2006).

The developmental phase model considers five phases of development required to arrive at the desired outcome of typical development (Stackhouse et al., 2006; Waring & Knight, 2013). The first phase is the prelexical phase which continues until about the age of 1;0 year and includes babbling from around the age of 0;5 months. The second phase is the whole word phase, where a child will say single words in isolation to request or to name an object. This typically continues until the age of 2;0 years (Stackhouse et al., 2006). As discussed by Owens (2008), when learning to produce single-word utterances, children rely

on imitation, words which are frequently used within daily activities, or words with which a child can associate an object or action are often common during this phase. They then progress to systematic simplification where an utterance is simplified to a more manageable phrase. This occurs between the ages of 2;6–4;0 years. Around the age of 3;0–4;0 years, children start to master connected speech within the assembly phase and their speech starts to become more adult-like (Stackhouse et al., 2006). Around the school-going age of 5;0 years, children start to enter into the metalinguistic phase. This phase influences school performance as these skills are important for the emergence of literacy. Metalinguistic awareness allows one to reflect on language and one's own utterances, shifting the focus from understanding and production of language (Owens, 2008).

#### **1.4 Theories of phoneme acquisition**

Theories of language acquisition date back to before the 1940s when Jakobson discussed the theory of universals in which age of acquisition occurs globally as a result of the distribution of phonemes across languages. It is widely acknowledged that the first phonemes to develop across languages include nasals, front consonants and stops (Hua & Dodd, 2000). This suggests that phonemes, which are common across languages, develop first, regardless of a child's first language. Van der Merwe and Le Roux (2014) highlight some of the differences between English and Bantu languages, such as clicks, the velaric air stream mechanism and ejectives. Furthermore, prenasalized phonemes occur in Zulu, but are not present in English. In relation to the theory of universals, within the current study, language specific phonemes, such as clicks, prenasalized phonemes and ejectives, would be expected to be acquired later than more common phonemes.

This universal theory was expanded later to include the markedness of sounds, however there are various ways that the term markedness can be understood (Jensen, 2012). Hawkins (1984) noted that although two sounds may be related, one may be easier to pronounce than the other. Unmarked sounds are easier to produce and often act as substitutes for marked sounds (Hawkins, 1984; Hua & Dodd, 2000). Children therefore develop unmarked sounds earlier than marked sounds (Hawkins, 1984). An example of a marked/unmarked pair of phonemes is nasal and oral vowels respectively. As discussed by Zamuner, Gerken and Hammond (2005), markedness can be related to the frequency of use within a specific language, as well as the occurrence across languages. These theories have been adjusted and expanded through research, however much can still be drawn from these initial theories (Jensen, 2012). Maphalala et al. (2014) suggested that although this theory can be used to a degree in predicting outcomes of language acquisition, individual language differences have an influence on findings.

Demuth (1995) expanded on the theory of markedness by considering the development of prosodic structures in English and Dutch, and by theorizing that the development seen in these languages can likely be expanded to other languages through the theory of universal grammar. The development is broken down into four levels, the first being the unmarked syllable structure CV, which is expanded in the second stage to include binary forms, with syllable structures including CVCV, CVC and CVV. In the third stage prosodic words are formed, which are longer than the binary form, and in the final stage the targeted word form is produced. Demuth (1995) further illustrates through this concept that in languages which have more complex word structures and prosodic forms, development of target word forms will occur at a later age than languages with more simple word structures. In Zulu, words are normally open-ended and consist largely of CVCV structures; therefore children should reach level four at a relatively early age. In line with this theory, Maphalala et al. (2014) found that unmarked syllables and shorter word shapes (i.e. VCV/VCVCV) were acquired first.

As discussed by (Durand, 1990) there are two streams of phoneme acquisition, under which many approaches exist. These include linear phonology which depicts a phoneme in its simplest form and non-linear phonology which consider the many aspects accompanying a phoneme such as tone and stress. Non-linear phonology includes approaches such as autosegmental phonology, whilst generative phonology is an approach based on linear phonology. Although these two streams have some differences, they both include the same fundamental principles of what a theory of phonology should account for.

## **1.5 Zulu**

Zulu is the language spoken by the amaZulu people, who make up the largest ethnic group of South Africa. King Goodwill Zwelethini is the current leader of the AmaZulu nation (Brand South Africa, 2015). More than a fifth (22,7%) of people in South Africa speak Zulu as their first language, making it the most spoken language in the country, as well as one of the eleven official languages of South Africa (Brand South Africa, 2015). It is estimated to be spoken by more than ten million people worldwide, with a majority of Zulu speakers residing in South Africa. Within South Africa, the great majority (77,8%) of Zulu speakers reside in KwaZulu-Natal (Brand South Africa, 2015). Cele, Lala, Qwabe and Transvaal Zulu are four documented dialects of Zulu (Paul, Simons, & Fennig, 2015). There are also regional variants which exist due to the many borrowed words from English, Afrikaans and other African languages, and also linked to the location of speakers who are distributed over a wide geographical area.

Zulu is a tonal language. This means that tone alone can alter the meaning of a word and is thus an important aspect of the language which cannot be conveyed in written text (van der Merwe & Le Roux, 2014). It is part of the Nguni group of the Southern Bantu family. There are estimated to be 500 languages within the Bantu family of languages. Zulu is considered to be a close relation to Xhosa and Ndebele (Accredited language services, 2015). Linguists have suggested that Zulu and Xhosa may be varying dialects of one language and are therefore described as sister languages. Although to some degree they may be mutually intelligible, speakers of the language view them as separate languages (Accredited language services, 2015).

Manguzi is a small, rural town situated in the Umkhanyekude district of Northern KwaZulu-Natal, within the sub-district of Umhlabuyalingana. Umkhanyekude has a population of 625 846 people, with 587 736 (94.56%) of these people being first language Zulu-speaking (Frith, 2011a). Manguzi, which is where the current study is situated, covers an area of 11.83km<sup>2</sup> with a population of 6 875 people. According to the Census done in 2011, 6 098 (92.44%) people in Manguzi speak Zulu as their first language (Frith, 2011b). Manguzi Hospital, which serves the population of Manguzi has one permanent Junior SLP, who is first language English-speaking and has been working in the community for over four years, and one community service SLP who is also first language English-speaking.

## **1.6 Summary**

The chapter has introduced the rich linguistic diversity of South Africa, but at the same time highlighted the challenges faced by SLPs working in this setting. Children with SSDs comprise a substantial proportion of SLP's caseloads. Yet SLPs find themselves with few assessment materials that can accurately and reliably assess the speech of children acquiring most of the country's official languages, and limited normative data that can help them to evaluate what is typical and who requires therapy. Literature suggests that it is not sufficient to translate assessments and therapy materials from other languages. Zulu is the most spoken language in South Africa, with a majority of speakers residing in KwaZulu-Natal. Despite this majority status, research that pertains specifically to speech sound acquisition of Zulu and development of resources is significantly lacking.

## Chapter Two – Literature review

This chapter reviews literature focused on speech sound development in general, before focusing more specifically on Bantu languages. When analysing studies focused on speech development in children, differences in methodology, sample size and results are discussed. Zulu phonology is discussed in more detail, and finally the small body of research focusing on Zulu speech acquisition is discussed.

### 2.1 Phoneme acquisition in English

Many studies have investigated phoneme acquisition in English (Cohen & Anderson, 2011; Dodd et al., 2003; McLeod, van Doorn, & Reed, 2001; Moskowitz, 1970; Mowrer & Burger, 1991). Over many years these studies have employed a range of different methodologies, often making the results difficult to compare. Moskowitz (1970) analysed English speech sound acquisition using case studies of three 2;0 year old children, whereas Dodd et al. (2003) made use of a cross-sectional study, with a large sample of 684 English-speaking British children between the ages of 3;0 and 6;11. Mowrer and Burger (1991) assessed 70 English-speaking children between 2;6 and 6;0 in South Africa. Cohen and Anderson (2011) focused on phonological processes in 94 children between 3;1 and 4;11 years and McLeod et al. (2001) discussed consonant cluster production through the use of a literature review. Although this is not an exhaustive list of studies detailing acquisition of English, the studies selected will be discussed further as they represent a variety of different methodologies and approaches, and are summarized in Table 2.

Dodd et al. (2003) used a large sample in order to ensure accuracy in the results obtained. Groups of children were studied who differed in terms of gender, language background and the families' socio-economic status, the sample was representative of the population, including those with language delays. The purpose of Mowrer and Burgers' (1991) study was to compare Xhosa and English phoneme acquisition. The authors thus only analysed the acquisition of 20 English phonemes which also feature in Xhosa. The study by Dodd et al. (2003) used subtests of the Diagnostic Evaluation of Articulation and Phonology (DEAP) (Dodd, Hua, Crosbie, Holm, & Ozanne, 2002) to assess the participants. When investigating English, there are a wide variety of assessments available. It was found that all phonological processes were eliminated by the age of 6;0 years, with gliding being the last process present after the age of 5;0. All participants were able to produce all vowels correctly suggesting that these develop before the age of 3;0. This is in agreement with other studies summarised by Owens (2008). Furthermore it was found that plosives and nasals develop first (by the age of 3;5) whilst affricates were acquired by 4;5, approximants by 6;5 and fricatives by 7;0 years (Dodd et al., 2003). The results were

analysed further to find that socio-economic status had no bearing on the age or accuracy of phoneme acquisition, and female's phonological accuracy was higher than males, but the gender difference was only noted in the older age groups (between 5;6 and 7;0 years). This gender finding is in contrast to that of Mowrer and Burger (1991), who found no significant difference between the acquisition of phonemes between males and females – although they only investigated children up to the age of 6;0.

Table 2

*Summary of selected studies detailing phoneme acquisition in English*

Study Title and Author	Population	Data collected	Main Findings
Phonological Development: A normative study of British English-speaking children (Dodd et al., 2003)	684 British English-speaking children 3;0-6;11	<ul style="list-style-type: none"> <li>• Phoneme acquisition</li> <li>• Gender and phoneme acquisition</li> <li>• Socio-economic status and phoneme acquisition</li> <li>• Error patterns</li> </ul>	<ul style="list-style-type: none"> <li>• Older children used less error patterns and produced words more accurately</li> <li>• Younger age groups displayed no differences between gender</li> <li>• In older age groups, females displayed more phonological accuracy</li> <li>• Socio-economic status did not affect phonological accuracy</li> <li>• Plosives and nasals developed by 3;5</li> <li>• Fricatives develop last, not complete by 6;11</li> </ul>
The two-year old stage in the acquisition of English phonology (Moskowitz, 1970)	3 English-speaking children at the age of 2;0	<ul style="list-style-type: none"> <li>• Phoneme acquisition</li> <li>• Substitutions</li> </ul>	<ul style="list-style-type: none"> <li>• Phoneme acquisition is unique to each child</li> <li>• Phonological representation is learnt alongside pronunciation</li> </ul>
A comparative analysis of phonological acquisition of consonants in the speech of 2 ½ - 6 year-old Xhosa- and English-speaking children (Mowrer & Burger, 1991)	70 Xhosa-speaking children 2;6-6;0 70 English-speaking children 2;6-6;0	<ul style="list-style-type: none"> <li>• Phoneme acquisition</li> <li>• Gender and phoneme acquisition</li> <li>• Misarticulations</li> <li>• Phoneme substitutions</li> </ul>	<ul style="list-style-type: none"> <li>• Xhosa-speaking children acquire phonemes earlier than English-speaking children</li> <li>• Age of acquisition is not related to gender</li> <li>• Similar substitutions for fricatives, affricates and liquids are used by Xhosa and English speakers</li> </ul>
Identification of phonological processes in preschool children's single-word productions (Cohen & Anderson, 2011)	94 English-speaking children 3;1 – 4;11	<ul style="list-style-type: none"> <li>• Phonological processes</li> </ul>	<ul style="list-style-type: none"> <li>• Velar fronting, devoicing and stopping of affricates not present after 3;5</li> <li>• Obstruent + approximant cluster reductions not present after 3;11</li> <li>• /s/ cluster reduction not present after 4;5</li> <li>• Stopping of affricates, gliding and substitution of /θ/ with</li> </ul>

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Normal acquisition of consonant clusters (McLeod et al., 2001)	Literature review	<ul style="list-style-type: none"> <li>• Consonant cluster production</li> </ul>	<p>/f/ still present at end of study</p> <ul style="list-style-type: none"> <li>• Word-final consonant clusters develop before word-initial consonant clusters</li> <li>• Consonant clusters containing fricatives develop after clusters containing stops</li> <li>• Acquisition of consonant clusters occurs over time and follows a developmental sequence</li> <li>• Individual variation is present in the development of consonant clusters</li> </ul>
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Phonological processes were analysed in the studies by Dodd et al. (2003) and Cohen and Anderson (2011). Both studies found that the process of velar fronting was no longer present after the age of 3;5. Dodd et al. (2003) analysed cluster reductions as a single group and found cluster reductions to be present until 4;11 years (including tri-clusters). Cohen and Anderson (2011) analysed cluster reductions by description, finding that obstruent + approximant cluster reductions disappear by the age of 4;0, and those including /s/ are no longer present after 4;5 years. They emphasized the importance of separating similar phonological processes to allow for all relevant findings to be apparent.

Consonant cluster productions were discussed in the literature review by McLeod et al. (2001), in which 70 years of research was analysed and a list of trends in consonant cluster production was created. The main findings from this study are documented in Table 2. Consonant cluster production was not analysed in as much detail in any of the other studies discussed.

## 2.2 Phoneme acquisition across other languages

Moving beyond English, studies have been conducted in various other languages worldwide. A few examples of these languages include Putonghua (Modern Standard Chinese), Hong Kong Cantonese and Québécois French. Although this is not an exhaustive list, the discussion below includes studies relating to these languages.

A study by Hua and Dodd (2000) analysed speech sound acquisition of 129 monolingual Putonghua-speaking children between the ages of 1;6 and 4;6. The phonemes in Putonghua include six pairs of aspirated and unaspirated, voiceless consonants, three alveo-palatal phonemes, nine simple vowels, nine diphthongs and four triphthongs. As no

standardized assessments in Putonghua were available, Hua and Dodd (2000) made use of single-word picture naming and image description. The images selected were chosen based on the ability to illustrate the word as well as the word's familiarity to children within the specified age categories. Differences in phoneme acquisition were assessed in single words and at a sentence level, with no significant differences found. Similar to British English, simple vowels in Putonghua emerged early, with the youngest group in the study being able to produce them correctly. Reductions and vowel substitutions were found in the production of diphthongs and triphthongs.

Hong Kong Cantonese was studied by To, Cheung and McLeod (2012), in which 1 726 children between the ages of 2;4 and 12;4 were assessed using the Hong Kong Cantonese Articulation Test. Cantonese is made up of 19 word-initial consonants, six word-final consonants, 11 vowels, 11 diphthongs and nine tones. The effects of age (13 age groups) and sex (male and female) on phoneme acquisition were studied using a two way analysis of variance. This was carried out on each of the four elements (i.e. initial consonants, final consonants, vowels/diphthongs and tones) included in the study. Mean accuracy and standard deviations were calculated. In contrast to other studies, findings suggested that females acquired initial and final consonants as well as vowels/diphthongs before males. Tones appeared to be developed by the age of 2;6. A reverse pattern of acquisition was noted for some consonants in which they were developed in the word-final position before the word-initial position. This highlights the importance of assessing phoneme acquisition in various word positions, specifically as they relate to the language in question.

A study conducted by MacLeod, Sutton, Trudeau and Thordardottir (2011) analysed consonant acquisition in Québécois French. Participants included 156 children between 1;8 and 4;5 years. Assessment was conducted using a picture naming tool which has no standardized norms. The dialect of French used in this study consists of 20 consonants (voiceless unaspirated stops, prevoiced stops, voiceless fricatives, voiced fricatives, liquids, uvular fricative rhotic, glides and nasals) and 16 monophthongs. The accuracy in consonant production plateaued around the age of 3;6. Differences were noted in age of acquisition in different word positions, again suggesting that assessment across various word positions is important. Limitations of this study include the use of modelled words. The broad range of ages meant that some of the younger participants were unable to name words without a model. Modelling words can cause an over-estimation of the age of acquisition.

From these studies, the complexity of each language structure and differences between them can be noted, thus emphasizing the need for studies to be carried out in a

wide variety of languages. All three studies used similar methods to assess their participants. Hua and Dodd (2000) and Macleod et al. (2011) used similar age ranges and a similar number of participants, whilst To et al. (2012) covered a larger age range and evaluated a much larger population.

### 2.3 Phoneme acquisition in Bantu Languages

Bantu languages such as Xhosa, Tswana, Sotho and Swahili have been investigated in order to understand children's speech development in these languages. A selection of these studies are summarised in Table 3. McLeod's (2007) book has more than 30 chapters each detailing what is known about phoneme acquisition in different languages and dialects around the world. Sotho speech acquisition, written by Demuth (2007) is the only chapter to focus on a Bantu language within this book. Zulu, the focus of the current study, is a Bantu language and is discussed separately in the following section.

Table 3

#### *Summary of studies on phoneme acquisition in Bantu languages*

Study Title and Author	Population	Data collected	Main Findings
Phonological development of first language isiXhosa-speaking children aged 3;0-6;0: A descriptive cross-sectional study (Maphalala et al., 2014)	24 Xhosa-speaking children aged 3;0-6;0	<ul style="list-style-type: none"> <li>Consonant acquisition</li> <li>Vowel acquisition</li> <li>Word shape development</li> <li>Error patterns</li> <li>PCC and PVC</li> </ul>	<ul style="list-style-type: none"> <li>Most phonemes acquired by 3;0</li> <li>Affricates, some clicks and aspirated plosives still developing between 4;0 and 5;0</li> <li>Able to produce six-syllable words by 6;0</li> </ul>
The acquisition of Xhosa phonemes (Tuomi, Gxhilishe, & Matomela, 2001)	10 Xhosa-speaking children between the ages of 1;0-3;0, collected over 12 months	<ul style="list-style-type: none"> <li>Vowel acquisition</li> <li>Consonant acquisition</li> <li>Consonant inventory change over time</li> </ul>	<ul style="list-style-type: none"> <li>Between 2;7-3;0 the frequency of use of clicks increased</li> <li>Nasals, stops and glides developed first</li> <li>Fricatives and liquids developed last</li> </ul>
The acquisition of clicks by Xhosa speaking children (Gxhilishe, 2004)	10 Xhosa-speaking children between the ages of 1;0-3;0, collected over 12 months	<ul style="list-style-type: none"> <li>Frequency of use of clicks</li> </ul>	<ul style="list-style-type: none"> <li>Basic clicks emerge in speech from the age of 1;0</li> <li>Acquisition of clicks is not complete by 3;0 years</li> <li>Increase in development between 1;7-2;0 years</li> </ul>
A comparative analysis of phonological acquisition of consonants in the speech of 2 ½-6 year-old Xhosa- and English-speaking children (Mowrer & Burger, 1991)	70 Xhosa-speaking children 2;6-6;0 70 English-speaking children 2;6-6;0	<ul style="list-style-type: none"> <li>Phoneme acquisition</li> <li>Gender and phoneme acquisition</li> <li>Misarticulations</li> <li>Phoneme substitutions</li> </ul>	<ul style="list-style-type: none"> <li>Xhosa-speaking children acquire phonemes earlier than English-speaking children</li> <li>Age of acquisition is not related to gender</li> <li>Similar substitutions for fricatives, affricates and</li> </ul>

<p>The acquisition of Setswana phonology in children aged 3;0–6;0 years: A cross sectional study (Mahura, 2014)</p>	<p>36 Setswana-speaking children aged 3;0–6;0</p>	<ul style="list-style-type: none"> <li>• Acquisition of consonants</li> <li>• Acquisition of vowels</li> <li>• Development of syllable structures</li> <li>• Description of error patterns</li> </ul>	<p>liquids are used by Xhosa and English speakers</p> <ul style="list-style-type: none"> <li>• Most consonants developed by 3;0</li> <li>• Error patterns decrease with age</li> <li>• Syllables structures other than V were acquired in word-initial position before the age of 3;0</li> </ul>
<p>Swahili speech development: preliminary normative data from typically developing preschool children in Tanzania (Gangji et al., 2014)</p>	<p>24 Swahili-speaking children aged 3;0–5;11</p>	<ul style="list-style-type: none"> <li>• Phonetic inventory</li> <li>• Development of syllable structure</li> <li>• Error patterns</li> <li>• PCC and PVC</li> </ul>	<ul style="list-style-type: none"> <li>• All vowels and most consonants developed by 3;0</li> <li>• Phoneme accuracy increased and error patterns decreased with age</li> <li>• All children were able to produce words containing up to four syllables</li> </ul>
<p>Sesotho speech acquisition (Demuth, 2007)</p>	<p>Review of literature</p>	<ul style="list-style-type: none"> <li>• Acquired phonemes</li> <li>• PCC/PVC</li> <li>• Phonological processes</li> <li>• Syllable structure</li> <li>• Prosody</li> <li>• Phonological awareness</li> </ul>	<ul style="list-style-type: none"> <li>• Most consonants acquired by 2;0</li> <li>• Palatal alveolar click is one of the last phonemes to be acquired (at age of 3;0)</li> <li>• Phonological processes still present after 3;0</li> <li>• The use of high and low tone is evident by 2;0</li> </ul>

The studies conducted by Maphalala et al. (2014), Gangji et al. (2015) and Mahura (2014) are similar in terms of sample size (24–36 participants); they used a single-word picture naming assessment tool to collect data and similar categories to analyse the data. These three studies are therefore easily comparable and will be discussed in more detail.

As there are no phonology assessments available in Xhosa, Swahili or Tswana, assessments had to be developed. These studies employed similar strategies when developing the assessments used during the studies. A word list was developed, including all phonemes of the language in various word positions. For the Xhosa study, a wordlist had been generated before the study and was adapted and expanded on during the study. Once the wordlists had been generated, they underwent expert panel discussion to determine the age and cultural appropriacy as well as to ensure the correct phoneme was being targeted. Following this, the wordlists were reviewed and illustrations for each word were generated. All of these assessments were used in pilot studies before starting data collection (Gangji et al., 2014; Mahura, 2014; Pascoe & Maphalala, 2012). Following the

pilot studies, further refinements were made such as generating cues to assist participants in producing the target word without modelling it (Mahura, 2014).

Most phonemes are acquired before the age of 3;0 in Xhosa (Maphalala et al., 2014; Mowrer & Burger, 1991; Tuomi et al., 2001), Swahili (Gangji et al., 2014) and Tswana (Mahura, 2014); whilst in Sotho, most consonants were acquired before 2;0 (Demuth, 2007). Within Xhosa, Swahili and Tswana, it was found that nasals were developed before the age of 3;0 (Gangji et al., 2014; Mahura, 2014; Maphalala et al., 2014; Tuomi et al., 2001). In Tswana, the inventory of plosives and fricatives is complete within the second age group (3;6-3;11) (Mahura, 2014). For Xhosa these groups remained incomplete at 6;0 years, the oldest age group in the study (Maphalala et al., 2014), whilst in Swahili, the only incomplete groups at the age of 3;0 were the fricatives and trills (Gangji et al., 2014). In Swahili, the last sounds to develop are /θ/ and /r/. The trill developed late in all of the studies. Mowrer and Burger (1991) suggested that this is expected as it is a borrowed sound, not common in the Xhosa vocabulary, and this may be similar for other Bantu languages. According to Bleile (2013), /θ/ and /r/ are two of the sounds within the 'late eight', the last sounds to develop in English. Maphalala et al. (2014) noted that nasal clicks are the most difficult clicks to produce, however no overall pattern emerged for the acquisition of clicks in Xhosa. Although children between 3;0–3;6 years could correctly produce 10 of the clicks in Xhosa, the inventory of clicks was only complete by the age of 5;0. Within this study, the three basic clicks /ǀ/, /ǁ/ and /ǃ/, were included within the phoneme inventory by the age of 3;7. This is in agreement with other studies (Lewis, 1994; Mowrer & Burger, 1991). In the study by Gxilishe (2004), clicks emerged from the age of 1;0, although the frequency of use was low, participants between the ages of 1;0–1;6 used the three basic clicks (i.e. /ǀ/, /ǁ/ and /ǃ/) in spontaneous speech. Mahura (2014) suggested a progressive pattern of consonant acquisition in Tswana, in which children appear to regress in their acquisition before mastering consonants; however this may also have been related to extraneous factors, such as gender differences within the age groups. Within Sotho, only the palatal click /ǀ/ and aspirated palatal click /ǀʰ/ occur, these are thought to be acquired later than in other Bantu languages, as they are only present in spontaneous speech samples from the age of 3;0 years (Demuth, 2007).

In Xhosa, it was found that all of the participants could produce the vowels correctly at least once, demonstrating that the acquisition of vowels occurs early (Maphalala et al., 2014; Tuomi et al., 2001). Similarly in Tswana and Swahili, children appear to have a complete vowel inventory by the age of 3;0 (Gangji et al., 2014; Mahura, 2014). However, it was also found that the accuracy of vowel production increases with age

in Tswana (Mahura, 2014). Although studies looking at the acquisition of Sotho have not been conclusive with regards to vowel acquisition, findings suggest that word-final vowels are often devoiced or omitted (Demuth, 2007).

Bantu languages use an agglutinating orthography (Van de Velde, Nurse, Bostoen, & Philippson, 2014), in which prefixes and suffixes are added onto words to convey meaning. Zulu uses a conjunctive orthography in which an orthographic word equates to a linguistic word, whereas some other Bantu languages, such as Northern Sotho use a disjunctive orthography in which four orthographic words equate to one linguistic word (Taljad & Bosch, 2006). When analysing word shape this needs to be considered as the omission of syllables may be related to the development of morphology (Maphalala et al., 2014). In Xhosa, children below the age of 3;6 were able to use two- to three-syllable words (Maphalala et al., 2014), whereas in Tswana and Swahili, the same age group were able to produce four-syllable words correctly (Gangji et al., 2014; Mahura, 2014). Maphalala et al. (2014) found that, even in the older age groups, in words longer than five syllables, the initial syllable (or two) was often omitted when producing the word.

As expected, there is a decrease in the use of phonological processes as age increases (Gangji et al., 2015; Mahura, 2014; Mowrer & Burger, 1991; Maphalala et al., 2014). Vowel elision (or assimilation) is a common process, in which a vowel is omitted from a word. It has been noted in both Xhosa and Tswana. As it is a feature of adult-like connected speech, it is not considered a developmental process. In Tswana, after the age of 3;5, the most prominent error patterns were found to be assimilation and phoneme substitution (Mahura, 2014), whereas in Xhosa the most prominent were sound preference substitution, vowel substitution and the insertion of consonants and vowels (Maphalala et al., 2014). The most common phonological processes noted in Swahili were lateralization, weak syllable deletion and cluster reduction (Gangji et al., 2014). Further research is required to look at the presence of phonological processes in Sotho, however it has been noted that processes are still present at the age of 3;0 (Demuth, 2007).

Mowrer and Burger (1991) compared English and Xhosa language development, by comparing the data collected for each language. Participants included 70 monolingual Xhosa-speaking children and 70 monolingual English-speaking children. It was found that most phonemes are mastered in Xhosa earlier than in English, with 80% of Xhosa phonemes acquired by the age of 3;0 compared to 48% of English phonemes mastered at the same age. Similar substitutions were noted in English and Xhosa when analysing phonological processes within the languages. No significant difference was noted between genders in the acquisition of phonology. The significant differences noted between the acquisition of

these languages highlights the importance of using language specific information when assessing children of various languages (Gangji et al., 2014).

## 2.4 Zulu Phonology

Zulu is made up of 59 consonants (including clicks), and five vowel sounds, with two variants (Naidoo et al., 2005; van der Merwe & Le Roux, 2014). Consonant clusters are not a feature of Zulu. The placement for production of the vowels are shown in Figure 3. There are no diphthongs used in Zulu (Cope, 1983; van der Merwe & Le Roux, 2014). The clicks, which are a characteristic feature of Nguni languages, are produced using three positions (Naidoo et al., 2005), which are thought to have been borrowed from Khoisan languages (Accredited language services, 2015). These positions include alveo-lateral, palatal and dental. The lingual position is the same for both the dental and lateral clicks, however the dental click is produced frontally and the alveo-lateral, laterally (Cope, 1983). There is still some discrepancy in the International Phonetic Alphabet (IPA) transcription of the click sounds, the place of articulation of clicks and the make-up of affricated clicks (Roux, 2007). For the purpose of this study, the transcriptions used will include alveo-lateral (x) /x/, dental (c) /c/ and palatal (q) /q/ with the aspirated versions depicted as /x<sup>h</sup>/, /c<sup>h</sup>/ and /q<sup>h</sup>/ respectively (Roux, 2007).

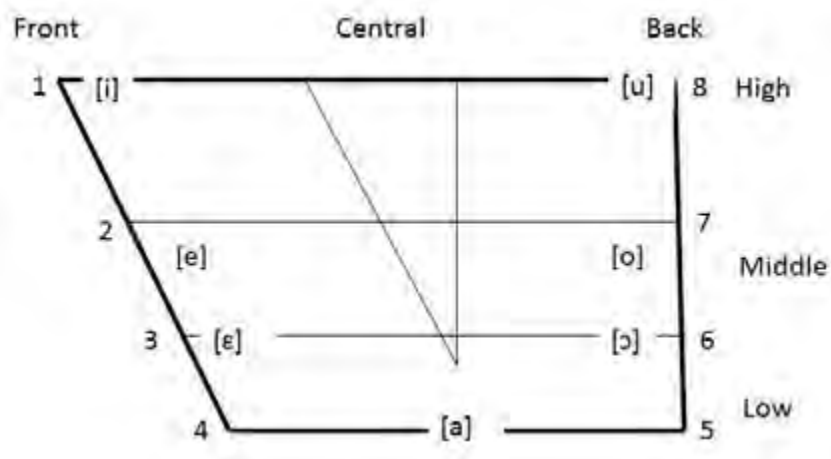


Figure 3. Zulu vowel chart (adapted from Poulos & Bosch, 1997).

In Bantu languages words typically follow a CVCV pattern (Mosaka, 2000). This open-ended syllable structure means that all words end in vowel sounds, making the language structure different to that of other languages, such as English. The syllable structures present in Zulu include V, C and CV (van der Merwe & Le Roux, 2014). Zulu has a conjunctive orthography which implies that prefixes and suffixes are added onto a root word in order to create meaning, resulting in every syllable adding importance to the

meaning of the utterance (Cope, 1983; van der Merwe & Le Roux, 2014). Mosaka (2000) suggests that in Bantu languages, emphasis is normally placed on the second last syllable of a word, thus using a system of penultimate syllable lengthening.

In Zulu, as well as other Bantu languages, tone is used to alter the meaning of words. These differences are not conveyed in written language and can occur in the following patterns, with H depicting high tone and L depicting low tone: HH, LL, HL and LH (van der Merwe & Le Roux, 2014). In English, a pulmonic airstream is utilized to produce all words, however in Zulu, a combination of airstreams are employed in order to correctly produce the various sounds, e.g., pulmonic, glottalic ingressive, glottalic egressive and velaric airstreams (van der Merwe & Le Roux, 2014). Another feature in Zulu which can alter the meaning of a word is the difference between an aspirated and unaspirated phoneme. This is normally indicated orthographically by the use of an 'h'. An example in Zulu is the difference between '*ibele*' (breast) [unaspirated] and '*ibhele*' (bear) [aspirated] (van der Merwe & Le Roux, 2014).

## 2.5 Phoneme acquisition in Zulu

Speech development in Zulu-speaking children has not been well researched. The studies discussed in this section include Demuth and Suzman's (1997) study which analysed language impairment in a Zulu-speaking child; van der Spuy (2014a) who focused exclusively on bilabial palatalisation in Zulu, and Naidoo et al. (2005), who analysed phoneme acquisition, syllable structure and phonological processes in young children acquiring the language.

Demuth and Suzman (1997) analysed the speech of one 2;7 year old child with a language impairment in order to understand difficulties in his language. The sample was compared to a 2;0 year old child with typically developing speech. It was concluded that the participant's speech appeared to be globally delayed when considering phonological, morphological and syntactic systems, compared to the typically developing child. No norms could be gathered from this study as only one child was assessed. However, the study was pioneering in documenting the nature of speech and language difficulties in Zulu.

Phonologically and morphologically based error patterns may occur in Zulu. The difference between these types of errors is the surrounding environment in which they occur, with phonological errors relating to occurrence within an identified phonological environment and morphological difficulties linked to certain morphological characteristics being met (van der Spuy, 2014a). Zulu consists of a simple vowel structure which does not include diphthongs. Van der Spuy (2014) discussed the morphology underlying a potential

VV syllable changing in order to enforce the VV avoidance rule. This article further discusses the process of bilabial palatalisation occurring as a result of morphological rules.

The study by Naidoo et al. (2005), is the only published study to date which has investigated the development of phonemes and syllables in Zulu. It is therefore discussed in more detail as it pertains specifically to the current study. The study aimed to detail the inventory of phonemes present in first language Zulu-speaking children's speech between the ages of 3;0 and 6;2; how frequently these phonemes occurred; the length of words produced by children; and the frequency of use of different word shapes. This study differed in design compared to the group of studies previously mentioned (i.e. Bantu language studies by Gangji et al. (2014), Mahura (2014) and Maphalala et al. (2014)), in that it used a smaller sample size of only 18 participants and a 100 word spontaneous speech sample as opposed to a single-word picture naming assessment. Furthermore, children were grouped into age categories of 12 months, viz. 3;0–4;0, 4;1–5;1 and 5;2–6;2, as opposed to the six month age categories that were used in the other three studies.

Naidoo et al. (2005) suggested that vowels develop before the age of 3;0 in Zulu, similar to other Bantu languages (Gangji et al., 2015; Mahura, 2014; Maphalala et al., 2014). Children between the ages of 3;0–4;0 had complete sound inventories of nasals, plosives and approximants. During the study two affricates were acquired by the participants, but no other phoneme groups were complete by the age of 6;2. Children between 3;0–4;0 produced 54% of the sound inventory of Zulu, with children aged 4;1–5;1 and 5;2–6;2 producing 47% and 52% respectively. Clicks and prenasalized consonants were produced the least by the participants, a finding attributed to the complexity of these sounds (Naidoo et al., 2005). When considering syllable length it was found that children between 3;0–4;0 could produce words consisting of up to five syllables, and children between 5;2–6;2 could produce up to six-syllable words correctly (Naidoo et al., 2005). This is in contrast with the syllable structure noted in Xhosa where children up to the age of 6;0 omit syllables in words longer than five syllables (Maphalala et al., 2014).

Naidoo et al. (2005) completed a small study making it difficult to generalize findings to a larger population. As the findings depict that much phoneme acquisition occurs before the age of 3;0 and after the age of 6;2, increasing the age categories included in the study could provide more detailed findings. Naidoo et al. (2005) reported that a larger speech sample could allow for more phonemes to be produced, as this study had relied on the guidelines for English of using a 100 word speech sample. The authors acknowledged that their findings be interpreted with caution as the use of spontaneous samples meant that it could not be known whether the participants had an opportunity to

produce all of the speech sounds or were avoiding some which were challenging for them. For this reason a more structured assessment tool may have been beneficial, as used in other studies of phoneme acquisition (Gangji et al., 2014; Hua & Dodd, 2000; Mahura, 2014; Maphalala et al., 2014). The study was an important step towards the development of norms for Zulu, and directed attention towards the need for further research into Zulu with a focus on obtaining norms for speech development (Naidoo et al., 2005).

## **2.6 Summary**

This chapter has described research focusing on speech sound acquisition across a range of languages. There is a fairly large amount of literature describing speech sound development in English, and some other languages such as Putonghua, Cantonese and French. Where standardised assessment tools have been developed, researchers typically use large samples of children to build on what has already been documented. Research into speech sound development in the Bantu languages is in its infancy, although there are studies that have been published for Xhosa, Swahili, Tswana, Sotho and Zulu. Many similarities and differences were noted between the development of phonemes, syllable structures and error patterns in these languages, highlighting the importance of studying each language individually in order to develop clinically useful norms. The structure of Zulu was discussed in more detail, as well as the findings and shortfalls of Naidoo et al.'s (2005) study, which is the only published study to discuss phoneme acquisition in Zulu.

## Chapter Three – Methods

This chapter describes the methods used in this study and provides rationales for the choices made. The aims, objectives and research design are presented, together with information relating to the participant selection, materials and procedures used in collecting and analysing data. Finally the validity, reliability and ethical considerations pertaining to the study are discussed.

### 3.1 Aims

This study aimed to detail the phonological development of typically developing first language Zulu-speaking children between the ages of 2;6 and 6;5 years.

### 3.2 Objectives

In order to achieve the aim, the study followed three objectives with regard to Zulu speech acquisition in typically developing children between the ages of 2;6 and 6;5.

These were to describe:

1. The order and age of acquisition of vowels and consonants.
2. The development of word shapes / number of syllables.
3. The presence and elimination of phonological processes.

### 3.3 Research design

The study followed a descriptive, cross-sectional design. As discussed by Creswell (2009) and Kothari (2006), descriptive research provides data that can be analysed in a measurable way. It does not give information as to why these results may occur. For descriptive research, the researcher has no control over the data but rather reports what is seen at a certain point in time. In cross-sectional studies data is collected at a single point in time across various age groups, as opposed to analysing a single participant's development over time (Creswell, 2009; Kothari, 2006). In order to accurately document the order and age of acquisition, it was important to assess more than one child across various age groups in order to build a profile of phonological development. The research design is based on the similar designs used in studies by Maphalala et al. (2014), Gangji et al. (2014) and Mahura (2014).

