



Unmasking Ghost Segments in South African IsiNdebele

by

**Wandile Yende
2396216**

A dissertation submitted to the University of the Witwatersrand in fulfilment of the requirements of the degree of Master of Arts in Linguistics.

Supervisor:
Professor Maxwell Kadenge

30 March 2025

PLAGIARISM DECLARATION

I hereby declare that this dissertation is my original work. All outside sources have been acknowledged. It has not been previously submitted, in part or entirety, to any institution of higher learning.



Signature

18/03/2025

Date

Acknowledgements

Firstly, I would like to thank my supervisor and mentor Professor Maxwell Kadenge for all his support and guidance throughout my research. Without his guidance, I would not be where I am.

I would like to thank the MPD fellowship for their endless support throughout the academic journey. Their guidance has helped to guide and refine my research. A big thanks to the fellows for their friendship and support. A special thanks to Karabo-Maya Rodwell and Yolanda Mdluli for the check-in sessions which provided support and a space to just laugh and cry about everything.

A big thanks to my family; my parents and sister, for always being there to listen to me vent about anything thesis related and for giving me the space to work and flourish. To Siya, thanks for being my personal therapist and for helping me improve my Ndebele. To my friends and family, thank you for the encouragement.

Thank you to Jehovah God without whom I would not exist.

Abstract

Ghost segments, also known as latent segments or floating features, are phonological segments which alternate with zero (Sibanda, 2011). Many languages contain these unique segments which are thought to be unpredictable, and one such language that has them is South African isiNdebele. This study discusses the behaviour of ghost segments evident in three phonological processes: high vowel elision, vowel hiatus resolution, and minimality effects. The theoretical objective is to explain the intricate relationship between ghost segments and markedness.

High vowel elision is productive in Southern Ndebele, with the language undergoing mu-reduction and interconsonantal elision (syncope). This is one of the structural features that distinguish it from Northern Ndebele in which mu-reduction is not productive. Syncope is productive in both dialects and occurs during fast speech. Although occurring in fast speech, this process is limited and guided by phonological rules of the language. Vowel hiatus is a dispreferred configuration in isiNdebele. IsiNdebele makes use of five repair strategies to repair hiatus: glide formation, secondary articulation, glide insertion, vowel coalescence, and vowel elision. As is common in Bantu languages, isiNdebele enforces disyllabicity. Evidence of this requirement is gleaned from morphological structures such as the imperative, passive, and reduplication. IsiNdebele makes use of an epenthetic segment to ensure that subminimal forms are repaired.

Using the findings from these three processes, ghost segment behaviour is analyzed, and a prediction is provided. It is shown that the ghost consonants in this language function as hero ghosts which rescue words from being ill-formed and thus repair markedness. Ghost vowels, except for the [i] in the imperative, behave as martyr ghosts that delete if their presence creates phonologically ill-formed words. This study aims to predict the behaviour of ghost segments and link their behaviour to markedness.

The analysis is couched within Optimality Theory (Prince and Smolensky, 2004) and some aspects of Feature Geometry (Clements and Hume, 1995). Optimality Theory provides different constraints which account for the strategies chosen by isiNdebele in repairing words. Furthermore, the ranking of constraints accounts for variation in the two dialects of isiNdebele.

The results found in this study are compared to those in other Bantu languages to situate isiNdebele within the language family and contribute, in a small but significant way, to linguistic typology.

Key words: Ghost segments, hero ghost, martyr ghost, markedness, Optimality Theory, Feature Geometry, constraint, input, output

Definitions of Key Terms

Ghost segments	Phonological segments that alternate with zero.
Hero ghost	A type of ghost that is typically absent and only surfaces to repair markedness.
Martyr ghost	A type of ghost that is typically present and deletes to maintain markedness.
Markedness	Structural well-formedness
Optimality Theory	A constraint-based theory of generative grammar developed by Prince and Smolensky in 1991 (Kager, 1999).
Feature Geometry	A feature-based theory of generative grammar that illustrates the distinctive phonetic features of sounds (Clements and Hume, 1995).
Constraint	The requirements governing grammatical structure, based on language universals.
Candidate	The possible output forms based on the input.
Input	The original form of a word before it is repaired or rephonologised.
Output	The realisation of the input once the optimal form has been determined based on the constraints.

List of Symbols, Abbreviations and Constraints

List of Symbols

//	Phonemic/ broad transcription (Optimality Theory input)
[]	Phonetic/ narrow transcription (Optimality Theory output)
>>	Outranks
→	Is realised as
.	Syllable boundary
-	Morpheme boundary
σ	Root node
μ	Mora
∅	Zero

List of Abbreviations

OT	Optimality Theory
FG	Feature Geometry
GP	Government Phonology
C	Consonant
V	Vowel
CC	Consonant Cluster
UG	Universal Grammar
AUG	Augment
NC	Noun Class
OM	Object Marker
NP	Noun Prefix
COP	Copulative

SM	Subject Marker
INF	Infinitive
DJ	Disjoint
DIM	Diminutive
REV	Reverential
RED	Reduplicative
PASS	Passive
FV	Final Vowel
PREF	Perfect

List of Constraints

PARSE-GHOST	Don't skip over ghost (deletion of ghost segments banned).
*[MU]	Co-occurrence of [m] and [u] is prohibited.
MINWORD	Words must be minimally disyllabic
*COMPLEX	Complex onsets prohibited
ALIGNSTEML	The left edge of a stem must coincide with the left edge of a syllable.
IDENTITY-IO (place) Nasals	Corresponding input and output nasals have the same value for the feature (place).
AGREE (place) NC	Adjacent output segments have the same value for the feature (place) in NCs.
NOGEM	No multiple links from root node to higher tier (no geminates allowed).

*[mβ]	Co-occurrence of [m] and [β] is prohibited.
*[Liquid.Vowel]	A liquid cannot be followed by a vowel.
*V[+hi]	Assign a violation mark to a [+hi] vowel.
MAX/PROM	Parse a vowel in a prominent syllable.
MAX/LEX	Parse a vowel in a lexical morpheme.
NOZERO	No scale containing x implies that $\emptyset$ is more harmonic than x.
NO-HIATUS	A sequence of two vowels across a syllable boundary is prohibited.
MAX-IO (μ)	Every input mora has a correspondent in the output.
*V:	No long vowels.
MAX-IO (RT)	Every input root node has a correspondent in the output.
OCP	A sequence of identical features is prohibited.
UNIQUE	$\forall x$, where x is a feature or class node, x must have a unique segmental anchor y.
UNIFORMITY	A segment in the output cannot have more than one correspondent in the input.
*C⁵	No pharyngealized consonants.
ANCHOR-L	Any root node to the left edge of a morpheme in the input has a correspondent root node in the output.

*Cj	No palatalized consonants.
*FLOAT	Floating features are prohibited.
NO-FLOP	Let [F] be a feature (autosegment) in the output representation, and let [F'] be the input correspondent of that feature. If the output feature [F] is dominated by a root node (segment) X, then the input feature [F'] must likewise be dominated by a root node (segment) X', where X' is the input correspondent of X.
MAX (MEL)	Assign one violation for every melodic subsegment present in the input that is absent in the output.
DEP (SKEL)	Assign one violation for every skeletal subsegment present in the output that is absent in the input.
ONSET	Syllables must have an onset.
DEP-IO	Every element in the output has a correspondent in the input (No epenthesis).
IDENT-MORPH	No augmentation of minimally well-formed forms.
PSTEM = FOOT	PStem is coextensive with a foot.
RED [σσ]	The reduplicant is minimally disyllabic.
DEP (GHOST)	The ghost segment in the output must have a correspondent in the input.

Table of contents

Plagiarism Declaration	2
Acknowledgements	3
Abstract	4
Definitions of Key Terms	6
Lists of Symbols, Abbreviations, and Constraints	7
Table of contents	11
List of Tables	13
List of Tableaux	14
List of Figures	16
Chapter 1: Introduction	17
1.1. Introduction	17
1.2. Problem statement	18
1.3. Objectives	21
1.4. Justification	21
1.5. Structure of dissertation	22
1.6. Summary of chapter	23
Chapter 2: Literature Review	24
2.1. Introduction	24
2.2. Existing literature on isiNdebele	24
2.3. Global literature	28
2.4. Ghost segments in African languages	39
2.5. Ghost segments in Nguni	45
2.6. Summary of chapter	48
Chapter 3: Background of IsiNdebele	49
3.1. Introduction	49
3.2. History of isiNdebele	49
3.3. Phonemic inventory	50
3.3.1. Vowels	50
3.3.2. Consonants	51
3.4. Syllable structure	53
3.5. Morphosyntactic aspects	53
3.6. Summary of chapter	55
Chapter 4: Methodology	56
4.1. Introduction	56
4.2. Sources of data	56
4.3. Data verification	56

4.4.	Theoretical framework	57
4.4.1.	Optimality Theory	57
4.4.2.	Feature Geometry	58
4.5.	Summary of chapter	59
Chapter 5: Ghost segments		60
5.1.	Introduction	60
5.2.	High vowel elision	60
5.2.1.	Ghost vowels and high vowel elision	67
5.2.2.	Ghost vowels and interconsonantal high vowel elision	75
5.2.3.	IsiNdebele and other Bantu languages: A comparison	78
5.3.	Vowel hiatus resolution	82
5.3.1.	Vowel hiatus repair strategies	83
5.3.2.	Vowel hiatus and ghost segments	94
5.3.3.	IsiNdebele and other Bantu languages: A comparison	101
5.4.	Minimality effects	104
5.4.1.	PWord and PStem	105
5.4.2.	Strategies to maintain minimality	106
5.4.3.	Minimality effects and ghost segments	112
5.4.4.	IsiNdebele and other Bantu languages: A comparison	114
5.5.	Discussion	115
5.6.	Summary of chapter	118
Chapter 6: Conclusion and Recommendations for further study		120
6.1.	Conclusion	120
6.2.	Recommendations for further study	122
6.3.	Summary of chapter	123
Reference List		124
Appendices		130
Appendix 1: Minimality Data		132
Appendix 2: High vowel elision		133
Appendix 3: Vowel hiatus resolution		135
Ethics waiver letter		139

List of Tables

Table 1	isiNdebele Consonant inventory	52
Table 2	Click sounds in isiNdebele	52
Table 3	isiNdebele noun classes	54
Table 4	isiNdebele concord markers	54
Table 5	Comparisons of NC behaviour	81
Table 6	Differences and Similarities in hiatus resolution	104
Table 7	Imperatives in isiNdebele	106
Table 8	Monosyllabic imperatives in isiNdebele	106
Table 9	The imperative ‘eat’ in Bantu languages	114
Table 10	Summary of ghost segments behaviour	116

List of Tableaux

Tableau 1	English definite allomorphy	36
Tableau 2	Mu-reduction of disyllabic noun stems in Southern Ndebele	68
Tableau 3	Mu-reduction of monosyllabic noun stem	69
Tableau 4	Mu-reduction of disyllabic nouns in Class 3	69
Tableau 5	Mu-reduction of monosyllabic nouns in Class 3	70
Tableau 6	Failure of mu-reduction in Northern Ndebele	70
Tableau 7	Resyllabification of the nasal after mu-reduction in Southern Ndebele	71
Tableau 8	NC behaviour in Southern Ndebele	73
Tableau 9	NC behaviour in Northern Ndebele	73
Tableau 10	Geminate formation in Northern Ndebele	74
Tableau 11	Slow speech, PARSE-GHOST >>*V[+hi]	76
Tableau 12	Fast speech, *V[+hi] >> PARSE-GHOST	76
Tableau 13	Syncope in isiNdebele	77
Tableau 14	High vowel zero alternation in isiNdebele	78
Tableau 15	Glide formation	85
Tableau 16	Secondary articulation	86
Tableau 17	Behaviour of absolute pronoun (bona)	87
Tableau 18	Glide insertion	89
Tableau 19	Vowel coalescence	90
Tableau 20	Vowel elision in isiNdebele	92
Tableau 21	Vowel hiatus in Northern Ndebele	93
Tableau 22	Coalescence of ghost vowel and formative	97
Tableau 23	Ghost glides of the imperative	98
Tableau 24	Ghost glide and vowel hiatus	99

Tableau 25	Compensatory lengthening in Luganda	103
Tableau 26	Disyllabic imperatives in isiNdebele	107
Tableau 27	Monosyllabic verb roots	108
Tableau 28	Passive construction with disyllabic verb roots	109
Tableau 29	Passive construction with monosyllabic verb root	109
Tableau 30	Reduplication of polysyllabic verb roots	111
Tableau 31	Reduplication of monosyllabic verb root	111
Tableau 32	Hero ghost in the imperative (monosyllabic)	112
Tableau 33	Failure of ghost surfacing in well-formed word	112

List of Figures

Figure 1	isiNdebele vowel chart	51
Figure 2	Progressive nasal assimilation in Northern Ndebele	64
Figure 3	Geminate formation in Northern Ndebele	65
Figure 4	Glide formation	83
Figure 5	Palatalization in the passive	113
Figure 6	Latent segments	117
Figure 7	Floating features	118

Chapter 1: Introduction

1.1. Introduction

Ghost segments are phonological segments which have zero alternation or alternate with zero (Sibanda, 2011). In other words, ghost segments are sounds which are sometimes visible or sometimes hidden depending on the phonological context. They either surface or delete depending on the morphophonological context.

Ghost segments lack a root node and are considered floating segments by scholars such as Zoll (1994). Ghost segments have been identified in Welsh, Chaha, ChiShona and Nguni languages, among many other languages. Welsh contains ghost consonants which surface to avoid vowel hiatus. The floating labial in Chaha deletes if there is no coronal or velar which it can dock onto (Zoll, 1994).

Sibanda (2011) indicates that ghost segments are unpredictable. Against this background, this study is aimed at exposing the nature, behaviour and quality of ghost segments in South African isiNdebele, one of the main Nguni languages spoken in the Mpumalanga Province of South Africa. Their predictability or lack thereof is examined in this study.

There are two types of ghost segments which are relevant for the current study as discussed by Lindsey (2019) and Zimmermann (2019), namely, hero (appearing) and martyr (disappearing) ghosts. Hero or appearing ghosts are typically absent and surface only to resolve marked structures. They rescue the word from markedness. An example of a hero ghost is the Polish ghost vowel. Yer vowels in Polish and other Slavic languages are absent by default but surface to repair illicit consonant clusters (Lindsey, 2019).

Martyr or disappearing ghosts are typically present but disappear if their presence creates markedness (Zimmermann, 2019). Welsh ghost consonants are martyr ghosts which occur in the definite article. They are present by default but disappear or delete if their presence results in an additional coda or vowel hiatus (Zimmermann, 2019). It is noteworthy that ghost segments behave differently from ordinary segments and have different rules governing them

(Zimmermann, 2019). As mentioned earlier, this thesis aims to study and analyze ghost segments in isiNdebele.

Using Optimality Theory (hereafter OT), this study aims to identify how ghost segments in isiNdebele interact with markedness (structural well-formedness). By identifying and explaining the relationship between ghost segments and markedness, this study allows for the systematic classification of ghosts in Transvaal Ndebele (made up of Southern and Northern Ndebele) in particular and Nguni languages by extension, thus showing whether they are hero or martyr ghosts or both. Furthermore, building on Sibanda's (2011) work, this study aims to illustrate how these ghost segments operate in different morphophonological processes, especially in the context of minimality effects, vowel coalescence, and high vowel elision to maintain the preferred phonological structures of the language. Lastly, this study analyzes the structure of ghost segments in isiNdebele and identifies the structural features that distinguish them from other segments.

1.2. Problem statement

Ghost segments are found in many languages around the world (Lindsey, 2019; Zimmermann, 2019). These elements alternate with zero (Sibanda, 2011). As mentioned earlier, ghost segments appear or disappear depending on the type of ghost segment. Markedness is one of the main factors that determine the behaviour of a ghost segment (Zimmermann, 2019). This study aims to provide a detailed description and theoretical analysis of ghost segments found in isiNdebele. The study aims to come up with a cogent generalization on the nature, and behaviour of ghost segments in the language.

Sibanda's (2011) study on ghost segments in Nguni is a useful starting point for this study. He identifies ghost vowels and consonants in Nguni. Nguni languages contain five simple vowels, three of these vowels exhibit ghost behaviour (floating root node), namely, /i/, /a/ and /u/ (Sibanda, 2011). The high coronal vowel /i/ is the most common ghost vowel (Iskender, 2008). It has been noted by Iskender (2008) that many languages prefer high vowels for zero alternation, it would seem Nguni is not an exception to this.

The first context identified by Sibanda (2011) whereby a ghost segment exists is vowel coalescence. In example (1) below, the low vowel /a/ changes to the mid vowel [e]. According to Sibanda (2011), this is not a form of dissimilation but rather vowel coalescence. The low vowel coalesces with the high ghost vowel /i/ to form the mid vowel [e]. This is in line with coalescence patterns in Nguni in general.

(1) /a-(i)-z-a/ → [eza]/[aza] ‘they come’

The coalescence pattern for Nguni is given in (2) below.