### 3.4 Participants

#### 3.4.1. Selection criteria.

The study included Zulu-speaking children between the ages of 2;6 and 6;5. In the only published study of Zulu speech acquisition, Naidoo et al. (2005), focused on children between 3;0 and 6;2 years, but concluded that a broader age range should be studied. The literature suggests that children acquiring the related language of Xhosa acquire many

phonemes relatively early. Children described by Maphalala et al. (2014) had already acquired much of their inventory by the age of 3;0. The inclusion of younger children was an attempt to obtain insights into early development but needed to be balanced with the challenges of presenting such young children with a formal picture naming assessment.

As most children living in Manguzi are exposed to more than one language and the language of teaching changes to English in Grade Four at schools in the area, children chosen for the study spoke Zulu at home, but may have had exposure to other languages from bi-/multilingual parents and teachers. Participants included 32 first language Zulu-speaking children, who have been regarded as typically developing by both their parents/legal guardians and teachers. All participants attended the school/crèches identified and are taught in Zulu at school. Participants with hearing or visual impairments which could affect the assessment, children who had previously or were currently attending speech therapy, as well as those who had been identified as having a developmental delay were excluded from the study. The inclusion and exclusion criteria are summarized in Table 4.

Table 4

*Inclusion and exclusion criteria for the study participants*

<b>Inclusion Criteria</b>	<b>Exclusion criteria</b>
Between the ages of 2;6 and 6;5	Visual impairment (affecting assessment) (as reported by caregiver/class teacher)
Typically developing (as judged by class teacher and developmental screener completed by caregiver)	Hearing impairment (affecting assessment) (as reported by caregiver/class teacher)
First language Zulu-speaking (as judged by class teacher)	Currently attending speech therapy (as reported by caregiver when contacted)
Taught in Zulu at school/crèche	Previously attended speech therapy (as reported by caregiver when contacted)

### **3.4.2 Methods of identification.**

Participants were identified from one school and two crèches in Manguzi, KZN (SA), where Zulu is the language of education. A letter explaining the nature and requirements of the study was sent to the KZN Department of Education (*Appendix A*) and approval for the study was received in February 2015. A letter was hand delivered to the principal of one school, and three crèches (*Appendix B*). The study was also verbally discussed during the delivery. The schools/crèches were chosen due to their location for ease of accessibility for the assessments. Approval was received from one school and two crèches, with one crèche choosing not to take part in the study. The study was explained to the teachers, who

distributed consent forms to children falling within the correct age categories. These were sent home for the parents/legal guardians to sign (*Appendix C*). The consent form was distributed in Zulu. It was translated using back translation by a first language Zulu-speaking research assistant. The first consent forms received per age bracket formed the participants of the study. Due to Manguzi having a high illiteracy rate, the parents/legal guardians of each participant were contacted telephonically before the assessment took place to answer any questions and to ensure that the purpose of the study was understood. Verbal assent was obtained from each participant before the assessment took place.

### **3.4.3 Sampling.**

Non-probability convenience sampling was used as participants were identified on a first-come, first-served basis as consent was received from parents/legal guardians. For the purpose of data collection and analysis the participants were separated into the following eight six month age groups:

- Group 1: 2;6 – 2;11
- Group 2: 3;0 – 3;5
- Group 3: 3;6 – 3;11
- Group 4: 4;0 – 4;5
- Group 5: 4;6 – 4;11
- Group 6: 5;0 – 5;5
- Group 7: 5;6 – 5;11
- Group 8: 6;0 – 6; 5

Following the sampling method used in Maphalala et al.'s (2014) study, four participants were allocated to each category on a first-come, first-served basis, after which the category was closed. Although the sample was small, it was manageable in terms of the time frame and budget. The number of participants per category was also similar to other studies looking at language acquisition (e.g., Gxilishe, 2004; Maphalala et al., 2014). The sample used in Naidoo et al.'s. (2005) study included six participants per category; however the categories were in one year intervals. Thus the sample size used in the current study is larger, as it includes eight children per one year interval.

Gender was not considered when allocating children per age group, as the aim of the current study was not to relate differences in findings to gender, but rather to describe acquisition inclusively. The impact of gender on phoneme acquisition differs between

studies, where some studies have found a significant difference in older age groups (Dodd et al., 2003; Mahura, 2014), whilst others found that phoneme acquisition is not gender specific (Mowrer & Burger, 1991). The mean age per group and stratification of participants can be found in Table 5.

Table 5

*Stratification of participants*

Group	Mean Age	Total girls	Total boys	Total
1 (2;6 – 2;11)	2;8	2	2	4
2 (3;0 – 3;5)	3;4	0	4	4
3 (3;6 – 3;11)	3;8	1	3	4
4 (4;0 – 4;5)	4;2	4	0	4
5 (4;6 – 4;11)	4;9	0	4	4
6 (5;0 – 5;5)	5;4	3	1	4
7 (5;6 – 5;11)	5;9	3	1	4
8 (6;0 – 6;5)	6;2	3	1	4
<b>Total</b>		16	16	32

### 3.5 Study personnel

Study personnel consisted of the main researcher, a qualified SLP, who is first language English-speaking and has been working in Manguzi for the past four years. Although the main researcher is not able to speak Zulu fluently, working within a first language Zulu-speaking community, she has had considerable exposure to the language and is used to working with first language Zulu-speaking children. The research assistant is first language Zulu-speaking, completed her matric and was previously volunteering at the Manguzi Hospital Therapy department.

### 3.6 Description of materials

An oral-peripheral examination (OPE) was conducted with each participant to ensure that there were no additional factors influencing their speech abilities. This was done before the assessment in order to rule out any structural difficulties which could affect speech production. The OPE screener can be found in *Appendix D*.

There are currently no published assessments to assess Zulu phonology. This may be the reason that Naidoo et al. (2005) used spontaneous speech samples. However, a short-coming of that study was that conclusions could not be drawn about the development of certain phonemes as these were not present within the sample that was analysed. This does not necessarily mean that the participant had not acquired the specific

phoneme (Naidoo et al., 2005). An important component of the current study was to develop a single-word phonology assessment which includes the various phonemes present in Zulu. These phonemes occur in various word positions, as appropriate within the structure of Zulu syllables. As nouns often have a vowel in word-initial and final position (e.g., *isicathulo* (shoe)), consonants are assessed in the penultimate syllable. As is discussed by Eisenberg and Hitchcock (2010), consonants produced within stressed syllables allow for more accurate assessment of production. In Zulu primary stress falls on the penultimate syllable, with secondary stress falling on alternate syllables (Clark, 1988), this is similar to the stress noted in Xhosa (Mowrer & Burger, 1991). The method used to develop this assessment follows the method employed by Maphalala et al. (2014) and Gangji et al. (2015) and is described in further detail below.

### **3.6.1 Developing and validating the assessment**

A word list was developed based on the 66 phonemes described in the Zulu phoneme list used in Naidoo et al.'s (2005) study. When creating this list of words, attention was paid to the cultural appropriacy of the words as well as the age of the participants. This word list was reviewed by a first language Zulu-speaking SLP with postgraduate qualifications and a first language Zulu-speaking linguist with a PhD before sending it to the expert panel. No suitable words could be found for the targeted phonemes /ts/ and /<sup>h</sup>dz/. These phonemes were included in the original word list to obtain suggestions from the expert panel, but no suggestions were made. The list of words that was developed was given to a panel of 'experts' which comprised seven first language Zulu-speaking professionals (SLPs, audiologists and assistants). Following this review the following twelve targeted phonemes were discussed and substituted as depicted in Table 6. A breakdown of the panel's responses to each item can be found in *Appendix E*. The main reason for target words being altered or omitted from the list was due to them being culturally inappropriate or not appropriate for the age group targeted. An example of this was the word '*ibhubesi*' (lion), which was reported to be age inappropriate by three members of the panel and culturally inappropriate by one member due to the lack of exposure to lions in this area. For targeted phonemes where no suitable word could be found, the phoneme was omitted from the word list. These are highlighted in the tables that follow.

Table 6

*Words adapted after expert panel review*

Targeted phoneme	Word	Reason for elimination	Alternative
ɓ	<i>ibhubesi</i> (lion)	Age and culturally inappropriate	<i>ubisi</i> (milk)
ts	Unable to find suitable word		No suitable word
ʰdʒ	Unable to find suitable word		No suitable word
k	<i>umabonakude</i> (television)	Age and culturally inappropriate	<i>ukudla</i> (food)
kɬ	<i>iklasi</i> (class)	Age and culturally inappropriate	No alternative
!ʰ	<i>iqhwa</i> (ice)	Age and culturally inappropriate	<i>iqhude</i> (male chicken)
lg	<i>igcembe lembali</i> (petal)	Age and culturally inappropriate	<i>igceke</i> (yard)
ŋlg	<i>ingcebo</i> (wealth)	Age and culturally inappropriate	No alternative
ʰ	<i>ixhumela</i> (high heel)	Age and culturally inappropriate	No alternative
g	<i>igxolo lomuthi</i> (bark)	Age and culturally inappropriate	<i>gxuma</i> (jump)
ŋ	<i>inxuluma</i> (large kraal)	Age and culturally inappropriate	<i>inxeba</i> (wound)
ŋ  g	<i>ingxibongo</i> (chicken pox)	Age and culturally inappropriate	<i>ingxabano</i> (quarrel)

*Note.* Phonemes highlighted were omitted from the assessment

The adapted word list was illustrated by the researcher using coloured pencils on A5 pages (see *Appendix F* for an example). These were then mounted onto coloured cardboard with the target word, and where necessary a descriptive phrase, added to the back of each card, which were then laminated. Although time consuming to draw these by hand, the researcher undertook this task because of previous experience illustrating therapy and educational materials, and because of cost-effectiveness and the degree of control it gave her. In the study by Maphalala et al. (2014) illustrations were professionally designed but it was found that many of these were inappropriate and needed modification (e.g., porridge not being sufficiently white and thick in texture; a doctor looking too much like a father). During illustration, difficulties were noted in illustrating the words targeting the phonemes /ŋ!/ 'inqulu' (hip) and /ŋ||g/ 'ingxabano' (quarrel). As no age appropriate alternatives for these words could be found, they were omitted from the word list. Table 7 includes the phonemes omitted from the word list during the pilot study. To accompany the

picture cards, a recording sheet was developed. This sheet included the phoneme targeted, the target word in both Zulu and English, IPA transcription of target word, number of syllables, a column in which the participant's response was transcribed using the IPA, a column to indicate whether the word was modelled and a column to identify if the word was produced differently from the target. The final recording sheet can be found in *Appendix G*. The assessment used during the pilot study consisted of 54 A5 picture cards targeting 59 phonemes.

Table 7

*Phonemes omitted from the pilot study word list*

Targeted sound	Word	Reason	Alternative
ts	Unable to find suitable word		No suitable word
<sup>h</sup> dz	Unable to find a suitable word		No suitable word
kɬ	<i>iklasi</i> (class)	Age and culturally inappropriate	No alternative
ŋ g	<i>ingcebo</i> (wealth)	Age and culturally inappropriate	No alternative
<sup>h</sup>	<i>ixhumela</i> (high heel)	Age and culturally inappropriate	No alternative
ŋ!	<i>inqulu</i> (hip)	Unable to illustrate	No alternative
ŋ  g	<i>ingxabano</i> (quarrel)	Unable to illustrate	No alternative

During the pilot study, multiple challenges were encountered. Many of the participants could not identify the pictures correctly due to the illustrations and limited vocabulary. Some of the words were not named as expected due to a colloquial version of the language being used and influenced by English even though the participants were first language Zulu-speaking (e.g., '*inhlanzi*' (fish) /i<sup>h</sup>ɬlanzi/ is called '*ufishi*' /ufiji/. Multiple Zulu words can also be used to describe the same item (e.g., '*iyembe*', '*iskepe*' (shirt)). Table 8 contains the words which were altered for the final word list to be used during the assessment. The final word list can be found in *Appendix G*. The phonemes omitted from the word list are listed at the bottom of the recording sheet, in total there were 10 phonemes omitted from the assessment. The final assessment consisted of 51 A5 pictures, targeting a total of 56 phonemes.

Table 8

*Changes made to word list after pilot study*

Targeted sound	Word	Reason	Alternative
p <sup>h</sup>	<i>iphepha</i> (paper)	Illustration	New drawing
ɓ	<i>ubisi</i> (milk)	Illustration	<i>ubaba</i> (father)
v	<i>vula</i> (open)	Illustration	New drawing
<sup>m</sup> ɓv	<i>imvubu</i> (hippopotamus)	culturally inappropriate	<i>imvula</i> (rain)
t <sup>h</sup>	<i>isithuthuthu</i> (motorbike)	culturally inappropriate	<i>isicathulo</i> (shoe)
t'	<i>ubhatata</i> (sweet potato)	age inappropriate	<i>isitulo</i> (chair)
nt	<i>intamo</i> (neck)	culturally inappropriate	<i>intambo</i> (rope)
<sup>n</sup> ts	<i>insipho</i> (soap)	Illustration	New drawing
<sup>n</sup> tɬ	<i>inhlanzi</i> (fish)	culturally inappropriate	New drawing
n	<i>uphayinaphu</i> (pineapple)	culturally inappropriate	<i>inesi</i> (nurse)
ʃ	<i>ishumi</i> (ten)	age inappropriate	<i>isheti</i> (shirt)
ɔ	<i>ukudla</i> (food)	Illustration	New drawing
g	<i>ugogo</i> (grandmother)	Illustration	New drawing
h	<i>ihhashi</i> (horse)	culturally inappropriate	<i>ihhala</i> (rake)
h	<i>hamba</i> (go/walk)	Illustration	New drawing
ŋ	<i>ingalo</i> (arm)	culturally inappropriate	<i>ingane</i> (child)
ε	<i>ebusuku</i> (in the evening)	Illustration	<i>elikhulu</i> (big)
ɔ	<i>iloli</i> (lorry)	culturally inappropriate	<i>ugogo</i> (grandmother)
u	<i>ufudu</i> (tortoise)	culturally inappropriate	<i>umuntu</i> (person)
j	<i>iyembe</i> (shirt)	culturally inappropriate	No alternative
ŋ!g	<i>ingqathu</i> (skipping)	culturally and age inappropriate	No alternative
l <sup>h</sup>	<i>ichibi</i> (lake)	culturally inappropriate	No alternative
l̥g	<i>igceke</i> (yard)	Illustration	New drawing
ll̥g	<i>gxuma</i> (jump)	Illustration	New drawing

Note. Phonemes highlighted were omitted from the assessment

### 3.7 Procedure and Data Collection

#### 3.7.1 Pilot study.

The pilot study included six participants between the ages of 2;6 and 6;5. It was conducted before the main study and was used to identify difficulties with the assessment tool (as discussed above). Changes to the assessment were made accordingly after the pilot. During the pilot study age appropriate cues for target words were developed to assist

the participants with the correct naming of the stimuli (e.g., for *'iqanda'* (egg) *'Yini oyidlayo ekuseni nesinkwa?'* (What do you eat in the morning with bread?); for *'igceke'* (yard) *'Uhhala kuphi?'* (Where do you rake?). The pilot study followed the same procedure as the main study, with the research assistant being present to carry out the assessment whilst the researcher audio recorded and transcribed the responses using the IPA.

### **3.7.2 Data collection.**

Once permission had been granted by the UCT Faculty of Health Sciences Human Research Ethics Committee (*Appendix H*), the KZN Department of Education (*Appendix I*), and the identified school and crèches, Zulu consent forms and developmental screeners were distributed to parents/legal guardians of pupils who fell within the identified age brackets. Parents/legal guardians and participants were informed that consent was voluntary and they could withdraw from the study at any time. The research assistant contacted each parent/legal guardian telephonically before the assessment took place and verbally explained the nature of the study in order to obtain verbal consent. No pressure was placed on the parents/legal guardians by the research assistant. Before data collection started, the assessment was explained to the participants in Zulu, by the research assistant, and verbal assent was obtained. It was explained to the participants that they could choose to withdraw from the study with no negative repercussions.

Participants were assessed at their schools/crèches, at a time that was arranged between the class teacher and the researcher. Data collection occurred over seven days and assessments lasted between 20 and 45 minutes. Each participant was taken out of class and assessed in a room with only the researcher and research assistant present. Due to the nature of the school environment and the infrastructure available at the crèches, the available room was not always quiet, making recordings of the assessments difficult to review, so field transcriptions were very important. An OPE was conducted and details recorded on the OPE screener before conducting the single-word Zulu phonology assessment. It was explained to participants in Zulu that they needed to try and name the pictures as accurately as possible. They were encouraged to take their time and a cue was provided if they could not identify the picture. When a participant was unable to name an item after receiving the cue, the word was modelled for them once and they were asked to repeat it. This imitation was then documented on the recording form. Transcriptions for each participant were recorded using the IPA. Audio recordings of each assessment were made, using a voice recorder (Samsung S6), to allow for a review of the transcriptions. The titles of the recordings were coded according to the allocated number per age group to

ensure that information remained confidential. Participants were given positive reinforcement and encouragement throughout the assessments.

### **3.8 Data analysis**

Once field transcriptions had been reviewed alongside the audio recordings, transcriptions were entered into a table electronically, per age group, to allow for ease of interpretation. The data was analysed descriptively in line with the analysis used in Maphalala et al's. (2014) study. According to Baker (2004), when assessing for SSDs in children, analysis needs to occur at both an independent and relational level. Data was also analysed both within and across the various age brackets. Independent analysis includes documenting what a participant can do, what they can almost do and what they are unable to do (Baker, 2004). Through analysing the transcriptions descriptively, an inventory of the phonemes present in each participant's speech was developed. Due to the structure of Zulu, consonants were analysed in the penultimate syllable.

The various word shapes produced correctly were also documented. This inventory was developed based both on the words that were produced spontaneously and those that were modelled during the assessment. These speech sound inventories and word shapes were analysed within each age group.

As an independent analysis does not consider the accuracy of speech production, a relational analysis is important to compare one's production to that of an adult target (Baker, 2004). Due to dialectal changes within Zulu, it was important to consider adult targets within this population, as the production of a target word may vary from another dialect; this was considered with regards to some of the error processes documented in the data analysis. The relational analysis involved calculating the percentage of consonants produced correctly (PCC) and the percentage of vowels produced correctly (PVC). These were calculated by getting a percentage of the consonants/vowels produced correctly, with reference to the total consonants/vowels targeted, based on the method used by Shriberg, Austin, Lewis, McSweeny and Wilson (1997). PCC and PVC were analysed within each group, and then compared across the various age groups in order for a developmental profile of PCC and PVC to be realized. Following this, phonological processes used within each age group were discussed.

#### **3.8.1 Phoneme acquisition.**

In order for phoneme acquisition to be mapped accurately, it should be described both at an individual level and within a group. The criteria for phoneme acquisition within the current study were described as follows. Words were analysed, whether produced

spontaneously or modelled, in order to allow for all of the phonemes to be covered within each assessment, spontaneously produced and modelled targets were not differentiated between during data analysis as many of the younger participants required prompting to name the target words.

#### ***3.8.1.1 Individual phoneme acquisition.***

Each target phoneme appeared once within the assessment, although participants who were unable to produce a word correctly were often given a second opportunity to repeat the word. For the purpose of this study a child was considered to have acquired a phoneme provided they could correctly produce it once within the assessment, within the targeted word.

#### ***3.8.1.2 Phoneme acquisition within a group.***

Studies have used different criteria for phoneme acquisition. Differing percentages for phoneme acquisition and mastery makes studies difficult to compare (Dodd et al., 2003). Many studies (e.g., Dodd et al., 2003; Gildersleeve-Neumann et al., 2008; Gildersleeve-Neumann & Wright, 2010) analyze phoneme acquisition across multiple word positions, influencing the analysis of acquisition. However, it is important to adapt analysis based on the language structure. Adaptations of assessment can be seen in the studies looking at the acquisition of Modern Standard Chinese and Xhosa (Hua & Dodd, 2000; Maphalala et al., 2014) due to the structure of these languages. For the current study, it was important to alter acquisition criteria as consonants were only analysed in the penultimate syllable. For this reason criteria of acquisition were based on the criteria used in the study by Maphalala et al. (2014) as the structure of Zulu is similar to that of Xhosa. A phoneme was included within the inventory of an age group if produced correctly by 75% of participants (three out of four participants).

Three levels of acquisition were used as follows:

1. Developing – correct production of the phoneme in the penultimate syllable by 50% or fewer participants within the group
2. Age of acquisition – correct production of the phoneme in the penultimate word position by 75% of the group (three out of four participants within the group must produce the phoneme correctly).
3. Phoneme mastery – correct production of the phoneme in the penultimate word position by 100% of the group (all of the participants within the group must produce the phoneme correctly).

After analysis of each assessment was complete, reports were sent to each parent/legal guardian describing the participant's assessment results.

### **3.8.2 Word shape development.**

Throughout the assessment, many opportunities were provided to produce each word shape. For this reason the criteria for word shape development was compared to phoneme acquisition. A word shape was considered to be acquired by a participant if produced correctly for half of the opportunities provided. This is similar to the criteria used by Maphalala et al. (2014). A syllable structure was acquired if produced correctly once during the assessment, in line with the analysis of phoneme acquisition.

The criteria used for analysis of word shape and syllable structure across the age groups were in line with the the criteria for phoneme acquisition:

1. Developing – 50% or fewer (two or fewer) participants produced the word shape/syllable structure correctly;
2. Acquired – 75% (three out of of four) participants produced the word shape/syllable structure correctly;
3. Mastered – 100% (four out of four) participants produced the word shape/syllable structure correctly.

### **3.8.3 Relational analysis.**

PCC and PVC scores were calculated for each individual using the formula discussed by Shriberg et al. (1997) and used in the studies by Hua and Dodd (2000) and Mahura (2014). This was calculated by dividing the number of times a phoneme was produced correctly by the number of times a phoneme could have been produced. Within the study, there were 166 opportunities to produce vowels and 124 to produce consonants. After each individual score was calculated, the mean and standard deviation were worked out for each age group.

Phonological processes were considered to be present within an age group if used by one participant within the age group. The percentage of participants using each process were calculated to determine the prevalence of each process and to establish individual differences.

## **3.9 Validity and reliability**

When considering the validity of a study, one needs to look at the internal, external and measurement validity. Internal validity refers to the ability to draw conclusions from a study based on the data that it gathered (van der Riet & Durrheim, 2007). In Naidoo et al.'s

(2005) study, data was collected from a speech sample, rather than a single-word assessment, resulting in some of the phonemes not being elicited. Using a single-word assessment increased the internal validity of the study as the participant was given the opportunity to elicit every phoneme which was included in the study; conclusions drawn from the data are therefore more reliable.

External validity refers to whether the study can be generalized to the larger community (van der Riet & Durrheim, 2007). Participants were selected using non-probability convenience sampling and attended school/crèche within the Manguzi area. Four participants were selected within each category. As all the participants are from the same rural community, the results may not describe the language acquisition in more affluent areas. However, the language development is likely to be similar in similar rural areas and can therefore be generalized with caution to those populations.

Measurement validity refers to whether a study collects data that is correlated to the aims and objectives of the study (van der Riet & Durrheim, 2007). The single-word assessment that was developed for this study was tailored to collect the data necessary to fulfill the identified objectives; it was based on similar assessments in other languages (e.g., Mahura, 2014; Maphalala et al., 2014), and underwent expert panel reviews and adaptations after the pilot study to ensure that it was culturally and age appropriate for the population. Unfortunately, through this process ten phonemes had to be omitted from the assessment.

Reliability refers to whether the same results would be obtained if the study were to be repeated (Golafshani, 2003). Using a single-word assessment increases the reliability of the study as, if repeated, the same data would be elicited. Furthermore, each assessment was audio recorded and reviewed by the researcher to assess for uniformity across transcriptions. Over 10% of the transcriptions were transcribed by another SLP, more experienced in using the IPA. Discrepancies in transcriptions were discussed and altered accordingly across all of the transcriptions. This assisted in increasing reliability as Zulu is not the first language of the researcher and the IPA has not been used by the researcher to analyse Zulu words before. Intra-rater reliability was monitored by transcribing 20% of the data twice and checking for discrepancies. Inter-rater reliability was established by having an experienced SLP transcribe 10% of the data, compare the transcriptions and discuss the differences to resolve any discrepancies.

### **3.10 Ethical considerations**

#### **3.10.1 Autonomy.**

Autonomy refers to the participants' rights to confidentiality and consent to a study (Wassenaar, 2007). Children's details remained confidential throughout the study as the information was coded per age group; the only element linking a participant to a particular group was their age. Before the study began the participant and their parent/legal guardian were informed, in their home language, Zulu, that they could choose not to participate in the study and had the right to withdraw from the study at any time with no negative repercussions.

#### **3.10.2 Non-maleficence.**

Non-maleficence refers to the participants' right not to undergo any harm during the study, including being led to believe something that is not true (Wassenaar, 2007). The researcher ensured no harm was experienced as data was collected using a single-word picture naming speech assessment and occurred at a time that was convenient within the school day. The participants' parents/legal guardians were informed of the purpose of the study before agreeing for them to participate and the participants gave verbal assent before the assessment started. After the assessment was completed, the parent/legal guardians received a report detailing the assessment of their child.

#### **3.10.3 Beneficence.**

Beneficence refers to the way in which an individual or community will benefit from taking part in a study (Wassenaar, 2007). As the participants were typically developing, it is unlikely that they will directly benefit from the assessment that was developed. However, as there is limited research in Zulu speech development, this study will benefit their community by adding to the development of an assessment tool that can be used to identify speech delays in first language Zulu-speaking children, as well as adding to the development of norms for phoneme acquisition in Zulu-speaking children. Furthermore, this study adds to the limited knowledge base of the Zulu language.

#### **3.10.4 Justice.**

Justice refers to the fair treatment of participants and the inclusion of these individuals in receiving the benefits of the study (Wassenaar, 2007). As discussed in relation to beneficence, although participants are unlikely to directly benefit from the study itself, they benefitted individually from having their speech development screened and were referred to relevant health professionals wherever necessary.

### **3.10.5 Risks and benefits.**

The current study posed no risks to participants. They were not paid and received no rewards for their involvement, apart from the 1:1 assessment and a summary report about their speech development. Taking part in the study allowed for information to be gathered on typical Zulu language development. As there are currently no norms for Zulu this could benefit other Zulu-speaking children in being assessed and managed more accurately. A Zulu phonology assessment was generated and made available to Manguzi Hospital Speech Therapy Department, which will allow for assessments with other children to be completed. Time spent out of the usual class routine was minimised and the researcher ensured that children did not miss out on special activities (e.g., outings, parties).

### **3.10.6 Referrals.**

In line with the ethical considerations considered, any participant, including those initially excluded from the study, who was found to have a speech delay or who would benefit from medical or rehabilitative intervention or screening was referred to the audiologist, the Ear-Nose-Throat Surgeon (ENT) or for SLP services as appropriate. This was discussed with their parent/legal guardian and the correct referral procedure was followed. Throughout the course of the study, two children were referred for SLP services.

## **3.11 Summary**

This chapter outlined the aims, objectives and research design used in the study. The study followed a descriptive, cross-sectional design, using non-probability sampling to select 32 first language Zulu-speaking children between the ages of 2;6–6;5. As there is no freely available or published Zulu speech assessment, an important component of the project was to develop a linguistically and culturally appropriate assessment tool. The method used to develop and pilot the assessment was discussed, as well as the challenges faced in this process. The assessment tool consisted of 51 hand-drawn pictures and was designed to sample 56 phonemes in the language. Procedures used in collecting and analysing the data were detailed. Finally, the validity, reliability and ethical considerations that pertained to the study were discussed.

## Chapter 4 – Results

This chapter presents the results of the data analyses. In keeping with the study objectives, results are separated into three sub-sections: phoneme acquisition, the development of word shapes and syllable structures and a relational analysis which includes phonological processes, PCC and PVC. Within each of these sub-sections results are presented for each age group, followed by analysis across all of the age groups in order for developmental patterns to be identified.

### 4.1 Phoneme acquisition

This section analyses the acquisition of consonants and vowels within each age group, starting from the youngest to the oldest age group. Following this the age groups are compared and developmental patterns are identified and presented. As previously discussed, the criteria for phoneme acquisition used within this study was based on the criteria used in the study by Maphalala et al. (2014)

#### 4.1.1. Individual phoneme acquisition.

##### 4.1.1.1 Group 1 (2;6 – 2;11).

Table 9 summarizes the phoneme acquisition of the four participants in Group 1.

Table 9

*Phoneme acquisition in Group 1 (2;6 – 2;11)*

Phonemes (manner)	Participant 1	Participant 2	Participant 3	Participant 4
Plosives				
Voiced	/b/ /d/ /k/ /g/	/b/ /d/ /k/ /g/	/b/ /d/ /k/ /g/	/b/ /d/ /k/ /g/
Ejected	/p' /t' /k' /	/p' /t' /k' /	/p' /t' /k' /	/p' /t' /k' /
Aspirated	/p <sup>h</sup> /t <sup>h</sup> /k <sup>h</sup> /	/p <sup>h</sup> /t <sup>h</sup> /k <sup>h</sup> /	/p <sup>h</sup> /t <sup>h</sup> /k <sup>h</sup> /	/p <sup>h</sup> /t <sup>h</sup> /k <sup>h</sup> /
Implosive	/ɓ/	/ɓ/	/ɓ/	/ɓ/
Fricatives	/f/ /v/ /s/ /z/ /t/ /ʃ/ /h/	/f/ /v/ /s/ /z/ /t/ /ʃ/ /h/	/f/ /v/ /s/ /z/ /t/ /ʃ/ /h/	/f/ /v/ /s/ /z/ /t/ /ʃ/ /h/
Affricates	/dʒ/ /tʃ/	/dʒ/ /tʃ/	/dʒ/ /tʃ/	/dʒ/ /tʃ/
Approximants	/w/	/l/ /w/	/w/	/l/ /w/
Nasals	/ŋ/ /m/ /n/ /ɲ/	/ŋ/ /m/ /n/ /ɲ/	/ŋ/ /m/ /n/ /ɲ/	/ŋ/ /m/ /n/ /ɲ/
Prenasalized consonants	/ <sup>m</sup> p/ / <sup>m</sup> b/ / <sup>nk</sup> / / <sup>n</sup> t/ / <sup>nd</sup> / / <sup>ndʒ</sup> / / <sup>m</sup> ɸf/ / <sup>m</sup> ɸv/ / <sup>nts</sup> / / <sup>ndʒ</sup> /	/ <sup>m</sup> p/ / <sup>m</sup> b/ / <sup>nk</sup> / / <sup>n</sup> t/ / <sup>nd</sup> / / <sup>ndʒ</sup> / / <sup>ntʃ</sup> / / <sup>m</sup> ɸv/ / <sup>nts</sup> / / <sup>ntʃ</sup> / / <sup>ndʒ</sup> /	/ <sup>m</sup> p/ / <sup>m</sup> b/ / <sup>nk</sup> / / <sup>n</sup> t/ / <sup>nd</sup> / / <sup>ndʒ</sup> / / <sup>ntʃ</sup> / / <sup>m</sup> ɸv/ / <sup>nts</sup> / / <sup>ntʃ</sup> / / <sup>ndʒ</sup> /	/ <sup>m</sup> p/ / <sup>m</sup> b/ / <sup>nd</sup> / / <sup>ndʒ</sup> / / <sup>m</sup> ɸv/ / <sup>nts</sup> / / <sup>ntʃ</sup> /
Clicks	/ŋ/ /l/ /!/ /! <sup>h</sup> / /!g/ /!g/ /ll/ /ŋll/	/ŋ/ /l/ /!g/ /ll/	/ŋ/ /l/ /!/ /! <sup>h</sup> / /!g/ /!g/ /ll/ /ŋll/	/ŋ/ /l/ /!/ /! <sup>h</sup> / /!g/ /!g/ /ll/ /ŋll/
Vowels	/a/ /e/ /ɔ/ /ɛ/ /i/ /u/	/a/ /e/ /ɔ/ /ɛ/ /i/ /u/	/a/ /e/ /ɔ/ /ɛ/ /i/ /u/	/a/ /e/ /ɔ/ /ɛ/ /i/ /u/

Note. Incomplete inventories are highlighted in the table above for ease of analysis.

Participants in Group 1 could produce all of the voiced, ejected and aspirated plosives, affricates, the implosive /ɓ/ and nasals correctly. Participant 1 was unable to produce two (/ɓ/ and /h/) of the nine fricatives correctly, producing them as /l/ and /h/ respectively. Prenasalized consonants were incomplete in the inventory of participants 1, 2 and 4. Participant 4 was unable to produce the prenasalized consonant /<sup>ɱ</sup>k/, producing it as the voiced plosive /k/ (e.g., *'inkukhu'* (chicken) /i<sup>ɱ</sup>kuk<sup>h</sup>u/ pronounced as *'kukhu'* /kuk<sup>h</sup>u/); /<sup>ɱ</sup>t/ was simplified to /t/ (e.g., *'intambo'* (rope) /i<sup>ɱ</sup>tam<sup>ɓ</sup>ɔ/ produced as *'tambo'* /tam<sup>ɓ</sup>ɔ/). /<sup>ɱ</sup>tʃ/ was denasalized and produced as /tʃ/ by two participants. /<sup>ɱ</sup>ɸf/ was produced correctly by two participants, and reduced by the remaining two participants to /f/ (e.g., *'umfana'* (boy) /u<sup>ɱ</sup>ɸfana/ produced as *'ufana'* /ufana/). /<sup>ɱ</sup>ts/ was produced as /d/ by participant 2, /<sup>ɱ</sup>t/ as /ɸ/ by participant 1 and /<sup>ɱ</sup>dɓ/ as /dɓ/ by participant 4 (e.g., *'insipho'* (soap) /i<sup>ɱ</sup>tsip<sup>h</sup>ɔ/ as *'idipho'* /idip<sup>h</sup>ɔ/; *'inhlanzi'* (fish) /i<sup>ɱ</sup>tlanzi/ as *'inhlan'* /i<sup>ɱ</sup>lan/; *'indlebe'* (ear) /i<sup>ɱ</sup>dɓɛɓɛ/ as *'dleba'* /dɓɛba/). Thus nasalization was still developing in Group 1.

The clicks were the only group of phonemes which were incomplete in the inventories of every participant within Group 1. Only four (/ŋ|/, /|/, /|g/, /||/) of the nine clicks were produced correctly by all four participants. /||g/ was not produced correctly by any of the participants. It was simplified to the lateral click /||/ by three of the participants, with one participant approximating the sound to /|g/ (e.g., *'gxuma'* (jump) /||guma/ was produced as *'xuma'* /||uma/ and *'gcuma'* /|guma/). The remainder of the clicks (/!/, /!<sup>h</sup>/, /|g/, /ŋ||/) were produced correctly by three participants. Participant 2 produced them as /|/, /!/, /!/ and /ŋ|/ respectively (e.g., *'iqanda'* (egg) /i!anda/ as *'canda'* /|anda/; *'iqhude'* (male chicken) /i!<sup>h</sup>ude/ as *'iqude'* /i!ude/; *'isigqoko'* (hat) /isi!gɔk<sup>ɔ</sup>/ as *'isqo'* /isiɔ/; *'inxeba'* (wound) /iŋ||eba/ as *'inceba'* /iŋ|eba/).

All participants correctly produced all six vowels during the assessment.

#### 4.1.1.2 Group 2 (3;0 – 3;5).

Table 10 summarizes the phoneme acquisition of the four participants in Group 2. Within Group 2, participants were able to produce the implosive /ɓ/, affricates, approximants and nasals correctly. The voiced plosive /k/ was omitted from participant 8's inventory (e.g., *'ukudla'* (food) /ukudla/ was produced as /udla/), whilst the ejective plosive /k'/ was produced as /j/ by participant 7 (e.g., *'amasokisi'* (socks) /amasɔk'isi/ produced as *'amatoyis'* /amatɔjis/). Two participants had an incomplete repertoire of fricatives, with participant 7 being unable to pronounce six of the nine fricatives correctly (i.e. /f/, /v/, /s/, /z/, /t/ and /ʃ/). Participant 5 produced all of the prenasalized consonants correctly; whilst

participant 6 simplified /<sup>o</sup>t/ to /<sup>o</sup>t/ (e.g., ‘*inhlanzi*’ (fish) /i<sup>o</sup>tlanzi/ produced as ‘*inhlanzi*’ /i<sup>o</sup>tlanzi/) and participant 8 replaced /<sup>o</sup>ts/ with /<sup>o</sup>/ (e.g., ‘*insipho*’ (soap) /i<sup>o</sup>tsiph<sup>o</sup>/ produced as ‘*incipo*’ /i<sup>o</sup>lip<sup>o</sup>/). Participant 7 was unable to produce five of the prenasalized consonants correctly, however all phonemes used were prenasalized (e.g., ‘*inhlanzi*’ (fish) /i<sup>o</sup>tlanzi/ produced as ‘*intanzi*’ /i<sup>o</sup>tanzi/; ‘*intsipho*’ (soap) /i<sup>o</sup>tsiph<sup>o</sup>/ produced as ‘*intipho*’ /i<sup>o</sup>tip<sup>o</sup>/).

Table 10

*Phoneme acquisition in Group 2 (3;0 – 3;5)*

Phonemes (manner)	Participant 5	Participant 6	Participant 7	Participant 8
Plosives				
Voiced	/b/ /d/ /k/ /g/	/b/ /d/ /k/ /g/	/b/ /d/ /k/ /g/	/b/ /d/ /g/
Ejected	/p’/ /t’/ /k’/	/p’/ /t’/ /k’/	/p’/ /t’/	/p’/ /t’/ /k’/
Aspirated	/p <sup>h</sup> / /t <sup>h</sup> / /k <sup>h</sup> /	/p <sup>h</sup> / /t <sup>h</sup> / /k <sup>h</sup> /	/p <sup>h</sup> / /t <sup>h</sup> / /k <sup>h</sup> /	/p <sup>h</sup> / /t <sup>h</sup> / /k <sup>h</sup> /
Implosive	/ɓ/	/ɓ/	/ɓ/	/ɓ/
Fricatives	/f/ /v/ /s/ /z/ /t/ /ʒ/ /ʃ/ /h/	/f/ /v/ /s/ /z/ /t/ /ʒ/ /ʃ/ /h/ /h/	/ʒ/ /h/ /h/	/f/ /v/ /s/ /z/ /t/ /ʒ/ /ʃ/ /h/ /h/
Affricates	/dʒ/ /tʃ/	/dʒ/ /tʃ/	/dʒ/ /tʃ/	/dʒ/ /tʃ/
Approximants	/l/ /w/	/l/ /w/	/l/ /w/	/l/ /w/
Nasals	/ŋ/ /m/ /n/ /ɲ/	/ŋ/ /m/ /n/ /ɲ/	/ŋ/ /m/ /n/ /ɲ/	/ŋ/ /m/ /n/ /ɲ/
Clicks	/ŋ/ /l/ /!/ /!g/	/ŋ/ /l/ /!/ /!h/ /!g/ /!g/ /!l/ /!g/ /!g/ /!l/	/ŋ/ /!/ /!h/ /!g/ /!l/ /!g/ /!g/ /!l/	/ŋ/ /l/ /!/ /!h/ /!g/ /!g/ /!l/
Prenasalized consonants	/ <sup>m</sup> p/ / <sup>m</sup> b/ / <sup>o</sup> k/ / <sup>n</sup> t/ / <sup>o</sup> d/ / <sup>o</sup> dʒ/ / <sup>o</sup> tʃ/ / <sup>m</sup> ɸf/ / <sup>m</sup> ɸv/ / <sup>n</sup> ts/ / <sup>o</sup> t/ / <sup>o</sup> dʒ/	/ <sup>m</sup> p/ / <sup>m</sup> b/ / <sup>o</sup> k/ / <sup>n</sup> t/ / <sup>o</sup> d/ / <sup>o</sup> dʒ/ / <sup>o</sup> tʃ/ / <sup>m</sup> ɸf/ / <sup>m</sup> ɸv/ / <sup>n</sup> ts/ / <sup>o</sup> dʒ/	/ <sup>m</sup> p/ / <sup>m</sup> b/ / <sup>o</sup> k/ / <sup>n</sup> t/ / <sup>o</sup> d/ / <sup>o</sup> dʒ/ / <sup>o</sup> tʃ/	/ <sup>m</sup> p/ / <sup>m</sup> b/ / <sup>o</sup> k/ / <sup>n</sup> t/ / <sup>o</sup> d/ / <sup>o</sup> dʒ/ / <sup>o</sup> tʃ/ / <sup>m</sup> ɸf/ / <sup>m</sup> ɸv/ / <sup>o</sup> t/ / <sup>o</sup> dʒ/
Vowels	/a/ /e/ /ɔ/ /ɛ/ /i/ /u/	/a/ /e/ /ɔ/ /ɛ/ /i/ /u/	/a/ /e/ /ɔ/ /ɛ/ /i/ /u/	/a/ /e/ /ɔ/ /ɛ/ /i/ /u/

Note. Incomplete inventories are highlighted in the table above for ease of analysis

Participant 6 was the only participant in Group 2 to have a complete inventory of clicks. Participant 5 produced /!<sup>h</sup>/ as /!<sup>h</sup>/ (e.g., ‘*iqhude*’ (fish) /i!<sup>h</sup>ude/ as ‘*ichude*’ /i!<sup>h</sup>ude/), /!g/ as /!/ (e.g., ‘*isigqoko*’ (hat) /isi!gɔk’ɔ/ as ‘*isqoko*’ /is!ɔk’ɔ/), the lateral click /!l/ as the dental click /!/ (e.g., ‘*isixubho*’ (toothbrush) /isi!lubo/ as ‘*iscubo*’ /is!lubo/) and both /!g/ and /!l/ as /!l/ (e.g., ‘*gxuma*’ (jump) /!l!guma/ as ‘*uyaxuma*’ /ujal!uma/; ‘*inxeba*’ (wound) /iŋ!l!eba/ as ‘*ixeba*’ /i!l!eba/). Participant 7 simplified the dental click /!/ to /k/ (e.g., ‘*icici*’ (earring) /i!i!i/ to ‘*ikici*’ /iki!i/) and /!g/ to the palatal click /!/ (e.g., ‘*isigqoko*’ (hat) /isi!gɔk’ɔ/ to ‘*iqoko*’ /i!ɔk’ɔ/); whilst participant 8 produced /!g/, /!l/ and /!l!g/ as /!/ (e.g., ‘*igceke*’ (yard) /i!geke/ as ‘*iceke*’ /i!eke/; ‘*isixubho*’ (toothbrush) /isi!lubo/ as ‘*cu*’ /!u/; ‘*gxuma*’ (jump) /!l!guma/ as ‘*cuma*’ /!uma/).

All participants in Group 2 produced all of the vowels correctly during the assessment.

#### 4.1.1.3 Group 3 (3;6 – 3;11).

Table 11 summarizes the phoneme acquisition of the four participants in Group 3.

Table 11

#### Phoneme acquisition in Group 3 (3;6 – 3;11)

Phonemes (manner)	Participant 9	Participant 10	Participant 11	Participant 12
Plosives				
Voiced	/b/ /d/ /k/ /g/	/b/ /d/ /k/ /g/	/b/ /d/ /k/ /g/	/b/ /d/ /k/ /g/
Ejected	/p' /t' /k' /	/p' /t' /k' /	/p' /t' /k' /	/p' /t' /k' /
Aspirated	/p <sup>h</sup> /t <sup>h</sup> /k <sup>h</sup> /	/p <sup>h</sup> /t <sup>h</sup> /k <sup>h</sup> /	/p <sup>h</sup> /t <sup>h</sup> /k <sup>h</sup> /	/p <sup>h</sup> /t <sup>h</sup> /k <sup>h</sup> /
Implosive	/ɓ/	/ɓ/	/ɓ/	/ɓ/
Fricatives				
	/f/ /v/ /s/ /z/ /t/ /ʃ/ /h/ /h/	/f/ /v/ /s/ /z/ /t/ /ʒ/ /ʃ/ /h/ /h/	/f/ /v/ /s/ /z/ /t/ /ʒ/ /ʃ/ /h/ /h/	/f/ /v/ /s/ /z/ /t/ /ʒ/ /ʃ/ /h/ /h/
Affricates				
	/dʒ/ /tʃ/	/dʒ/ /tʃ/	/dʒ/ /tʃ/	/dʒ/ /tʃ/
Approximants				
	/l/ /w/	/l/ /w/	/w/	/w/
Nasals				
	/ŋ/ /m/ /n/ /ɲ/	/ŋ/ /m/ /n/ /ɲ/	/ŋ/ /m/ /n/ /ɲ/	/ŋ/ /m/ /n/ /ɲ/
Prenasalized consonants				
	<sup>m</sup> p/ <sup>m</sup> b/ <sup>n</sup> t/ <sup>o</sup> d/ <sup>o</sup> dʒ/ <sup>o</sup> tʃ/ <sup>m</sup> ɸf/ <sup>m</sup> ɸv/ <sup>o</sup> ts/ <sup>o</sup> dʒ/	<sup>m</sup> p/ <sup>m</sup> b/ <sup>o</sup> k/ <sup>n</sup> t/ <sup>o</sup> d/ <sup>o</sup> dʒ/ <sup>o</sup> tʃ/ <sup>m</sup> ɸf/ <sup>m</sup> ɸv/ <sup>o</sup> ts/ <sup>o</sup> tʃ/ <sup>o</sup> dʒ/	<sup>m</sup> p/ <sup>m</sup> b/ <sup>o</sup> k/ <sup>n</sup> t/ <sup>o</sup> d/ <sup>o</sup> dʒ/ <sup>o</sup> tʃ/ <sup>m</sup> ɸf/ <sup>m</sup> ɸv/ <sup>o</sup> ts/ <sup>o</sup> tʃ/ <sup>o</sup> dʒ/	<sup>m</sup> p/ <sup>m</sup> b/ <sup>o</sup> k/ <sup>n</sup> t/ <sup>o</sup> d/ <sup>o</sup> dʒ/ <sup>o</sup> tʃ/ <sup>m</sup> ɸf/ <sup>m</sup> ɸv/ <sup>o</sup> ts/ <sup>o</sup> tʃ/ <sup>o</sup> dʒ/
Clicks				
	/ɽ/ /ɽ  /	/ɽ/ /l/ /!g/ /!g/ /  / /!g/ /!g/ /  /	/ɽ/ /l/ /!/ /ɽ  /	/ɽ/ /l/ /!/ /!h/ /!g/ /!g/ /  / /!g/ /!g/ /  /
Vowels				
	/a/ /e/ /ɔ/ /ε/ /i/ /u/	/a/ /e/ /ɔ/ /ε/ /i/ /u/	/a/ /e/ /ɔ/ /ε/ /i/ /u/	/a/ /e/ /ɔ/ /ε/ /i/ /u/

Note. Incomplete inventories are highlighted in the table above for ease of analysis

Participants in Group 3 had a full repertoire of plosives, the implosive, affricates and nasals. Participant 11 and 12 produced the approximant /l/ as /r/ (e.g., *'iphalishi'* (porridge) /ip<sup>h</sup>aliʃi/ produced as *'ipharishi'* /ip<sup>h</sup>ariʃi/). Participant 9 simplified the fricative /ʒ/ to /l/ (e.g., *'isibhedlela'* (hospital) /isibɛʒɛla/ produced as *'esbelela'* /esbelɛla/), the prenasalized consonant /<sup>o</sup>k/ to the voiced plosive /k/ (e.g., *'inkukhu'* (chicken) /i<sup>o</sup>kuk<sup>h</sup>u/ produced as *'ikukha'* /ikuk<sup>h</sup>a/) and the prenasalized consonant /<sup>o</sup>tʃ/ to /<sup>o</sup>tʃ/ (e.g., *'inhlanzi'* (fish) /i<sup>o</sup>tʃlanzi/ produced as *'inhlanzi'* /i<sup>o</sup>lanzi/).

Participant 12 was the only participant in Group 3 to produce all nine clicks correctly; whereas participant 9 only produced two clicks correctly. /!g/ and /||g/ were produced as /b/ and /dʒ/ respectively (e.g., *'isigqoko'* (hat) /isi!gɔk'ɔ/ produced as *'isiboko'* /isibɔk'ɔ/; *'gxuma'* (jump) /!lguma/ produced as *'uyajuma'* /ujadzuma/), whilst /!/ and /!h/

were both produced as /k<sup>h</sup>/ (e.g., ‘iqanda’ (egg) /i!anda/ as ‘ikhanda’ /ik<sup>h</sup>anda/; ‘iqhude’ (male chicken) /i!hude/ as ‘ikhude’ /ik<sup>h</sup>ude/). The clicks /!/, /!/, /!g/ were all produced as /t’/ (e.g., ‘icici’ (earring) /i|i|i/ as ‘itici’ /it’i|i/; ‘isixubho’ (toothbrush) /isi|lubɔ/ as ‘isitubo’ /isit’ubɔ/; ‘igceke’ (yard) /ilgeke/ as ‘iteke’ /it’eke/). Participant 10 produced /!/ and /!h/ as the dental click /!/ (e.g., ‘iqanda’ (egg) /i!anda/ as ‘icanda’ /i|anda/; ‘iqhude’ (male chicken) /i!hude/ as ‘icude’ /i|ude/). Whilst participant 11 produced /!h/ and /!g/ as the palatal click /!/ (e.g., ‘iqhude’ (male chicken) /i!hude/ as ‘nqudi’ /n!udi/; ‘isigqoko’ (hat) /isi!gɔk’ɔ/ as ‘isqoko’ /is!ɔk’ɔ/); /!g/ and /!/ as the dental click /!/ (e.g., ‘igceke’ (yard) /ilgeke/ as ‘iceke’ /i|eke/; ‘isixubho’ (toothbrush) /isi|lubɔ/ as ‘iscubo’ /is|ubɔ/) and /!g/ as /!/ (e.g., ‘gxuma’ (jump) /!guma/ as ‘xuma’ /!uma/). Thus /ŋ/ and /ŋ/ were the only clicks that all four participants had acquired.

All of the participants in Group 3 were able to produce all vowels correctly.

#### 4.1.1.4 Group 4 (4;0 – 4;5).

Table 12 summarizes the phoneme acquisition of the four participants in Group 4.

Table 12

#### Phoneme acquisition in Group 4 (4;0 – 4;5)

Phonemes (manner)	Participant 13	Participant 14	Participant 15	Participant 16
Plosives				
Voiced	/b/ /d/ /k/ /g/	/b/ /d/ /k/ /g/	/b/ /d/ /k/ /g/	/b/ /d/ /k/ /g/
Ejected	/p’/ /t’/ /k’/	/p’/ /t’/ /k’/	/p’/ /t’/ /k’/	/p’/ /t’/ /k’/
Aspirated	/p <sup>h</sup> / /t <sup>h</sup> / /k <sup>h</sup> /	/p <sup>h</sup> / /t <sup>h</sup> / /k <sup>h</sup> /	/p <sup>h</sup> / /t <sup>h</sup> / /k <sup>h</sup> /	/p <sup>h</sup> / /t <sup>h</sup> / /k <sup>h</sup> /
Implosive	/ɓ/	/ɓ/	/ɓ/	/ɓ/
Fricatives	/f/ /v/ /s/ /z/ /t/	/f/ /v/ /s/ /z/ /t/	/f/ /v/ /s/ /z/ /t/	/f/ /v/ /s/ /z/ /t/
	/ʒ/ /ʃ/ /h/ /h/	/ʒ/ /ʃ/ /h/ /h/	/ʒ/ /ʃ/ /h/ /h/	/ʒ/ /ʃ/ /h/ /h/
Affricates	/dʒ/ /tʃ/	/dʒ/ /tʃ/	/tʃ/	/dʒ/ /tʃ/
Approximants	/w/	/l/ /w/	/l/ /w/	/w/
Nasals	/ŋ/ /m/ /n/ /ɲ/	/ŋ/ /m/ /n/ /ɲ/	/ŋ/ /m/ /n/ /ɲ/	/ŋ/ /m/ /n/ /ɲ/
Prenasalized consonants	/ <sup>m</sup> p/ / <sup>m</sup> b/ / <sup>ɔ</sup> k/	/ <sup>m</sup> p/ / <sup>m</sup> b/ / <sup>ɔ</sup> k/	/ <sup>m</sup> p/ / <sup>m</sup> b/ / <sup>ɔ</sup> k/	/ <sup>m</sup> p/ / <sup>m</sup> b/ / <sup>ɔ</sup> k/
	/ <sup>n</sup> t/ / <sup>ɔ</sup> d/ / <sup>ɔ</sup> dʒ/	/ <sup>n</sup> t/ / <sup>ɔ</sup> d/ / <sup>ɔ</sup> dʒ/	/ <sup>n</sup> t/ / <sup>ɔ</sup> d/ / <sup>ɔ</sup> dʒ/	/ <sup>n</sup> t/ / <sup>ɔ</sup> d/ / <sup>ɔ</sup> dʒ/
	/ <sup>ɔ</sup> tʃ/ / <sup>m</sup> ɸf/ / <sup>m</sup> ɸv/	/ <sup>ɔ</sup> tʃ/ / <sup>m</sup> ɸf/ / <sup>m</sup> ɸv/	/ <sup>ɔ</sup> tʃ/ / <sup>m</sup> ɸf/ / <sup>m</sup> ɸv/	/ <sup>ɔ</sup> tʃ/ / <sup>m</sup> ɸf/ / <sup>m</sup> ɸv/
	/ <sup>n</sup> ts/ / <sup>ɔ</sup> tʃ/ / <sup>ɔ</sup> dʒ/	/ <sup>n</sup> ts/ / <sup>ɔ</sup> tʃ/ / <sup>ɔ</sup> dʒ/	/ <sup>n</sup> ts/ / <sup>ɔ</sup> tʃ/ / <sup>ɔ</sup> dʒ/	/ <sup>n</sup> ts/ / <sup>ɔ</sup> tʃ/ / <sup>ɔ</sup> dʒ/
Clicks	/ŋ/ /!/ /!/ /!h/	/ŋ/ /!/ /!/ /!h/	/ŋ/ /!/ /!/ /!h/	/ŋ/ /!/ /!/ /!h/
	/!g/ /!g/ /!/ /!g/	/!g/ /!/ /ŋ/	/!g/ /!g/ /!/ /!g/	/!g/ /!g/ /!/ /!g/
	/ŋ/		/ŋ/	/ŋ/
Vowels	/a/ /e/ /ɔ/ /ɛ/ /i/	/a/ /e/ /ɔ/ /ɛ/ /i/	/a/ /e/ /ɔ/ /ɛ/ /i/	/a/ /e/ /ɔ/ /ɛ/ /i/
	/u/	/u/	/u/	/u/

Note. Incomplete inventories are highlighted in the table above for ease of analysis

Participants in Group 4 could produce the plosives, implosive, fricatives, nasals and prenasalized consonants correctly. Participant 15 produced the affricate /dʒ/ as /d/ (e.g., ‘*ijezi*’ (jersey) /idʒezi/ produced as ‘*idez*’ /idez/). Participant 13 and 16 produced the approximant /l/ as /r/ (e.g., ‘*iphalishi*’ (porridge) /ip<sup>h</sup>alifi/ as ‘*ipharishi*’ /ip<sup>h</sup>arifi/).

Participant 14 was the only participant in Group 4 with an incomplete click inventory, being able to produce seven of the nine clicks correctly. /!g/ was simplified to the palatal click /!/ (e.g., ‘*isigqoko*’ (hat) /isi!gɔk’ɔ/ produced as ‘*isqoko*’ /is!ɔk’ɔ/) and /!lg/ was simplified to the lateral click /!l/ (e.g., ‘*gxuma*’ (jump) /!lguma/ produced as ‘*uyaxuma*’ /uja!luma/).

All participants in Group 4 were able to produce the vowels correctly during the assessment.

#### 4.1.1.5 Group 5 (4;6 – 4;11).

Table 13 summarizes the phoneme acquisition of the four participants in Group 5.

Table 13

#### *Phoneme acquisition in Group 5 (4;6 – 4;11)*

Phonemes (manner)	Participant 17	Participant 18	Participant 19	Participant 20
Plosives				
Voiced	/b/ /d/ /k/ /g/	/b/ /d/ /k/ /g/	/b/ /d/ /k/ /g/	/b/ /d/ /k/ /g/
Ejected	/p’/ /t’/ /k’/	/p’/ /t’/ /k’/	/p’/ /t’/ /k’/	/p’/ /t’/ /k’/
Aspirated	/p <sup>h</sup> / /t <sup>h</sup> / /k <sup>h</sup> /	/p <sup>h</sup> / /t <sup>h</sup> / /k <sup>h</sup> /	/p <sup>h</sup> / /t <sup>h</sup> / /k <sup>h</sup> /	/p <sup>h</sup> / /t <sup>h</sup> / /k <sup>h</sup> /
Implosive	/ɓ/	/ɓ/	/ɓ/	/ɓ/
Fricatives	/f/ /v/ /s/ /z/ /t/	/f/ /v/ /s/ /z/ /t/	/f/ /v/ /s/ /z/ /t/	/f/ /v/ /s/ /z/ /t/
	/ʒ/ /ʃ/ /h/ /ɦ/	/ʒ/ /ʃ/ /h/ /ɦ/	/ʒ/ /ʃ/ /h/ /ɦ/	/ʒ/ /ʃ/ /h/ /ɦ/
Affricates	/dʒ/ /tʃ/	/dʒ/ /tʃ/	/dʒ/ /tʃ/	/dʒ/ /tʃ/
Approximants	/w/	/l/ /w/	/l/ /w/	/w/
Nasals	/ŋ/ /m/ /n/ /ɲ/	/ŋ/ /m/ /n/ /ɲ/	/ŋ/ /m/ /n/ /ɲ/	/ŋ/ /m/ /n/ /ɲ/
Prenasalized consonants	<sup>m</sup> p/ / <sup>m</sup> b/ / <sup>ɔ</sup> k/	<sup>m</sup> p/ / <sup>m</sup> b/ / <sup>ɔ</sup> k/	<sup>m</sup> p/ / <sup>m</sup> b/ / <sup>ɔ</sup> k/	<sup>m</sup> p/ / <sup>m</sup> b/ / <sup>ɔ</sup> k/
	<sup>n</sup> t/ / <sup>ɔ</sup> d/ / <sup>ɔ</sup> dʒ/	<sup>n</sup> t/ / <sup>ɔ</sup> d/ / <sup>ɔ</sup> dʒ/	<sup>n</sup> t/ / <sup>ɔ</sup> d/ / <sup>ɔ</sup> dʒ/	<sup>n</sup> t/ / <sup>ɔ</sup> d/ / <sup>ɔ</sup> dʒ/
	<sup>ɔ</sup> tʃ/ / <sup>m</sup> ɸf/ / <sup>m</sup> ɔv/	<sup>ɔ</sup> tʃ/ / <sup>m</sup> ɸf/ / <sup>m</sup> ɔv/	<sup>ɔ</sup> tʃ/ / <sup>m</sup> ɸf/ / <sup>m</sup> ɔv/	<sup>ɔ</sup> tʃ/ / <sup>m</sup> ɸf/ / <sup>m</sup> ɔv/
	<sup>n</sup> ts/ / <sup>ɔ</sup> tʰ/ / <sup>ɔ</sup> dʒ/	<sup>n</sup> ts/ / <sup>ɔ</sup> tʰ/ / <sup>ɔ</sup> dʒ/	<sup>n</sup> ts/ / <sup>ɔ</sup> tʰ/ / <sup>ɔ</sup> dʒ/	<sup>n</sup> ts/ / <sup>ɔ</sup> tʰ/ / <sup>ɔ</sup> dʒ/
Clicks	/ŋ / / / /!/ /!ʰ/	/ŋ / / / /!/ /!ʰ/	/ŋ / / / /!/ /!ʰ/	/ŋ / / / /!/ /!ʰ/ /!l/
	/!g/ /!g/ /!l/ /!lg/	/!g/ /!g/ /!l/ /!lg/	/!g/ /!g/ /!l/ /!lg/	/!lg/ /ŋ /
	/ŋ  /	/ŋ  /	/ŋ  /	
Vowels	/a/ /e/ /ɔ/ /ɛ/ /i/	/a/ /e/ /ɔ/ /ɛ/ /i/	/a/ /e/ /ɔ/ /ɛ/ /i/	/a/ /e/ /ɔ/ /ɛ/ /i/
	/u/	/u/	/u/	/u/

Note. Incomplete inventories are highlighted in the table above for ease of analysis

Participants in Group 5 could produce all plosives, implosive, fricatives, affricates and nasals correctly. Participants 17 and 20 produced the lateral /l/ as /r/ (e.g., ‘*iphalishi*’ (porridge) /ip<sup>h</sup>alifi/ produced as ‘*pharish*’ /p<sup>h</sup>ariʃ/). Participants 18 and 20 simplified the prenasalized consonant /<sup>n</sup>ts/ to /<sup>n</sup>t/ (e.g., ‘*insipho*’ (soap) /i<sup>n</sup>tsip<sup>h</sup>ɔ/ produced as ‘*intipho*’ /i<sup>n</sup>tip<sup>h</sup>ɔ/).

Participant 20 was the only participant with an incomplete inventory of clicks, simplifying /!g/ to the palatal click /!/ (e.g., ‘*isigqoko*’ (hat) /isi!gɔkɔ/ produced as ‘*isqogo*’ /isiɔgɔ/) and /!g/ to the dental click /|/ (e.g., ‘*igceke*’ (yard) /i!geke/ produced as ‘*iceka*’ /i|eka/).

All of the participants in Group 5 were able to produce all of the vowels in an adult-like manner during the assessment.

#### 4.1.1.6 Group 6 (5;0 – 5;5).

Table 14 summarizes the phoneme acquisition of the participants in Group 6.

Table 14

#### Phoneme acquisition in Group 6 (5;0 – 5;5)

Phonemes (manner)	Participant 21	Participant 22	Participant 23	Participant 24
Plosives				
Voiced	/b/ /d/ /k/ /g/	/b/ /d/ /k/ /g/	/b/ /d/ /k/ /g/	/b/ /d/ /k/ /g/
Ejected	/pʰ/ /tʰ/ /kʰ/	/pʰ/ /tʰ/ /kʰ/	/pʰ/ /tʰ/ /kʰ/	/pʰ/ /tʰ/ /kʰ/
Aspirated	/p <sup>h</sup> / /t <sup>h</sup> / /k <sup>h</sup> /	/p <sup>h</sup> / /t <sup>h</sup> / /k <sup>h</sup> /	/p <sup>h</sup> / /t <sup>h</sup> / /k <sup>h</sup> /	/p <sup>h</sup> / /t <sup>h</sup> / /k <sup>h</sup> /
Implosive	/ɓ/	/ɓ/	/ɓ/	/ɓ/
Fricatives	/f/ /v/ /s/ /z/ /t/ /ʒ/ /ʃ/ /h/ /ɦ/	/f/ /v/ /s/ /z/ /t/ /ʒ/ /ʃ/ /h/	/f/ /v/ /s/ /z/ /t/ /ʒ/ /ʃ/ /h/ /ɦ/	/f/ /v/ /s/ /z/ /t/ /ʒ/ /ʃ/ /h/
Affricates	/dʒ/ /tʃ/	/dʒ/ /tʃ/	/dʒ/ /tʃ/	/dʒ/ /tʃ/
Approximants	/w/	/w/	/w/	/w/
Nasals	/ŋ/ /m/ /n/ /ɲ/	/ŋ/ /m/ /n/ /ɲ/	/ŋ/ /m/ /n/ /ɲ/	/ŋ/ /m/ /n/ /ɲ/
Prenasalized consonants	/ <sup>m</sup> p/ / <sup>m</sup> b/ / <sup>nk</sup> / / <sup>nt</sup> / / <sup>nd</sup> / / <sup>ndʒ</sup> / / <sup>ntʃ</sup> / / <sup>mpf</sup> / / <sup>mbv</sup> / / <sup>nts</sup> / / <sup>ntt</sup> / / <sup>ndʒ</sup> /	/ <sup>m</sup> p/ / <sup>m</sup> b/ / <sup>nk</sup> / / <sup>nt</sup> / / <sup>nd</sup> / / <sup>ndʒ</sup> / / <sup>ntʃ</sup> / / <sup>mpf</sup> / / <sup>mbv</sup> / / <sup>nts</sup> / / <sup>ntt</sup> / / <sup>ndʒ</sup> /	/ <sup>m</sup> p/ / <sup>m</sup> b/ / <sup>nk</sup> / / <sup>nt</sup> / / <sup>nd</sup> / / <sup>ndʒ</sup> / / <sup>ntʃ</sup> / / <sup>mpf</sup> / / <sup>mbv</sup> / / <sup>nts</sup> / / <sup>ntt</sup> / / <sup>ndʒ</sup> /	/ <sup>m</sup> p/ / <sup>m</sup> b/ / <sup>nk</sup> / / <sup>nt</sup> / / <sup>nd</sup> / / <sup>ndʒ</sup> / / <sup>ntʃ</sup> / / <sup>mpf</sup> / / <sup>mbv</sup> / / <sup>nts</sup> / / <sup>ntt</sup> / / <sup>ndʒ</sup> /
Clicks	/ŋ / / / /!/ /!ʰ/ /!g/ /!g/ /  / /!g/ /ŋ  /	/ŋ / / / /!/ /!ʰ/ /!g/ /!g/ /  / /!g/ /ŋ  /	/ŋ / / / /!/ /!ʰ/ /!g/ /!g/ /  / /!g/ /ŋ  /	/ŋ / / / /!/ /!ʰ/ /!g/ /!g/ /  / /!g/ /ŋ  /
Vowels	/a/ /e/ /ɔ/ /ɛ/ /i/ /u/	/a/ /e/ /ɔ/ /ɛ/ /i/ /u/	/a/ /e/ /ɔ/ /ɛ/ /i/ /u/	/a/ /e/ /ɔ/ /ɛ/ /i/ /u/

Note. Incomplete inventories are highlighted in the table above for ease of analysis

Within Group 6, the fricatives and approximants were the only incomplete phoneme groups. Participant 22 and 24 simplified the fricative /ɦ/ to /h/ (e.g., ‘*ihhala*’

(rake) /ihala/ produced as 'ihala' /ihala/). All of the participants within Group 6 produced the approximant /l/ as /r/ (e.g., 'iphalishi' (porridge) /ip<sup>h</sup>alifi/ produced as 'ipharish' /ip<sup>h</sup>arij/).

All of the clicks and all of the vowels were produced correctly by the participants within Group 6.

#### 4.1.1.7 Group 7 (5;6 – 5;11).

Table 15 summarizes the phoneme acquisition of the four participants in Group 7.

Table 15

#### Phoneme acquisition in Group 7 (5;6 – 5;11)

Phonemes (manner)	Participant 25	Participant 26	Participant 27	Participant 28
Plosives				
Voiced	/b/ /d/ /k/ /g/	/b/ /d/ /k/ /g/	/b/ /d/ /k/ /g/	/b/ /d/ /k/ /g/
Ejected	/p' /t' /k'/	/p' /t' /k'/	/p' /t' /k'/	/p' /t' /k'/
Aspirated	/p <sup>h</sup> / /t <sup>h</sup> / /k <sup>h</sup> /	/p <sup>h</sup> / /t <sup>h</sup> / /k <sup>h</sup> /	/p <sup>h</sup> / /t <sup>h</sup> / /k <sup>h</sup> /	/p <sup>h</sup> / /t <sup>h</sup> / /k <sup>h</sup> /
Implosive	/ɓ/	/ɓ/	/ɓ/	/ɓ/
Fricatives	/f/ /v/ /s/ /z/ /t/	/f/ /v/ /s/ /z/ /t/	/f/ /v/ /s/ /z/ /t/	/f/ /v/ /s/ /z/ /t/
	/ʒ/ /ʃ/ /h/ /h/	/ʒ/ /ʃ/ /h/	/ʒ/ /ʃ/ /h/	/ʒ/ /ʃ/ /h/ /h/
Affricates	/dʒ/ /tʃ/	/dʒ/ /tʃ/	/dʒ/ /tʃ/	/dʒ/ /tʃ/
Approximants	/w/	/w/	/w/	/w/
Nasals	/ŋ/ /m/ /n/ /ɲ/	/ŋ/ /m/ /n/ /ɲ/	/ŋ/ /m/ /n/ /ɲ/	/ŋ/ /m/ /n/ /ɲ/
Prenasalized consonants	/ <sup>m</sup> p/ / <sup>m</sup> b/ / <sup>nk</sup> / / <sup>n</sup> t/	/ <sup>m</sup> p/ / <sup>m</sup> b/ / <sup>nk</sup> / / <sup>n</sup> t/	/ <sup>m</sup> p/ / <sup>m</sup> b/ / <sup>nk</sup> / / <sup>n</sup> t/	/ <sup>m</sup> p/ / <sup>m</sup> b/ / <sup>nk</sup> / / <sup>n</sup> t/
	/ <sup>n</sup> d/ / <sup>n</sup> dʒ/ / <sup>n</sup> tʃ/	/ <sup>n</sup> d/ / <sup>n</sup> dʒ/ / <sup>n</sup> tʃ/	/ <sup>n</sup> d/ / <sup>n</sup> dʒ/ / <sup>n</sup> tʃ/	/ <sup>n</sup> d/ / <sup>n</sup> dʒ/ / <sup>n</sup> tʃ/
	/ <sup>m</sup> ɸf/ / <sup>m</sup> ɸv/ / <sup>n</sup> ts/	/ <sup>m</sup> ɸf/ / <sup>m</sup> ɸv/ / <sup>n</sup> tʃ/	/ <sup>m</sup> ɸf/ / <sup>m</sup> ɸv/ / <sup>n</sup> ts/	/ <sup>m</sup> ɸf/ / <sup>m</sup> ɸv/ / <sup>n</sup> ts/
	/ <sup>n</sup> tʃ/ / <sup>n</sup> dʒ/	/ <sup>n</sup> dʒ/	/ <sup>n</sup> tʃ/ / <sup>n</sup> dʒ/	/ <sup>n</sup> tʃ/ / <sup>n</sup> dʒ/
Clicks	/ŋ / / / /!/ /! <sup>h</sup> / /!g/	/ŋ / / / /!/ /!g/ /  /	/ŋ / / / /!/ /! <sup>h</sup> / /!g/	/ŋ / / / /!/ /!g/ /  /
	/ g/ /  / /  g/ /ŋ  /	/  g/	/ g/ /  / /  g/ /ŋ  /	/  g/ /ŋ  /
Vowels	/a/ /e/ /ɔ/ /ɛ/ /i/	/a/ /e/ /ɔ/ /ɛ/ /i/	/a/ /e/ /ɔ/ /ɛ/ /i/	/a/ /e/ /ɔ/ /ɛ/ /i/
	/u/	/u/	/u/	/u/

Note. Incomplete inventories are highlighted in the table above for ease of analysis

Participants in Group 7 were able to produce plosives, affricates, and nasals correctly. Participant 26 and 27 produced /h/ as /h/. All of the participants produced the approximant /l/ as /r/. Participant 26 simplified the prenasalized consonant /<sup>n</sup>ts/ to /<sup>n</sup>t/ (e.g., 'insipho' (soap) /i<sup>n</sup>tsip<sup>h</sup>ɔ/ produced as 'intipho' /i<sup>n</sup>tip<sup>h</sup>ɔ/).

Participant 26 and 28 had incomplete click inventories, both producing the aspirated palatal click /!<sup>h</sup>/ as /!/ and simplifying /|g/ to the dental click /|. Participant 26 also produced /ŋ||/ as /ŋ|/ (e.g., 'inxeba' (wound) /iŋ||eba/ produced as 'inceba' /iŋ|eba/). Six of the nine clicks were produced correctly by all four participants.

All of the vowels were produced correctly during the assessment.

#### 4.1.1.8 Group 8 (6;0 – 6;5).

Table 16 summarizes the phoneme acquisition of the four participants in Group 8.

Table 16

#### Phoneme acquisition in Group 8 (6;0 – 6;5)

Phonemes (manner)	Participant 29	Participant 30	Participant 31	Participant 32
Plosives				
Voiced	/b/ /d/ /k/ /g/	/b/ /d/ /k/ /g/	/b/ /d/ /k/ /g/	/b/ /d/ /k/ /g/
Ejected	/pʰ/ /tʰ/ /kʰ/	/pʰ/ /tʰ/ /kʰ/	/pʰ/ /tʰ/ /kʰ/	/pʰ/ /tʰ/ /kʰ/
Aspirated	/pʰ/ /tʰ/ /kʰ/	/pʰ/ /tʰ/ /kʰ/	/pʰ/ /tʰ/ /kʰ/	/pʰ/ /tʰ/ /kʰ/
Implosive	/ɓ/	/ɓ/	/ɓ/	/ɓ/
Fricatives	/f/ /v/ /s/ /z/ /ʃ/ /ʒ/ /ʃ/ /h/ /h/	/f/ /v/ /s/ /z/ /ʃ/ /ʒ/ /ʃ/ /h/	/f/ /v/ /s/ /z/ /ʃ/ /ʒ/ /ʃ/ /h/ /h/	/f/ /v/ /s/ /z/ /ʃ/ /ʒ/ /ʃ/ /h/ /h/
Affricates	/dʒ/ /tʃ/	/dʒ/ /tʃ/	/dʒ/ /tʃ/	/dʒ/ /tʃ/
Approximants	/w/	/w/	/w/ /l/	/w/
Nasals	/ŋ/ /m/ /n/ /ɲ/	/ŋ/ /m/ /n/ /ɲ/	/ŋ/ /m/ /n/ /ɲ/	/ŋ/ /m/ /n/ /ɲ/
Prenasalized consonants	/ᵐp/ /ᵐb/ /ᵐk/ /ᵐt/ /ᵐd/ /ᵐdʒ/ /ᵐtʃ/ /ᵐɸf/ /ᵐɸv/ /ᵐts/ /ᵐtʃ/ /ᵐdʒ/	/ᵐp/ /ᵐb/ /ᵐk/ /ᵐt/ /ᵐd/ /ᵐdʒ/ /ᵐtʃ/ /ᵐɸf/ /ᵐɸv/ /ᵐts/ /ᵐtʃ/ /ᵐdʒ/	/ᵐp/ /ᵐb/ /ᵐk/ /ᵐt/ /ᵐd/ /ᵐdʒ/ /ᵐtʃ/ /ᵐɸf/ /ᵐɸv/ /ᵐts/ /ᵐtʃ/ /ᵐdʒ/	/ᵐp/ /ᵐb/ /ᵐk/ /ᵐt/ /ᵐd/ /ᵐdʒ/ /ᵐtʃ/ /ᵐɸf/ /ᵐɸv/ /ᵐts/ /ᵐtʃ/ /ᵐdʒ/
Clicks	/ŋ/ /l/ /!/ /!ʰ/ /!g/ /lg/ /ll/ /llg/ /ŋll/	/ŋ/ /l/ /!/ /!ʰ/ /!g/ /lg/ /ll/ /llg/ /ŋll/	/ŋ/ /l/ /!/ /!ʰ/ /!g/ /ll/ /llg/ /ŋll/	/ŋ/ /l/ /!/ /!ʰ/ /!g/ /lg/ /ll/ /llg/ /ŋll/
Vowels	/a/ /e/ /ɔ/ /ɛ/ /i/ /u/	/a/ /e/ /ɔ/ /ɛ/ /i/ /u/	/a/ /e/ /ɔ/ /ɛ/ /i/ /u/	/a/ /e/ /ɔ/ /ɛ/ /i/ /u/

Note. Incomplete inventories are highlighted in the table above for ease of analysis

Within Group 8, incomplete phoneme groups included fricatives, approximants and clicks. Participant 30 simplified the fricative /h/ to /h/ and three participants produced the approximant /l/ as /r/ (e.g., *'iphalishi'* (porridge) /ipʰalifi/ produced as *'ipharishi'* /ipʰarifi/).