(2) /a/ + /a/ → [a]
 /a/ + /i/ → [e]
 /a/ + /u/ → [o]

The ghost vowel /u/ is found in Siswati and is observed in the relative concords of noun classes 11, 14 and 15 (Sibanda, 2011). The ghost vowel /u/ occurs in vowel coalescence patterns whereby the ghost vowel coalesces with the low vowel in (3) to form [o].

(3) /la+ (u)lu/ → [lolu]

The morphophonological context of vowel coalescence provides evidence for the existence of ghost segments in Nguni. The ghost segment, although not visible, undergoes this process and disappears to prevent markedness (vowel hiatus). An isiNdebele example of vowel coalescence involving ghost segments is given in (4) below.

(4) /na + (i)muⁿru/ → [nemuⁿru] ‘with a person’

The example above shows the low vowel of the formative coalescing with the ghost vowel to form the mid vowel. This shows that vowel coalescence is indeed a context for ghost segments in isiNdebele. This process is discussed in detail in later chapters.

Nguni contains three ghost consonants: [b], [j] and [w] (Sibanda, 2011:137). The ghost glides surface to resolve markedness. For instance, in the Ndebele imperative, every syllable must

contain an onset. Onsetful syllables are unmarked. To satisfy this markedness constraint, the ghost glide surfaces to provide an onset. This is shown in (5) below.

(5) /-ak^h-a/ → [(y)ak^ha] ‘build’

The palatal glide surfaces before [-round] vowels while the labial glide surfaces before [+round] vowels. Hiatus resolution strategies provide the context for ghost consonants, particularly ghost glides. In example (6), the expected repair strategy is vowel coalescence, instead a glide is inserted. Sibanda (2011) argues that this is the surfacing of a ghost glide to repair hiatus.

(6) /ka-u-k^hul-i/ → [ka(w)uk^huli] *[kok^huli] ‘it does not grow’

From the evidence provided thus far, ghost glides are hero ghosts which surface to repair markedness such as onset requirements and vowel hiatus (which is also an onset requirement as discussed in chapter 5). This study is aimed at providing an original analysis that is based on fresh data to illustrate and account for the behaviour of ghost glides in isiNdebele.

The common phonological process where the presence of ghost segments is evident in hiatus resolution is vowel coalescence and glide insertion, both of which are discussed in detail later in this study. This study discusses phonological processes such as minimality effects and high vowel elision, which expose the link between ghost segments and markedness. The study classifies the ghost segments as either hero or martyr depending on their default state.

The study is couched within the OT framework to analyze and identify exactly how ghosts affect markedness. Feature geometry (FG) is utilized to illustrate the phonological (featural) structure of ghost segments and what makes them unique. This study predicts the behaviour of ghost segments in isiNdebele, and Nguni by extension.

1.3. Objectives

This study has three aims as provided below.

- To identify and explain the nature of ghost segments in isiNdebele.
- To examine how ghost segments interact with markedness in isiNdebele.
- To contribute to typology by theoretically analyzing ghost segments in isiNdebele, using OT.

1.4. Justification

Ghost segments in the world's languages have been extensively documented (Paradis and El Fenne, 1995; Zimmermann, 2019; Szpyra, 1992). The same cannot be said of ghost segments in African languages. Few studies focusing on ghost segments have been conducted on African languages (Mudzingwa and Kadenge, 2013; Showalter, 2007; Zoll, 1994) with only one study discussing this phenomenon in Nguni languages (Sibanda, 2011). This study expands this debate by focusing on unmasking ghost segments in isiNdebele, a Southern Bantu language spoken in South Africa. The study provides more than just a historical account of ghost segments such as Sibanda (2011) but focuses on the phonological vitality and relevance of ghost segments.

In addition to analyzing ghost segments, the study provides an in-depth discussion of some phonological processes related to the notion of ghost segments which have been understudied in the language such as minimality effects, vowel coalescence, and high vowel elision.

Minimality governs the acceptable minimal size of words (Park, 1997; Vratsanos, 2018). Most Bantu languages require words to be minimally disyllabic, to meet this requirement, a vowel is inserted (Vratsanos, 2018). High vowel elision is common in Bantu languages whereby the high vowel of the prefix is deleted (Kadenge and Chebanne, 2017). This deletion triggers other phonological processes such as syllabifying the remaining nasal and post-nasal hardening (Kadenge and Chebanne, 2017).

This study fills a gap in Nguni and isiNdebele grammar literature. The phonology of isiNdebele is thinly documented. The few contemporary studies include the work of Mahlangu (2007), Skhosana (2009), Skhosana (1998) and Jiyane (1994) which focus on loanwords in the language, the sociolinguistic differences between Southern and Northern Ndebele, the influence of foreign material in the grammar of the language, and the grammar of the language, respectively. Therefore, by looking at phonological processes involving ghost segments, this study fills a gap in the existing literature on the subject matter.

By using OT, the study presents a phonological constraint hierarchy that regulates the behaviour of ghost segments in isiNdebele. Thus, this study is a small but significant contribution to phonological typology.

1.5. Structure of dissertation

This dissertation is structured as follows.

CHAPTER 2 LITERATURE REVIEW- This chapter provides a survey of existing literature on ghost segments. This discussion begins with work done on isiNdebele, followed by global literature on ghost segments, ghost segments in African languages, and lastly, ghost segments in Nguni. This situates the study within broader phonological work on ghost segments.

CHAPTER 3 BACKGROUND OF ISINDEBELE- this chapter discusses the background and genetic affiliation of isiNdebele. This discussion includes the historical aspects of isiNdebele. This chapter is also concerned with some formal aspects of isiNdebele including phonemic inventory, syllable structure, and morphosyntax.

CHAPTER 4 METHODOLOGY- A discussion of the methods utilized in this study. Sources of data and theoretical framework are discussed in this chapter.

CHAPTER 5 GHOST SEGMENTS- this chapter focuses on the ghost segments in isiNdebele. This chapter discusses instances of vowel zero alternation. The relevant morphophonological processes discussed in this chapter are high vowel elision, minimality effects, and vowel hiatus resolution. A discussion on the phonological structure of ghost segments and a prediction of the behaviour of ghost segments in Nguni concludes this chapter.

CHAPTER 6 CONCLUSION- the chapter concludes the study and provides a summary of the findings in the study. The chapter concludes by outlining areas that require further exploration.

1.6. Summary of chapter

This chapter introduced the current study. The key concepts were explained and conceptualized. The objectives of the study were provided, as well as justification of the study. The structure of the thesis was presented. Chapter 2 provides a discussion on the studies that have been conducted on ghost segments and their relationship to the current study. This exposes the gap in knowledge which this study aims to fill.

Chapter 2: Literature review

2.1. Introduction

This chapter aims to provide existing literature on ghost segments in languages around the world. The literature indicates that many languages contain ghost segments (floating features and latent segments). Some of the languages that contain ghost segments include Welsh, Yawelmani, Ahousaht Nuuchalksal (Zimmermann, 2019), English (Yang, 2004), Polish (Rubach, 2016), French (Paradis and El Fenne, 1995), Galician (Ulfsgjornin, (2020), and Hebrew (Enguehard and Faust, 2018), among others. Furthermore, ghost segments have been documented in African languages such as Kaansa (Showalter, 2007), ChiShona (Mudzingwa and Kadenge, 2013), Chaha (Zoll, 1994), Shilluk (Remijnsen and Ayoker, 2020), and Nguni (Sibanda, 2011).

This chapter reviews these studies on ghost segments and couches the current study within the broader context of existing literature on ghost segments in Nguni. A good starting point is a discussion of linguistic work done on isiNdebele; this demonstrates why isiNdebele is a language that merits further research. This is followed by a review of the existing literature of ghost segments in global languages (excluding African languages). Thirdly, a review of studies on ghost segments in African languages is presented. Lastly, I present work done on ghost segments in Nguni, which isiNdebele is part of.

2.2. Existing research on isiNdebele

Existing literature on isiNdebele is scarce. Studies referencing isiNdebele refer to the language as a dialect of isiZulu and therefore only briefly mention the language (Mashiyane, 2002). Mashiyane (2002) argues that isiNdebele is not a dialect of isiZulu but is its own language (Ndebele and Zulu are sister languages and are both dialects of Nguni); therefore, it should be treated as an independent language and studied as such. This thesis takes the same view and aims to study isiNdebele as a separate and independent language. This section outlines the few linguistic studies done on isiNdebele.

Mashiyane's (2002) work focuses on the sociolinguistic aspects of Southern Ndebele in particular. He discusses the development of isiNdebele and the factors influencing this development. He briefly mentions that isiNdebele is far behind its sister languages in terms of terminology development (a fact discussed by Mabena (2020)). He claims that this is due to the influence of languages surrounding it such as Afrikaans and Sepedi, and because of this influence, isiNdebele lagged behind its sister languages. Following in the footsteps of other Ndebele scholars, Mashiyane (2002) discusses the influence of Sepedi on isiNdebele. From this discussion, he concludes that scholars studying isiNdebele should also take note of the influences from Sepedi which have been internalized by isiNdebele.