Three participants in Group 8 had a full inventory of clicks. Participant 31 simplified /!g/ to the palatal click /!/ (e.g., *'isigqoko'* (hat) /isi!gɔk'ɔ/ produced as *'isqoko'* /isi!k'ɔ/).

All of the participants produced the vowels correctly within the assessment.

#### 4.1.2 Acquisition across the age groups.

Table 17 documents phoneme acquisition across the age groups, with the phonemes organised into manner of articulation. A consonant was included in the inventory for an age group if 75% of the participants in the group (three out of the four participants) were able to produce it correctly within the targeted word in the penultimate

syllable. A vowel was included in the inventory if it was produced correctly in various word positions throughout the assessment.

Table 17

*Phoneme acquisition across the age groups (2;6 – 6;5)*

Phonemes	Grp 1 2;6-2;11	Grp 2 3;0-3;5	Grp 3 3;6-3;11	Grp 4 4;0-4;5	Grp 5 4;6-4;11	Grp 6 5;0-5;5	Grp 7 5;6-5;11	Grp 8 6;0-6;5
Plosives								
Voiced	/b/ /d/	/b/ /d/	/b/ /d/	/b/ /d/	/b/ /d/	/b/ /d/	/b/ /d/	/b/ /d/
	/k/ /g/	/k/ /g/	/k/ /g/	/k/ /g/	/k/ /g/	/k/ /g/	/k/ /g/	/k/ /g/
Ejected	/p' /t' /	/p' /t' /	/p' /t' /	/p' /t' /	/p' /t' /	/p' /t' /	/p' /t' /	/p' /t' /
	/k' /	/k' /	/k' /	/k' /	/k' /	/k' /	/k' /	/k' /
Aspirated	/p <sup>h</sup> /t <sup>h</sup> /	/p <sup>h</sup> /t <sup>h</sup> /	/p <sup>h</sup> /t <sup>h</sup> /	/p <sup>h</sup> /t <sup>h</sup> /	/p <sup>h</sup> /t <sup>h</sup> /	/p <sup>h</sup> /t <sup>h</sup> /	/p <sup>h</sup> /t <sup>h</sup> /	/p <sup>h</sup> /t <sup>h</sup> /
	/k <sup>h</sup> /	/k <sup>h</sup> /	/k <sup>h</sup> /	/k <sup>h</sup> /	/k <sup>h</sup> /	/k <sup>h</sup> /	/k <sup>h</sup> /	/k <sup>h</sup> /
Implosive	/ɓ/	/ɓ/	/ɓ/	/ɓ/	/ɓ/	/ɓ/	/ɓ/	/ɓ/
Fricatives	/f/ /v/	/f/ /v/	/f/ /v/	/f/ /v/	/f/ /v/	/f/ /v/	/f/ /v/	/f/ /v/
	/s/ /z/	/s/ /z/	/s/ /z/	/s/ /z/	/s/ /z/	/s/ /z/	/s/ /z/	/s/ /z/
	/t/ /ʒ/	/t/ /ʒ/	/t/ /ʒ/	/t/ /ʒ/	/t/ /ʒ/	/t/ /ʒ/	/t/ /ʒ/	/t/ /ʒ/
	/ʃ/ /h/	/ʃ/ /h/	/ʃ/ /h/	/ʃ/ /h/	/ʃ/ /h/	/ʃ/ /h/	/ʃ/ /h/	/ʃ/ /h/
	/h/	/h/	/h/	/h/	/h/	/h/	/h/	/h/
Affricates	/dʒ/ /tʃ/	/dʒ/ /tʃ/	/dʒ/ /tʃ/	/dʒ/ /tʃ/	/dʒ/ /tʃ/	/dʒ/ /tʃ/	/dʒ/ /tʃ/	/dʒ/ /tʃ/
Approximants	/w/	/l/ /w/	/w/	/w/	/w/	/w/	/w/	/w/
Nasals	/ŋ/ /m/	/ŋ/ /m/	/ŋ/ /m/	/ŋ/ /m/	/ŋ/ /m/	/ŋ/ /m/	/ŋ/ /m/	/ŋ/ /m/
	/n/ /ɲ/	/n/ /ɲ/	/n/ /ɲ/	/n/ /ɲ/	/n/ /ɲ/	/n/ /ɲ/	/n/ /ɲ/	/n/ /ɲ/
Prenasalized consonants	<sup>m</sup> p/	<sup>m</sup> p/	<sup>m</sup> p/	<sup>m</sup> p/	<sup>m</sup> p/	<sup>m</sup> p/	<sup>m</sup> p/	<sup>m</sup> p/
	<sup>m</sup> b/ / <sup>nk</sup> /	<sup>m</sup> b/ / <sup>nk</sup> /	<sup>m</sup> b/ / <sup>nk</sup> /	<sup>m</sup> b/ / <sup>nk</sup> /	<sup>m</sup> b/ / <sup>nk</sup> /	<sup>m</sup> b/ / <sup>nk</sup> /	<sup>m</sup> b/ / <sup>nk</sup> /	<sup>m</sup> b/ / <sup>nk</sup> /
	<sup>n</sup> t/ / <sup>nd</sup> /	<sup>n</sup> t/ / <sup>nd</sup> /	<sup>n</sup> t/ / <sup>nd</sup> /	<sup>n</sup> t/ / <sup>nd</sup> /	<sup>n</sup> t/ / <sup>nd</sup> /	<sup>n</sup> t/ / <sup>nd</sup> /	<sup>n</sup> t/ / <sup>nd</sup> /	<sup>n</sup> t/ / <sup>nd</sup> /
	<sup>ndʒ</sup> /	<sup>ndʒ</sup> /	<sup>ndʒ</sup> /	<sup>ndʒ</sup> /	<sup>ndʒ</sup> /	<sup>ndʒ</sup> /	<sup>ndʒ</sup> /	<sup>ndʒ</sup> /
	<sup>m</sup> ɓv/	<sup>ntʃ</sup> /	<sup>ntʃ</sup> /	<sup>ntʃ</sup> /	<sup>ntʃ</sup> /	<sup>ntʃ</sup> /	<sup>ntʃ</sup> /	<sup>ntʃ</sup> /
	<sup>n</sup> ts/	<sup>m</sup> ɸf/	<sup>m</sup> ɸf/	<sup>m</sup> ɸf/	<sup>m</sup> ɸf/	<sup>m</sup> ɸf/	<sup>m</sup> ɸf/	<sup>m</sup> ɸf/
	<sup>nt</sup> /	<sup>m</sup> ɓv/	<sup>m</sup> ɓv/	<sup>m</sup> ɓv/	<sup>m</sup> ɓv/	<sup>m</sup> ɓv/	<sup>m</sup> ɓv/	<sup>m</sup> ɓv/
	<sup>ndʒ</sup> /	<sup>ndʒ</sup> /	<sup>n</sup> ts/	<sup>n</sup> ts/	<sup>nt</sup> /	<sup>n</sup> ts/	<sup>n</sup> ts/	<sup>n</sup> ts/
			<sup>nt</sup> /	<sup>nt</sup> /	<sup>ndʒ</sup> /	<sup>nt</sup> /	<sup>nt</sup> /	<sup>nt</sup> /
			<sup>ndʒ</sup> /	<sup>ndʒ</sup> /	<sup>ndʒ</sup> /	<sup>ndʒ</sup> /	<sup>ndʒ</sup> /	<sup>ndʒ</sup> /
Clicks	/ŋ/ /l/	/ŋ/ /l/	/ŋ/ /l/	/ŋ/ /l/	/ŋ/ /l/	/ŋ/ /l/	/ŋ/ /l/	/ŋ/ /l/
	/! /!ʰ/	/! /!ʰ/	/ŋ//	/! /!ʰ/	/! /!ʰ/	/! /!ʰ/	/! /!g/	/! /!ʰ/
	/!g/ /!g/	/!g/ /ŋ//		/!g/ /!g/	/!g/ /!g/	/!g/ /!g/	/! /!g/	/!g/ /!g/
	/! / /ŋ//			/! / /!g/	/! / /!g/	/! / /!g/	/ŋ//	/! / /!g/
				/ŋ//	/ŋ//	/ŋ//	/ŋ//	/ŋ//
Vowels	/a/ /e/	/a/ /e/	/a/ /e/	/a/ /e/	/a/ /e/	/a/ /e/	/a/ /e/	/a/ /e/
	/ɔ/ /ɛ/	/ɔ/ /ɛ/	/ɔ/ /ɛ/	/ɔ/ /ɛ/	/ɔ/ /ɛ/	/ɔ/ /ɛ/	/ɔ/ /ɛ/	/ɔ/ /ɛ/
	/i/ /u/	/i/ /u/	/i/ /u/	/i/ /u/	/i/ /u/	/i/ /u/	/i/ /u/	/i/ /u/

Note. Incomplete inventories are highlighted in the table above for ease of analysis

Many of the phonemes appear within the phonemic inventory of all of the age groups, acquired before 2;6. All of the plosives, the implosive, affricates and nasals were considered to be in the phonemic inventory across all age groups. The approximants were incomplete across all groups other than Group 2, in which all participants produced /l/

correctly; the approximant /l/ will be discussed further within the relational analysis section as the late acquisition is related to a sound substitution which is apparent in adult speech.

An incomplete inventory of prenasalized consonants was noted in Groups 1, 2 and 5. Group 1 was the only group in which the prenasalized consonants /<sup>h</sup>tʃ/ and /<sup>h</sup>mɸf/ did not appear within the phonemic inventory; this phoneme is acquired at the age of 3;0. The click inventory was incomplete between the ages of 2;6–3;11 (Groups 1–3), appearing to stabilize thereafter as Groups 4, 5, 6 and 8 had complete click inventories. However within Group 7, /!ʰ/ and /|g/ were not included within the phonemic inventory. Although /ŋ|/, /||/ and /ŋ||/ were the only clicks acquired across all age groups, eight of the nine clicks were acquired by Group 1.

From Table 17 it can be noted that there are three patterns of acquisition. Firstly, categories complete before the age of 2;6. These phonemes could be elicited consistently throughout the assessment and included the plosives, implosives, affricates, nasals and vowels. The second category consists of phonemes acquired later with the category complete before 6;5, including prenasalized consonants and clicks. The third category includes sounds which did not develop following a consistent pattern, i.e. the approximants and fricatives.

In order to analyse the emergence of each phoneme in more detail, *Figure 4* documents the development of each phoneme across the age groups. In order for a phoneme to be considered mastered all of the participants within a group (four out of four participants) had to produce it correctly. Age of acquisition refers to situations where 75% of participants (three out of four children) could produce the phoneme correctly (as seen in Table 17), whereas if 50% or fewer participants within a group (i.e. 0–2 children) could produce a phoneme correctly, the phoneme was considered to be developing.

Plosives were already acquired at the age of 2;6 by the children in the sample. Although in Group 2 only three out of four children (75%) could produce /k/ and /k'/ correctly, all other plosives were mastered across the age groups. The implosive /ɓ/ was fully mastered by the age of 2;6. When analysing the fricatives, /h/ is the only one to be mastered across all age groups. As noted above, the pattern of development is less clear within the fricatives, with age of acquisition being achieved by participants in Group 1 and 2 for the phoneme /ʃ/, Groups 1 and 3 for the phoneme /ʒ/, and Group 2 for the phonemes /f/, /v/, /s/, /z/ and /t/. However, the most difficult fricative /h/ was the only fricative to be developing after the age of 4;0, with two (50%) participants in Groups 6 and 7 producing it correctly, and three (75%) participants producing it correctly in Group 8. The affricates were mastered by all of the age groups, other than Group 4, where one participant was unable to

produce /dʒ/ correctly. The approximant /l/ was only mastered by Group 2, with 50% or fewer participants producing it correctly across all other age groups. The approximant /w/ was mastered across all age groups.

All nasals were mastered by the age of 2;6. The prenasalized consonants /<sup>m</sup>p/, /<sup>m</sup>b/, /<sup>n</sup>d/ and /<sup>n</sup>dʒ/ were mastered across all age groups. /<sup>n</sup>t/ and /<sup>n</sup>tʃ/ were mastered from 3;0; /<sup>n</sup>dʒ/, /<sup>m</sup>ɸf/, /<sup>m</sup>ɸv/ from age 3;6 and /<sup>n</sup>k/ and /<sup>n</sup>tʰ/ from the age of 4;0. /<sup>n</sup>ts/ was developing in Groups 2 and 5 (produced by 50% of participants), with 75% of participants in Groups 1 and 7 producing it correctly.

The only click mastered across all age groups was the prenasalized dental click /ŋ||/, with the dental click /||/, palatal click /!/, aspirated palatal click /!<sup>h</sup>/ and lateral click /||/ mastered from the age of 4;0 and /||g/ mastered by the age of 4;6. No clear developmental pattern was established for /!g/, /|g/ and /ŋ||/; /!g/ was produced by two (50%) participants in Groups 2 and 3, 75% by Groups 1, 4, 5 and 8 and mastered by Groups 6 and 7; /|g/ was developing in Groups 3 and 7, produced correctly by 75% of participants in Groups 2 and 5, and was mastered by Groups 1, 4, 6 and 8; whereas /ŋ||/ was produced by 75% of participants in Groups 1, 2 and 7 but mastered by all other age groups.

All of the vowels were mastered across all of the age groups.

#### **4.1.3 Summary: Phoneme acquisition.**

Although a developmental pattern for acquisition cannot be determined for each phoneme group, it is clear that plosives, implosives, fricatives, affricates and nasals are amongst the first consonants to develop. Prenasalized consonants were acquired from the age of 3;6 by most children in the sample; whilst clicks are acquired from 4;0. The approximants were only produced correctly by Group 2, which will be discussed further within the relational analysis. Thus for our sample, the clicks and approximants appear to be the last phonemes to develop.

Phoneme		Age group							
		Group 1 2;6-2;11	Group 2 3;0-3;5	Group 3 3;6-3;11	Group 4 4;0-4;5	Group 5 4;6-4;11	Group 6 5;0-5;5	Group 7 5;6-5;11	Group 8 6;0-6;5
Plosives	b								
	d								
	k								
	g								
	p'								
	t'								
	k'								
Implosive	ɓ								
Fricatives	f								
	v								
	s								
	z								
	ʃ								
	ʒ								
	h								
Affricates	dʒ								
tʃ									
Approximants	l								
	w								
Nasals	ŋ								
	m								
	n								
	ɲ								
Prenasalized consonants	<sup>m</sup> p								
	<sup>m</sup> b								
	<sup>m</sup> k								
	<sup>m</sup> t								
	<sup>m</sup> d								
	<sup>m</sup> ʒ								
	<sup>m</sup> ɟ								
	<sup>m</sup> ɟf								
	<sup>m</sup> ɟb								
	<sup>m</sup> ts								
<sup>m</sup> tʃ									
<sup>m</sup> dʒ									
Clicks	ǀ								
	ǁ								
	ǃ								
	ǂ								
	Ǆ								
	ǆ								
	Ǉ								
Vowels	a								
	e								
	ɔ								
	i								
	u								

Key:

	Mastered (100% of participants produced correctly)
	Age of acquisition (75% of participants produced correctly)
	Developing (<50% of participants produced correctly)

Figure 4. Percentage of participants producing phonemes correctly.

## 4.2 Word shape development

Word shape development is discussed in this section. This is first discussed within each age category, starting from the youngest to the oldest group. Following this the age groups are compared in order to determine progression across the age groups.

### 4.2.1 Individual word shape development.

The following section analyses the development of word shapes individually within each group. The words targeted during the assessment ranged between two and five syllables in length. The assessment consisted of five bi-syllabic words (VCVC/CVCV/VCCV/CVCCV) (e.g., 'ingane' (child) /iŋgan/; 'vula' (open) /vula/; 'inja' (dog) /i<sup>n</sup>dza/; 'hamba' (walk) /ha<sup>m</sup>ba/), 34 tri-syllabic words (VCVCV/VCCVCV/VCCVCCV) (e.g., 'iphapha' (paper) /ip<sup>h</sup>εp<sup>h</sup>a/; 'impuphu' (mealie meal) /i<sup>m</sup>pup<sup>h</sup>u/; 'intambo' (rope) /i<sup>n</sup>tambo/), nine words of four syllables (VCVCVCV/VCCVCVCV) (e.g., 'elikhulu' (big) /εlik<sup>h</sup>ulu/; inkomishi (cup) /i<sup>n</sup>komij*i*/) and three words containing five syllables (VCVCVCVCV) (e.g., 'amasokisi' (socks) /amasok<sup>i</sup>isi/). It should be noted that words in which two consonants occur next to each other include prenasalized consonants, as consonant clusters are not present in Zulu. The same criteria for word shape production was used as in the study by Maphalala et al. (2014): a participant was required to correctly produce a word shape for at least 50% of the provided opportunities; otherwise it was considered to be developing. This criterion differed from the individual phoneme acquisition as only one opportunity was given for each individual phoneme to be produced. The tables that follow show two examples of each word shape given, as well as whether they were produced correctly by each participant. The use of different syllable structures in word-initial and final positions are also discussed. For the word-initial position these consisted of V and CV, and for word-final position these consisted of CV and CCV. A syllable structure was considered to be acquired if it was produced once by the participant, as was used when analysing the acquisition of phonemes.

#### 4.2.1.1 Group 1 (2;6 – 2;11).

Table 18 documents the word shapes acquired by each of the four participants in Group 1. All of the participants in Group 1 had acquired the bi-syllabic word structure, with three participants being able to produce tri-syllabic words correctly. Participant 4 deleted the first syllable when producing some three-syllable words (e.g., 'iphapha' (paper) /ip<sup>h</sup>εp<sup>h</sup>a/ produced as 'phapha' /p<sup>h</sup>εp<sup>h</sup>a/; ipeni (pen) /ip<sup>i</sup>eni/ produced as 'peni' /p<sup>i</sup>eni/). Only participant 2 was able to produce the four-syllable word itafula (table) correctly; none of the participants in Group 1 could produce 'inkomishi' (cup) /i<sup>n</sup>komij*i*/ correctly, with all of them dropping the final vowel to produce 'inkomish' /i<sup>n</sup>komij/. Although the deletion of

these syllables affected word length they are processes that occur within adult speech and will be discussed further within the discussion. Two of the four participants were able to produce the five-syllable word ‘*amasokisi*’ (socks) /amasɔk’isi/ correctly, with participants 1 and 2 simplifying it to a four- (‘*amasoki*’ /amasɔk’i/) and two- (‘*fokis*’ /fɔk’is/) syllable word respectively. Therefore all four participants in this group are still developing four- and five-syllable word shapes.

Table 18

*Word shapes and syllable structures produced by participants in Group 1 (2;6-2;11)*

Word shape	Participant 1	Participant 2	Participant 3	Participant 4
2 syllables	Acquired	Acquired	Acquired	Acquired
‘ <i>vula</i> ’ (open) (CVCV)	✓	✓	✓	✓
‘ <i>inja</i> ’ (dog) (VCCV)	✓	✓	✗	✓
3 syllables	Acquired	Acquired	Acquired	Developing
‘ <i>iphapha</i> ’ (paper) (VCVCV)	✓	✓	✓	✗
‘ <i>imbali</i> ’ (flower) (VCCVCV)	✓	✓	✓	✓
4 syllables	Developing	Developing	Developing	Developing
‘ <i>itafula</i> ’ (table) (CVCVCV)	✗	✓	✗	✗
‘ <i>inkomishi</i> ’ (cup) (VCCVCVCV)	✗	✗	✗	✗
5 syllables	Developing	Developing	Developing	Developing
‘ <i>amasokisi</i> ’ (socks) (VCVCVCVCV)	✗	✗	✓	✓
‘ <i>isibhedlela</i> ’ (hospital) (VCVCVCVCV)	✗	✗	✗	✗
Syllable structure: Word-initial	V CV	V CV	V CV	V CV
Syllable structure: Word-final	CV CCV	CV	CV	CV CCV

*Note.* A word shape was considered acquired if produced correctly on 50% or more opportunities, if less than 50% it was deemed still developing.

A syllable structure was included if produced correctly once.

Participants in Group 1 could produce the word-initial syllable structure V and CV correctly (e.g., ‘*iphapha*’ (paper) /ip<sup>h</sup>ɛp<sup>h</sup>a/; ‘*vula*’ (open) /vula/). The word-final prenasalized consonant in the CCV combination was not produced by participants 2 and 3, as both participants omitted the final vowel in this structure (e.g., ‘*intambo*’ (rope) /i<sup>n</sup>tamɔ/ produced as /intamɔ/).

#### 4.2.1.2 Group 2 (3;0 – 3;5).

Table 19 documents the word lengths acquired by the four participants in Group 2. Similar to Group 1, all participants in Group 2 had acquired the bi-syllabic word shape. Participants 5, 6 and 7 had also acquired the tri-syllabic word shape. Although participants 5 and 6 could produce some of the words with four syllables correctly, these word shapes are still developing. Participant 7 simplified ‘*inkomishi*’ (cup) /i<sup>n</sup>kɔmijɪ/ to ‘*nkomi*’ /<sup>n</sup>kɔmi/ and ‘*itafula*’ (table) /itafula/ to ‘*tatula*’ /tatula/; participant 8 simplified both to bi-syllabic

word shapes produced as *'komish'* /kɔmiʃ/ and *'taful'* /taful/ respectively. Participant 6 was the only participant to produce a five-syllable word shape correctly, with all other participants omitting the first or last vowels in the word *'amasokisi'* (socks) /amasɔk'isi/. All participants in this group are still developing the five-syllable word shape; however this will be discussed further in relation to phonological processes.

Table 19

*Word shapes and syllable structures produced by participants in Group 2 (3;0 – 3;5)*

Word shape	Participant 5	Participant 6	Participant 7	Participant 8
2 syllables	Acquired	Acquired	Acquired	Acquired
<i>'vula'</i> (open) (CVCV)	✓	✓	✓	✓
<i>'inja'</i> (dog) (VCCV)	✓	✓	✗	✗
3 syllables	Acquired	Acquired	Acquired	Developing
<i>'iphepha'</i> (paper) (VCVCV)	✓	✓	✓	✓
<i>'imbali'</i> (flower) (VCCVCV)	✓	✓	✓	✓
4 syllables	Developing	Developing	Developing	Developing
<i>'itafula'</i> (table) (CVCVCV)	✓	✓	✗	✗
<i>'inkomishi'</i> (cup) (VCCVCVCV)	✗	✓	✗	✗
5 syllables	Developing	Developing	Developing	Developing
<i>'amasokisi'</i> (socks) (VCVCVCVCV)	✗	✓	✗	✗
<i>'isibhedlela'</i> (hospital) (VCVCVCVCV)	✗	✗	✗	✗
Syllable structure: Word-initial	V CV	V CV	V CV	V CV
Syllable structure: Word-final	CV CCV	CV CCV	CV CCV	CV CCV

*Note.* A word shape was considered acquired if produced correctly on 50% or more opportunities, if less than 50% it was deemed still developing.

A syllable structure was included if produced correctly once.

All participants in Group 2 were able to produce V and CV syllable structure in the word-initial position and CV and CCV structures in the word-final position. Thus the development of word length in this group would be related to processes rather than syllable structure development, as all of the syllable structures had already been acquired.

#### **4.2.1.3 Group 3 (3;6 – 3;11).**

Table 20 documents the word lengths acquired by the four participants in Group 3. Participants in Group 3 had acquired two- and three-syllable word shapes. Participant 12 dropped the first vowel in both *'itafula'* (table) /itafula/ and *'inkomishi'* (cup) /i<sup>h</sup>ɔkɔmifi/. It can be noted that participant 9 pronounced *'amasokisi'* (socks) /amasɔkisi/ correctly, and participant 10 pronounced *'isibhedlela'* (hospital) /isibɛɔɔɔɔɔ/ correctly; however the five-syllable word shape was still developing across the group. Participant 11 omitted the second and last vowel in *'isibhedlela'* (hospital) /isibɛɔɔɔɔɔ/, producing it as *'esbhedlel'* /esbɛɔɔɔɔɔ/ whilst participant 12 produced it as *'esbhedlela'* /esbɛɔɔɔɔɔ/. Although this is

considered to be close to the adult target production *'isbhedlela'* /isbɛʒɛla/, this structure is still developing, and will be discussed further in relation to processes. Four- and five-syllable structures are still developing at the age of 3;11.

Table 20

*Word shapes and syllable structures produced by participants in Group 3 (3;6 – 3;11)*

Word shape	Participant 9	Participant 10	Participant 11	Participant 12
2 syllables	Acquired	Acquired	Acquired	Acquired
<i>'vula'</i> (open) (CVCV)	✓	✓	✓	✓
<i>'inja'</i> (dog) (VCCV)	✓	✗	✓	✓
3 syllables	Acquired	Acquired	Acquired	Acquired
<i>'iphepha'</i> (paper) (VCVCV)	✓	✓	✓	✓
<i>'imbali'</i> (flower) (VCCVCV)	✓	✓	✗	✓
4 syllables	Developing	Developing	Developing	Developing
<i>'itafula'</i> (table) (CVCVCV)	✓	✓	✓	✗
<i>'inkomishi'</i> (cup) (VCCVCVCV)	✗	✗	✗	✗
5 syllables	Developing	Developing	Developing	Developing
<i>'amasokisi'</i> (socks) (VCVCVCVCV)	✓	✗	✗	✗
<i>'isibhedlela'</i> (hospital) (VCVCVCVCV)	✗	✓	✗	✗
Syllable structure: Word-initial	V CV	V CV	V CV	V CV
Syllable structure: Word-final	CV CCV	CV CCV	CV CCV	CV CCV

*Note.* A word shape was considered acquired if produced correctly on 50% or more opportunities, if less than 50% it was deemed still developing.

A syllable structure was included if produced correctly once.

All participants in Group 3 were able to produce V and CV syllable structure in the word-initial position and CV and CCV structures in the word-final position. Thus the development of word length in this group can be related to phonological process use.

#### **4.2.1.4 Group 4 (4;0 – 4;5).**

Table 21 documents the word length acquired by the four participants in Group 4. As in Group 3, participants in Group 4 had acquired bi- and tri-syllabic word shapes, with word shapes consisting of four to five syllables still developing. Although the four-syllable word shape was still developing, all of the participants in this group were able to produce *'itafula'* (table) /itafula/ correctly, and participants 13 and 16 were able to produce the word *'inkomishi'* (cup) /i<sup>ɔ</sup>kɔmifi/ correctly, showing some progression in the development of this word shape. Participants 14 and 15 simplified the production of *'inkomishi'* (cup) /i<sup>ɔ</sup>kɔmifi/ to a bi-syllabic length *'komish'* /komif/. None of the participants were able to produce words containing five syllables. The word *'amasokisi'* (socks) /amasɔk'isi/ was produced as *'amasokis'* /amasɔk'is/ by all four participants with *'isibhedlela'* (hospital)

/isibɛʒɛla/ being produced as 'isbedlela' /isbɛʒɛla/, 'sisbedlel' /sisbɛʒɛl/ and 'esbedlel' /esbɛʒɛl/. This will be discussed further in relation to phonological processes.

Table 21

*Word shapes and syllable structures produced by participants in Group 4 (4;0 – 4;5)*

Word shape	Participant 13	Participant 14	Participant 15	Participant 16
2 syllables	Acquired	Acquired	Acquired	Acquired
'vula' (open) (CVCV)	✓	✓	✓	✓
'inja' (dog) (VCCV)	✓	✓	✓	✓
3 syllables	Acquired	Acquired	Acquired	Acquired
'iphapha' (paper) (VCVCV)	✓	✓	✓	✓
'imbali' (flower) (VCCVCV)	✓	✗	✗	✓
4 syllables	Developing	Developing	Developing	Developing
'itafula' (table) (CVCVCV)	✓	✓	✓	✓
'inkomishi' (cup) (VCCVCVCV)	✓	✗	✗	✓
5 syllables	Developing	Developing	Developing	Developing
'amasokisi' (socks) (VCVCVCVCV)	✗	✗	✗	✗
'isibhedlela' (hospital) (VCVCVCVCV)	✗	✗	✗	✗
Syllable structure: Word-initial	V CV	V CV	V CV	V CV
Syllable structure: Word-final	CV CCV	CV CCV	CV CCV	CV CCV

*Note.* A word shape was considered acquired if produced correctly on 50% or more opportunities, if less than 50% it was deemed still developing.

A syllable structure was included if produced correctly once.

As in the previous two groups, participants in Group 4 had acquired the word-initial and final syllable structures. Again the development of word shape structures appears closely linked to phonological processes.

#### **4.2.1.5 Group 5 (4;6 – 4;11).**

Table 22 documents the word length acquired by the four participants in Group 5. Within Group 5, bi- and tri-syllabic word lengths were acquired; word shapes consisting of four and five syllables were still developing, with four-syllable words being produced correctly by three participants and five-syllable words being produced correctly by one participant. Participant 19 omitted the first vowel in 'itafula' (table) /itafula/ producing it as 'tafula' /tafula/. All participants omitted the last vowel in 'inkomishi' (cup) /i<sup>h</sup>komiji/ produced as 'inkomish' /i<sup>h</sup>komij/. Two of the participants produced 'isibhedlela' (hospital) /isibɛʒɛla/ as 'esbedlela' /esbɛʒɛla/, whilst the other two participants omitted the final vowel as well; producing it as 'esbedlel' /esbɛʒɛl/. Participants 17, 18 and 20 omitted the final vowel when producing 'amasokisi' (socks) /amasok'isi/ as 'amasokis' /amasok'is/. Thus no progression in development of four- and five-syllable word lengths was noted within this

group, however as noted previously this will be discussed in relation to phonological processes. Participants in Group 5 could produce the syllable structures correctly in both the word-initial and word-final positions.

Table 22

*Word shapes and syllable structures produced by participants in Group 5 (4;6 – 4;11)*

Word shape	Participant 17	Participant 18	Participant 19	Participant 20
2 syllables	Acquired	Acquired	Acquired	Acquired
'vula' (open) (CVCV)	✓	✓	✓	✓
'inja' (dog) (VCCV)	✓	✓	✓	✓
3 syllables	Acquired	Acquired	Acquired	Acquired
'iphepha' (paper) (VCVCV)	✓	✓	✗	✓
'imbali' (flower) (VCCVCV)	✓	✓	✓	✗
4 syllables	Developing	Developing	Developing	Developing
'itafula' (table) (CVCVCV)	✓	✓	✗	✓
'inkomishi' (cup) (VCCVCVCV)	✗	✗	✗	✗
5 syllables	Developing	Developing	Developing	Developing
'amasokisi' (socks) (VCVCVCVCV)	✗	✗	✓	✗
'isibhedlela' (hospital) (VCVCVCVCV)	✗	✗	✗	✗
Syllable structure: Word-initial	V CV	V CV	V CV	V CV
Syllable structure: Word-final	CV CCV	CV CCV	CV CCV	CV CCV

*Note.* A word shape was considered acquired if produced correctly on 50% or more opportunities, if less than 50% it was deemed still developing.

A syllable structure was included if produced correctly once.

#### 4.2.1.6 Group 6 (5;0 – 5;5).

Table 23 documents the word length acquired by the four participants in Group 6. Participants in Group 6 had acquired bi- and tri-syllabic word shapes. Whilst three of them could produce words containing four syllables and two of them could produce words containing five syllables correctly, these word shapes were still developing. Participant 23 omitted the first vowel in 'itafula' (table) /itafula/ producing it as 'tafula' /tafula/ as well as the last vowel in 'inkomishi' (cup) /i<sup>h</sup>komifi/, producing it as 'inkomish' /i<sup>h</sup>komij/. Two participants were able to produce the five-syllable word 'amasokisi' (socks) /amasok<sup>h</sup>isi/ correctly, with participant 23 omitting the first and last vowel and participant 24 omitting the last vowel, producing it as 'masokis' /masok<sup>h</sup>is/ and 'amasokis' /amasok<sup>h</sup>is/ respectively. None of the participants were able to produce 'isibhedlela' (hospital) /isibeh<sup>h</sup>zela/, with all four participants omitting the second vowel to produce 'isbhedlela' /isbeh<sup>h</sup>zela/ or 'esbhedlela' /esbeh<sup>h</sup>zela/. As similar processes were noted in the previous groups in relation to the development of these word shapes, they will be discussed further in the section on relational analysis.

Table 23

*Word shapes and syllable structures produced by participants in Group 6 (5;0 – 5;5)*

Word shape	Participant 21	Participant 22	Participant 23	Participant 24
2 syllables	Acquired	Acquired	Acquired	Acquired
'vula' (open) (CVCV)	✓	✓	✓	✓
'inja' (dog) (VCCV)	✓	✓	✗	✓
3 syllables	Acquired	Acquired	Acquired	Acquired
'iphepha' (paper) (VCVCV)	✓	✓	✓	✓
'imbali' (flower) (VCCVCV)	✓	✓	✓	✓
4 syllables	Developing	Developing	Developing	Developing
'itafula' (table) (CVCVCV)	✓	✓	✗	✓
'inkomishi' (cup) (VCCVCVCV)	✗	✗	✗	✗
5 syllables	Developing	Developing	Developing	Developing
'amasokisi' (socks) (VCVCVCVCV)	✓	✓	✗	✗
'isibhedlela' (hospital) (VCVCVCVCV)	✗	✗	✗	✗
Syllable structure: Word-initial	V CV	V CV	V CV	V CV
Syllable structure: Word-final	CV CCV	CV CCV	CV CCV	CV CCV

*Note.* A word shape was considered acquired if produced correctly on 50% or more opportunities, if less than 50% it was deemed still developing.

A syllable structure was included if produced correctly once.

As seen in previous groups, participants in Group 6 could produce the syllable structures correctly in both the word-initial and final positions. The development of word shape is closely tied to phonological processes.

#### **4.2.1.7 Group 7 (5;6 – 5;11).**

Table 24 documents the word length acquired by the four participants in Group 7. As seen in the previous groups, participants in Group 7 had acquired bi- and tri-syllabic word shapes, and were still developing word shapes consisting of four to five syllables. One participant simplified four-syllable words to a three syllable length by omitting the first vowel (e.g., 'itafula' (table) /itafula/ produced as 'tafula' /tafula/; participant 25, 26 and 27 omitted the last vowel in 'inkomishi' (cup) /i<sup>o</sup>kɔmifi/ producing it as 'inkomish' /i<sup>o</sup>kɔmif/). Word shapes containing five syllables were still developing in Group 7, with none of the participants being able to produce 'amasokisi' (socks) /amasɔk'isi/ or 'isibhedlela' (hospital) /isibɛɟɛla/ correctly. Three participants pronounced them as 'amasokis' /amasɔk'is/ and 'esbhedlela' /esbɛɟɛla/ whilst participant 25 pronounced them as 'sokis' /sɔk'is/ and 'isibhedlel' /isibɛɟɛl/. The development of four- and five-syllable word lengths will be discussed further in the relational analysis. Participants in Group 7 were able to produce all of the syllable structures in the word-initial and word-final positions correctly.

Table 24

*Word shapes and syllable structures produced by participants in Group 7 (5;6 – 5;11)*

Word shape	Participant 25	Participant 26	Participant 27	Participant 28
2 syllables	Acquired	Acquired	Acquired	Acquired
'vula' (open) (CVCV)	✓	✓	✓	✓
'inja' (dog) (VCCV)	✓	✓	✗	✓
3 syllables	Acquired	Acquired	Acquired	Acquired
'iphepha' (paper) (VCVCV)	✓	✓	✓	✓
'imbali' (flower) (VCCVCV)	✓	✓	✓	✓
4 syllables	Developing	Developing	Developing	Developing
'itafula' (table) (CVCVCV)	✗	✓	✓	✓
'inkomishi' (cup) (VCCVCVCV)	✗	✗	✗	✓
5 syllables	Developing	Developing	Developing	Developing
'amasokisi' (socks) (VCVCVCVCV)	✗	✗	✗	✗
'isibhedlela' (hospital) (VCVCVCVCV)	✗	✗	✗	✗
Syllable structure: Word-initial	V CV	V CV	V CV	V CV
Syllable structure: Word-final	CV CCV	CV CCV	CV CCV	CV CCV

*Note.* A word shape was considered acquired if produced correctly on 50% or more opportunities, if less than 50% it was deemed still developing.

A syllable structure was included if produced correctly once.

#### **4.2.1.8 Group 8 (6;0 – 6;5).**

Table 25 documents the word length acquired by the four participants in Group 8. Similar to the analysis undertaken for Groups 3 to 7, participants in Group 8 had acquired bi- and tri-syllabic word shapes, and were developing words containing four and five syllables. Participant 31 simplified three- and four-syllable words as follows: 'iphepha' (paper) /ip<sup>h</sup>εp<sup>h</sup>a/ to 'pheph' /p<sup>h</sup>εp<sup>h</sup>/, 'ipeni' (pen) /ip<sup>h</sup>eni/ to 'pen' /p<sup>h</sup>εn/, itafula (table) /itafula/ to 'tafula' /tafula/ and 'inkomishi' (cup) /i<sup>h</sup>komij/ to 'inkomish' /i<sup>h</sup>komij/. Three participants were able to produce words containing five syllables correctly, with participants 29 and 32 producing 'amasokisi' (socks) /amasok<sup>h</sup>isi/ as 'amasokis' /amasok<sup>h</sup>is/ and participants 29, 30 and 31 producing 'isibhedlela' (hospital) /isibεzεla/ as 'isbhedlela' /isbεzεla/, 'esibhedlel' /esibεzεl/ and 'sisbhedlela' /sisbεzεla/. Participants in Group 8 could produce the syllable structures correctly in both word-initial and final positions. The development of four- and five-syllable word shapes will be discussed within the relational analysis.

Table 25

*Word shapes and syllable structures produced by participants in Group 8 (6;0 – 6;5)*

Word shape	Participant 29	Participant 30	Participant 31	Participant 32
2 syllables	Acquired	Acquired	Acquired	Acquired
'vula' (open) (CVCV)	✓	✓	✓	✓
'inja' (dog) (VCCV)	✗	✓	✓	✓
3 syllables	Acquired	Acquired	Acquired	Acquired
'iphapha' (paper) (VCVCV)	✓	✗	✗	✓
'imbali' (flower) (VCCVCV)	✓	✓	✓	✓
4 syllables	Developing	Developing	Developing	Developing
'itafula' (table) (CVCVCV)	✓	✓	✗	✓
'inkomishi' (cup) (VCCVCVCV)	✗	✓	✗	✓
5 syllables	Developing	Developing	Developing	Developing
'amasokisi' (socks) (VCVCVCVCV)	✗	✓	✓	✗
'isibhedlela' (hospital) (VCVCVCVCV)	✗	✗	✗	✓
Syllable structure: Word-initial	V CV	V CV	V CV	V CV
Syllable structure: Word-final	CV CCV	CV CCV	CV CCV	CV CCV

*Note.* A word shape was considered acquired if produced correctly on 50% or more opportunities, if less than 50% it was deemed still developing.

A syllable structure was included if produced correctly once.

#### 4.2.2 Word shape and syllable structure development across the age groups.

Figure 5 depicts the development of word length between the ages of 2;6 and 6;5. This is based on stages of acquisition including mastery, acquisition and developing. If all participants within an age group (i.e. four out of four) have acquired a shape, the shape is considered mastered by the group; if three of the four participants in a group have acquired a structure, the structure is considered acquired by the age group; if two or fewer participants had acquired the structure, the structure is considered still developing. The same criteria apply for development of syllable structures in the word-initial and final positions.

Bi-syllabic words (e.g., CVCV 'vula' (open) /vula/) were mastered across all age groups. This structure was therefore developed before the age of 2;6. Words consisting of three syllables (e.g., VCVCV 'idolo' (knee) /idlo/) were acquired by the age of 2;6 and mastered by the age of 3;6. Structures containing four and five syllables were still developing at the age of 6;5, thus only two or fewer participants per group were able to correctly produce these structures 50% of the time. When analysing four- and five-syllable structures further, a progression can be noted in the number of participants who were able to produce them correctly, although they were still developing.

It should also be noted that the three five-syllable words *'iscathulo'* (shoe), *'isibhedlela'* (hospital) and *'amasokisi'* (socks) are often shortened in adult conversational speech to be produced as *'iscathulo'* /is/at<sup>h</sup>ulo/; *'isbhedlela'* /isbɛɜ̃ɜ̃la/ and *'amasokis'* /amasok<sup>k</sup>is/. These approximations were seen across all age groups in the assessment. Although the analysis suggests these word shapes have not been acquired, the production of these words mimic adult speech; in the processes which are used and the way in which the target words are contracted. However, the production of these words in adult speech would be contracted to shorter word shapes than what was targeted in the study, thus affecting the results. This will be discussed further within the relational analysis; the use of these adult speech processes had not been taken into consideration when developing the assessment tool, which is a short-coming of this study.



Figure 5. Word shape and syllable structure development between 2;6 and 6;5.

The word-initial syllable structures V and CV and word-final syllable structure CV were mastered across all age groups. The word-final syllable structure CCV (e.g., *'intambo'* (rope) /i<sup>n</sup>ta<sup>m</sup>bo/) was still developing in Group 1, but was mastered from the age of 3;0. This indicates that the development of word structure within this study is not affected by syllable structure development, as all syllable structures were mastered by the age of 3;0.

#### 4.2.3 Summary: Word shape development.

Although no change was noted in the development of word shape after 3;6 years, the children's productions appear to closely approximate adult speech. The bi-syllabic word length is already mastered by the age of 2;6, tri-syllabic word length was acquired by the age of 2;6 and mastered from the age of 3;6. Word shapes containing four and five syllables were still developing across all age groups; however this appears to be related to processes

present in adult speech. The word-initial and final syllable structures were mastered from the age of 3;0; thus not affecting the development of word shape within this study.

### 4.3 Relational Analysis: PCC, PVC and phonological processes

Relational analysis is presented for each age group, followed by a discussion across the age groups. In this study the total number of opportunities to produce vowels was 166, with 124 opportunities to produce consonants.

#### 4.3.1 Relational analysis of each age group.

Relational analysis was undertaken for each age group. PCC and PVC scores for each participant are documented as well as the phonological processes that were used during the assessment. A word may appear under more than one process, as multiple processes were used in some words.

##### 4.3.1.1 Group 1 (2;6–2;11).

Table 26 documents the PCC and PVC for each participant as well as the phonological processes used within Group 1.

Table 26

#### *Relational analysis for Group 1 participants*

	Target word	Participant 1	Participant 2	Participant 3	Participant 4
PCC		85%	80%	98%	93%
PVC		77%	72%	82%	68%
<b>Phonological processes at a phoneme level</b>					
Consonant harmony	isibeɬɛla	ebeɬɛla			
Deaspiration	i!hude		i!ude		
Denasalization	i <sup>n</sup> tamɔ				tamɔ
	i <sup>ɔ</sup> dlebe				dɬɛba
	i <sup>ɔ</sup> tʃɛbe	tʃɛbe			tʃɛbe
	i <sup>ɔ</sup> kuk <sup>h</sup> u				kuk <sup>h</sup> u
	u <sup>m</sup> ɔfana		ufana		fana
Dentalization	i!anda		ɭanda		
	i  ɔ  ɔ		i ɔ ɔ		
	guma		gum		
	iŋ  eba		iŋ eba		
Postvocalic devoicing	iɦala	iɦa			
	isi  ubɔ		is  up		
Simplification of co-articulated phonemes	i <sup>ɔ</sup> tʃanzi	i <sup>ɔ</sup> ʃan			
	isi!gɔk'ɔ		is!ɔ		
	guma	uma		uma	uma
Specific phoneme substitution	ip <sup>h</sup> alifi	p <sup>h</sup> arɪf		ip <sup>h</sup> arɪf	
	amasɔk'isi		fok'is		
	i <sup>n</sup> tsip <sup>h</sup>		idip <sup>h</sup> ɔ		

Vowel elision (word-medial position)	isi at <sup>h</sup> ulɔ			is at <sup>h</sup> ulɔ	is at <sup>h</sup> ulu
	isit <sup>u</sup> ulɔ	st <sup>u</sup>		ist <sup>u</sup> ul	st <sup>u</sup> ulɔ
	isit <sup>at</sup> at	ist <sup>at</sup>			ist <sup>at</sup> at
	isibe ɛ ɛla			esbe ɛ ɛl	esbe ɛ ɛla
	isi!gɔk <sup>ɔ</sup>	is!gɔk <sup>ɔ</sup>	is!ɔ	is!gɔk <sup>ɔ</sup>	is!gɔk <sup>ɔ</sup>
	isi  ubɔ		is  up	is  ub	is  ubɔ
Vowel elision (word-final position) <sup>a</sup>	i <sup>ɔ</sup> kɔmij	kɔmij	i <sup>ɔ</sup> kɔmij	i <sup>ɔ</sup> kɔmij	kɔmij
	iphali j	p <sup>h</sup> ari j	ip <sup>h</sup> ali j	ip <sup>h</sup> ari j	p <sup>h</sup> ali j
	ifeti	ifet	fet	ifet	fet
	iwa j	iwa j	iwa j	iwa j	wa j
Vowel substitution	isi at <sup>h</sup> ulɔ				is at <sup>h</sup> ulu
	unesi	inesi			
	isibe ɛ ɛla	ebe ɛ ɛla		esbe ɛ ɛl	esbe ɛ ɛla
	ind ɛ ɛbe				d ɛ ɛba
	elik <sup>h</sup> ulu		lik <sup>h</sup> uli		
<b>Phonological processes affecting syllable structure</b>					
Initial syllable deletion <sup>b</sup>	itafula	taful		tafula	tafula
	isisu		sis		sisu
	elik <sup>h</sup> ulu	lik <sup>h</sup> ulu	lik <sup>h</sup> uli		lik <sup>h</sup> ulu
	iliji	liji		liji	liji
Final syllable deletion <sup>c</sup>	amazijɔ	mazin	izin	amazin	
	i <sup>ɔ</sup> t <sup>h</sup> anzi	i <sup>ɔ</sup> tan			
	isit <sup>u</sup> ulɔ	st <sup>u</sup>			
	i <sup>ɔ</sup> tamɔ	intam			

<sup>a</sup> Vowel elision (word-final position) was used 55 times in 32 different words, thus only a few examples are given.

<sup>b</sup> Initial syllable deletion was used 56 times in 29 different words, thus only a few examples are given.

<sup>c</sup> Final syllable deletion was used 15 times in 12 words during the assessment, thus only a few examples are given.

In Group 1, the PVC scores of each individual were lower than their PCC scores. This could possibly be related to the number of syllable deletion and vowel elision processes noted within this group. Although these were not analysed as developmental processes, these omissions still influenced PVC scores. Participant 3 had the highest PVC and PCC scores within Group 1, which were 82% and 98% respectively.

Participants in Group 1 used multiple phonological processes within the assessments. Common processes used by all participants at a phoneme level include simplification of co-articulated phonemes (e.g., 'gxuma' (jump) /||guma/ produced as 'xuma' /||uma/), vowel elision in a word-medial and final position (e.g., 'iscathulo' (shoe) /isi|at<sup>h</sup>ulɔ/ produced as 'iscathulo' /is|at<sup>h</sup>ulɔ/; 'isheti' (shirt) /ifeti/ produced as 'ishet' /ifet/) and vowel substitution (e.g., 'unesi' (nurse) /unesi/ produced as 'inesi' /inesi/). Final vowel elision was the process used most throughout Group 1. Dentalization was used by participant 2 and denasalization was used by participants 1 and 4. Although not used by all participants, these processes were used multiple times (e.g., 'ixoxo' (frog) /i|ɔ|ɔ/ produced as 'icoco' /i|ɔ|ɔ/; 'intshebe' (beard) /i<sup>ɔ</sup>t|ɛ|ɛ/ produced as 'tshebe' /t|ɛ|ɛ/).

Processes affecting syllable structure within Group 1 include both initial (e.g., 'itafula' (table) /itafula/ produced as 'tafula' /tafula/) and final syllable deletion (e.g., 'amazinyo' (teeth) /amazinjɔ/ produced as 'amazin' /amazin/). Initial syllable deletion was used by every participant in Group 1 (used 56 times in 29 words). Final syllable deletion was used by three participants and occurred within 12 words.

#### 4.3.1.2 Group 2 (3;0 – 3;5).

Table 27 documents the PCC and PVC for each participant as well as the phonological processes used within Group 2.

Table 27

#### Relational analysis for Group 2 participants

	Target word	Participant 5	Participant 6	Participant 7	Participant 8
PCC		93%	96%	70%	90%
PVC		85%	91%	79%	72%
<b>Phonological processes at a phoneme level</b>					
Backing	i iji			iki i	
Consonant harmony	itafula			tatula	
Denasalization	inj  eba	i  eba			
Dentalization	i <sup>n</sup> tsip <sup>h</sup> ɔ				<sup>n</sup>  ip <sup>h</sup> ɔ
	i <sup>h</sup> ude	i <sup>h</sup> ude			
	i  ɔ  ɔ				ɔ
	isi  ubu	is ubu			u
	guma				uma
Phoneme insertion	unesi	inɛks		itʃɛti	
	ijɛti			watʃ	
Postvocalic devoicing	ihala	ihala			
	isi  ubu		is  upɔ		
Simplification of co-articulated phonemes	i <sup>n</sup> tʰanzi		i <sup>n</sup> tʰanzi	i <sup>n</sup> tanzi	
	i <sup>n</sup> dʒɛɛ			i <sup>n</sup> dɛ	
	i <sup>n</sup> tsip <sup>h</sup> ɔ			i <sup>n</sup> tip <sup>h</sup> ɔ	
	isi!gɔk'ɔ	is!ɔk'ɔ		i!ɔk'ɔ	
	i geke				i eke
Specific phoneme substitution	ukudla	ukudʔa		amatɔjis	
	amasɔk'isi				
Stopping	ibasi			ibat	
	u <sup>m</sup> ɔɸfana			u <sup>m</sup> tana	
	vula			dula	
	i <sup>m</sup> ɔvula			i <sup>m</sup> dul	
	isisu			itsitu	
	amazinjɔ			amadinjɔ	
	isiʔaʔa			idlada	
	amasɔk'isi			amatɔjis	

Vowel elision (word-medial position)	isi at <sup>h</sup> ulɔ	is at <sup>h</sup> ulɔ	is/at <sup>h</sup> ulɔ	is at <sup>h</sup> ul
	isit <sup>h</sup> ulɔ	ist <sup>h</sup> ulɔ	ist <sup>h</sup> ulɔ	st <sup>h</sup> ulɔ
	isit <sup>h</sup> at <sup>h</sup>	ist <sup>h</sup> at <sup>h</sup>		ist <sup>h</sup> at <sup>h</sup>
	isibɛʒɛla	ɛsbɛʒɛl	ɛsbɛʒɛla	isbɛʒɛl
	isi!gɔk <sup>h</sup> ɔ	is!ɔk <sup>h</sup> ɔ	is!gɔk <sup>h</sup> ɔ	is!gɔk <sup>h</sup> ɔ
	isi  ubɔ	is ubu	is  upɔ	
Vowel elision (word-final position) <sup>a</sup>	ifɛti	ifɛt		itʃɛt
	i <sup>h</sup> difi	i <sup>h</sup> dif	i <sup>h</sup> dif	i <sup>h</sup> dif
	i <sup>h</sup> dʒa			i <sup>h</sup> dʒ
	isisu	isis	isis	
Vowel substitution	unesi	ineks	inesi	ines
	isibɛʒɛla	ɛsbɛʒɛl	ɛsbɛʒɛla	ɛbɛʒ
	iliji	ilɛ ɛ		
	isi  ubɔ	is ubu		
<b>Phonological processes affecting syllable structure</b>				
Initial syllable deletion <sup>b</sup>	itafula			tatula
	ɛlik <sup>h</sup> ulu	ik <sup>h</sup> ulu		lik <sup>h</sup> ulu
	iliji			liji
	ɛli ŋane	liŋ ani	liŋ a	liŋ ane
Final syllable deletion <sup>c</sup>	ɛli ŋane		liŋ a	
	i <sup>h</sup> kɔmifi			<sup>h</sup> kɔmi
	i <sup>h</sup> dʒɛɔɛ			i <sup>h</sup> dɛ
	il ɔ ɔ			i <sup>h</sup> dʒɛ  ɔ
Medial syllable deletion	isit <sup>h</sup> at <sup>h</sup>	it <sup>h</sup> at <sup>h</sup>	it <sup>h</sup> at <sup>h</sup>	
	isi at <sup>h</sup> ulɔ			i at <sup>h</sup> u
	isit <sup>h</sup> ulɔ			it <sup>h</sup> ul
	isi!gɔkɔ			i!ɔk <sup>h</sup> ɔ
	isi  ubɔ			i  ubɔ
	ukudla			

<sup>a</sup> Vowel elision (word-final position) was used 50 times in 31 different words, thus only a few examples are given.

<sup>b</sup> Initial syllable deletion was used 27 times in 18 different words, thus only a few examples are given.

<sup>c</sup> Final syllable deletion was used 14 times in 13 words during the assessment, thus only a few examples are given.

PCC scores for Group 2 ranged between 70% and 93%, with PVC scores ranging from 72% to 91%. As seen in Group 1, the PVC scores in Group 2 are generally lower than the corresponding PVC score. However, participant 7, who had a PCC of 70%, had a PVC score of 79%. This score is related to the high occurrence of phonological processes produced by this child.

A number of processes were present in Group 2. Processes which were only used by one participant within the group included backing, consonant harmony and denasalization. Dentalization was used by participants 5 and 8 (e.g., *'iqhude'* (male chicken) /i<sup>h</sup>ude/ produced as *'ichude'* /i<sup>h</sup>ude/). Phoneme insertion, which was not present in Group 1, was present in the speech of participants 5 and 7 (e.g., *'isheti'* (shirt) /ifeti/ produced as *'itshet'* /itʃɛt/). Postvocalic devoicing was also apparent within the speech of participants 5 and 6 as *'ihhala'* (rake) /ihala/ was produced as *'ihala'* /ihala/. Vowel elision in the word-

medial position occurred in the speech of participants 5, 6 and 8. Vowel substitution and elision in the word-final position occurred in all four participants' speech; vowel elision was the most common process within this group occurring 50 times in 31 words.

Final syllable deletions were present in three participants' speech, whilst initial and medial syllable deletion occurred across the group. Initial syllable deletion was the second most common process seen within Group 2, occurring 27 times (e.g., 'elikhulu' (big) /ɛlik<sup>h</sup>ulu/ produced as 'likhulu' /lik<sup>h</sup>ulu/).

#### 4.3.1.3 Group 3 (3;6 – 3;11).

Table 28 documents the PCC and PVC for each participant as well as the phonological processes used within the group.

Table 28

#### Relational analysis for Group 3 participants

	Target word	Participant 9	Participant 10	Participant 11	Participant 12
PCC		90%	95%	93%	98%
PVC		89%	80%	86%	87%
<b>Phonological processes at a phoneme level</b>					
Backing	i!anda	ik <sup>h</sup> anda			
	i! <sup>h</sup> ude	ik <sup>h</sup> ude			
Consonant harmony	isibɛʒɛla	esbelela			
Denasalization	i <sup>ɱ</sup> kuk <sup>h</sup> u	ikuk <sup>h</sup> a			
Dentalization	i!anda		ijanda		
	i! <sup>h</sup> ude		ijude		
	isi  ubɔ			is ubɔ	
Fronting	isi!gɔk'ɔ	isibɔk'ɔ			
	ilgeke	it'eke			
	iliji	it'iji			
Simplification of co-articulated phonemes	i <sup>ɱ</sup> t!anzi	i <sup>ɱ</sup> anzi			
	isi!gɔk'ɔ			is!ɔk'ɔ	
	ilgeke			iljeke	
Specific phoneme substitution	ip <sup>h</sup> alifi			ip <sup>h</sup> arifi	p <sup>h</sup> arif
	guma	ujadzuma			
	i! <sup>h</sup> ude			n!udi	
Stopping	isi  ubɔ	isit'ubɔ			
Vowel elision (word-medial position)	isi at <sup>h</sup> ulɔ		is at <sup>h</sup> ulɔ	is at <sup>h</sup> ulɔ	is at <sup>h</sup> ulɔ
	isit'ulɔ	ist'ulɔ	ist'ulɔ	ist'u	ist'ulɔ
	isi!tɔtɔ		is!tɔtɔ		is!tɔt
	isibɛʒɛla	esbelela	isbɛʒɛla	esbɛʒɛl	esbɛʒɛla
	amasɔk'isi		amasɔk's		
	isi!gɔk'ɔ		is!gɔk'ɔ	is!ɔk'ɔ	is!gɔk'ɔ
isi  ubɔ		is  ubɔ	is ubɔ	is  ubɔ	

Vowel elision <sup>a</sup> (word-final position)	i <sup>o</sup> komifi ip <sup>h</sup> alifi ifeti iwafi	i <sup>o</sup> komif ifet	i <sup>o</sup> komif p <sup>h</sup> alif ifet iwaf	i <sup>o</sup> komif ifet	p <sup>h</sup> arif iwaf
Vowel substitution	unesi isibeɬɛla i <sup>o</sup> kuk <sup>h</sup> u i! <sup>h</sup> ude	inesi esbelela ikuk <sup>h</sup> a		esbeɬɛl n!udi	esbeɬɛla
<b>Phonological processes affecting syllable structure</b>					
Initial syllable deletion <sup>b</sup>	isisu ip <sup>h</sup> alifi ɛlik <sup>h</sup> ulu ɛli ŋane	sisu p <sup>h</sup> alifi lik <sup>h</sup> ulu ŋ ane		sisu	p <sup>h</sup> arif lik <sup>h</sup> ulu liŋ ane
Final syllable deletion <sup>c</sup>	ip <sup>ʼ</sup> eni isit <sup>ʼ</sup> ulɔ i <sup>o</sup> dɬɛɔɛ amazinɔ		ip <sup>ʼ</sup> en amazin	ist <sup>ʼ</sup> u i <sup>o</sup> dɬɛ	amazin
Medial syllable deletion	isiɬata			ɪɬata	

<sup>a</sup> Vowel elision (word-final position) was used 43 times in 27 different words, thus only a few examples are given.

<sup>b</sup> Initial syllable deletion was used 18 times in 11 different words, thus only a few examples are given.

<sup>c</sup> Final syllable deletion was used 8 times in 6 words during the assessment, thus only a few examples are given.

Within Group 3, the PCC score of every child was higher than their corresponding PVC score. Participant 9 had the lowest PCC score of 90% and the highest PVC score of 89%. The highest PCC score was that of participant 12 (98%) and the lowest PVC score was scored by participant 10 (80%).

Many processes were used by participants in Group 3. Processes only used by participant 9 (who had the lowest PCC) included backing (e.g., *'iqanda'* (egg) /i!anda/ produced as *'ikhanda'* /ik<sup>h</sup>anda/), consonant harmony (e.g., *'isibhedlela'* (hospital) /isibeɬɛla/ produced as *'esbelela'* /esbelela/), denasalization (e.g., *'inkukhu'* (chicken) /i<sup>o</sup>kuk<sup>h</sup>u/ produced as *'ikukha'* /ikuk<sup>h</sup>a/), fronting (e.g., *'isigqoko'* (hat) /isi!gɔk'ɔ/ produced as *'isiboko'* /isibɔk'ɔ/) and stopping (e.g., *'isixubho'* (toothbrush) /isi||ubɔ/ produced as /isit<sup>ʼ</sup>ubɔ/).

Dentalization was used by participants 10 and 11 (e.g., *'iqhude'* (male chicken) /i!<sup>h</sup>ude/ produced as *'icude'* /i|ude/) and simplification of co-articulated phonemes was used by participants 9 and 11 (e.g., *'igceke'* (yard) /i|geke/ produced as *'iceke'* /i|eke/). More common processes included specific phoneme and vowel substitution, which were used by participants 9, 11 and 12 (e.g., *'iphalishi'* (porridge) /ip<sup>h</sup>alifi/ produced as *'ipharishi'* /ip<sup>h</sup>arifi/; *'unesi'* (nurse) /unesi/ produced as *'inesi'* /inesi/). Vowel elision in the medial and word-final position, was used within all of the participants' speech. In the word-final

position, it was the most common process within this group, used 43 times (e.g., *'inkomishi'* (cup) /i<sup>h</sup>kɔmifi/ produced *'inkomish'* /i<sup>h</sup>kɔmif/).

All participants in Group 3 used initial and final syllable deletion within their speech, whilst only participant 11 used medial syllable deletion on the word *'isihlahla'* (tree) /isit̪at̪a/ produced as *'ihlahla'* /it̪at̪a/. Initial syllable deletion was the second most frequently used process, occurring 18 times, whilst final syllable deletion was only used eight times by Group 3.

#### **4.3.1.4 Group 4 (4;0 – 4;5).**

Table 29 documents the PCC and PVC for each participant as well as the phonological processes used in Group 4.

As seen in previous age groups, all Group 4 participants had lower PVC scores than PCC scores. Participants 13 and 16 had the highest PCC scores of 98%. Participant 13 had the highest PVC of 92%. Participant 15 had the lowest PCC and PVC score within Group 4 of 96% and 75% respectively.

Phonological processes present within Group 4 at a phoneme level included simplification of co-articulated phonemes, denasalization, specific phoneme substitution, stopping, vowel elision and vowel substitution. Vowel elision was used by all four participants in both a medial and word-final position. Vowel substitution was used by participant 13 (e.g., *'unesi'* (nurse) /unɛsi/ produced as *'ines'* /inɛs/), participant 15 (e.g., *'unyawo'* (foot) /unɔwɔ/ produced as *'inyawo'* /inɔwɔ/) and participant 16 (e.g., *'isisu'* (stomach) /isisu/ produced as *'isisa'* /isisa/). Specific phoneme substitution was used by participants 13 and 16, with the phoneme /l/ replaced by /r/ (e.g., *'iphalishi'* (porridge) /ip<sup>h</sup>halifi/ produced as *'ipharishi'* /ip<sup>h</sup>arifi/). Vowel elision in the word-final position was the most common process used, occurring 74 times.

Initial and final syllable deletions were present in Group 4 and were used by all four participants. The occurrence of these processes was significantly reduced within this group compared to the younger groups, with the word-initial process occurring 11 times, and word-final occurring five times (e.g., *'idolo'* (knee) /idɔlɔ/ produced as *'ido'* /idɔ/).

Table 29

*Relational analysis for Group 4 participants*

	Target word	Participant 13	Participant 14	Participant 15	Participant 16
PCC		98%	97%	96%	98%
PVC		92%	82%	75%	82%
<b>Phonological processes at a phoneme level</b>					
Denasalization	i <sup>h</sup> komifi			komif	
Simplification of co- articulated phonemes	isi!gɔk'ɔ   guma		is!ɔk'ɔ uja  uma		
Specific phoneme substitution	ip <sup>h</sup> alifi	ip <sup>h</sup> arifi			ip <sup>h</sup> arif
Stopping	idʒezi i <sup>h</sup> dʒa			idez i <sup>h</sup> da	
Vowel elision (word-medial position)	isi at <sup>h</sup> ulɔ isit'ulɔ isitaʔa isibeʒɛla isi!gɔk'ɔ isi  ubɔ	is at <sup>h</sup> ulɔ ist'ulɔ istaʔa isibeʒɛla is!gɔk'ɔ is  ubɔ	is at <sup>h</sup> ulɔ ist'ulɔ istaʔa sisbeʒɛl is!ɔk'ɔ is  ubɔ	ist'ul istaʔ esbeʒɛl is!gɔk'ɔ is  ub	is at <sup>h</sup> ulɔ ist'ulɔ istaʔ is!gɔk'ɔ is  ubɔ
Vowel elision (word-final position) <sup>a</sup>	i <sup>h</sup> komifi ip <sup>h</sup> alifi ifeti iwafi		i <sup>h</sup> komif ip <sup>h</sup> alif ifet iwaʔ	komif ip <sup>h</sup> alif ifet iwaʔ	ip <sup>h</sup> arif ifet iwaʔ
Vowel substitution	isisu unesi isibeʒɛla uɲawɔ iŋ  eba	inesu inesu		ines esbeʒɛl iɲawɔ	isisa esbeʒɛl iŋ  ebe
<b>Phonological processes affecting syllable structure</b>					
Initial syllable deletion	i <sup>h</sup> komifi isi at <sup>h</sup> ulɔ amazɪɲɔ isibeʒɛla elik <sup>h</sup> ulu eli ŋane		mazɪɲɔ sisbeʒɛl lik <sup>h</sup> ulu liŋ ane	komif  at <sup>h</sup> ulɔ lik <sup>h</sup> ulu liŋ an	lik <sup>h</sup> ul liŋ an
Final syllable deletion	amazɪɲɔ idɔɔ i <sup>h</sup> dʒɛɛ	amazɪn	idɔ i <sup>h</sup> dʒɛ	amazɪn	amazɪn

<sup>a</sup> Vowel elision (word-final position) was used 74 times in 36 different words, thus only a few examples are given.**4.3.1.5 Group 5 (4;6 – 4;11).**

Table 30 documents the PCC and PVC for each participant as well as the phonological processes used within Group 5.

Table 30

*Relational analysis for Group 5 participants*

	Target word	Participant 17	Participant 18	Participant 19	Participant 20
PCC		97%	97%	99%	94%
PVC		89%	81%	86%	80%
<b>Phonological processes at a phoneme level</b>					
Consonant harmony	isi at <sup>h</sup> ulo				tat <sup>h</sup> ulo
Simplification of co-articulated phonemes	i <sup>n</sup> tsip <sup>h</sup> ɔ		i <sup>n</sup> tip <sup>h</sup> ɔ		i <sup>n</sup> tip <sup>h</sup>
	isi!gɔk'ɔ				is!ɔgɔ
	ilgeke				ilɛka
Specific phoneme substitution	ip <sup>h</sup> alifi	p <sup>h</sup> arɪf			ip <sup>h</sup> arɪf
Voicing	isi!gɔk'ɔ				is!ɔgɔ
Vowel elision (word-medial position)	isi at <sup>h</sup> ulo	is at <sup>h</sup> ulo	is at <sup>h</sup> ulo	is at <sup>h</sup> ulo	
	isit'ulo	ist'ulo	ist'ulo	ist'ulo	ist'ulo
	isiɬaɬa				isiɬaɬa
	isibɛɬɛla	esbɛɬɛla	esbɛɬɛl		esbɛɬɛla
	isi!gɔk'ɔ	is!gɔk'ɔ	is!gɔk'ɔ	is!gɔk'ɔ	is!ɔgɔ
	isi  ubɔ	is  ubɔ	is  ubɔ	is  ubɔ	is  ubɔ
Vowel elision <sup>a</sup> (word-final position)	i <sup>o</sup> komifi	i <sup>o</sup> komɪf	i <sup>o</sup> komɪf	i <sup>o</sup> komɪf	i <sup>o</sup> komɪf
	ip <sup>h</sup> alifi	p <sup>h</sup> arɪf	ip <sup>h</sup> alɪf	ip <sup>h</sup> alɪf	ip <sup>h</sup> arɪf
	ɪfɛti	ɪfɛt	ɪfɛt	ɟɛt	ɪfɛt
	iwaɟi		iwaɟ	waɟ	
Vowel substitution	unesi			inesɪ	
	isibɛɬɛla	esbɛɬɛla	esbɛɬɛl	esbɛɬɛl	esbɛɬɛla
	utʃani				otʃan
	ɪnawɔ		ɪnawɔ		ɪnawɔ
	i! <sup>h</sup> ude				i! <sup>h</sup> uda
	ilgeke				ilɛka
<b>Phonological processes affecting syllable structure</b>					
Initial syllable deletion <sup>b</sup>	isi at <sup>h</sup> ulo				tat <sup>h</sup> ulo
	ɛlik <sup>h</sup> ulu	lik <sup>h</sup> ulu	lik <sup>h</sup> ulu	lik <sup>h</sup> ulu	
	ɛliŋ ane	liŋ ane	liŋ an	liŋ an	
	i! <sup>h</sup> ude		! <sup>h</sup> ude	! <sup>h</sup> ude	
Final syllable deletion	amazɪɔ	amazɪn	amazɪn		
	i  ɔ	i  ɔ			
	i <sup>o</sup> tʃanzi		i <sup>o</sup> tʃan		
Medial syllable deletion	isiɬaɬa	ɪɬaɬa	ɪɬaɬa	ɪɬaɬa	

<sup>a</sup> Vowel elision (word-final position) was used 46 times in 23 different words, thus only a few examples are given.<sup>b</sup> Initial syllable deletion was used 15 times in 10 different words, thus only a few examples are given.

In Group 5, participant 20 scored the lowest PVC and PCC score with 80% and 94% respectively. The highest PVC score was 89% (participant 17) and the highest PCC score was 99% (participant 19).

Few phonological processes were observed in Group 5. At a phoneme level, processes included simplification of co-articulated phonemes, consonant harmony, specific phoneme substitution, voicing, vowel elision and vowel substitution. All participants in Group 5 used vowel elision, in the medial and word-final position, and substitution processes (e.g., *'isigqoko'* (hat) /isi!gɔk'ɔ/ produced as *'isgqoko'* /is!gɔk'ɔ/; *'iqhude'* (male chicken) /i!hude/ produced as *'iqhuda'* /i!huda/). As seen within the previous groups, vowel elision in the word-final position was the most frequently used process, occurring 46 times. In keeping with their low PCC and PVC scores, participant 20 used the most phonological processes. Participant 17 used specific phoneme substitution (e.g., *'iphalishi'* (porridge) /ip<sup>h</sup>aliji/ produced as *'pharish'* /p<sup>h</sup>ariʃ/) and participant 19 used the simplification of co-articulated phonemes to produce *'insipho'* (soap) /i<sup>n</sup>tsip<sup>h</sup>ɔ/ as *'intipho'* /i<sup>n</sup>tip<sup>h</sup>ɔ/.

Phonological processes affecting syllable structure were used frequently. All participants in Group 5 used initial syllable deletion, which occurred 15 times (e.g., *'elincane'* (small) /ɛliŋjane/ produced as *'lincane'* /liŋjane/. Medial syllable deletion was used by participants 17, 18 and 19. Final syllable deletion was not common; it was used by two participants and occurred in three words.

#### **4.3.1.6 Group 6 (5;0 – 5;5).**

Table 31 documents the PCC and PVC for each participant as well as the phonological processes used within Group 6.

Within Group 6, participants 21 and 22 scored the highest PCC of 98%. Participant 24 had the lowest PCC score of 94%. The lowest PVC score of 79% was from participant 23. Participant 21 had the highest PVC score of 92%.

Phonological processes present at a phoneme level in Group 6 included specific phoneme substitution, vowel elision (in word-medial and word-final positions) and vowel substitution, which were used by all four participants. Vowel elision was the most common process in this group, occurring 31 times in 18 words. Participant 22 used deaspiration to produce the word *'inkukhu'* (chicken) /i<sup>n</sup>kuk<sup>h</sup>u/ as *'inkuku'* /i<sup>n</sup>kuku/; participant 24 used dentalization to produce *'ixoxo'* (frog) /i||ɔ||ɔ/ as *'icoco'* /i|ɔ|ɔ/. Postvocalic devoicing was used by participants 22 and 24 (e.g., *'ihhala'* (rake) /ihala/ produced as *'ihala'* /ihala/).

Table 31

*Relational analysis for Group 6 participants*

	Target word	Participant 21	Participant 22	Participant 23	Participant 24
	PCC	98%	98%	96%	94%
	PVC	92%	89%	79%	86%
<b>Phonological processes at a phoneme level</b>					
Deaspiration	i <sup>h</sup> kuk <sup>h</sup> u		i <sup>h</sup> kuku		
Dentalization	i  ɔ  ɔ				i ɔ ɔ
Postvocalic devoicing	ihala		ihala		ihala
Specific phoneme substitution	ip <sup>h</sup> alifi i <sup>n</sup> tlanzi	p <sup>h</sup> arifi	ip <sup>h</sup> arifi	p <sup>h</sup> arifi i <sup>n</sup> tlanzi	ip <sup>h</sup> arif
Vowel elision (word-medial position)	isi at <sup>h</sup> ulɔ isit <sup>h</sup> ulɔ isit <sup>h</sup> ulɔ isibɛɟɛla isi!gɔk'ɔ isi  ubɔ	s at <sup>h</sup> ulɔ ist <sup>h</sup> ulɔ ist <sup>h</sup> ulɔ isibɛɟɛla is!gɔk'ɔ is  ubɔ	isi at <sup>h</sup> ulɔ ist <sup>h</sup> ulɔ ist <sup>h</sup> ulɔ isibɛɟɛla is!gok' is  ubɔ	s at <sup>h</sup> u ist <sup>h</sup> ulɔ ist <sup>h</sup> ulɔ isibɛɟɛla is  ubɔ	isi at <sup>h</sup> ulɔ ist <sup>h</sup> ulɔ ist <sup>h</sup> ulɔ esbɛɟɛla is!gɔk'ɔ is  ubɔ
Vowel elision <sup>a</sup> (word-final position)	i <sup>h</sup> komifi ibasi ifeti iwafi	i <sup>h</sup> komif ibas ibas	i <sup>h</sup> komif ibas ibas	i <sup>h</sup> komif bas ɟet waf	i <sup>h</sup> komif ibas ifet iwaf
Vowel substitution	unesi isibɛɟɛla uɲawɔ	inesi	inesi	ines	esbɛɟɛla iɲawɔ
<b>Phonological processes affecting syllable structure</b>					
Initial syllable deletion <sup>b</sup>	isi at <sup>h</sup> ulɔ ɛlik <sup>h</sup> ulu ɛliɲ ane i <sup>h</sup> ude	s at <sup>h</sup> ulɔ ik <sup>h</sup> ulu ɲ ane	lik <sup>h</sup> ulu liɲ ane	s at <sup>h</sup> u lik <sup>h</sup> ulu liɲ ane i <sup>h</sup> ude	lik <sup>h</sup> ulu liɲ ane
Final syllable deletion	isi at <sup>h</sup> ulɔ amazɪɔ i <sup>h</sup> ɟɛbɛ			s at <sup>h</sup> u amazon	amazon i <sup>h</sup> ɟɛ
Medial syllable deletion	isit <sup>h</sup> at <sup>h</sup> a	it <sup>h</sup> at <sup>h</sup> a			it <sup>h</sup> at <sup>h</sup> a

<sup>a</sup> Vowel elision (word-final position) was used 31 times in 18 different words, thus only a few examples are given.

<sup>b</sup> Initial syllable deletion was used 25 times in 17 different words, thus only a few examples are given.