Furthermore, Mashiyane (2008) briefly discusses the dialects of isiNdebele. He shows that isiNdebele has three main dialects: Nzunza, Manala, and the Northern dialect (Mthombeni). The Nzunza and Manala dialects make up the Southern Ndebele group. The Nzunza dialect was chosen to be the standardized dialect (Mashiyane, 2008). He discusses the similarities and differences between the dialects.

As mentioned above, terminology development which is key to language development is discussed by Mabena (2020). She discusses the strategies utilized in developing terminology in isiNdebele and some of the guidelines, which help terminologists in this endeavor. Using three terminology lists provided by the Department of Arts and Culture (Multilingual Human, Social, Economic and Management Sciences, Multilingual terminology for Information Communication Technology, and Pharmaceutical terminology) she found that two main strategies are preferred when developing terms in isiNdebele: paraphrasing and transliteration. She concludes by providing some recommendations when it comes to terminology development in isiNdebele.

A few studies have been conducted on isiNdebele grammar. A few descriptive studies exist by Ziervogel (1959), Jiyane (1994), Wilkes (1997), and Skhosana (1998). Contemporary studies include the work of Mahlangu (2007), Skhosana (2009), Mahlangu (2016), Mndawe (2018), and Yende (2023).

Typical of the traditional Clement Doke's approach, Ziervogel (1959) discusses the various grammatical aspects of Northern isiNdebele, that is, its syntax, morphology, semantics, and phonology. From his discussion, it emerges that, unlike Southern Ndebele, Northern Ndebele

has strong influences from both Sepedi and Siswati. It is closer to the Sepedi language than it is to Nguni languages. However, as Mashiyane (2002) argues, it is still considered a Nguni language.

The work by Ziervogel (1959) is supplemented by the work of Jiyane (1994) which is more contemporary. Jiyane (1994) discusses some grammatical aspects of isiNdebele. His work on isiNdebele is the foundation for subsequent studies done on the structural aspects of isiNdebele such as Skhosana (1998,2009) and Mahlangu (2007). His dissertation focuses on the morphology, syntax and semantics of eight different word categories: nouns, pronouns, ideophones, interjectives, conjunctives, verbs, copulatives, and qualificatives.

Jiyane's (1994) work has made a significant impact on work done on isiNdebele grammar. Prior to his work, isiNdebele grammar was studied by scholars such as Ziervogel (1959), Potgieter (1950) and Van Warmelo (1930). As a native speaker of the language, he provides an up-to-date analysis of the language as used by speakers on the ground. Jiyane is cited as one of the foremost scholars of isiNdebele grammar (Mashiyane, 2002).

Scholars agree that isiNdebele is a Nguni language with strong influence from Sepedi and Setswana, and Afrikaans (Skhosana, 1998; Mahlangu, 2007). It comes as no surprise that many of these scholars have devoted time to the research of the influence of these languages on isiNdebele. Skhosana (1998) is one such scholar. He discusses the impact of the foreign interferences on the sound, grammatical and lexical system of Southern Ndebele. He provides an in-depth discussion on some aspects of Southern Ndebele which set it apart from its sister languages. He accounts for these differences by showing that they have come about due to the close contact isiNdebele has with Sotho languages.

For example, in Nguni languages, some Class 9 nouns contain a nasal consonant compound. In Southern Ndebele, this nasal is dropped before voiceless consonants. This is different from what occurs in isiZulu and the other Nguni languages. This difference is illustrated in example (7) below.

(7) [ikosi] 'chief' (Zulu: inkosi)

The nasal is maintained before voiced consonants, shown in (8) below.

(8) [induna] ‘headman’ (Zulu: induna)

According to Skhosana (1998), this difference is a result of influence from neighbouring Sotho languages (Sepedi and Setswana). The close geographical contact with these languages, which also drop the nasal in class 9, has influenced isiNdebele (Skhosana, 1998). Wilkes (1997) gives a summarized discussion of this foreign interference and notes that the reason for the borrowings from the Sotho language is not necessity. Instead, he argues that prestige is a motivating factor for why isiNdebele has borrowed so much from these neighbouring languages.

Other scholars such as Mahlangu (2007) discuss loanwords from Afrikaans, one of the languages which isiNdebele has been in close contact with. Mahlangu (2007) focuses on the phonological, morphological, and semantic changes in Afrikaans and English loanwords when they are adapted into isiNdebele. She provides a detailed analysis of loanwords by looking at the way vowels and consonants in the two source languages are adapted into the target language of isiNdebele. Her study shows which semantic categories isiNdebele has borrowed many of its words from. Furthermore, she shows that at times isiNdebele does have its own terminology for certain items but has still borrowed due to prestige.

Her study provided a solid background for Yende’s (2023) work on isiNdebele loanwords. Yende (2023) provides an OT analysis of loanwords in the language and accounts for the different repair strategies utilized by the language. Such phonological studies have been supplemented by other studies which show how borrowings from Afrikaans become part of isiNdebele (Mahlangu, 2016).

Moving away from the impact of foreign interferences, Mndawe (2018) compares noun valency and in particular compounding of the possessive pronoun with the co-referent noun. He discusses the differences and similarities between isiZulu and isiNdebele. Of interest to the current study is the isiNdebele discussion. IsiNdebele allows the compounding of the noun and possessive pronoun; unlike in isiZulu, this compounding is not limited to kinship terms. Examples (9)-(11) below give some examples of this compounding in isiNdebele, the first two examples denote kinship terms which are also found in isiZulu, the third example is not a kinship term.

- (9) [nodadwenu] ‘your sister’
- (10) [umntwanami] ‘my child’
- (11) [ihliziyakhe] ‘his heart’

(Mndawe, 2018:347)

This process of compounding usually results in illegal VV sequences, which are usually repaired through processes such as glide formation and vowel coalescence (Mndawe, 2018). The current study is concerned with these processes in relation to ghost segments.

These are the few studies done on the structural elements of isiNdebele. There is indeed a gap which needs to be filled in the literature. This study focuses on some processes which have been mostly ignored or briefly mentioned in the literature. Furthermore, the studies which discuss isiNdebele focus on Southern Ndebele which includes the Nzunza and Manala dialects of isiNdebele. The few studies which reference Northern Ndebele include Ziervogel (1959) and Skhosana (2009). Skhosana (2009) discusses the phonological, morphological, and syntactic differences between Northern and Southern Ndebele. This is the first contemporary study which looks at Northern Ndebele in detail.

This shows that the Northern dialect of isiNdebele is widely ignored and should be studied as well. While this study does not differentiate between the two types of isiNdebele, it includes work on Northern Ndebele, which is a start towards de-marginalizing the language in scholarship.

This section has discussed the various studies done on isiNdebele. The following sections focus on the area of focus of this thesis: ghost segments. The next section discusses the global literature on ghost segments.

2.3. Global literature

This subsection focuses on what has been documented on ghost segments in languages globally. This section provides a strong foundation for the analysis of ghost segments in isiNdebele.

Zimmermann (2019) defines ghost segments as segments which alternate with zero. She refers to these segments as exceptional due to their exceptional phonological behaviour. Of interest to the current study is Zimmermann's (2019) discussion on the relationship between the appearance and disappearance of ghost segments and markedness. From this relationship, two groups of ghost segments are found, namely, appearing (hero) ghost segments and disappearing (martyr) ghost segments.

Appearing or hero ghosts are typically absent but surface to resolve markedness (Zimmermann, 2019; Lindsey, 2019). Welsh contains a ghost consonant which is found in some functional morphemes. Typically, this ghost consonant is not present, but it surfaces if there is vowel hiatus (a heterosyllabic sequencing of adjacent vowels). Therefore, this ghost consonant rescues the word from vowel hiatus, which is generally an unwanted phonological structure. Example (12) and (13) illustrate the default absence of the ghost consonant and its hero behaviour, respectively.

- | | | |
|------|---------------------------------|---------------|
| (12) | <i>guda_ tri</i> | “with three” |
| (13) | <i>gudag_g eraill</i> | “with others” |

(Zimmermann, 2019:3)

The example illustrates that in the absence of vowel hiatus the ghost consonant does not surface (12); however, it surfaces to resolve the hiatus across the two words in (13) above.

Disappearing or martyr ghosts are present by default but delete or disappear if their presence creates markedness. For example, the Welsh definite article contains two consonants, /yr/ (ghost consonants) which can surface as [yr] (before a vowel), [y] (before a consonant) or [ʹr] (after a vowel). This behaviour of the definite article helps to avoid an additional coda and vowel hiatus. This is shown in examples (14) to (16) below.