At a syllable structure level, initial syllable deletion was the only process used by all four participants, occurring 25 times. Final syllable deletion was used by participants 23 and 24 and occurred in four words. Medial syllable deletion was used by participants 21 and 24, both of whom produced *'isihlahla'* (tree) /isit<sup>h</sup>at<sup>h</sup>a/ as *'ihlahla'* /it<sup>h</sup>at<sup>h</sup>a/.

#### 4.3.1.7 Group 7 (5;6 – 5;11).

Table 32 documents the PCC and PVC for each participant as well as the phonological processes used in Group 7.

Table 32

*Relational analysis for Group 7 participants*

	Target word	Participant 25	Participant 26	Participant 27	Participant 28
	PCC	97%	93%	97%	94%
	PVC	85%	86%	85%	85%
<b>Phonological processes at a phoneme level</b>					
Deaspiration	i <sup>n</sup> tsip <sup>h</sup> ɔ i! <sup>h</sup> ude		i!ude		i <sup>n</sup> tsipɔ i!ude
Dentalization	inj  eba		inj eba		
Postvocalic devoicing	ihala		ihala	ihala	
Simplification of co-articulated phonemes	i <sup>n</sup> tsip <sup>h</sup> ɔ i geke		i <sup>n</sup> tip <sup>h</sup> ɔ i eke		e ekeni
Specific phoneme substitution	ip <sup>h</sup> alifi i <sup>n</sup> tʰanzi	ip <sup>h</sup> arifi i <sup>n</sup> tʰanzi	ip <sup>h</sup> arifi	p <sup>h</sup> arif	ip <sup>h</sup> arif
Vowel elision (word-medial position)	isi at <sup>h</sup> ulɔ isit <sup>h</sup> ulɔ isibe ʒela isi!gɔk <sup>h</sup> ɔ isi  ubɔ	is at <sup>h</sup> ulɔ ist <sup>h</sup> ulɔ	is at <sup>h</sup> u ist <sup>h</sup> ulɔ esbe ʒela isi!gɔk <sup>h</sup> ɔ is  u	is at <sup>h</sup> ulɔ ist <sup>h</sup> ulɔ esbe ʒela	is at <sup>h</sup> ulɔ ist <sup>h</sup> u esbe ʒela isi!gɔk <sup>h</sup> ɔ is  ubɔ
Vowel elision <sup>a</sup> (word-final position)	indifi amasɔk <sup>h</sup> isi iwafi	sɔk <sup>h</sup> is waf	indif amasɔk <sup>h</sup> is iwaf	indif amasɔk <sup>h</sup> is waf	indif amasɔk <sup>h</sup> is iwaf
Vowel substitution	unɛsi uɲawɔ isibe ʒela eliŋ ane	inɛsi iɲawɔ	inɛsi esbe ʒela iŋ ani	esbe ʒela	esbe ʒela
<b>Phonological processes affecting syllable structure</b>					
Initial syllable deletion <sup>b</sup>	ifeti elik <sup>h</sup> ulu eliŋ ane iwafi	feti lik <sup>h</sup> ulu liŋ ane waf	lik <sup>h</sup> ulu iŋ ani	fet lik <sup>h</sup> ulu liŋ ane waf	lik <sup>h</sup> ulu liŋ an
Final syllable deletion <sup>c</sup>	ip <sup>h</sup> ɛni amazinjɔ isi  ubɔ inj  eba		amazin is  u	amazin	ip <sup>h</sup> ɛn amazin
Medial syllable deletion	isitʰatʰa	itʰatʰa	itʰatʰa	itʰatʰa	itʰatʰa

<sup>a</sup> Vowel elision (word-final position) was used 36 times in 20 different words, thus only a few examples are given.<sup>b</sup> Initial syllable deletion was used 25 times in 17 different words, thus only a few examples are given.<sup>c</sup> Final syllable deletion was used 8 times in 6 different words, thus only a few examples are given.

As seen within the previous groups, all participants in Group 7 obtained higher PCC scores than PVC scores. The highest PCC score was 97% (participants 25 and 27). The lowest PCC and highest PVC score were both scored by participant 26, being 93% and 86% respectively; whilst all other participants had PVC scores of 85%.

Phonological processes at a phoneme level included simplification of co-articulated phonemes and deaspiration, which were present in the responses of participants 26 and 28 (e.g., *'igceke'* (yard) /i|geke/ produced as /i|eke/; *'iqhude'* (male chicken) /i!hude/ produced as *'iqude'* /i!ude/). Dentalization (e.g., *'inxeba'* (wound) /iŋ||eba/ produced as *'inceba'* /iŋ|eba/) was used by participant 26, and post vocalic devoicing was used by participants 26 and 27. Vowel elision (in the word-medial and final position), vowel substitution and phoneme substitution were used by all participants. Vowel elision was the most frequently used process, occurring 36 times.

At a syllable structure level initial, final and medial syllable deletion were used by all four participants. Initial syllable deletion was the second most frequently occurring process, occurring 25 times in 17 different words. As in the previous group, medial syllable deletion occurred only in the word *'isihlahla'* (tree) /isi!ata/, which was produced as *'ihlahla'* /i!ata/.

#### **4.3.1.8 Group 8 (6;0 – 6;5).**

Table 33 documents the PCC and PVC for each participant as well as the phonological processes used in the group.

Participants in Group 8 had generally high PCC scores. Participants 25, 26 and 28 scored 98%. The lowest PCC (97%) and PVC (87%) scores were scored by participant 27. The highest PVC score was 92% (participant 26).

The use of phonological processes at a phoneme level within Group 8 was minimal. Simplification of co-articulated phonemes and deaspiration were used by participant 27 (e.g., *'isigqoko'* (hat) /isi!gɔk'ɔ/ produced as *'isqoko'* /is!ɔk'ɔ/; *'inkukhu'* (chicken) /i<sup>ɱ</sup>kuk<sup>h</sup>u/ produced as *'inkuku'* /i<sup>ɱ</sup>kuku/). Postvocalic devoicing was only present in participant 26's speech (e.g., *'ihhala'* (rake) /ihala/ produced as *'ihala'* /ihala/); whilst phoneme substitution was used by participants 25, 26 and 28 but only used on the word *'iphalishi'* (porridge) /ip<sup>h</sup>aliji/ which was produced as *'ipharishi'* /ip<sup>h</sup>arifi/. Vowel elision in the medial and final position and vowel substitution were used by all participants in Group 8. Vowel elision in the word-final position occurred 26 times, and was the most frequently used process within the group.

Table 33

*Relational analysis for Group 8 participants*

	Target word	Participant 25	Participant 26	Participant 27	Participant 28
PCC		98%	98%	97%	98%
PVC		88%	92%	87%	91%
<b>Phonological Processes at a phoneme level</b>					
Deaspiration	i <sup>h</sup> kuk <sup>h</sup> u			i <sup>h</sup> kuku	
Postvocalic devoicing	ihala		ihala		
Simplification of co-articulated phonemes	isi!gɔk'ɔ			is!ɔk'ɔ	
Specific phoneme substitution	ip <sup>h</sup> alifi	p <sup>h</sup> arifi	ip <sup>h</sup> arif		ip <sup>h</sup> arifi
Vowel elision (word-medial position)	isi at <sup>h</sup> ulɔ isit <sup>h</sup> ulɔ isi at <sup>h</sup> ulɔ isibe ɛɛla isi!gɔk'ɔ isi  ubɔ	is at <sup>h</sup> ulɔ ist <sup>h</sup> ulɔ is at <sup>h</sup> ulɔ isibe ɛɛla is!gɔ is  ubɔ	is at <sup>h</sup> ulɔ ist <sup>h</sup> ulɔ is at <sup>h</sup> ulɔ is!gɔk'ɔ is  ubɔ	is at <sup>h</sup> ulɔ ist <sup>h</sup> ulɔ is!gɔk'ɔ is  ubɔ	is at <sup>h</sup> ulɔ ist <sup>h</sup> ulɔ is!gɔk'ɔ is  ubɔ
Vowel elision <sup>a</sup> (word-final position)	ifeti amasɔk'isi iwafi utʃani	ifet amasɔk'is iwaf	ifet utʃan	ifet iwaf	ifet amasɔk'is iwaf utʃan
Vowel substitution	unesi isibe ɛɛla i <sup>h</sup> ude	inesi	esibe ɛɛl	inesi e <sup>h</sup> ude	esibe ɛɛla
<b>Phonological processes affecting syllable structure</b>					
Initial syllable deletion	ip <sup>h</sup> ɛp <sup>h</sup> a ip <sup>h</sup> ɛni itafula ip <sup>h</sup> alifi elik <sup>h</sup> ulu ɛliŋ ane	p <sup>h</sup> arifi lik <sup>h</sup> ulu liŋ ane	p <sup>h</sup> ɛp <sup>h</sup> a lik <sup>h</sup> ulu liŋ ane	p <sup>h</sup> ɛp <sup>h</sup> p <sup>h</sup> ɛn tafula p <sup>h</sup> alifi lik <sup>h</sup> ulu liŋ ane	lik <sup>h</sup> ulu liŋ ane
Final syllable deletion	amazipɔ isi!gɔk'ɔ   guma	amazin is!gɔ	uja  gu		amazin
Medial syllable deletion	isi at <sup>h</sup> a		i at <sup>h</sup> a	i at <sup>h</sup> a	i at <sup>h</sup> a

<sup>a</sup> Vowel elision (word-final position) was used 26 times in 19 different words, thus only a few examples are given.

Initial syllable deletion was the only process affecting syllable structure which was used by all four participants in Group 8. This process was used 14 times (e.g., *'iphepha'* (paper) /ip<sup>h</sup>ɛp<sup>h</sup>a/ produced as *'phepha'* /p<sup>h</sup>ɛp<sup>h</sup>a/). Final syllable deletion was only used by three participants, and was used within three words. Medial syllable deletion was used by

participants 26, 27 and 28, as in Group 6 and 7; this process was only used in the word 'isihlahla' (tree).

#### 4.3.2 Relational analysis across the groups.

Relational analysis is compared across the age groups to allow for comparisons of developmental progression amongst the age groups. Average PCC and PVC scores per age group are tabulated along with phonological processes present in each group.

Table 34 documents a summary of the PCC and PVC scores across the age groups, followed by Figure 6 which documents the frequency of use of phonological processes by each age group.

Table 34

#### *PCC and PVC scores across the age groups*

	<b>Group 1</b> <b>2;6-2;11</b>	<b>Group 2</b> <b>3;0-3;5</b>	<b>Group 3</b> <b>3;6-3;11</b>	<b>Group 4</b> <b>4;0-4;5</b>	<b>Group 5</b> <b>4;6-4;11</b>	<b>Group 6</b> <b>5;0-5;5</b>	<b>Group 7</b> <b>5;6-5;11</b>	<b>Group 8</b> <b>6;0-6;5</b>
PCC: Mean	89%	87%	94%	97%	97%	97%	95%	98%
Std Dev	8,04	11,76	3,37	0,96	2,06	1,91	2,06	0,5
PVC: Mean	75%	82%	86%	83%	84%	87%	85%	90%
Std Dev	6,08	8,14	3,87	6,99	4,24	5,57	0,5	2,38

When looking at PCC scores across the age groups, a general increase can be noted with children between 2;6 and 2;11 years (Group 1) scoring an average of 89%, and children between 6;0 and 6;5 years (Group 8) with a mean of 98%. The two groups which were not part of the progression trend were Groups 2 and 7. Group 2 scored 87%, with the highest standard deviation of 11,76. Corresponding PVC scores were consistently lower than PCC scores, but followed a similar progressive trend, with Groups 4, 5 and 7 being outliers. Children between 2;6 and 2;11 years (Group 1) scored an average PVC of 75% whilst children between 6;0 and 6;5 scored an average of 90%.

Fifteen processes were present at a phoneme level across the age groups. Processes that were used by less than 25% of each age group are considered to be related to individual variation and will not be discussed in detail. These include backing, consonant harmony, fronting, stopping and voicing. Similarly, phoneme insertion was only present in Group 2, where it was used by 50% of participants (e.g., 'unesi' (nurse) /unesi/ produced as 'ineks' /ineks/).

Denasalization was a process that showed a clear decrease in frequency of use. It was used by 50% of participants in Group 1; 25% in Groups 2, 3 and 4 and was not used thereafter (e.g., 'intambo' (rope) /i<sup>h</sup>tam<sup>h</sup>ɔ/ produced as 'tambo' /tam<sup>h</sup>ɔ/). The

simplification of co-articulated phonemes also showed a decrease in frequency of use, with all participants between 2;6 and 3;5 using this process. Although this process was present in almost every age group, from the age of 3;6 it was present in 50% or less of the participant's speech .

A clear developmental trend could not be established for deaspiration, dentalization and post-vocalic devoicing. All three of these processes occurred within the first and last age groups, but did not occur within the middle groups. Deaspiration (e.g., *'iqhude'* (male chicken) /i!hude/ produced as *'iqude'* /i!ude/), was used by 25% of participants in Groups 1, 6 and 8, with two out of four participants in Group 7 using this process. Similarly dentalization was used by 25% of participants in Groups 1, 6 and 7 with 50% of participants in Groups 2 and 3 using this process (e.g., *'ixoxo'* (frog) /i||ɔ||ɔ/ produced as *'icoco'* /i|ɔ|ɔ/). Postvocalic devoicing was used by 50% of participants in Groups 1, 2, 6 and 7, as well as 25% of participants in Group 8 (e.g., *'ihhala'* (rake) /ihala/ produced as *'ihala'* /ihala/).

Specific phoneme substitution was used across all age groups. This process occurred in the target word *'iphalishi'* (porridge) /ip<sup>h</sup>aliji/ produced as *'ipharishi'* /ip<sup>h</sup>arifi/, in every group other than Group 2. It can be assumed that the target transcription for this word should be altered, and this should not be considered as a developmental process.

Vowel elision in the medial and final position, and vowel substitution were noted across all age groups. Vowel elision in the word-final position was the process used most frequently across all age groups. The process of elision is present in adult speech and should not be considered as a developmental process (e.g., *'inkomishi'* (cup) /i<sup>ɹ</sup>komiji/ produced as *'inkomish'* /i<sup>ɹ</sup>komij/).

Phonological processes at a phoneme level			1	2	3	4	5	6	7	8
Group	Process	Target	E.g.							
	Backing	ijiji	ikiji							
	Consonant harmony	itafula	itatula							
	Deaspiration	i! <sup>h</sup> ude	i!ude							
	Denasalization	i <sup>ɲ</sup> tʃebe	tʃebe							
	Dentalization	i!anda	i/anda							
	Fronting	i/geke	iteke							
	Phoneme insertion	unesi	inɛks							
	Postvocalic devoicing	ihala	ihala							
	Simplification of co-articulated phonemes	i/geke	i/eke							
	Specific phoneme substitution	ip <sup>h</sup> aliji	ip <sup>h</sup> arifi							
	Stopping	i/i/i	iti/i							
	Voicing	isi!gɔk'ɔ	is!gɔ							
	Vowel elision (medial)	isiɬaɬa	isɬaɬa							
	Vowel elision (final)	ijeti	ijɛt							
	Vowel substitution	unesi	inɛsi							
Phonological processes affecting syllable structure										
	Initial syllable deletion	ijɛti	ʃɛti							
	Final syllable deletion	iwaji	iwaj							
	Medial syllable deletion	isiɬaɬa	iɬaɬa							

Key:

	100% of participants used the process
	75% of participants used the process
	50% of participants used the process
	25% of participants used the process
	0% participants used the process

Figure 6. Frequency of use of phonological processes across the age groups.

At a syllable level, phonological processes included initial, final and medial syllable deletion. Medial syllable deletion was present across many age groups, however from the age of 3;6 was only used in the word '*isihlahla*' (tree) /isiɬaɬa/ which was produced as '*ihlahla*' /iɬaɬa/. Initial and final syllable deletion occurred across all age groups. These processes are present in adult speech (e.g., '*itafula*' (table) /itafula/ produced as '*tafula*' /tafula/; '*isigqoko*' (hat) /isi!gɔk'ɔ/ produced as '*isgqo*' /is!gɔ/). A general decrease in the use of phonological processes can be noted with an increase in age.

### **4.3.3 Summary: Relational analysis.**

On average PCC scores were higher than the corresponding PVC scores. A general trend was noted in the increase of PCC and PVC scores across the age groups. Vowel elision, substitution, and syllable deletion were present across the age groups; however these processes are present in adult speech. A general decrease could be noted in the frequency of use of phonological processes across the age groups. Phonological processes still present in Group 8, which are not common in adult speech, include deaspiration, post vocalic devoicing and the simplification of co-articulated phonemes.

### **4.4 Chapter Summary**

In summary, plosives, implosives, fricatives, affricates and nasals are amongst the first phonemes to develop, with clicks and approximants developing last. No change was noted in the development of word shapes after 3;6 years, at which age the bi- and tri-syllabic word shapes had been mastered; however the development of word shape could have been influenced by the choice of target words and the target transcription used. The accuracy of production of words increased across the age groups with participants in Group 8 having the highest PCC and PVC scores and using the least phonological processes. The most common processes, where skilled processes which included vowel elision and initial and final syllable deletion.

## Chapter 5 – Discussion

The aim of the study was to describe the phonological development of first language Zulu-speaking children between the ages of 2;6 and 6;5. There is currently limited research available on Zulu phoneme acquisition. The findings of this study contribute to this limited database. The results may assist with clinical practice, as clinicians working with Zulu-speaking children find it challenging to effectively identify, assess and manage SSDs in a situation where language specific norms, assessment and evidence-base is lacking. A single-word Zulu phonology assessment was developed during the course of the study and was used to assess 32 typically developing first language Zulu-speaking children in Manguzi, in South Africa's KwaZulu-Natal province. In this chapter, the results from the study are discussed and compared to data available for other Bantu languages (including the small set of Zulu studies) and related to theoretical frameworks that inform our knowledge of phonological development.

### 5.1 Phoneme acquisition

From the results it was noted that three patterns of development were evident in Zulu phoneme acquisition: Phonemes that are acquired before 2;6 years and present throughout the age groups sampled in this study; phonemes which are acquired later than 2;6 but before 6;5; phonemes which did not follow a clear developmental pattern. These groups will be discussed separately.

#### 5.1.1 Early acquisition.

The first developmental pattern included phonemes already developed at 2;6 years. In terms of consonant acquisition, participants had acquired plosives, the implosive, affricates and nasals by 2;6 years. Similarly, in Tswana and Swahili plosives, nasals and affricates are amongst the first consonants to develop (Gangji et al., 2014; Mahura, 2014); whereas, in Xhosa, nasals and the implosive develop early, in contrast plosives and affricates were some of the last phonemes to develop, as these groups were incomplete at 6;0 (Maphalala et al., 2014). Differences noted between Bantu languages emphasize the importance of studying each language separately. Many Zulu phonemes appear to develop relatively early; which is in agreement with studies of development in other Bantu languages (Gangji et al., 2014; Mahura, 2014; Maphalala et al., 2014; Naidoo et al., 2005).

It is challenging to compare the findings from the current study to Zulu phoneme acquisition data collected from Naidoo et al.'s (2005) study, due to differences in method. Although it was noted in their study that plosives, approximants and the implosive were present in the youngest group, it cannot be determined whether the participants were able

to produce affricates and nasals, as no opportunity to produce these phonemes was provided.

Vowels were acquired before the age of 2;6 by the participants within the current study. These findings concur with another study on Zulu phoneme acquisition (Naidoo et al., 2005), as well as studies of other Bantu languages which found that vowels develop before the age of 3;0 (Gangji et al., 2015; Mahura, 2014; Maphalala et al., 2014). Unfortunately, the target word chosen to assess the closed vowel /o/ was 'ixoxo' (frog) /i||o||o/. During the first assessments, it became apparent that the correct transcription for this word in the dialect spoken in Manguzi was /i||ɔ||ɔ/. Thus the closed vowel did not appear within the assessment and cannot be discussed.

The early acquisition of vowels, nasals and plosives in Zulu, are in line with the theory of universals as discussed by Jakobson (1968). Eight of the nine clicks were present in the inventory of Group 1 (2;6–2;11), which is in contrast to the findings from Naidoo et al.'s (2005) study, which proposed that clicks are later developing phonemes. However, this finding is similar to Xhosa in which 10 of the 16 clicks were produced correctly by children between 3;0 and 3;6 years (Maphalala et al., 2014). This is in contradiction to the theory of universals, as according to that hypothesis, clicks should be amongst the last phonemes to develop. It could be suggested that in Zulu, as in Xhosa as discussed by Maphalala et al. (2014), the frequency of use of clicks in everyday language makes these familiar phonemes to children learning Zulu.

### **5.1.2 Phonemes acquired before 6;5.**

The second pattern of acquisition included sounds that developed after 2;6 years, but were acquired before the age of 6;5. These included the prenasalized phonemes and clicks. Each of these groups will be discussed separately.

#### **5.1.2.1 Prenasalized phonemes.**

Prenasalized phonemes were still developing in Groups 1, 2 and 7. This is in line with the findings in Naidoo et al.'s (2005) study in which the prenasalized consonants were amongst the phonemes produced least. Interestingly, some of the phonemes still developing in Group 1 differed from those in Groups 2 and 7. /<sup>m</sup>ɸf/ was still developing in Group 1; /<sup>n</sup>ts/ and /<sup>n</sup>tʃ/ in Group 2 and /<sup>n</sup>ts/ in Group 7. The participant in Group 1, who was unable to produce /<sup>m</sup>ɸf/, simplified this sound to a fricative /f/, thus denasalising the phoneme (e.g., 'umfana' (boy) /u<sup>m</sup>fana/ produced as 'ufana' /ufana/). /<sup>n</sup>tʃ/ was denasalized by two participants in Group 1 (e.g., 'intshebe' /i<sup>n</sup>tʃɛbɛ/ (beard) was produced as 'itshebe' /itʃɛbɛ/), but was acquired and mastered from the age of 3;0 onwards. The corresponding affricates /dʒ/ and /tʃ/ were within the phoneme inventory of all groups, thus it is likely that

although the phonemes were present, the process of nasalization was still developing at the age of 2;6. As discussed by Khumalo (1987), classification of prenasalized phonemes has been debated as there are no clusters in Zulu. However, the later development of these prenasalized co-articulated phonemes could be related to the complexity of producing the elements of these phonemes. Prenasalized phonemes are not common in other Bantu languages, making these phonemes rare across languages. The late acquisition of these phonemes is thus in line with the theory of universals (Jakobson, 1968).

#### **5.1.2.2 Clicks.**

Conclusions cannot be drawn regarding the development of clicks in Zulu as six clicks were not included in the assessment (i.e. /ŋ!g/; /!ʰ/; /ŋ!g/; /ŋ!/; /!ʰ/; /ŋ!g/). These clicks were excluded from the study as appropriate target words could not be found. The discussion below relates to the clicks which were included in the study. As findings from Maphalala et al. (2014) suggest that some complex clicks develop early, assumptions cannot be made about the order of development of the clicks omitted from the current study in relation to the theory of universals.

Nine of the 15 clicks were assessed within the current study. The clicks appeared to be acquired from 4;0, which is earlier than noted in Xhosa, in which the clicks were acquired by 5;0 according to Maphalala et al. (2014). Lewis (1994) also suggests that clicks are amongst the last phonemes to develop in Xhosa. Group 6 had mastered all of the clicks within the assessment, however Group 7, had an incomplete click inventory. These results could indicate that although clicks may appear early, refinement and mastery of the clicks continues past the age of 6;5. This is similar to findings in Xhosa (Maphalala et al., 2014). As was found in Xhosa, in Zulu /ŋ/, /!/ and /ŋ!/ were acquired by all of the age groups. /!g/ was acquired from 4;0 years. The remaining clicks had unique developmental patterns and will be discussed individually.

The palatal /!/ and aspirated palatal click /!ʰ/ were present in the inventory of Group 1 and 2 and appeared to be developing in Group 3. On further analysis, it was noted that the target words were modelled for participants in Group 1 and 2, which could account for this confounding age effect (Edwards & Beckman, 2008). However in Group 7, two participants produced /!ʰ/ without aspiration as /!/ (e.g., 'iqhude' (male chicken) /i!ʰude/ produced as 'iqude' /i!ude/).

The same developmental pattern cannot be explained for /!g/ and /!ʰ/ as the target words 'isigqoko' (hat) and 'isixubho' (toothbrush) are common and were not modelled for participants in Group 1. These phonemes were acquired by Group 1, were seen to be developing in Groups 2 and 3, and acquired thereafter. Participants who had not yet

acquired /!g/ often pronounced it as /!/ (e.g., *'isigqoko'* (hat) /isi!gɔk'ɔ/ pronounced as *'isiqoko'* /isi!ɔk'ɔ/) and /||/ as /|/ (e.g., *'isixubho'* (toothbrush) /isi||ubɔ/ pronounced as *'isicubo'* /isi|ubɔ/). The target word *'ixoxo'* (frog) /i||ɔ||ɔ/ was included in the assessment in order to assess the acquisition of the vowel, as discussed earlier. Consonants were only analysed within the target word to ensure consistency throughout the study, however most of the participants who were unable to produce /||/ in the target word *'isixubho'* (toothbrush) /isi||ubɔ/, were able to produce it within *'ixoxo'* (frog) /i||ɔ||ɔ/, showing that the length of the target word could affect the findings of phoneme acquisition. Had the word *'ixoxo'* been chosen as the target for /||/, this phoneme would have been acquired by all age groups. This finding would have been in agreement with Tuomi, Gxhilishe, and Matomela (2001), Maphalala et al. (2014) and Mowrer and Burger (1991), that the three basic clicks develop early. This shows the close relationship between phonology and the lexicon, and how phonology can be influenced by the specific lexical items chosen for use in speech assessments. Many studies (including the present one) focus on one specific domain of language (e.g., phonology), but there is a great need for work which contains more closely the relationship between different domains (e.g., phonology and the lexicon). Stoel-Gammon (2011) reviewed this relationship through a literature review, concluding this as a bi-directional relationship occurring between birth and 4;0 years. This relationship should be considered in future research.

In contrast to the previous target word, *'igceke'* (yard) was modelled for many participants across the age groups, as it was difficult to illustrate or explain. This phoneme was acquired by all age groups other than Groups 3 and 7. However, similarly to /!g/, this phoneme was simplified from /|g/ to /|/ (e.g., *'igceke'* (yard) /i|geke/ produced as *'iceke'* /i|eke/). The developmental patterns seen in the clicks /!g/, /|g/ and /!ʰ/ cannot be explained by the theory of universals, discussed by Jakobson (1968) as a progressive developmental pattern was not noted. It is possible that the developmental pattern seen for these phonemes could be related to individual differences due to the small scale of the current study.

Although the clicks have been studied within a few Xhosa based studies (e.g., Gxhilishe, 2004; Lewis, 1994; Maphalala et al., 2014; Mowrer & Burger, 1991), minimal research has been conducted on the development of clicks in Zulu. Although the developmental pattern of the clicks was inconsistent, it is of interest to note that eight of the nine clicks assessed appeared within the inventory of children between the ages of 2;6 and 2;11, which is in agreement with previous studies of Bantu languages which suggest that the majority of clicks develop early (Maphalala et al., 2014; Mowrer & Burger, 1991;

Tuomi et al., 2001). Gxilishe (2004) proposed that the three basic clicks, in Xhosa, have already developed before the age of 1;6. Within the current study, all three clicks were present in Group 1 (2;6–2;11) and were mastered by the age of 4;0. Previous studies have suggested the order of development of the basic clicks in Xhosa as dental, palatal and then lateral (Gxilishe, 2004; Mowrer & Burger, 1991). Due to the limitation with the target words in this study, a clear developmental pattern of the Zulu clicks cannot be determined from the data. However, within Group 1, the dental // and lateral click // were mastered, whilst the palatal click /!/ was developing, tentatively suggesting that the palatal click could be the last to develop in Zulu. Within the study by Naidoo et al. (2005), the dental click // was the only click included in the speech sound inventory of participants between the ages of 3;0–5;1 years; whereas no clicks were included in the inventory for participants between the ages of 5;2–6;2. Findings from the current study have expanded on these findings, although many limitations are evident.

### 5.1.3 Phonemes with an unclear developmental pattern.

The last group of phonemes to be discussed includes the fricatives and approximants, which appeared to have an unclear developmental pattern within the current sample. The fricatives were acquired by every group other than Groups 6 and 7, and were produced correctly by 50% of participants within these age groups. Interestingly, the phoneme that was missing from both age group's inventory was /h/, which was devoiced in the participants production of *'ihhala'* (rake) /ihala/ produced as *'ihala'* /ihala/. As this phoneme is present in the earlier (i.e. 2;6–5;0 years) and later groups (i.e. 6;0–6;5 years), it is possible that the mispronunciation of this sound within these age groups was due to personal variation rather than indicative of a developmental pattern. This is one of the limitations of using a small group of participants. In the study by Naidoo et al. (2005), /h/ was produced infrequently and was not included in the speech sound inventory for any age groups. In Xhosa, this phoneme is noted to develop early, before the age of 3;0 (Maphalala et al., 2014).

The approximants were only complete in Group 2. However, during the study it was noted that the use of the target word *'iphalishi'* (porridge) /ip<sup>h</sup>alifi/ was not an appropriate target to assess the phoneme /l/. This word is produced by most adults within this area as *'ipharishi'* /ip<sup>h</sup>arifi/. This was the substitution used by every participant not producing the phoneme /l/. Thus, no conclusions can be drawn for the approximant /l/. The target word should be changed in future research. The approximant /l/ was included in the phonemic inventory of children between 3;0–6;2 years by Naidoo et al. (2005), it is thus likely that this

phoneme would have been present in the inventory of participants from at least Group 2 onwards, had a more appropriate target word been chosen.

#### 5.1.4 'Late Eight'.

Bleile (2013) discusses the 'late eight' phonemes of English, the last phonemes to develop in the language, and thus the most difficult. The eight phonemes are /θ/, /ð/, /s/, /z/, /l/, /r/, /ʃ/ and /tʃ/. As the frequency of use of phonemes differs across languages, it is expected that phonemes will develop at different ages. The current study did not include all of the phonemes in Zulu, which means that the last set of consonants to emerge in this language cannot yet be determined. However, from the phonemes that were included within the study, a tentative list of 'late' phonemes would include /h/, /dʒ/, /ʰts/, /!h/, /!g/, /!g/ /!g/ and /ŋ!/. These phonemes showed continued development after the age of 3;11. The approximant /l/ was not included in the list, because the late acquisition of this phoneme appears to have been affected by the target word chosen to sample it. It is likely that the difficulty noted in finding target words for some of the phonemes omitted from the study relates to the frequency of use of those phonemes within Zulu, thus some of these would be considered marked phonemes (Zamuner et al., 2005). A comprehensive list of the late eight in Zulu would probably include some of the phonemes omitted from the study.

## 5.2 Word shape development

Word shape development was analysed in terms of the number of syllables produced in relation to the target word. Although the pronunciation of the word was not taken into account, syllable structures were analysed in relation to their adult targets, and thus a five-syllable word produced as four syllables was considered an incomplete five-syllable structure, not a complete four-syllable structure. Methods of analysis of word shape development differ across studies.

Naidoo et al. (2005) analysed the word shapes produced in a spontaneous speech sample, which was different to the analysis used in the current study. General findings on word shape development between these two studies are thus not comparable.

In comparison to Xhosa and Tswana, word shape development in Zulu appears to occur slightly later. Xhosa children acquire words consisting of two to four syllables by 3;0; whilst at least 75% of participants could produce five- and six-syllable word shapes from the age of 3;7 (Maphalala et al., 2014). In Tswana the four-syllable word shape is present at 3;0 (Mahura, 2014). Findings from the current study are most similar to findings of Swahili word shape development, in which word shapes consisting of one to three syllables were

present from the age of 3;0, whilst complex syllable structures were still developing after 5;11 years (Gangji et al., 2014). Findings for word shape development within the current study can be related to the theory of universals as longer word shapes and more complex syllable structures are acquired later. As Zulu and Xhosa share similar language structures and are both from the Nguni language family, it would be expected that findings of word shape development between these two languages would be similar. This will be discussed further.

The production of four-syllable words in the current study was inhibited by the deletion of initial and final syllables. Due to the conjunctive orthography noted in Bantu languages, prefixes and suffixes in Xhosa often hold morphological meanings, as discussed by Gxilishe, de Villiers and de Villiers (2007), and the pre-prefix is often omitted. Further analysis should be carried out within Zulu, as the development of word shape could be affected by this. Thus it could appear that word shape development is delayed, when in fact the participant's morphology is still developing (e.g., in the word '*amasokisi*' (socks) '*ama-*' is the class six prefix which indicates plural). This highlights the point made earlier about the need to look beyond phonology into other linguistic domains, despite starting off with a view to describe only phonology. As similar morphological rules guide Xhosa and Zulu, it is unlikely that the differences in word shape development would have been influenced by morphological rules. However, exposure to conversations and discussions throughout the course of the study revealed shortening of words used by adult speakers, which could affect the production of target words by the participants. Adult productions of each target word could be studied further to ensure that the target transcriptions are appropriate, as this could have further affected word shape development, causing differences in findings between Zulu and Xhosa.

In relation to word shape development, it is important for SLPs working with Zulu-speaking patients to consider the conjunctive orthography of the language during assessment. In English, multisyllabic words are often used as a diagnostic marker for speech disorders, such as childhood apraxia of speech (Davis, Jakielski, & Marquardt, 1998; Forrest, 2003). The inability to produce a long word correctly in Zulu could be related to the developing understanding of morphology rather than the complexity of production of a longer utterance. Thus, choice of target words in assessing the production of longer utterances is complicated in Zulu and should be researched further. Allie, Singh and Pascoe (2015) are carrying out research that considers the nature of Xhosa stimuli required for a valid and reliable assessment of apraxia of speech in adults who are first language speakers of Xhosa, and the results of their study will likely have implications for speakers of Zulu.

Within the current study, factors affecting the analysis of word shape development could include the chosen target word. Although the production of many of the five-syllable words approximated adult speech, they did not produce the number of syllables targeted within the word list; furthermore the deletion of initial and final syllables also appears to be a common process in Zulu. This is a short-coming of the study, as these adult targets should have been considered more carefully during the development of the assessment, to ensure that the transcriptions were as close to adult speech as possible. Khumalo (1987) suggested that vowel coalescence includes the lowering and deletion of vowels and aspects of palatalisation may be morphologically based. A more recent study by van der Spuy (2014) builds on this theory, suggesting that vowel lowering and palatalisation are morphologically based, thus present in adult speech and not to be considered as phonological processes. This will be discussed further within the study limitations.

### **5.3 Relational analysis**

#### **5.3.1 PCC and PVC scores.**

As consonants were assessed in the penultimate syllable only; PCC scores were calculated to include all consonants within the words, to allow for a more generalized assessment of the percentage produced correctly. As a relational analysis was not used in the study by Naidoo et al. (2005) these results are discussed in relation to other Bantu languages.

A general trend towards a more accurate production of consonants was noted across the age groups, starting from 89% PCC score in Group 1, with the final group reaching close to the ceiling with a PCC score of 98%. However, Groups 2 and 7 did not follow the same trend. Group 2 had an average PCC of 87%. The regression of accuracy in this group could be attributed to one participant who scored a low PCC score of 70% (the lowest score throughout the study), resulting in a standard deviation of 11,76. Due to the small scale of this study, individual results can significantly alter findings. These findings cannot be related to gender bias, as Group 2 consisted of four boys and Group 7 consisted of three girls and one boy. Children between the ages of 4;0 and 5;6, showed no progression in the accuracy of production, as these groups maintained a PCC score of 97%, with the last group scoring 98%. This could indicate that development reaches a plateau from the age of 4;0, however other aspects of language not included within this study could have been developing within this time. PCC scores within this study are similar to scores in Xhosa, which ranged from 91–97% between the ages of 3;0 and 5;11 (Maphalala et al., 2014). These scores would suggest that children's accuracy of speech production is close to target speech from the age of 4;0.

In studies of Xhosa and Swahili, PVC scores were consistently higher than the PCC scores of their corresponding group (Gangji et al., 2014; Maphalala et al., 2014). This was not in agreement with findings in Tswana (Mahura, 2014) or Zulu. In the current study, PVC scores ranged between 75–90%. Although vowels were seen to emerge early in Zulu, and all vowels were present at the start of the study, phonological processes such as initial and final consonant deletion, vowel elision and vowel substitution significantly altered the accuracy of the use of vowels throughout the study. These processes will be discussed further in the following section.

### **5.3.2 Phonological processes.**

Within the diagnostic framework, Dodd (2005a) identifies four categories of speech disorders in which the nature and use of the phonological processes affect the interpretation of results for an individual. In order to classify children correctly within these groups, norms need to be available regarding the phonological processes present in typical speech development and the age of elimination of these processes. Without appropriate norms, a child could be classified as having a consistent phonological disorder rather than a phonological delay or an articulation disorder. The therapy for each of these categories would differ depending on the severity of the delay or disorder. Although norms cannot be derived from the current study due to the small sample size and the inclusion of repetition to assess phonemes, the results from this study can be used to identify typical phonological processes which are apparent in the development of Zulu children between the ages of 2;6 and 6;5. This framework has been applied to the study of other languages (e.g., German: Fox & Dodd, 2001; Putonghua: Hua & Dodd, 2000; Tswana: Mahura, 2014; Xhosa: Maphalala et al., 2014; Cantonese: To et al., 2012). The most common processes used within this study were skilled processes which included vowel elision and initial and final syllable deletion. Of the developmental processes, simplification of co-articulated phonemes and vowel substitution were amongst the most frequently used.