- | | | |
|------|----------------------------|------------------|
| (14) | <i>y^r afon</i> | ‘the river’ |
| (15) | <i>y llyfr</i> | ‘the book’ |
| (16) | <i>oʹ^r afon</i> | ‘from the river’ |

(Zimmermann, 2019:3)

In example (15), the ghost consonant [r] deletes to avoid an additional coda while in example (16) [y] deletes to avoid additional vowel hiatus (Zimmermann, 2019). Zimmermann (2019) argues that these are disappearing ghosts which surface provided they do not create markedness in the form of an additional coda or vowel hiatus.

The example of Welsh proves that a language can contain both hero and martyr ghosts. Zimmermann (2019) concludes that the relationship between ghost segments and markedness is not fixed but varies with each ghost segment.

Zoll (1994, 1996) has done extensive work on ghost segments using both OT and FG. A similar theoretical stance is adopted in this investigation. She provides a distinction between floating features and latent segments in her work on these phonological units in Yawelmani and Chaha. Floating features lack a root node and link to existing segments (Zoll, 1994). Latent segments contain a root node and surface as independent segments (Zoll, 1994).

Yawelmani contains both floating features and latent segments. Latent segments in Yawelmani exist in the form of ghost vowels and consonants. Hansson (2005) shows that the behaviour of latent segments which alternate with zero is different from normal segments. A ghost consonant, when present in a word, triggers deletion if its presence creates markedness, whereas a normal consonant that creates markedness remains, but triggers vowel epenthesis to resolve the markedness (Hansson, 2005). This shows that there is indeed a relationship between markedness and the surfacing of ghost segments. The latent ghost vowel behaves as a hero ghost that surfaces in only one position to rescue an unsyllabifiable consonant (Zoll, 1994)

The glottal ghost in Yawelmani behaves as a floating feature. The glottalization feature surfaces on the rightmost post-vocalic sonorant, as shown below (17) (Zoll, 1994). Interestingly, when the root is biconsonantal, this feature surfaces as a full segment (suffix initial glottal stop) (18). This feature is unique in its behaviour because it behaves as both a floating feature and a latent segment.

- (17) /caaw-(ʔ) aa-/ → caaw^ʔ aa- “shout”
 (18) /maax- (ʔ) aa-/ → max^ʔaa- “procure”

(Zoll, 1994:8)

Zoll (1994) argues that the behaviour of ghost segments, both floating features and latent segments, is determined by the grammar of the language. The grammar determines if the ghost surfaces as a full segment or not. Hansson (2005) describes latent segments in Yawelmani too. He claims that the behaviour of ghost segments is a “predictable consequence of differences in the phonologies associated with the two layers of verb morphology” (Hansson, 2005:109). This shows the interface between the morphology and phonology. Similarly, the grammar of isiNdebele provides the contexts for the surfacing or deletion of ghost segments within the language. Zoll (1994) makes use of OT to illustrate the behaviour of ghost segments in Yawelmani and Chaha. The constraints introduced by Zoll (1994) are defined below (19-21), this is followed by the constraint ranking for Yawelmani in (22) below.

(19) *STRUC (σ)

Minimize number of syllables in a word.

(Zoll, 1994:20)

(20) PARSE-feature

Features should be parsed.

(Zoll, 1994:20)

(21) ALIGN-suffix

Establishes edge affinity for morphemes.

(Zoll, 1994:20)

(22) Yawelmani ranking: *STRUC >> Parse-Feature >> ALIGN

(Zoll, 1994:20)

This constraint ranking shows that in Yawelmani deleting a ghost segment is preferred over having more than the minimum number of syllables in a word. In line with Hansson’s (2005) findings, this shows that ghost segments (latent segments) trigger deletion rather than the epenthesis of a vowel which adds a new syllable. Furthermore, Hansson (2005) shows that the morphological templatic and non-templatic affixation can predict the behaviour of latent segments in Yawelmani. He claims that latent segments occur with templatic suffixes, and their presence is predictable. Using OT, he comes up with a constraint ranking for latent and normal

segments in templatic and non-templatic affixation using the constraints DEP-V and MAX-C. This results in a co-phonology; the ranking is given in (23) below.

- (23) Templatic (underparsing): DEP-V >> MAX-C
Non-templatic (overparsing): MAX-C >> DEP-V

(Hansson, 2005:10)

This indicates that latent segments prefer to delete while normal segments trigger epenthesis. This proves that the behaviour of ghost segments can be predicted phonologically and by the grammar of a language, Lindsey (2019) comes to the same conclusion in her study of ghost elements in Ende.

Lindsey (2019) argues that the behaviour of ghost segments is predictable, as they either surface or delete in phonologically predictable contexts. Following Zimmermann's (2019) classification, she identifies two types of ghost segments: hero and martyr ghosts. The behaviour of martyr ghosts is just like the process of syncope whereby a phonological element deletes to repair markedness (Lindsey, 2019).

Gouskova (2003) discusses syncope in relation to economy effects and Iskender (2008) discusses this process in his discussion of vowel-zero alternation in Turkish. Hero ghosts exhibit behaviour like that of epenthesis; however, unlike typical epenthesis, the behaviour of hero ghosts cannot be entirely predicted (Lindsey, 2019).

Ende has both hero and martyr ghost segments. The infinitival theme vowels are hero ghosts that are typically absent but surface to resolve minimality. Minimality requirements in Ende state that words must be minimally disyllabic; therefore, the infinitival theme vowel surfaces to satisfy this requirement (Lindsey, 2019). Floating nasals are martyr ghosts that are typically present and are found root-initial in inflected forms and root-medial in infinitival forms (Lindsey, 2019). The floating nasals disappear if their presence results in word-initial nasal-stop clusters, which are prohibited in Ende.

Using OT, Lindsey (2019) argues that a co-phonology exists in languages which have both hero and martyr ghosts. The ranking of hero ghosts is opposite to that of martyr ghosts. This is because hero ghosts surface when necessary while martyr ghosts delete when necessary.

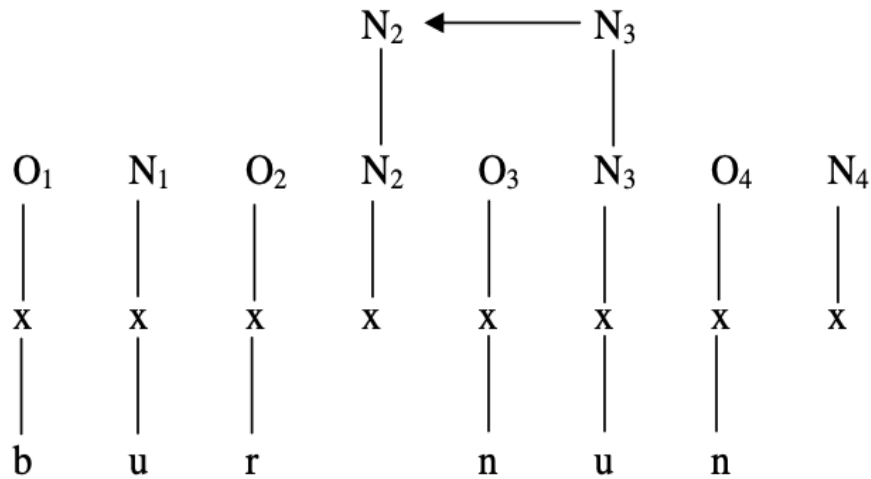
Lindsey's (2019) study illustrates the potency of using OT in explaining the behaviour of ghost segments; using this framework, ghost segments can be classified as hero or martyr.

Vowel-zero alternation, a phenomenon related to ghost vowels, is of special interest to the current study. The process of zero alternation is a phonological process which exhibits martyr ghost characteristics. Iskender (2008) discusses this process in detail in his study on the process in Turkish. He argues that the process of vowel-zero alternation in Turkish is predictable and optional, this is contrary to previous studies on this process in Turkish (Iskender, 2008).

Vowel-zero alternation has been attributed to economy effects, which is the avoidance of complex structures or the minimality of hierarchical structures in outputs, this process always applies unless blocked by higher ranking constraints (Iskender, 2008). High vowels are universally preferred for alternation, but non-high vowels can also be alternated. This explains why the most common ghost vowels in Nguni are high vowels [u] and [i]. In addition, syncope is the term used in the literature when referring to this process (Gouskova, 2008). High vowels are easily dropped by languages unless there are phonological, morphological or lexical constraints preventing this (Iskender, 2008).

Furthermore, syllable structure is vital for vowel-zero alternation. The required syllable structure for alternation in many languages is CvCV, whereby the small v is the alternated vowel (Iskender, 2008). Iskender (2008) utilizes Government phonology (hereafter GP) to explain the alternation of vowels in Turkish, and to determine the conditions under which the process occurs. According to GP, the alternated vowel alternates with zero or does not surface if it is properly governed by the following vowel (Iskender, 2008). This indicates that if a vowel cannot be governed by a following vowel, it does not alternate with zero and instead surfaces. Using the word 'burnun' (your nose), Iskender (2008) illustrates the vowel alternation using GP, as shown in (24) below.

(24) Burun-un → burønun ‘your nose’



(Iskender, 2008:76)

When N₃ governs N₂ the high vowel does not surface (alternates with zero). Turkish, like many other languages, allows only high vowels to alternate with zero (Iskender, 2008). Although the use of GP is able to explain clearly the pattern of vowel-zero alternation, it does not show the constraints that predict this. Furthermore, he does not concentrate on exploring the relationship between vowel-zero alternation and markedness, which the current study does.

Iskender (2008) confirms his findings with new data used by modern Turkish speakers. Paradis and El Fenne (1995) do the same when looking at floating consonants in French. They define floating consonants as consonants without a timing slot or x-slot. Thus far, this is the first study to provide an analysis of the structure of ghost segments and their relation to root nodes. Contrary to Polish yers, which is discussed shortly, floating consonants in French are visible to syllabification rules. This argument is attested by many scholars such as Iskender (2008) who show that vowel-zero alternation requires a particular syllable structure. Mudzingwa and Kadenge (2013) demonstrate that ghost segments somehow affect syllabification. In this study I argue that ghost segments in isiNdebele are also visible to syllabification.

Floating segments in French occur in the present indicative and infinitive. In the 3pl., the suffix attaches to the final floating consonant which then anchors it and allows for the realisation of the floating consonant (Paradis and El Fenne, 1995). In the 3sg, the ghost consonant cannot anchor unless a x-slot is inserted to form a coda (this is not a minimal strategy in French)

(Paradis and El Fenne, 1995). This is exemplified in (25) below. Deletion of the ghost segment before a consonant in the infinitive and preceding a plural suffix in adjectives occurs; however, this is not a preferred strategy in the language, instead French prefers reassociation in order to preserve part of the segment (Paradis and El Fenne, 1995). Following findings of previous studies discussed so far, Paradis and El Fenne (1995) conclude that zero alternation is a predictable and phonological process in French.

(25) *ekriv* ‘to write’

<i>UR</i>		<i>3sg.</i>		<i>3pl.</i>
x x x x		x x x x		x x x x x
e k r i v		e k r i ∅		e k r i v

(Paradis and El Fenne, 1995:191)

The floating consonant is not associated to the x-slot in the underlying representation, it does not surface in the singular form, unless a coda is formed by inserting an x-slot, and the floating consonant surfaces in the plural form and is anchored (Paradis and El Fenne, 1995).

As mentioned earlier, Zimmermann (2019) discussed the link between ghost segments and markedness, Yang (2004) discusses ghost segments from an alternative perspective. She states that ghost segments surface or delete when there is space in the syllable. Using the definite article in English, she discusses the surfacing of the /n/ in ‘an’. The definite article contains two allomorphs that surface in different environments; ‘an’ before vowel-initial words, and ‘a’ appears elsewhere (Yang, 2004). Ghost consonants and vowels behave differently; ghost consonants surface only when there is room for them while ghost vowels surface when necessary (Yang, 2004).

Using constraints introduced by Zoll (1996), she predicts the behaviour of ghost segments (whether they appear or delete). The constraint which regulates this behaviour is the PARSE-GHOST constraint which bans the deletion of ghosts. Other relevant constraints discussed by Yang (2004) include *STRUC(s) and PARSE (defined in 26-28 below). In English, the PARSE-GHOST constraint is low-ranking which indicates that ghost segment deletion is optimal. The constraint hierarchy is given in (29), and Tableau 1 is provided below to illustrate this.

(26) PARSE-GHOST

Do not skip over ghost (no deletion of ghosts).

(Yang, 2004:72)

(27) PARSE

No deletion of regular segments.

(Yang, 2004:72)

(28) *STRUC (s)

Minimize number of syllables in a word.

(Yang, 2004:79)

(29) English constraint hierarchy: PARSE >> *STRUC(s) >> PARSE-GHOST

(Yang, 2004:81)

Tableau 1: English definite allomorphy

/a(n) possible/	PARSE	*STRUC(s)	PARSE-GHOST
a. aN.pos.si.ble		*!	
b. a*.pos.si.ble			*

(Yang, 2004:81)

The first candidate is eliminated as it violates high-ranking *STRUC (s) by having the unnecessary syllable. The optimal candidate only violates the low-ranking PARSE-GHOST by deleting the ghost consonant /N/. Using the classification proposed by Zimmermann (2019) and Lindsey (2019), I argue that the ghost consonant in English is a martyr ghost that typically surfaces but deletes if its presence violates the constraint against adding unnecessary syllables. Yang (2004) and Zoll (1994) utilize OT when discussing the behaviour of ghost segments, these studies provide a solid background on how to utilize OT when discussing ghost segments.

The ghost segments or floating features discussed thus far have been identifiable because they are present in the underlying representation and surface or delete under different circumstances.

Other ghost segments, however, are identified indirectly based on how they affect the surrounding environment, this is the case with the Hebrew guttural ghost (Enguehard and Faust, 2018). Guttural ghosts are not physically found in Modern Hebrew (henceforth MH), but their presence is perceived through the alternation between [a], zero and guttural [ʔ], Enguehard and Faust (2018) analyse these ghosts as underlying /a/.

The guttural ghost in MH is vocalic in nature and seeks to be realised on the V-slot, if this slot is not occupied, the ghost surfaces. However, if the V-slot is occupied the vocalic ghost remains floating or surfaces as a glottal stop [ʔ] (Enguehard and Faust, 2018). MH was revived from Biblical Hebrew (BH) by speakers whose languages did not contain certain consonants, as a result these consonants have been lost in MH. The guttural ghost occurs wherever a consonant has been lost from BH and is a ghost segment in that sense (Enguehard and Faust, 2018).

As mentioned, ghost segments in MH are perceived by their effects on the surrounding environment, this occurs in the passive verb. In MH, when /a/ is syncoped (lost), the result is a triconsonantal cluster which is prohibited (30). To repair this a vowel is inserted between the last two consonants (Enguehard and Faust, 2018). The example in (31) shows this epenthesis without the triconsonantal cluster, the authors argue that there is an underlying triconsonantal cluster where there is an inaudible consonant. This indicates that at times, ghost segments are only perceived indirectly by how they affect the environment. One context for the existence of ghost segments in isiNdebele (vowel coalescence) further proves this.

- | | | | |
|------|-------|---------|------------|
| (30) | ufkʌd | ufkʌd-u | ‘separate’ |
| (31) | ufkʌ | ufkʌe-u | ‘disturb’ |

(Enguehard and Faust, 2018:687)

The findings of studies discussed until this point have shown that ghost segments are phonologically predictable elements that alternate with zero. Scholars have shown the various environments these can exist in, and when they surface or delete and the constraints governing this. The remainder of this section discusses what scholars have said about the structure of ghost segments. A good starting point is Szpyra’s (1992) work on Polish yers.

Yers are ghost vowels found in Slavic languages such as Polish and Bulgarian (Szpyra, 1992; Rubach, 2016; Hristovsky, 2020). This ghost vowel alternates with zero, unlike full or normal vowels. These vowels are unpredictable, according to Rubach (2016), because they surface and delete in unpredictable environments. According to the standard generative approach, yers and non-yers differ in that the former are lax vowels while the latter are tense vowels (Szpyra, 1992). She criticises this view as it lacks phonetic justification, she suggests that yers are empty vocalic slots whose melodies are absent.

Szpyra (1992) argues that yers fail to undergo syllabification and block syllabification. She provides evidence from comparative and imperative allomorphy. The comparative degree stem has two allomorphs that are found in different environments. [-ejsz(y)] occurs in words where the final stem is unsyllabifiable, as shown in example (32), [-sz(y)] occurs after syllabifiable stems or elsewhere (33) (Szpyra, 1992). Example (34) illustrates that if yers were visible to syllabification, they could block comparative allomorphy but this yields an ungrammatical form; therefore, the yers must be invisible to syllabification. The imperative allomorphy (raising and nasal backing) proves that yers are both invisible to syllabification but also block it (Szpyra, 1992).