Various processes occurred across the age groups, and are present in adult speech. Although they have been listed as phonological processes; they are not indicative of a developmental pattern and should not be considered as developmental, but rather as skilled processes used to approximate adult speech. These processes include vowel elision, specific phoneme substitution (particularly /l/ to /r/) and syllable deletion. These will be discussed individually.

Vowel elision is widely used in the speech of Xhosa and Zulu children and adults (Blevins, 2005; Khumalo, 1987; Maphalala et al., 2014; van der Spuy, 2014b). The target words used within the current study should have been altered to allow for this process.

Vowel elision is a common process in Tswana, which often results in the creation of /s/C clusters (Mahura, 2014). In Zulu this process, when used in the word-medial position, followed similar patterns to Tswana, often creating an /s/C ‘cluster’ as seen in the creation of the VCCVCV word shape (e.g., *‘isitulo’* (chair) /isit’ulo/ produced as *‘istulo’* /ist’ulo/; *‘isibhedlela’* (hospital) /isibɛɛɛla/ produced as /isbɛɛɛla/). Vowel deletion used in this position has been discussed by Cook (2013) as a non-permanent, late developing rule, due to the formation of ‘clusters’ which are not considered to be present in Zulu. The inclusion of clusters due to vowel elision has been discussed within other Bantu languages (e.g., Tswana: Mahura, 2014; Palai & O’Hanlon, 2004; Rose & Demuth, 2006). Similarly vowel elision was apparent in the word-final position; this process changes the structure of words creating a closed syllable structure (VCVC), which is not a common word shape in Zulu (e.g., *‘isheti’* (shirt) /ifeti/ produced as *‘ishet’* /ifet/).

The substitution of the approximant /l/ with /r/ (e.g., *‘iphalishi’* (porridge) /ip<sup>h</sup>aliʃi/ produced as *‘ipharishi’* /ip<sup>h</sup>ariʃi/), was noted consistently across all groups (other than Group 2) and for most participants was the only word in which they used a specific phoneme substitution. It was noted during the data collection, that the research assistant also uses this process. This should be considered as a common pronunciation of the word in Manguzi, making this an inappropriate word choice to assess the acquisition of /l/. It can thus not be deduced from the data whether this phoneme is acquired or not. This specific substitution should not be considered as a developmental phonological process within this study. It highlights the need to have a group of adult speakers from the geographical region produce the selected words in a natural way prior to the development of a speech assessment, so that a clear and appropriate version of the target production (or productions) can be obtained to assist with transcription. Due to dialectal differences and evolution of languages, the productions of words as recorded in dictionary entries may be outdated. The expert panel within this study consisted of seven individuals (of which five live in Manguzi); it is thus likely that fair representations of target words could have been obtained if the review process included asking each panel member to say the word aloud and in a natural way.

Syllable deletion was present in every age group within the study. Initial syllable deletion was the most common process affecting syllable structure, present in every participant’s speech. In most cases, this pertained to only a vowel, however, as the initial syllable in Zulu is often a V structure, it was decided to classify this process as syllable deletion rather than vowel elision as it affected the word shape (e.g., *‘itafula’* (table) /itafula/ produced as *‘tafula’* /tafula/). Although this process was present throughout the

assessment, a general trend in decrease of frequency of use was noted as Group 1 used this process 56 times, whilst it only occurred 14 times in Group 8. As this process appears to be present in adult speech, it should not be considered as a developmental process, but rather related to the adult production of the language and perhaps the evolution of Zulu over time. Furthermore, the use of medial syllable deletion after 3;5 years was only present in the word '*isihlahla*' (tree) /*isitata*/ produced as '*ihlahla*' /*itata*/. As this was present in 50% or more of participants' production in the older groups (Groups 5–8), it can be assumed that this production is adult-like, and should not be considered as a developmental phonological process. The inclusion of this word within the wordlist should be reviewed in future research. From the above it can be noted that in Zulu vowel elision and initial and final syllable deletion are skilled processes used by children to approximate adult speech. This is important for SLPs working in Zulu to note, as therapy would not be indicated.

The use of phonological processes decreased across the age groups, with children in Group 1 (2;6–2;11 years) using more processes than children in Group 8 (6;0–6;5 years). This pattern has been observed in studies of many languages, including other Bantu languages (Gangji et al., 2014; Mahura, 2014; Maphalala et al., 2014) and languages more generally. Although there are still 10 processes present in Group 8, many of these should not be considered as developmental processes, but rather skilled processes of adult speech. Phonological processes across the age group have been adjusted according to the above discussion in Figure 7; skilled processes have been removed from the table, as well as 'processes' related to inappropriate target words (e.g., '*iphalishi*' (porridge)). Processes only used by one participant within a group have also been removed. In Figure 7, the decrease in use of processes can be seen more clearly. Within English, processes such as initial consonant deletion are considered as atypical processes, however within the current study, this was viewed as a skilled or non-developmental process, thus highlighting the importance of developing norms for different languages.

Processes common in Xhosa included deaspiration, deaffrication, denasalization, stopping and gliding of liquids (Maphalala et al., 2014). Although some of these processes were apparent in Zulu, they were not used commonly. The most common processes used in Zulu, as seen in Figure 7, included vowel substitution, postvocalic devoicing, simplification of co-articulated phonemes, specific phoneme substitution, post-vocalic devoicing and dentalization. The differences noted in the use of phonological processes between these two similar Bantu languages increases the importance of studying each language individually. Although it has been argued that Xhosa and Zulu are two variants of the same language (Accredited language services, 2015), the different phonological processes used

indicate that children undergo different developmental paths, increasing the importance of viewing them separately.

Developmental phonological processes at a phoneme level			1	2	3	4	5	6	7	8
Group			2;6- 2;11	3;0- 3;5	3;6- 3;11	4;0- 4;5	4;6- 4;11	5;0- 5;5	5;6- 5;11	6;0- 6;5
Process	Target	E.g.								
Deaspiration	i!hude	i!ude								
Denasalization	i <sup>n</sup> tʃeβe	tʃeβe								
Dentalization	i!anda	i/anda								
Phoneme insertion	unesi	ineks								
Postvocalic devoicing	iħala	ihala								
Simplification of co-articulated phonemes	i/geke	i/eke								
Specific phoneme substitution	i <sup>n</sup> tʃanzi	i <sup>n</sup> tlanzi								
Vowel substitution	unesi	inesi								
Phonological processes affecting syllable structure										
Medial syllable deletion	isit'ulɔ	ist'ulɔ								

Key:

	100% of participants used the process
	75% of participants used the process
	50% of participants used the process
	25% of participants used the process
	0% participants used the process

Figure 7. Phonological processes across the age groups (with non-developmental processes removed).

In relation to Dodd's (2005b) diagnostic framework, tentative suggestions for normal developmental processes could include:

- Medial syllable deletion and phoneme insertion (not present after the age of 3;6)
- Denasalization (not present after the age of 4;6)
- Dentalization and specific phoneme substitution (not present after the age of 6;0)
- Deaspiration, postvocalic devoicing, simplification of co-articulated phonemes and vowel substitution (still present after 6;5 years)

Phonological processes present in other languages, which were not observed during the course of the study and could tentatively be considered atypical processes in Zulu include:

- Gliding of liquids
- Deaffrication
- Depalatalisation
- Reduplication

#### **5.4 The developmental phase model**

Findings from the current study are discussed in relation to the developmental phase model as described by Stackhouse and Wells (2001). This model has been used in studies of other Bantu languages (e.g., Tswana: Mahura, 2014; Xhosa: Maphalala et al., 2014).

As can be seen in Figure 8, participants between the ages of 2;6 and 3;11 appear to be in the systematic simplification phase, as they used the most developmental processes. These findings are in agreement with findings from Tswana and Xhosa, as participants between the ages of 3;0 and 3;11 for those languages also fell within this phase (Mahura, 2014; Maphalala et al., 2014). Although participants within the current study between the ages of 4;0–5;5 had transitioned into the assembly phase, as they used fewer phonological processes and had higher PCC and PVC scores, participants in Group 7 remained in the systematic simplification phase. The reason for this was thought to be due to individual differences as it cannot be attributed to gender, and the other groups follow a progressive developmental pattern. In Tswana, children were in the assembly phase between 4;0–4;5 years (Mahura, 2014), and within Xhosa between the ages of 4;6–6;0 (Maphalala et al., 2014). Even when considering the regression noted in Group 7, children acquiring Zulu appeared to move into the assembly phase at the same age as Tswana-speaking children and slightly earlier than Xhosa-speaking children. As information regarding metaphonological development was not collected during the current study, it is unclear when children are transitioning into this phase. As studies by Mahura (2014) and Maphalala et al. (2014) had an upper age limit of 6;0, children within Group 8 of the current study cannot be compared to their participants. Children in Group 8 used minimal phonological processes and had the highest PCC score of 98%, it therefore seems likely that they would be metaphonologically skilled.

The previous (Naidoo et al., 2005) and current study on Zulu speech development did not include the development of tone or metaphonological information. The

development of tone would contribute to information within the systematic simplification phase and would thus impact on the findings as related to the developmental phase model. Including information related to metaphonology, such as pre-literacy and written language skills, would assist with bridging the gap in the transition between the assembly phase and the normal development phase. As tone is an important element in Zulu, impacting on the meaning of words, future studies focusing on Zulu language development should not overlook this element of language. Through studying these two elements, a more conclusive model of Zulu language development could be proposed.

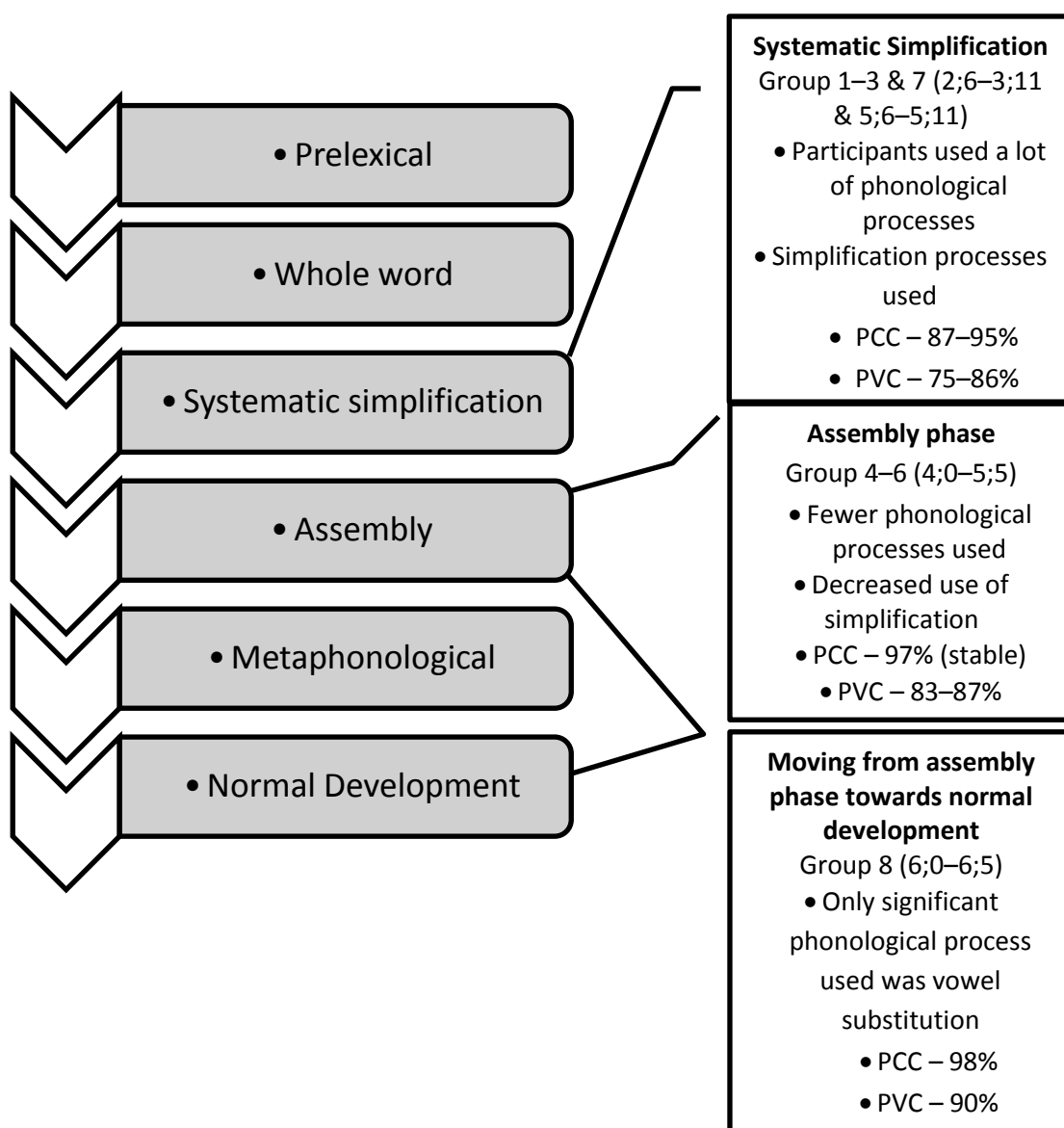


Figure 8. A developmental phase model based on Zulu (adapted from Stackhouse and Wells (2001)).

## 5.5 Summary

Within this chapter the results of the study were discussed in relation to theories of phonological acquisition. The results are compared to other Bantu languages such as Xhosa,

Tswana and Swahili. There appear to be three trends of acquisition which include phonemes developing before 2;6, those developing before 6;5 with a relatively clear developmental pattern and phonemes with an unclear developmental pattern. From the phonemes included within the study, the 'late eight' sounds include /h/, /dʒ/, /<sup>n</sup>ts/, /!h/, /!g/, /!g/ /!g/ and /ŋ//. Word shape development plateaus at the age of 3;6, as two- and three-syllable shapes were mastered by this age, but words consisting of four and five syllables were not developed by 6;5, likely due to processes present in adult speech. The use of phonological processes decreased throughout the study, processes seen to occur most frequently were also noted in adult speech and were thus not considered as developmental phonological processes.

## Chapter 6 – Clinical implications and conclusion

This final chapter discusses the clinical implications of the study findings. The limitations of the study are discussed, as well as future research opportunities to enhance the current study and field of knowledge. Finally the conclusions of the study are presented.

### 6.1 Clinical implications

There is limited normative data available for the assessment of children in Zulu, thus English norms are often used for the assessment of this population. As no published and formal assessments are available for the assessment of Zulu speech and language development, a single-word Zulu phonology assessment was developed for the purpose of the current study. The development of this assessment was based on similar studies conducted in other languages (Gangji et al., 2014; Mahura, 2014; Maphalala et al., 2014). Throughout the study it was noted that further analysis and adjustment of the current assessment needs to be made, however, the foundations of this assessment can be used to provide a starting point from which modification can be made. The illustrations used within the assessment were clear and appropriate for the children within the study. Furthermore, the increase in the lower age limit showed that this type of assessment can be conducted with children as young as 2;6 years. SLPs working with Zulu-speaking children will now have a speech assessment that can be used informally in clinical practice. This assessment can be carried out by SLPs who are not first language Zulu-speaking, as the target word, cues and IPA transcriptions are available within the assessment. This assessment can be used as a guideline, as norms are not available for Zulu, and should not be used diagnostically. Phonemes which were omitted from the assessment could be assessed through modelling the target words. The target words could be included as follows: /ŋ!g/ 'ingqathu' (skipping); /l<sup>h</sup>/ 'ichibi' (lake); /j/ 'iyoyo' (yo-yo); /ŋ!g/ 'ingxabano' (quarrel); /ŋ!/ 'inqulu' (hip); /l<sup>h</sup>/ 'ixhumela' (high heel); /ŋ!g/ 'ingcebo' (wealth) and /kɫ/ 'iklasi' (class). During the study no appropriate words were identified to assess the phonemes /<sup>h</sup>dz/; /ts/; /o/. However, it may be possible to identify words that could be modelled, rather than illustrated to assess these phonemes in future studies.

The current study provides preliminary data on the development of Zulu vowels, consonants, word shapes and phonological processes. Prior to this study, preliminary data available was from Naidoo et al. (2005). This data was expanded on, by including both younger and older children and using a more structured single-word assessment, thus allowing for relational analysis. The preliminary normative data collected within this study details information of both consonant and vowel acquisition, discussing the order and age

of development of each phoneme; word shape development, including the use of syllable structures at different ages and a relational analysis which documents PCC and PVC scores as well as phonological processes present within each age group. Although the results from this study cannot be generalized to a greater population, it provides the foundations for a larger study.

In order to categorize the information collected within the current study effectively, findings were analysed in light of the developmental phase model (Stackhouse & Wells, 1997). Although similar stages of development were noted, no information could be provided on the transition through the metaphonological phase. As found in Tswana (Mahura, 2014) and Xhosa (Maphalala et al., 2014), Zulu-speaking children appear to move through the phases earlier than English-speaking children. Thus further demonstrating the importance of the development of norms for each language, as using English norms would result in the under-diagnosis of language delays.

A tentative illustration of phonological processes in a first language Zulu-speaking child at the age of 6;5 years can be seen in Figure 9 and can be used to assist in a clinical setting. Through further research this illustration would be expanded and adapted to include a description of each age group, as well as examples of each process in Zulu to assist clinicians who are not first language Zulu-speaking.

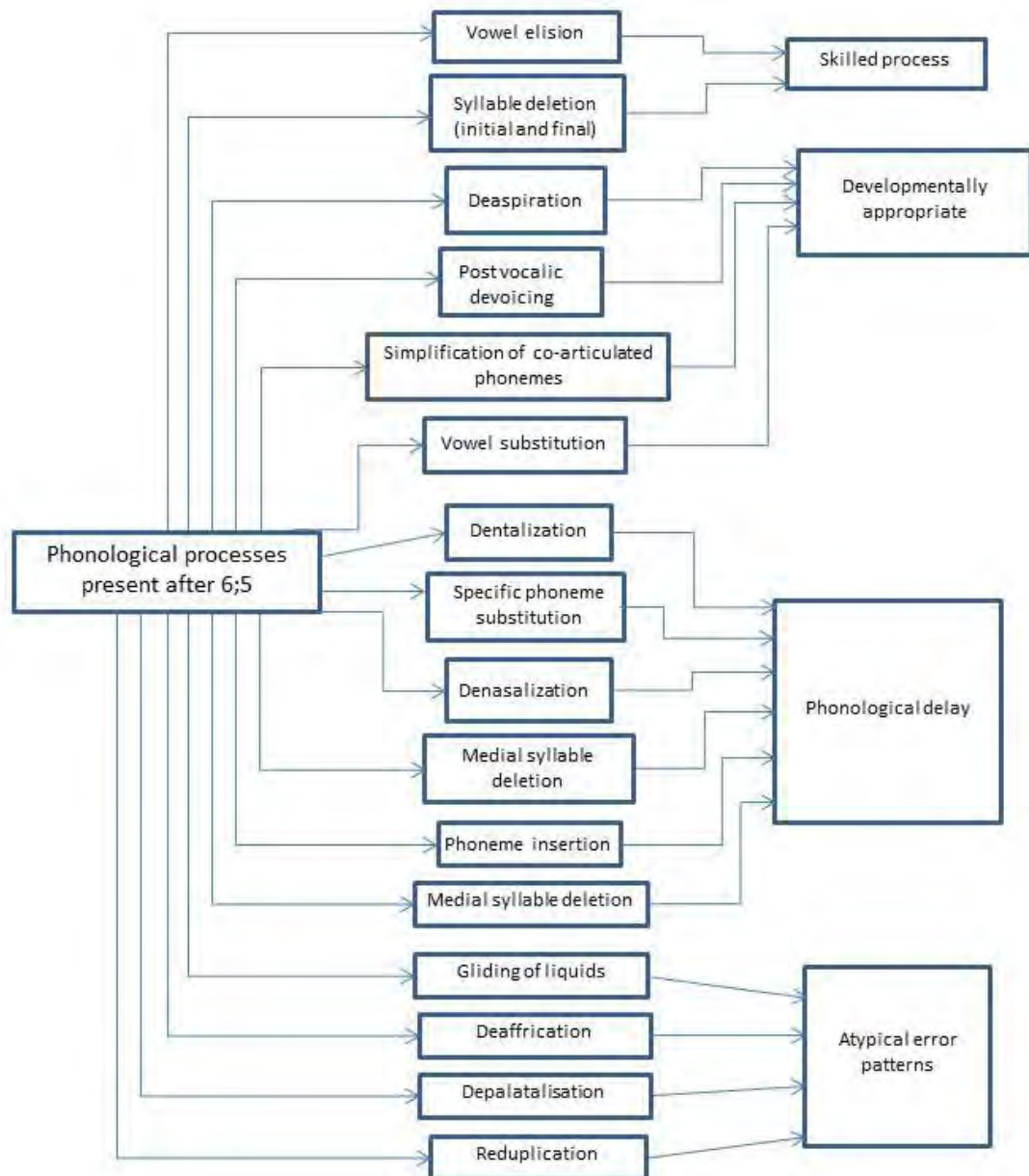


Figure 9. Tentative classification of phonological processes in Zulu at 6;5 years.

## 6.2 Limitations

There are several limitations associated with the current study. These should be considered when utilizing the findings from this study, as these limitations impact on the findings. These are discussed in terms of sample size, the assessment tool, the study personnel and limited previous research in Zulu.

### 6.2.1 Sample size.

A sample size of 32 children is limited. With the separation of children into six month age categories, only four participants were included in each group. With a sample of this size, individual differences can dramatically affect the entire group. This was seen in the PCC score in Group 2, as well in the phonological processes and classification of Group 7. If a larger sample had been used, these differences may have been less noticeable.

Future studies could build on this work by including a larger sample size, as seen in studies of other languages, which ranged between 129 and 1 726 participants (e.g., British English: Dodd et al., 2003; Putonghua: Hua & Dodd, 2000; Québécois French: MacLeod et al., 2011; Hong Kong Cantonese: To et al., 2012).

Although the upper and lower age limit in the current study were broader (2;6–6;5) than previous studies (e.g., Tswana and Zulu: 3;0–6;0 (Mahura, 2014; Maphalala et al., 2014); Swahili: 3;0–5;11 (Gangji et al., 2014)), the majority of phoneme acquisition appeared to occur before the age of 2;6. As seen in the younger groups of this study, many of the target words had to be modelled for them, emphasizing the difficulties which would occur should the lower age limit be decreased. For younger children to be included in this study a different method would need to be used, such as naturalistic observation, as discussed by Mahura (2014). However, in the study of language acquisition, naturalistic observation presents challenges, as noted in previous studies (Conradie, Jeggo, Purchase, Rosewall, & Winfield, 2011; Naidoo et al., 2005), as participants are not given the opportunity to produce all phonemes, and productions are interpreted according to the researcher's interpretation of the environment and utterance. Another alternative would be to devise an assessment that uses real objects rather than pictures, use word repetition tasks or rely on parental report / parental checklists. Although it is beneficial to increase the age limit of the study, there are limitations associated with this. For example, having increased the upper limit of the study could have skewed results as older children may have had more exposure to English, affecting their phoneme acquisition.

As all of the participants were from the same area and were enrolled at one of the three data collection sites, influence of dialect and teaching could be apparent in this study. The findings from the current study cannot be generalised to any other area. Mahura's (2014) study is currently being developed through work which attempts to detail some Tswana dialects more carefully rather than assuming there is only one variety of the language. This could be a consideration when building on the present study.

### **6.2.2 Assessment tool.**

As no assessment tool was available to assess the acquisition of Zulu, a single-word assessment tool was developed and illustrated by the researcher specifically for the purposes of the study. This was an important and large component of the project which brought with it many challenges.

#### **6.2.2.1 Target transcriptions.**

Although the assessment tool was reviewed by a panel of experts; within this analysis the adult targets were not discussed. When analysing the data, many processes

used in adult speech were identified. These processes affect the development of word shape as well as the acquisition of certain phonemes; however they are not considered as developmental phonological processes as they occur within adult speech; they are likely used due to evolution of the Zulu language. Although it appears that processes were used to produce these words, they approximated the adult targets. Had this been adjusted in the original word list, changes could have been made to ensure that appropriate targets were included for every phoneme and word shape, assisting with the correct analysis of the data. During the expert panel review, an adult recording of production should have been included in order to standardise the target transcription.

#### **6.2.2.2 Word choice.**

Some of the target words chosen to assess phoneme acquisition consisted of four to five syllables, in order to assess word shape development. The length of these words could have affected the production of the targeted phoneme. It would thus be more appropriate to have a separate section to assess word shape development, which would not affect the age of acquisition of phonemes. Furthermore, some of the words were difficult for the participants to identify. In these cases a model was given and the repeated response was accepted as a production. This mostly occurred in the younger groups. The repetition of modelled speech is more accurate than spontaneous speech, which could result in a confounding age effect (Edwards & Beckman, 2008). This effect was noted in the production of some phonemes between Groups 1, 2 and 3. In order to control for this in further research, Edwards and Beckman (2008) suggest using imitation for all stimuli across all age groups. This could also assist in the lowering of the lower age limit.

Within the current study, the target words often resulted in words being modelled for the participants to repeat. This was not included during data analysis, should further research be conducted, and imitation not be used throughout the assessment, this should be considered within data analysis to identify discrepancies.

#### **6.2.2.3 Omission of phonemes.**

Ten phonemes, including six clicks (i.e. /ŋ!g/; /!ʰ/; /ŋ||g/; /ŋ!;/ /||ʰ/; /ŋ|g/), were omitted from the word list due to difficulty in illustrating appropriate target words. This impacted on the results of phoneme acquisition, as the age of acquisition cannot be projected for the omitted phonemes. Furthermore the difficulty in finding target words is likely to be correlated with the frequency of use of these phonemes in Zulu. These phonemes would probably develop later and could have been included within the late eight set. The vowel /o/ was inadvertently omitted from the study as the target word chosen was pronounced in a way that differed to the standard production as predicted by the

dictionary. Acquisition of this phoneme could not be discussed. Although modelling of the target words could affect the production of the sound, it would have been more appropriate to include these words as modelled targets rather than to omit them completely, as acquisition could then have been discussed. As discussed previously, in order to make results more accurate in relation to modelled targets, all targets should be modelled. Through the use of this method the confounding age effect and the omission of phonemes would be overcome.

#### ***6.2.2.4 Single production per phoneme.***

There was only one opportunity provided for the production of phonemes in the penultimate position. This decision was taken to ensure the assessment was not too long, and allowing for participants to complete the assessment without becoming distracted. However, there are limitations to this method, as findings might over-estimate the age of acquisition. In order to correct this without lengthening the assessment significantly, phonemes not produced by each participant should have been modelled, to assess stimulability. This would have allowed for further discussion and analysis of phone acquisition.

#### ***6.2.2.5 Suprasegmental aspects of phonology.***

The current study did not consider the development of tone in Zulu or assess metaphonological skills. This is a short-coming of the study that could be addressed in future research. Tone is an important aspect of Zulu as it can alter the meaning of a word. The inclusion of analysing tone within the assessment would allow for a more comprehensive assessment of the development of Zulu phonology. Through including assessment of pre-literacy awareness, a more comprehensive model of development of Zulu would also be supported.

#### **6.2.3 Study personnel.**

Although the main researcher has had exposure to Zulu and has worked with a Zulu-speaking population for the past four years, she is not fluent in Zulu. This could have affected the original transcriptions of the target words chosen for the assessment, and rendered the expert panel review increasingly more important. Edwards and Beckman (2008) also highlight the importance of transcriptions being done by a first language speaker of the language being assessed, as well as strengthening the reliability of transcriptions by having more than one person transcribing all of the data. Although 10% of the transcriptions were transcribed by a more experienced SLP, and 20% of the data was retranscribed by the researcher, it would have been beneficial to have a first language speaker review the recordings and transcriptions, in order to increase the reliability of the

findings. Important information, such as the substitution of vowels being related to a specific cue, may have been overlooked. However, through the use of a first language Zulu-speaking research assistant, context and feedback could be provided to the researcher to assist with the correct understanding of the responses. Furthermore, through using standardized cues for words, responses tended to be standard amongst participants.

#### **6.2.4 Limited research.**

As there is limited information available on the acquisition of Zulu, there was a limited amount of data with which to compare the results of the current study. Thus, it was assumed for some productions that the process was related to the influence of adult speech; however there was often limited evidence to justify this reasoning. It is also not known whether these processes are dialectal, or whether they are used by adult Zulu speakers in different geographical areas. If this information had been available at the start of the study, adjustments would have been made to the assessment as appropriate, resulting in findings being more reliable.

### **6.3 Future research**

This study provides a foundation for future research in order to develop norms for children's speech development in Zulu. It builds on previous research which analysed Zulu phoneme acquisition within spontaneous speech samples, conducted by Naidoo et al. (2005). Future research in Zulu could be conducted as follows:

- The same study design could be followed, altering the word list to include all phonemes within Zulu, altering the target transcriptions to approximate adult targets, changing some target words as discussed, using separate targets for phoneme acquisition and word shape development and including the modelling and repetition of phonemes produced incorrectly, in order to validate and expand on the results found within the current study.
- The sample size could be increased in order to gather normative data. In doing this, participants from different geographical areas could be included to allow for generalization of the results. A normative study on British English conducted by Dodd et al. (2003) included 684 participants between the ages of 3;0 and 6;11. Using a sample of this size would prevent individual differences from affecting the outcome of each age group.
- Assessment of early acquisition of speech sounds in Zulu could be conducted by using a spontaneous speech sample from children between the ages of 1;0 and 2;6, as it was found that much phoneme acquisition

occurs before the age of 2;6. A spontaneous speech sample should be used as a single-word picture naming assessment would not be appropriate for children below the age of 2;6. This could follow a similar design to the study of Xhosa language development conducted by Conradie, Jeggo, Purchase, Rosewall and Winfield (2011). Otherwise a single-word picture (or object) naming assessment could be used with younger groups, with each item being modelled to assist with production. This would need to be consistently done for every participant throughout the study.

- Once a sample has been assessed, a percentage of participants could be reassessed to ensure test-retest reliability of the assessment.

As there is limited research in most of the official languages in South Africa, it is important that similar research is conducted in other languages to better understand the differences between languages; guiding the assessment and treatment used by SLPs and ultimately making SLP services more relevant and valuable for the entire population of the country. As there are a limited number of resources available to assess first language Zulu-speaking children, reviewing and finalizing the assessment used within the current study could benefit SLPs working with Zulu-speaking children. Even with only limited normative data, this assessment could be used by SLPs who are not fluent in Zulu to identify phonemes that are challenging or phonological processes that may need to be addressed. This type of information is much needed by SLPs who may then also be able to provide input into future research to refine the assessment.

#### **6.4 Conclusion**

This study aimed to describe speech sound acquisition in first language Zulu-speaking children between 2;6 and 6;5 years. This was conducted through the use of a single-word picture naming assessment designed specifically for the purposes of the project, in the absence of any other Zulu speech assessment. The data was analysed in terms of the age of acquisition of phonemes, the development of word shapes and syllable structures, PCC, PVC and phonological processes. The findings from this study were compared with findings from similar studies conducted in other Bantu languages.

Some phonemes were omitted from the assessment, as discussed in the limitations of the study. From the phonemes included, it was found that plosives, the implosive, affricates, nasals and vowels are acquired before the age of 2;6. Prenasalized consonants were the next category to be acquired by the age of 3;6 (although a regression could be noted in Group 5); whilst clicks were acquired from the age of 4;0 (with a regression noted in Group 7). A clear developmental pattern could not be determined for the approximants

and fricatives; however with regard to the approximants, this appeared to be related to word choice rather than phoneme acquisition. The 'late eight' (Bleile, 2013), in Zulu may include the phonemes /h/, /dʒ/, /ʰts/, /!ʰ/, /!g/, /!g/ /!g/ and /ŋ//, but further research would be needed to verify this since not all consonants were included in the study.

Word shape development appeared to plateau at the age of 3;6, as two- and three-syllable word shapes were mastered by this age; four- and five-syllable word shapes appeared to be developing throughout this study, however this was largely influenced by vowel elision and syllable deletion, which are skilled processes used in adult speech. The initial and final syllable structures were mastered by the age of 3;0, thus not influencing word shape development.

The use of phonological processes decreased with age in Zulu, as expected. The only developmental phonological process still present in more than 50% of the participant's speech at the age of 6;5 was vowel substitution. Common processes used throughout the study are present in adult speech and should thus be considered as skilled processes, rather than developmental phonological processes. The accuracy of speech production in Zulu increases with age. This fits with studies of other languages (e.g., British English: Dodd et al., 2003; Swahili: Gangji et al., 2015; Putonghua: Hua & Dodd, 2000; Tswana: Mahura, 2014; Xhosa: Maphalala et al., 2014; Tuomi et al, 2001).

The results were considered in light of Stackhouse and Wells' (1997, 2001) developmental phase model. It was found that in Zulu, as in studies of other Bantu languages (e.g., Tswana: Mahura, 2014; Xhosa: Maphalala et al., 2014), the same stages of development are noted as for English. Bantu-language speakers may move through the phases earlier than English-speaking children, showing the importance of conducting studies and developing language specific norms. However, suggestions made regarding Zulu and the developmental phase model are tentative and will need to be developed further by studies focusing more comprehensively on aspects such as tone, metaphonological awareness and written language. As discussed by Southwood and van Dulm (2015) and Pascoe and Norman (2013), there is a lack of culturally and linguistically appropriate resources in South Africa. This study contributes to needs-based research on speech development in Zulu and aims to support SLPs working within this language. Further development of this work may lead to the standardization of a Zulu speech assessment which would be an important step towards ensuring that SLP services are available and relevant to first language Zulu-speaking children within South Africa.

## References

- Accredited language services. (2015). No Title. Retrieved from <https://www.alsintl.com/resources/languages/Zulu/>
- Allen, M. M. (2013). Intervention efficacy and intensity for children with speech sound disorder. *Journal of Speech, Language and Hearing Research, 56*, 865–877. doi:10.1044/1092-4388(2012/11-0076)Journal
- Allie, N., Singh, S., & Pascoe, M. (2015). An isiXhosa speech assessment tool for adults with apraxia of speech: Research findings and clinical implications. In *Paper presented at the SAAA/SASLHA Conference, November 2015*.
- Baker, E. (2004). Phonological analysis summary and management plan. *Speech Pathology Australia, 6*(1), 14–18.
- Baker, E., Croot, K., Mcleod, S., & Paul, R. (2001). Psycholinguistic models of speech development and their application to clinical practice. *Journal of Speech, Language & Hearing Research, 44*, 685–702.
- Baker, E., & McLeod, S. (2011a). Evidence-based practice for children with speech sound disorders: Part 1 narrative review. *Language, Speech, and Hearing Services in Schools, 42*(2), 102–139. doi:10.1044/0161-1461(2010/09-0075)b
- Baker, E., & McLeod, S. (2011b). Evidence-based practice for children with speech sound disorders: Part 2 application to clinical practice. *Language, Speech & Hearing Services in Schools, 42*, 140–151. doi:10.1044/0161-1461(2010/10-0023)b
- Bernthal, J., & Bankson, N. (Eds.). (1994). *Child phonology: Characteristics, assessment and intervention with special populations*. New York: Thieme Medical Publishers, Inc.
- Bird, J., Bishop, D. V., & Freeman, N. H. (1995). Phonological awareness and literacy development in children with expressive phonological impairments. *Journal of Speech and Hearing Research, 38*(2), 446–462. doi:10.1044/jshr.3802.446
- Bleile, K. M. (2013). *The late eight* (Second edi.). San Diego, CA: Plural Publishers.
- Blevins, J. (2005). *Evolutionary phonology. The emergence of sound patterns*. Cambridge: Cambridge University Press.
- Bowen, C., & Cupples, L. (2006). PACT: Parents and children together in phonological therapy. *Advances in Speech-Language Pathology, 8*(3), 282–292.
- Brand South Africa. (2015). SouthAfrica.info. Retrieved September 5, 2015, from <http://www.medioclubsouthafrica.com/landstatic/80-languages#isizulu>

- Brinton, L. J., & Brinton, D. (2010). *The linguistic structure of modern English*. Amsterdam, Philadelphia: John Benjamins Publishing Company.
- Brumbaugh, M., & Smit, B. (2013). Treating children ages 3-6 who have speech sound disorder: A survey. *Language, Speech, and Hearing Services in Schools, 44*, 306–319. doi:10.1044/0161-1461(2013/12-0029)Preschoolers
- Clark, M. (1988). An accentual analysis of the isiZulu noun. In H. van der Hulst & N. Smith (Eds.), *Autosegmental studies on pitch accent* (pp. 51–81). Holland: Foris Publications.
- Cohen, W., & Anderson, C. (2011). Identification of phonological processes in preschool children's single-word productions. *International Journal of Language & Communication Disorders, 46*(4), 481–488. doi:10.1111/j.1460-6984.2011.00011.x
- Conradie, A., Jeggo, Z., Purchase, M., Rosewall, J., & Winfield, L. (2011). *Early phonological development in isiXhosa: a single case study*. University of Cape Town.
- Cook, T. (2013). *Morphological and phonological structure in Zulu reduplication*. University of Pennsylvania.
- Cope, A. T. (1983). *A comprehensive course in the Zulu language* (Revised.). KwaZulu-Natal: Department of Zulu Language and Literature.
- Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed approaches* (Third edit.). Los Angeles: Sage. doi:10.1002/1521-3773(20010316)40:6<9823::AID-ANIE9823>3.3.CO;2-C
- Crosbie, S., Holm, A., & Dodd, B. (2005). Intervention for children with severe speech disorder : A comparison of two approaches. *International Journal of Language & Communication Disorders, 40*, 467–491. doi:10.1080/13682820500126049
- Davis, B. L., Jakielski, K. J., & Marquardt, T. P. (1998). Developmental apraxia of speech: Determiners of differential diagnosis. *Clinical Linguistics & Phonetics, 12*(1), 25–45. doi:10.3109/02699209808985211
- de Lacy, P. (Ed.). (2007). *The Cambridge handbook of phonology*. Cambridge: Cambridge University Press.
- De Lamo White, C., & Jin, L. (2011). Evaluation of speech and language assessment approaches with bilingual children. *International Journal of Language & Communication Disorders, 46*, 613–627. doi:10.1111/j.1460-6984.2011.00049.x
- Demuth, K. (1995). Markedness and development of prosodic structure. In J. Beckman (Ed.), *Proceedings of the North Eastern Linguistic Society 25* (pp. 13–25). Amherst, MA:

GLSA, University of Massachusetts.