- | | | | | |
|------|---------|---|---------------|-----------|
| (32) | madr-y | → | madrz-ejszy-y | ‘wise’ |
| (33) | tward-y | → | tward-sz-y | ‘hard’ |
| (34) | pev En | → | *penvnsi | ‘certain’ |

(Szpyra, 1992)

She suggests that the yer be represented as an empty root node that is devoid of any melodic features, when realised, the yer is given the feature [-consonantal] (Szpyra, 1992). Ulfsbjorninn (2020) goes a step further by showing how ghost segments can be represented using strict CV. He claims that there are two layers; the skeletal, which contains the C and V slots, and the melodic tier which contains the features (Ulfsbjorninn, 2020). A feature with no skeletal structure is floating and can dock onto another segment. She also shows that in addition to floating features, there are unfixed segments. These are segments where no association line between the skeletal and melodic tier exists. Lastly, there are empty positions with no melodic tier (Ulfsbjorninn, 2020). These studies show that, structurally, ghost segments differ from normal segments.

This section discussed literature on ghost segments globally. The literature agrees that ghost segments are phonological entities which are predictable. Furthermore, ghost segments affect and are affected by markedness and the grammar of the language. Lastly, the literature shows that ghost segments are empty root nodes with no skeletal structure. Of special interest to the current study, various contexts for ghost segments surface from the literature; epenthesis and minimality being the two main ones. This indicates that in isiNdebele, these contexts should be analysed in detail. The next section discusses what has been documented on ghost segments in African languages.

2.4. Ghost segments in African languages

Ghost segments have been documented in several African languages, with many focusing on ghost tones. See, for example, Odden (1988) on floating tones in Kenyang and Paster (2003) on floating tones in Ga. But a few have focused specifically on ghost segments in the form of vowels and consonants. For the sake of the current study, this section only discusses the literature that focuses on ghost vowels and consonants. A good starting point is Showalter's (2007) work on the glottal stop in Kaansa.

Showalter (2007) discusses the glottal stop in Kaansa, a Gur language spoken in Burkina Faso. From this analysis, it is shown that the glottal stop and other consonants in the language are ghost segments. There are specific environments where the glottal stop is found; word-finally before a pause and after a pause in vowel initial words. Similar to the ghost consonant in Welsh, the glottal stop in Kaansa demarcates word boundaries for vowel initial words that are preceded by vowel final words, this repairs the vowel hiatus (Showalter, 2007). This is illustrated in example (35) below.

(35) kasiŋ? ʊ pi jiŋ? sim̃bɛ

Kasiya whom they call Simbe

“The Kasiya whose name is Simbe.”

(Showalter, 2007:98)

The glottal stop has five functions; it acts as a phonetic delimiter, marks short vowels before a pause, is the initial consonant in two personal pronouns, marks the diminutive state of noun class suffixes 1-4, and is the root-final marker of a lost consonant in nouns and verbs (Showalter, 2007). Of these five functions, only two are elaborated on by Showalter (2007).

The glottal stop is used as a marker of the diminutive for noun classes 1-4 suffixes. The insertion of the glottal stop to the class suffix creates a diminished noun. This is shown in (36) below whereby the word for ‘rock’ is given in its undiminished form and (37) gives the diminutive state.

- (36) [poŋ'ga] → [poi'f̥sa] ‘rock/s’
 (37) [poŋ áʔra] → [pŋ áʔja] ‘very small stone/s’

(Showalter, 2007:101)

Of interest to the area of focus, glottal stops in Kaansa are inserted to indicate that a consonant has been lost, in this way, it behaves as a ghost segment (Showalter, 2007). He shows this by arguing that glottal stops at word boundaries mark lost consonants which appear as ghost consonants. Examples (38) and (39) below illustrate this. When nouns are suffixed with the class 1 suffix, the ghost consonant surfaces (in bold); however, in the root form, the same ghost consonant is marked by a glottal stop (39) (Showalter, 2007).

- (38) boro ‘hare, rabbit’
 (39) boʔ ‘hare, rabbit’

(Showalter, 2007:106)

Although Showalter (2007) provides a detailed analysis of the glottal stop, there is little emphasis on the ghost aspect of the glottal stop. Mudzingwa and Kadenge (2013) provide a detailed analysis of the ghost augment in ChiShona, a Bantu language spoken in Zimbabwe.

Nguni languages such as isiZulu and isiNdebele contain an overt augment or preprefix. ChiShona, on the other hand, does not contain an overt augment. According to Kadenge and Mudzingwa (2013), ChiShona has a ghost augment. They provide two sources of evidence for

their argument. Firstly, coalescence patterns in ChiShona (provided below in (40)) give evidence for the existence of the ghost augment. In ChiShona, like other Bantu languages, a sequence of two vowels is prohibited, as such various strategies are used to repair this illegal structure, and one of these strategies is vowel coalescence whereby features from both vowels combine to form one vowel with features from both vowels (Mudzingwa and Kadenge, 2013; Sibanda, 2011).

- (40) /a/ + /a/ → [a]
 /a/ + /i/ → [e]
 /a/ + /u/ → [o]

The associative in examples (41) to (43) below, coalesces with the ghost augment to form the coalesced vowel. This provides evidence for the ghost augment. If there was no ghost augment, these examples would be considered exceptions to the rule. This illustrates that ghost segments can be perceived indirectly by how they affect the surrounding environment.

- (41) /sa=(**u**)-mu-ti/ → [somuti]
 (42) /sa=(**a**)-ka-mba/ → [sakamba]
 (43) /sa=(**i**)-ŋi-tota/ → [seŋitota]

(Mudzingwa and Kadenge, 2013:89)

The ghost augment comprises floating V-place features. Therefore, the ghost augment is a latent segment which contains floating features. The second source of evidence for the existence of the ghost augment is negative evidence. Mudzingwa and Kadenge (2013) state that there are cases where the ghost augment is present but coalescence does not occur. Their argument is that this is not the environment for vowel coalescence (across prosodic word boundary); therefore, coalescence does not occur and instead the ghost augment remains unrealised. This is shown in (44) below.

- (44) /ka=(u)-murume/ → [kamurume] *[komurume]

(Mudzingwa and Kadenge, 2013:92)

This study makes use of OT in the analysis of the ghost augment. The insights in this paper can be applied to the current study as both languages are Bantu languages. The constraint ranking for the ghost augment is provided in (50); the constraints found in the ranking are defined in (45)-(49).

(45) *FLOAT

Floating features are prohibited.

(Mudzingwa and Kadenge, 2013:90)

(46) ONSET

Syllables must have onsets.

(Mudzingwa and Kadenge, 2013:90)

(47) DEPRT

Every root node of the output has a correspondent root node in the input.

(Mudzingwa and Kadenge, 2013:90)

(48) MAX {LAB}

Any [labial] feature in the input must have a correspondent in the output.

(Mudzingwa and Kadenge, 2013:90)

(49) NO-FLOP

Let [F] be a feature (autosegment) in the output representation, and let [F'] be the input correspondent of that feature. If the output feature [F] is dominated by a root node (segment) X, then the input feature [F'] must likewise be dominated by a root node (segment) X', where X' is the input correspondent of X.

(Mudzingwa and Kadenge, 2013:90)

(50) ChiShona ranking= *FLOAT >> ONSET >> MAX {LAB} >> DEPRT >> NO- FLOP

(Mudzingwa and Kadenge, 2013:91)

Floating features are strictly prohibited in ChiShona as indicated by the high-ranking constraint prohibiting this (Mudzingwa and Kadenge, 2013). Chaha, a Gurage language spoken in Ethiopia, allows floating features. This means that in Chaha, the *FLOAT constraint would be low-ranking.

Chaha contains two floating features; labialization and palatalization. These features occur in similar environments, with some key differences (Zoll, 1994). Labialization occurs on the third person masculine singular object morpheme. This feature is typically present but deletes if its presence violates phonotactic constraints; therefore, this feature is a martyr ghost (Lindsey, 2019). Labialization surfaces on the rightmost labializable consonant (coronal or velar obstruents), if such a consonant does not exist, the feature does not surface (Zoll, 1994). The process of labialization or lack thereof occurs in the object form of verbs in Chaha (Zoll, 1994). Example (51) illustrates the occurrence of labialization while (52) shows a context where this does not occur.

- (51) dænæg^w ‘hit’
 (52) sædæd ‘chase’

(Zoll, 1994:20)

Palatalization, on the other hand, surfaces on the right edge (Zoll, 1994). Palatalization is present in the imperative and impersonal on the rightmost palatalizable consonant (coronal and velar obstruents), unlike labialization, this feature is restricted to the right edge consonant only (Zoll, 1994). Example (53) below shows this.

- (53) nəkēs → nəkēs^y ‘love’

(Zoll, 1994:22)

Using OT, Zoll (1994) comes up with a constraint ranking for the Chaha floating features using the features *STRUC (19), ALIGN-imperative (54), PARSE-feature (20), and ALIGN-object (55). The constraint ranking is given in (56) below. She uses the same set of constraints and reranks them to show the difference between Yawelmani and Chaha. The current study makes use of OT to show the behaviour of ghost segments across different languages too.