- Demuth, K. (2007). Sesotho speech acquisition. In S. McLeod (Ed.), *The International Guide to Speech Acquisition* (pp. 528–538). Clifton Park, NY: Thomson Delmar Learning.
- Demuth, K. A., & Suzman, S. M. (1997). Language impairment in Zulu. In E. M. Hughes & A. Green (Eds.), *Proceedings of the 21st Annual Boston University Conference on Language Development* (Vol. 1, pp. 124–135). Somerville: Cascadilla Press.
- Dodd, B. (2005a). Children with speech disorder: Defining the problem. In B. Dodd (Ed.), *Differential Diagnosis and Treatment of Children with Speech Sound Disorders* (Second Edi.). London: Whurr.
- Dodd, B. (2005b). *Differential diagnosis and treatment of children with speech sound disorders*. (B. Dodd, Ed.) (Second edi.). London: Whurr.
- Dodd, B., Crosbie, S., McIntosh, B., Holm, A., Harvey, C., Liddy, M., ... Rigby, H. (2008). The impact of selecting different contrasts in phonological therapy. *International Journal of Speech-Language Pathology*, *10*(5), 334–345. doi:10.1080/14417040701732590
- Dodd, B., Holm, A., Crosbie, S., & Hua, Z. (2005). Children's acquisition of phonology. In B. Dodd (Ed.), *Differential diagnosis and treatment of children with speech sound Disorders* (Second edi., pp. 24–43). London: Whurr.
- Dodd, B., Holm, A., Hua, Z., & Crosbie, S. (2003). Phonological development: a normative study of British English-speaking children. *Clinical Linguistics & Phonetics*, *17*(8), 617–643. doi:10.1080/0269920031000111348
- Dodd, B., Hua, Z., Crosbie, S., Holm, A., & Ozanne, A. (2002). *Diagnostic evaluation of articulation and phonology (DEAP)*. London: Psychology Corporation.
- Durand, J. (1990). *Generative and non-linear phonology*. London: Routledge.
- Edwards, J., & Beckman, M. E. (2008). Methodological questions in studying consonant acquisition. *Clinical Linguistics & Phonetics*, *22*(12), 937–956. doi:10.1080/02699200802330223
- Eisenberg, S. L., & Hitchcock, E. R. (2010). Using standardized tests to inventory consonant and vowel production: A comparison of 11 tests of articulation and phonology. *Language, Speech & Hearing Services in Schools*, *41*, 488–503.
- Forrest, K. (2003). Diagnostic criteria of developmental apraxia of speech used by clinical speech-language pathologists. *American Journal of Speech-Language Pathology*, *12*(3), 376–380. doi:10.1044/1058-0360(2003/083)

- Fox, A. V, & Dodd, B. (2001). Phonologically disordered German-speaking children. *American Journal of Speech-Language Pathology*, 10(3), 291.
- Frith, A. (2011a). Census 2011. Retrieved September 5, 2015, from <http://census2011.adrianfrith.com/place/527>
- Frith, A. (2011b). Census 2011. Retrieved September 5, 2015, from <http://census2011.adrianfrith.com/place/582029>
- Gangji, N., Pascoe, M., & Smouse, M. R. (2014). Swahili speech development: preliminary normative data from typically developing pre-school children in Tanzania. *International Journal of Language & Communication Disorders*, 50(2), 151–164. doi:10.1111/1460-6984.12118
- Gildersleeve-Neumann, C. E., Kester, E. S., Davis, B. L., & Peña, E. D. (2008). English speech sound development in preschool-aged children from bilingual English-Spanish environments. *Language, Speech & Hearing Services in Schools*, 39, 314–328.
- Gildersleeve-Neumann, C. E., & Wright, K. L. (2010). English speech acquisition in 3- to 5-year-old children learning Russian and English. *Language, Speech & Hearing Services in Schools*, 41, 429–445.
- Gillon, G. T. (2005). Facilitating phoneme awareness development in 3- and 4-year-old children with speech impairment. *Language, Speech & Hearing Services in Schools*, 36, 308–324.
- Golafshani, N. (2003). Understanding reliability and validity in qualitative research. *The Qualitative Report*, 8(4), 597–606.
- Grunwell, P. (1987). *Clinical phonology* (Second ed.). Beckenham, England: Croom Helm.
- Gxilishe, S. (2004). The acquisition of clicks by IsiXhosa-speaking children. *Per Linguam*, 20(2), 1–12.
- Gxilishe, S., de Villiers, P., & de Villiers, J. (2007). The acquisition of subject agreement in Xhosa. In A. Belikova, L. Meroni, & M. Umeda (Eds.), *Proceedings of the 2nd conference on generative approaches to language acquisition North America (GALANA)* (pp. 114–123). Somerville: Cascadilla Proceedings Project.
- Hawkins, P. (1984). *Introducing phonology*. London: Hutchinson & Co. Ltd.
- Hesketh, A., Adams, C., Nightingale, C., & Hall, R. (2000). Phonological awareness therapy and articulatory training approaches for children with phonological disorders: a comparative outcome study. *International Journal of Language & Communication*

*Disorders*, 35(3), 337–354.

Hua, Z. H. U., & Dodd, B. (2000). The phonological acquisition of Putonghua (Modern Standard Chinese). *Journal of Child Language*, 27(1), 3–42.

International Expert Panel on Multilingual Children's Speech. (2012). Multilingual children with speech sound disorders: position paper, 1–5. Retrieved from [www.csu.edu.au/research/multilingual-speech/position-paper](http://www.csu.edu.au/research/multilingual-speech/position-paper)

Jakobson, R. (1968). *Child language, aphasia and phonological universals*. The Hague: Mouton.

Jensen, E. S. (2012). Markedness, participation and grammatical paradigms: Jakobson and Hjelmslev revisited. *Nordic Journal of Linguistics*, 35(2), 145–168.  
doi:10.1017/S0332586512000170

Kamhi, A. G. (2006). Treatment decisions for children with speech-sound disorders. *Language Speech and Hearing Services in Schools*, 37, 271–279.

Khumalo, J. (1987). *An autosegmental account of Zulu phonology*. Unpublished PhD thesis. University of the Witwatersrand.

Kothari, C. R. (2006). *Research methodology: Methods and techniques* (Second ed.). Delhi: New Age International Publisher. Retrieved from [http://books.google.co.za/books?hl=en&lr=&id=8c6gkbKi-F4C&oi=fnd&pg=PR7&dq=research+methodology+&ots=iGoCuXN4rH&sig=gaE8qbIRXnSlxkfqclD0N6iwPWw#v=onepage&q=research methodology&f=false](http://books.google.co.za/books?hl=en&lr=&id=8c6gkbKi-F4C&oi=fnd&pg=PR7&dq=research+methodology+&ots=iGoCuXN4rH&sig=gaE8qbIRXnSlxkfqclD0N6iwPWw#v=onepage&q=research%20methodology&f=false)

Law, J., Boyle, J., Harris, F., Harkness, A., & Nye, C. (2000). Prevalence and natural history of primary speech and language delay: Findings from a systematic review of the literature. *International Journal of Language & Communication Disorders*, 35(2), 165–188.

Lewis, B. A., Freebairn, L. A., & Taylor, H. G. (2000). Academic outcomes in children with histories of speech sound disorders. *Journal of Communication Disorders*, 33, 11–30.

Lewis, P. (1994). *Aspects of the phonological acquisition of clicks in Xhosa*. University of Stellenbosch.

MacLeod, A. A. N., Sutton, A., Trudeau, N., & Thordardottir, E. (2011). The acquisition of consonants in Québécois French : A cross-sectional study of pre-school aged children. *International Journal of Speech-Language Pathology*, 13(2), 93–109.  
doi:10.3109/17549507.2011.487543

- Mahura, O. (2014). *The acquisition of Setswana phonology in children aged 3;0 - 6;0 years: a cross-sectional study*. University of Cape Town.
- Maphalala, Z., Pascoe, M., & Smouse, M. R. (2014). Phonological development of first language isiXhosa-speaking children aged 3;0–6;0 years: A descriptive cross-sectional study. *Clinical Linguistics & Phonetics*, *28*(3), 176–194.  
doi:10.3109/02699206.2013.840860
- McCormack, J., McLeod, S., McAllister, L., & Harrison, L. J. (2009). A systematic review of the association between childhood speech impairment and participation across the lifespan. *International Journal of Speech-Language Pathology*, *11*(2), 155–170.  
doi:10.1080/17549500802676859
- Mckinnon, D., & Reilly, S. (2007). The prevalence of stuttering, voice, and speech-sound disorders in primary school students in Australia. *Language Speech and Hearing Services in Schools*, *38*, 5–15. doi:10.1044/0161-1461(2007/002)
- McLeod, S. (Ed.). (2007). *The international guide to speech acquisition*. Clifton Park, NY: Thomson Delmar Learning.
- McLeod, S., & Harrison, L. J. (2009). Epidemiology of speech and language impairment in a nationally representative sample of 4- to 5-year-old children. *Journal of Speech, Language and Hearing Research*, *52*, 1213–1229.
- McLeod, S., van Doorn, J., & Reed, V. A. (2001). Normal acquisition of consonant clusters. *American Journal of Speech-Language Pathology*, *10*(2), 99–110.
- Mosaka, N. M. (2000). Stress assignment in syllabic structures in Xhosa and Tswana. *South African Journal of African Languages*, *20*(2), 177–185.  
doi:10.1080/02572117.2000.10587424
- Moskowitz, A. I. (1970). The two-year-old stage in the acquisition of English phonology. *Language*, *46*(2), 426–441. doi:137.158.158.60
- Mowrer, D. E., & Burger, S. (1991). A comparative analysis of phonological acquisition of consonants in the speech of 2 1/2-6 year old Xhosa- and English- speaking children. *Clinical Linguistics & Phonetics*, *5*(2), 139–164.
- Mullen, R., & Schooling, T. (2010). The national outcomes measurement system for pediatric speech-language pathology. *Language, Speech, and Hearing Services in Schools*, *41*, 44–61.
- Naidoo, Y., van der Merwe, A., Groenewald, E., & Naudé, E. (2005). Development of speech

sounds and syllable structure of words in Zulu-speaking children. *Southern African Linguistics and Applied Language Studies*, 23(1), 59–79.

doi:10.2989/16073610509486374

Oliveira, C., Lousada, M., & Jesus, L. M. (2015). The clinical practice of speech and language therapists with children with phonologically based speech sound disorders. *Child Language Teaching and Therapy*, 31(2), 173–194. doi:10.1177/0265659014550420

Owens, R. E. (2008). *Language development - An introduction* (Seventh.). New York: Pearson International Limited.

Palai, E. B., & O'Hanlon, L. (2004). Word and phoneme frequency of occurrence in conversational Setswana: a clinical linguistic application. *Southern African Linguistics and Applied Language Studies*, 22, 125–142. doi:10.2989/16073610409486366

Pascoe, M., Le Roux, J., Mahura, O., Danvers, E., de Jager, A., Esterhuizen, N., ... van der Merwe, A. (2015). Three-year-old children acquiring South African English in Cape Town. In *International Symposium of Monolingual and Bilingual Speech 2015*. Chania, Crete, Greece.

Pascoe, M., & Maphalala, Z. (2012). *Phonological development of first language isiXhosa-speaking a descriptive cross-sectional study*. University of Cape Town.

Pascoe, M., Maphalala, Z., Ebrahim, A., Hime, D., Mdladla, B., Mohamed, N., & Skinner, M. (2010). Children with speech difficulties: an exploratory survey of clinical practice in the Western Cape. *The South African Journal of Communication Disorders*, 57, 66–75.

Pascoe, M., & Norman, V. (2013). Are we there yet ? On a journey towards more contextually relevant resources in speech-language therapy and audiology. *South African Journal of Communication Disorders*, 60, 2–9. doi:10.7196/SAJCD.256

Paul, L. M., Simons, G. F., & Fennig, C. D. (Eds.). (2015). *Ethnologue: Languages of the world*. *Ethnologue* (18th Ed.). Texas: SIL International. Retrieved from <http://www.ethnologue.com/language/zul>

Penn, C., Frankel, T., Watermeyer, J., & Müller, M. (2009). Informed consent and aphasia: Evidence of pitfalls in the process. *Aphasiology*, 23(1), 3–32. doi:10.1080/02687030701521786

Poulos, G., & Bosch, S. E. (1997). *Zulu*. Munchen: Lincom Publishers.

Roach, P. (2009). *English phonetics and phonology glossary: A little encyclopaedia of phonetics*. Cambridge: University Press.

- Rose, Y., & Demuth, K. (2006). Vowel epenthesis in loanword adaptation: Representational and phonetic considerations. *Lingua*, *116*(7), 1112–1139.  
doi:10.1016/j.lingua.2005.06.011
- Roux, J. (2007). Unresolved issues in the representation and phonetic description of click articulation in Xhosa and Zulu. *Language Matters*, *38*(1), 8–25.  
doi:10.1080/10228190701640009
- Rvachew, S. (2007). Phonological processing and reading in children with speech sound disorders. *American Journal of Speech-Language Pathology*, *16*, 260–270.  
doi:10.1044/1058-0360(2007/030)
- Rvachew, S., Nowak, M., & Cloutier, G. (2004). Effect of phonemic perception training on the speech production and phonological awareness skills of children with expressive phonological delay. *American Journal of Speech-Language Pathology*, *13*(3), 250–263.  
doi:10.1044/1058-0360(2004/026)
- Shriberg, L., Austin, D., Lewis, B., McSweeney, J., & Wilson, D. (1997). The percentage of consonants correct (PCC) metric: extensions and reliability data. *Journal of Speech, Language & Hearing Research*, *40*, 708–722.
- South African Speech-Language-Hearing Association. (2011). Principles of ethics. Retrieved November 22, 2015, from  
<http://www.mm3admin.co.za/documents/docmanager/55E836D5-3332-4452-BB05-9F12BE8DA9D8/00012416.pdf>
- Southwood, F., & van Dulm, O. (2015). The challenge of linguistic and cultural diversity: Does length of experience affect South African speech-language therapists' management of children with language impairment? *South African Journal of Communication Disorders*, *62*, 1–14. doi:10.4102/sajcd.v62i1.71
- Stackhouse, J., Pascoe, M., & Gardner, H. (2006). Intervention for a child with persisting speech and literacy difficulties : A psycholinguistic approach. *Advances in Speech-Language Pathology*, *8*, 231–244. doi:10.1080/14417040600861029
- Stackhouse, J., & Wells, B. (1997). *Children's speech and literacy difficulties: A psycholinguistic framework* (Volume 9.). Wiley.
- Stackhouse, J., & Wells, B. (2001). *Children's speech and literacy difficulties 2: Identification and intervention*. London: Whurr Publishers.
- Stoel-Gammon, C. (2011). Relationships between lexical and phonological development in young children. *Journal of Child Language*, *38*(1), 1–34.

doi:10.1017/S0305000910000425

- Taljad, E., & Bosch, S. E. (2006). A comparison of approaches to word class tagging: Disjunctively vs. conjunctively written Bantu languages. *Nordic Journal Of African Studies*, 15(4), 428–442.
- To, C. K. S., Cheung, P. S. P., & McLeod, S. (2012). A population study of children's acquisition of Hong Kong Cantonese consonants, vowels, and tones. *Journal of Speech, Language, and Hearing Research*, 56, 103–123. doi:10.1044/1092-4388(2012/11-0080)
- Tuomi, S. K., Gxhilishe, S., & Matomela, L. (2001). The acquisition of Xhosa phonemes. *Per Linguam*, 17(1), 14–23.
- Van de Velde, M., Nurse, D., Bostoen, K., & Philippson, G. (2014). *The Bantu languages*. (D. Nurse & G. Philippson, Eds.). London: Routledge.
- van der Merwe, A., & Le Roux, M. (2014). Idiosyncratic sound systems of the South African Bantu languages: Research and clinical implications for speech-language pathologists and audiologists. *South African Journal of Communication Disorders*, 61(1), 1–8. doi:10.4102/sajcd.v61i1.86
- van der Riet, M., & Durrheim, K. (2007). Putting research into practice: Writing and evaluating research proposals. In T. B. M., K. Durrheim, & D. Painter (Eds.), *Research in practice* (pp. 80–111). Cape Town: UCT Press.
- van der Spuy, A. (2014a). Bilabial palatalisation in Zulu: A morphologically conditioned phenomenon. *Stellenbosch Papers in Linguistics Plus*, 44, 71–87. doi:10.5842/44-0-645
- van der Spuy, A. (2014b). The morphology of the Zulu locative. *Transactions of the Philological Society*, 112(1), 61–79. doi:10.1111/1467-968X.12004
- van Dulm, O., & Southwood, F. (2013). Child language assessment and intervention in multilingual and multicultural South Africa: Findings of a national survey. *Stellenbosch Papers in Linguistics*, 42, 55–76. doi:10.5774/42-0-147
- Waring, R., & Knight, R. (2013). How should children with speech sound disorders be classified? A review and critical evaluation of current classification systems. *International Journal of Language & Communication Disorders*, 25–40. doi:10.1111/j.1460-6984.2012.00195.x
- Wassenaar, D. R. (2007). Ethical issues in social science research. In M. Terre Blanche, K. Durrheim, & D. Painter (Eds.), *Research in practice* (pp. 60–79). Cape Town: UCT Press.

Yavas, M., & Goldstein, B. (1998). Phonological assessment and treatment of bilingual speakers. *American Journal of Speech-Language Pathology*, 7, 49–60.

Zamuner, T. S., Gerken, L., & Hammond, M. (2005). The acquisition of phonology based on input: A closer look at the relation of cross-linguistic and child language data. *Lingua*, 115(10), 1403–1426. doi:10.1016/j.lingua.2004.06.005

## Appendix A: Letter to KZN Department of Education

Dear Sir/Madam

Re: Permission to conduct research at schools in Manguzi

I am a Speech Therapist working at Manguzi Hospital and am currently registered as a Masters student in the Department of Communication Sciences and Disorders at the University of Cape Town. The course requirements include the completion of a research study. My chosen area of interest is the phonological (speech) development of first language Zulu-speaking children between the ages of two and a half and six and a half years.

Limited research exists on Zulu language development and it is therefore important for studies of this nature to be conducted in order to allow for therapy to be more culturally and linguistically appropriate. Furthermore it is important to expand the knowledge database for African languages.

The current study aims to document the order in which Zulu consonants and vowels develop as well as the development of syllable structures. The study will also aim to describe phonological processes which are present within the Zulu language. This data will be collected by showing the children a set of pictures and recording their responses.

Once approval has been granted by the department of education, the schools/crèches will be approached for approval from the principal. Children will be included in the study only once approval has been granted by their parent/legal guardian and the child verbally agrees to participate. Basic information on the child's development will be gathered in order to ensure that the child is typically developing. The participants will be assessed individually at the school over a two week period, with as little disruption caused to the school schedule as possible. Should any developmental delays be recognized during the assessment the participant will be referred to the relevant health professional.

I would hereby request for permission to conduct my research at schools and crèches within the Manguzi area.

I appreciate the time you have taken to consider this request, and will be in contact with you for your response. Please feel free to contact me should you have any questions.

This study has been granted Ethical clearance from the University of Cape Town Faculty of Health Sciences Human Research Ethics Committee.

Ethical Clearance number: HREC 671/2014

Kind Regards,

Zenia Jeggo  
Researcher  
084 363 4058

Dr Michelle Pascoe  
Research Supervisor  
021 406 6043

## Appendix B: Letter to principal of school/crèche

Dear Sir/Madam

Re: Permission to conduct research at ... school/crèche

I am a Speech Therapist working at Manguzi Hospital and am currently registered as a Masters student in the Department of Communication Sciences and Disorders at the University of Cape Town. The course requirements include the completion of a research study; my chosen area of interest is the phonological (speech) development of first language Zulu-speaking children between the ages of two and a half and six and a half years

Limited research exists on Zulu language development and it is therefore important for studies of this nature to be conducted in order to allow for therapy to be more culturally and linguistically appropriate. Furthermore it is important to expand the knowledge database for African languages.

The current study aims to document the order in which Zulu consonants and vowels develop as well as the development of syllable structures. The study will also aim to describe phonological processes which are present within the Zulu language. This data will be collected by showing the children a set of pictures and recording their responses.

Approval has been granted by the KZN Education Department (*attach letter of approval*). Children will be included in the study only once approval has been granted by you (the principal of the school), the parents/legal guardians and the child themselves. Basic information on the child's development will be gathered in order to ensure that the child is typically developing. The participants will be assessed individually at the school over a two week period, with as little disruption caused to the school schedule as possible. Should any developmental delays be recognized during the assessment the participant will be referred to the relevant health professional.

During the research process, the researcher will be available to answer questions and provide feedback. Findings from the study will be shared with your school once the study is completed.

I would hereby request for permission to conduct my research at your school.

I appreciate the time you have taken to consider this request, and will be in contact with you for your response. Please feel free to contact me should you have any questions.

This study has been granted Ethical clearance from the University of Cape Town Faculty of Health Sciences Human Research Ethics Committee

Ethical Clearance number: HREC: 671/2014

Kind Regards,

Zenia Jeggo  
Researcher  
084 363 4058

Dr Michelle Pascoe  
Research Supervisor  
021 406 6043

## Appendix C: Letter to parents/legal guardians (Zulu)

Mzali/Mbheki

Invitation to consent in your child's participation in research study titled:  
The phonological development of typically developing first language Zulu-speaking children aged 2; 6  
– 6; 5 years:

A descriptive cross-sectional study

NginguDokotela Wokukhuluma ngisebenza esibhedlela saseManguzi. Okwamanje ngenza izifundo zeMasters enyuvesi yaseKapa. Emnyangweni wezokuxhumana mayelana nesayensi kanye neDisorders. Njengengxenywe yokufunda engikwenzayo. Ngicelwe ukuba uphenyo lwami lugxile ekuthuthukiseni abaneminyaka esukela kwemibili kuye ezinyangeni eziyisithupha. Kanye nabaneminyaka eyisithupha kuye ezinyangeni eziyisithupha.

Lukhona uphenyo oluncane olwenziwe ukuthuthukisa ulimi lwesiZulu eNingizimu Afrika. Ngaleso sizathu luseluncane ulwazi olukhona ekuthuthukiseni isiZulu. Lolulwazi lubalulekile ekuthuthukiseni isiZulu. Lolulwazi lubalulekile ekuthuthukiseni oDokotela bokukhuluma, isiZulu izingane ezilutholayo.

Ingane yakho iyacelwa ukuba ibe yingxenywe yestudy njengoba ikhuluma isiZulu njengolimi lwayo lokuqala. Kumele kube ingane ephakathi kwaleminyaka engenhla.

Uma ngabe uvuma ukuthi ingane yakho ibe yingxenywe yalesistudy. Ngizovakashela esikoleni lapho ingane yakho ifunda khona ngiyobheka ukuthi iqhuba kanjani. Ngizobe sengiyikhomba izithombe bese ingitshela amagama azo. Lezo zimpendulo ezoba ingipha zona zobe ziqoshwa kwiAudio. Izimpendulo ezinikeziwe zizohlolwa kusetshenziswa i-Audio le obekuqoshwa ngayo. Ngenhloso yokubona ukukhuluma ngokuyikhona. Lesisivinyo sizokwenzelwa esikoleni futhi ngeke sithathe imizuzu engaphezu kwamashumi amabili.

Uma ukhetha ukuba ingane yakho ibe yingxenywe yokufunda unyayiyekisa noma ngasiphi isikhathi ayikho imibuzo ozobuzwa yona. Yonke imininingwane nomntwana wakho izokhishwa kwi-final document ukuze kuvikeleke wena nomntwana wakho. Uma uyingxenywe yalokhu kufunda umntwana wakho akanazingozi azohlangana nazo futhi akunankokhelo edingekayo ngokuba yingxenywe yaloluhlelo. Uma ngabe ingane yakho ithatha kancane uma kufundwa izodluliselwa koncweti bezempilo abafanelekile.

Ngiyabonga ngokuthatha isikhathi sakho ubheka lesi sicelo. Uma ukhetha ukuqhubeka nokufunda ngicela ugcwalise lelifom elilandelayo bese ulibuyisela kuthisha womntwana. Uma kunenkinga ohlangabezana nayo ungasabi ukungifonela. Ngicela ubhale nezimbolo zakho (zocingo) ukuze ngizokwazi ukukufonela ngaphambi kokuqala lezifundo, ukuze ngizoqinisekisa ukuthi uyakuqonda konke okubhaliwe.

Ikomidi leUCT FHS Human Research Ethics ungaxhumana nayo kulenombolo ethi 021 406 6338 uma ufuna ukwazi kabanzi ngalesi study.

Ozithobayo,

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Zenia Jeggo

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Research Supervisor

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Ngingu \_\_\_\_\_ Mzali/umbheki ka \_\_\_\_\_ Ngifundile noma ngifundelwe (ngo \_\_\_\_\_) lolulwazi olungenhla. Ngiyakuqonda lokhu okuceliwe mayelana nomntwana wami ngalokho ke ngikhethe ukuthi eqhubeke noma engaqhubeki kulokhu kufunda. Ngithathe lesisinqumo ngokwami futhi angeke ngize ngiphoqwe. Ngiyaqonda ukuthi umntwana wami engayeka noma yinini nomphumela ongemuhle.

Ngiyaqonda ukuthi umntwana wami uzobe eqoshwa uma ehlolwa futhi lokho okuzobe kuqoshiwe kuzohlaziywa emva kokufunda ukuze kutholwe ulwazi olubalulekile.

Inamba yami yocingo ithi \_\_\_\_\_

Sayina:

\_\_\_\_\_

\_\_\_\_\_

Mzali/Mbheki

Usuku nendawo

\_\_\_\_\_

\_\_\_\_\_

Mzali/Mbheki

Usuku nendawo

Ufakazi (kugcwalisa ngomzali/ngombheki uma esefundelwe leli form)

Ngingu \_\_\_\_\_ (igama lofakazi) ngilizwile lelifom elifundelwe umzali noma umbheki womntwana uma engathandi angeke ephoqwe noma ebhekwe kabi ukuthi akazange evume nomntwana wakhe ukuthi ebe yingxenye yaloluhlelo. Kukuwena mzali/mbheki womntwana ukuthi uyavuma nomntwana wakho noma cha.

Sayina:

\_\_\_\_\_

\_\_\_\_\_

Ufakazi

Usuku nendawo

#### **Ukuhlolwa kokukhula**

Ngiyabonga ukungipha ithuba lokunikela ngengane yakho kulezifundo, ngicela ungiphe imizuzwana ukugcwalisa leform.

Igama lengane \_\_\_\_\_

Igama lesikole \_\_\_\_\_

Uneminyaka emingaki \_\_\_\_\_

Ukhuluma luphi ulimi \_\_\_\_\_

#### **Ngokwempilo**

Kungabe ingane yakho kukhona inkinga yokugula enakho? Yebo/cha

Uma uthi yebo chaza ngokugula kwayo \_\_\_\_\_

Kungabe ingane yakho inenkinga yokuzwa? Yebo/cha

Kungabe ingane yakho inenkinga yokubona? Yebo/cha

Ngabe ingane yakho ike yadluliselwa kudokotela wokukhuluma noma wezindlebe? Yebo/cha

#### **Ulwazi ekuzalwaneni**

Ngabe zaba khona izinkinga ngesikhathi ukhulelwe noma usubeletha? Yebo/cha

Uma uthi yebo chaza kabanzi \_\_\_\_\_

Wayenezinyanga ezingaki umntwana wakho uma enza lokhu

1. ukuhlala \_\_\_\_\_
2. ukusukuma \_\_\_\_\_
3. ukuhamba \_\_\_\_\_
4. ukukhuluma \_\_\_\_\_ yiwaphi amagama akwazi ukuwakhuluma \_\_\_\_\_

Ngiyabonga ngokuthatha isikhathi sakho ukuthi uphendule lemibuzo

## Appendix D: OPE screener

Name: \_\_\_\_\_

Date of birth: \_\_\_\_\_

School: \_\_\_\_\_

Grade: \_\_\_\_\_

### OME

**Lips**            At rest            \_\_\_\_\_

                    Lip closure        \_\_\_\_\_

                    Lip rounding      \_\_\_\_\_

                    Lip Spreading     \_\_\_\_\_

**Tongue**        Size                \_\_\_\_\_

                    Elevation          \_\_\_\_\_

                    Lateralization    \_\_\_\_\_

                    Backing            \_\_\_\_\_

**Dentition**    Occlusion          \_\_\_\_\_

                    Hygiene            \_\_\_\_\_

                    Missing teeth     \_\_\_\_\_

**Hard Palate**   Cleft                \_\_\_\_\_

                    Arch                \_\_\_\_\_

**Velum**         Symmetry          \_\_\_\_\_

                    Movement during phonation \_\_\_\_\_

### **Diadochokinesis (DDK rate)**

**Production**    p p p                \_\_\_\_\_

                          t t t                \_\_\_\_\_

                          k k k                \_\_\_\_\_

                          p t k p t k p t k \_\_\_\_\_









### Appendix F: Example of picture card



### Appendix G: Final recording sheet and word list

Symbol (IPA)	Zulu	English	Target Transcription (IPA)	NoS	Transcription	Notes	Modelled target	Different from target
p <sup>h</sup>	iphepha	paper	ip <sup>h</sup> εp <sup>h</sup> a	3				
p'	ipeni	pen	ip' <sup>h</sup> eni	3				
<sup>m</sup> p	impuphu	mealie meal	i <sup>m</sup> pup <sup>h</sup> u	3				
b	ibhasi	bus	ibasi	3				
<sup>m</sup> b	imbali	flower	i <sup>m</sup> bali	3				
ɓ	ubaba	father	uɓaɓa	3				
ŋ	ingane	baby	iŋgan	3				
m	inkomishi	cup	i <sup>n</sup> kɔmifi	4				
f	itafula	table	itafula	4				
<sup>m</sup> ɸf	umfana	boy	u <sup>m</sup> ɸfana	3				
v	vula	open	vula	2				
<sup>m</sup> ɔv	imvula	rain	i <sup>m</sup> ɔvula	3				
t <sup>h</sup>	isicathulo	shoe	isi at <sup>h</sup> ulɔ	5				
t'	isitulo	chair	isit'ulɔ	4				
<sup>n</sup> t	intambo	rope	i <sup>n</sup> tamɓɔ	3				
d	idolo	knee	idɔɔ	3				
<sup>n</sup> d	indishi	dish	i <sup>n</sup> difi	3				
s	isisu	stomach	isisu	3				
<sup>n</sup> ts	insipho	soap	i <sup>n</sup> tsip <sup>h</sup> ɔ	3				
z	amazinyo	teeth	amazijɔ	4				
a	amazinyo	teeth	amazijɔ	4				
ɬ	isihlahla	tree	isiɬaɬa	4				
<sup>n</sup> tɬ	inhlanzi	fish	i <sup>n</sup> tɬanzi	3				
ɮ	isibhedlela	hospital	isibeɮela	5				
<sup>n</sup> dɮ	indlebe	ear	i <sup>n</sup> dɮεɓε	3				
l	iphalishi	porridge	ip <sup>h</sup> alifi	4				
n	unesi	nurse	unesi	5				

dʒ	ijezi	jersey	idʒezi	3			
e	ijezi	jersey	idʒezi	3			
ᵀdʒ	inja	dog	iᵀdʒa	2			
ʃ	isheti	shirt	ifeti	3			
tʃ	utshani	grass	utʃani	3			
ᵀtʃ	intshebe	beard	iᵀtʃebe	3			
ɹ	unyawo	foot	uɹawo	3			
kʰ	ikhala	nose	ikʰala	3			
kʼ	amasokisi	socks	amasokʼisi	5			
k	ukudla	food	ukudla	3			
ᵀk	inkukhu	chicken	iᵀkukʰu	3			
g	ugogo	grandmother	ugogo	3			
ɔ	ugogo	grandmother	ugɔɔ	3			
ɦ	ihhala	rake	iɦala	3			
h	hamba	go/walk	haᵀba	2			
ɛ	elikhulu	big	ɛlikʰulu	4			
ŋ	elincane	small	ɛliŋ ane	4			
i	icici	earring	i i i	3			
	icici	earring	i i i	3			
ɔ	ixoxo	frog	i  ɔ  ɔ	3			
u	umuntu	person	umuntu	3			
w	iwashi	watch	iwaʃi	3			
!	iqanda	egg	i!anda	3			
!ʰ	iqhude	male chicken	i!ʰude	3			
!g	isigqoko	hat	isi!gokʼo	4			
g	igceke	yard	i geke	3			
	isixubho	toothbrush	isi  ubɔ	4			
g	gxuma	jump	guma	2			
ŋ	inxeba	wound	iŋ  eba	3			

Omitted sounds:

ŋ!g	!ʰ	j	ŋ  g	ŋ!	ʰ	ŋ g	kʰ	ᵀdz	ts
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## Appendix H: Ethics Approval



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



Room E52-24 Old Main Building  
 Groote Schuur Hospital  
 Observatory 7925  
 Telephone [021] 406 6338 - Facsimile [021] 406 6411  
 Email: shuretta.thomas@uct.ac.za  
 Website: [www.health.uct.ac.za/fhs/research/humanethics/forms](http://www.health.uct.ac.za/fhs/research/humanethics/forms)

09 September 2014

**HREC REF: 671/2014**

**Dr M Pascoe**  
 Health & Rehab  
 F-floor, OMB

Dear Dr Pascoe

**PROJECT TITLE: THE PHONOLOGICAL DEVELOPMENT OF TYPICALLY DEVELOPING FIRST LANGUAGE ISIZULU SPEAKING CHILDREN AGED 2; 6-6; 6 YEARS. A DESCRIPTIVE CROSS SECTIONAL STUDY**

Thank you for submitting your study to the Faculty of Health Sciences Human Research Ethics Committee for review.

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

**Approval is granted for one year until the 30<sup>th</sup> September 2015.**

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.

(Forms can be found on our website: [www.health.uct.ac.za/fhs/research/humanethics/forms](http://www.health.uct.ac.za/fhs/research/humanethics/forms))

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

***We acknowledge that the student, Zeina Jeggo will also be involved in this study.***

**Please quote the HREC reference no in all your correspondence.**

Yours sincerely

pp T. Burgess  
**PROFESSOR M BLOCKMAN**  
**CHAIRPERSON, FHS HUMAN ETHICS**  
 Federal Wide Assurance Number: FWA00001637.  
 Institutional Review Board (IRB) number: IRB00001938

HREC 671/2014

## Appendix I: Approval from KZN Department of Education



education

Department:  
Education  
**PROVINCE OF KWAZULU-NATAL**

Enquiries: Nomangisi Ngubene

Tel: 033 392 1004

Ref:24/8/361

Ms Z Jeggo  
Therapy Department  
Manguzi Hospital  
KWANGWANASE  
3973

Dear Ms Jeggo

### PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: "THE PHONOLOGICAL DEVELOPMENT OF TYPICALLY DEVELOPING FIRST LANGUAGE ISIZULU SPEAKING CHILDREN AGED 2;6 – 6;6 YEARS: A DESCRIPTIVE CROSS-SECTIONAL STUDY", in the KwaZulu-Natal Department of Education Institutions has been approved. The conditions of the approval are as follows:

1. The researcher will make all the arrangements concerning the research and interviews.
2. The researcher must ensure that Educator and learning programmes are not interrupted.
3. Interviews are not conducted during the time of writing examinations in schools.
4. Learners, Educators, Schools and institutions are not identifiable in any way from the results of the research.
5. A copy of this letter is submitted to District Managers, Principals and Heads of Institutions where the intended research and interviews are to be conducted.
6. The period of investigation is limited to the period from 01 March 2015 to 31 March 2016.
7. Your research and interviews will be limited to the schools you have proposed and approved by the Head of Department. Please note that Principals, Educators, Departmental Officials and Learners are under no obligation to participate or assist you in your investigation.
8. Should you wish to extend the period of your survey at the school(s), please contact Miss Connie Kehologile at the contact numbers below.
9. Upon completion of the research, a brief summary of the findings, recommendations or a full report / dissertation / thesis must be submitted to the research office of the Department. Please address it to The Office of the HOD, Private Bag X9137, Pietermaritzburg, 3200.
10. Please note that your research and interviews will be limited to schools and institutions in KwaZulu-Natal Department of Education.

UMkhanyakude District

Nkdsinathi S.P. Sishi, PhD  
Head of Department: Education  
Date: 25 February 2015

KWAZULU-NATAL DEPARTMENT OF EDUCATION

POSTAL: Private Bag X 9137, Pietermaritzburg, 3200, KwaZulu-Natal, Republic of South Africa  
PHYSICAL: 247 Burger Street, Anton Lembede House, Pietermaritzburg, 3201. Tel. 033 392 1004  
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CALL CENTRE: 0860 596 363; Fax: 033 392 1203 WEBSITE: [www.kzndoe.gov.za](http://www.kzndoe.gov.za)