(54) ALIGN-imperative

Align (imperative, R, Stem, R).

(Zoll, 1994:22)

(55) ALIGN-object

Align (object, R, Stem, R).

(Zoll, 1994:22)

(56) Chaha ranking= *STRUC >> ALIGN-imperative >> PARSE- Feature >> ALIGN-object

(Zoll, 1994:24)

As mentioned at the beginning of this section, literature on ghost segments or floating features focuses mainly on floating tones (Odden, 1998). Floating tones, according to Remijsen and Ayoker (2020), can associate within and across word boundaries. These scholars discuss floating quantity or floating moras in the Nilo-Saharan language, Shilluk (spoken in South Sudan). They claim that the floating quantity, which is found only in nouns, is realised on the following vocalic prefix (Remijsen and Ayoker, 2020). Floating quantity is not associated to any segmental content but associates with whatever vocalic material is available.

The floating mora is found in four suffixless forms; suffixless plural nouns, proximal demonstrative of suffixless singular nouns, pertensive with singular possessor of suffixless singular nouns, and the base form of singular nouns (Remijsen and Ayoker, 2020). It is important to note that the floating mora only docks onto a vocalic prefix, if the following word begins with a consonant, the floating quantity does not dock (Remijsen and Ayoker, 2020). Two vowels provide the environment for the docking of the floating quantity: [a] and [u], shown in (57).

(57) tɔ̀kʰ uː -lʰɪntɔ̀ [tɔ̀k uoʊlʰɪndɔ̀] ‘somebody is looking at the edges’

(Remijsen and Ayoker, 2020:141)

Interestingly, the floating quantity triggers lengthening of the prefix that it docks onto. This is especially evident in the pensive with singular possessor, whereby the floating mora conditions the lengthening of the vocalic prefix. In this context, this lengthening only occurs if the prefix has the vowel quality /a/ and carries a high tone, this is shown in (58) below (Remijsen and Ayoker, 2020).

(58) gɔ̌l̥ á-bác → gɔ̌l̥ āabác ‘the compound of Abac’

(Remijsen and Ayoker, 2020:147)

They conclude that the docking of the floating mora is “determined by phonological characteristics” (Remijsen and Ayoker, 2020:148).

This section has highlighted some studies conducted on ghost segments (latent segments and floating features) in African languages. The literature has shown that ghost segments are phonological entities which can be perceived indirectly, and trigger other phonological processes, for example, vowel coalescence or lengthening (Mudzingwa and Kadenge, 2013; Remijsen and Ayoker, 2020). The next section deals with the only study done on ghost segments in Nguni, which isiNdebele is a part of.

2.5. Ghost segments in Nguni

Sibanda (2011) discusses ghost segments in the Nguni language group. He draws many examples from Zimbabwean Ndebele, which is different from Transvaal Ndebele (which is the focus of the current study) (Mashiyane, 2002; Skhosana, 2009). His definition of ghost segments aligns with the definition found in the literature; that these are segments which alternate with zero or have zero alternation (Sibanda, 2011). Nguni contains both ghost consonants and vowels.

The ghost vowels found in Nguni, according to Sibanda (2011), include /i/, /a/ and /u/, with the most common being the high coronal vowel /i/. As shown by Iskender (2008), high vowels are preferred for zero alternation, so clearly Nguni is no exception to this. The context where ghost vowels occur is during vowel coalescence (features from two vowels in hiatus are combined to

form a single vowel). The coalescence pattern in Nguni is similar to that of ChiShona, this pattern is repeated in (59) below.

- (59) /a/ + /a/ → [a]
 /a/ + /i/ → [e]
 /a/ + /u/ → [o]

(Sibanda, 2009:39)

In (60) below, the low vowel /a/ changes to mid vowel [e], Sibanda (2011) argues that this is not a case of dissimilation. He argues that this must be vowel coalescence where the low vowel coalesces with a ghost vowel /i/ to form the mid vowel.

- (60) a-(i)-z-a → eza/aza ‘they come’

(Sibanda, 2011:132)

This phonological process (vowel coalescence) provides the context for the presence of ghost vowels in Nguni. This process also provides evidence for ghost vowels in isiNdebele (Skhosana, 2009). The ghost vowel /u/ is found in Siswati in the same phonological context. This ghost vowel occurs in the relative concords of noun classes 11, 14, and 15. This is given in (61) to (63) below.

- (61) la + (u)lu → lolu
 (62) la + (u)bu → lobu
 (63) la + (u)ku → loku

(Sibanda, 2011:133)

Sibanda (2009) argues that the [o] in the concord is evidence for a ghost vowel /u/ which coalesces with the low vowel to form [o].

There are three ghost consonants in Nguni; [b], and glides [j] and [w]. The ghost glides surface to resolve certain markedness constraints. For instance, when a word (such as the imperative) requires an initial C segment to be well-formed (64). Furthermore, ghost glides occur in vowel hiatus resolution strategies. What appears as glide insertion is actually just the ghost glide surfacing to prevent hiatus (Sibanda, 2009). This is given in (65) and (66).

- | | | | | | |
|------|-------------|---|-------------|----------|--------------------|
| (64) | -akh-a | → | (y)akha | | ‘build’ |
| (65) | ka-u-khul-i | → | ka(w)ukhuli | *kokhuli | ‘it does not grow’ |
| (66) | ka-i-khul-i | → | ka(y)ikhuli | *kekhuli | ‘it does not grow’ |

(Sibanda, 2011:136-137)

From (65) and (66) above, the palatal glide surfaces before [-round] vowels while the labial glide occurs before [+round] vowels. Scholars such as Mudzingwa (2010) and Mudzingwa and Kadenge (2014) argue that intrusive glides in verbs and deverbal nouns are a result of spreading. However, Sibanda (2011) indicates that this is not spreading or glide insertion but the ghost glide surfacing to repair hiatus. This would indicate that the ghost glides in Nguni are hero ghosts which surface to resolve hiatus. The choice of the ghost glide is informed by spreading, the quality of the vowel in the word determines which ghost glide surfaces; [+round] vowels result in the labial glide surfacing while [-round] vowels result in the palatal glide surfacing (Sibanda, 2011).

The ghost consonant /b/ surfaces with the low vowel /a/ and forms one ghost segment [ab]. According to Sibanda (2011), this segment is found when there is preceding /a/ in class 2a but no other noun classes. Examples (67) and (68) show this.

- | | | | | |
|------|----------------|----------|---------|--------------------|
| (67) | zi-a-(ab)omama | zabomama | *zomama | ‘mothers’ |
| (68) | la-(ab)omama | labomama | *lomama | ‘with the mothers’ |

(Sibanda, 2011:135-136)

This section has shown the ghost segments found in Nguni; /u/, /i/, /a/, /ab/, /j/, and /w/. Furthermore, this section has provided the contexts which these segments can be found. The study by Sibanda (2011) provides a starting point for the current study which focuses on ghost segments in isiNdebele (a Nguni language). The ghost segments discussed by Sibanda (2011) are discussed in this study, in the context of isiNdebele. Furthermore, unlike Sibanda (2011), this study uses OT to explain the behaviour of ghost segments.

2.6. Summary of chapter

This chapter discussed the literature on ghost segments. It is clear that ghost segments are attested in many languages, Nguni included. The literature shows that ghost segments are phonologically predictable, and are conditioned by morphophonological processes. This study aims to provide a prediction for the surfacing or deletion of ghost segments in isiNdebele. The literature indicates that ghost segments can exist in contexts such as vowel coalescence, minimality effects and vowel epenthesis. These are the contexts which are discussed in isiNdebele.

Chapter 3: Background of isiNdebele

3.1. Introduction

This chapter provides a background on isiNdebele. A brief history of the language is provided, followed by the phonemic inventory, syllable structure, and some morphosyntactic aspects of isiNdebele.

3.2. History of isiNdebele

IsiNdebele (S407 and S408) is a Southern Bantu language spoken by only 2.1 % of the population in South Africa. It is the least spoken language in South Africa (Statistics South Africa, 2012). 37 % of isiNdebele speakers are found in Mpumalanga. However, some Ndebele speakers are found in Gauteng, KwaZulu Natal, Limpopo, and the North West provinces (Statistics South Africa, 2012). IsiNdebele is one of the 12 official languages of South Africa.

It is important to make clear which Ndebele is the focus of this study. There are two groups of isiNdebele speakers: Zimbabwean Ndebele (S401) and Transvaal Ndebele. Zimbabwean Ndebele is spoken in the Matebeleland provinces of Zimbabwe (Downing, 2000). The Zimbabwean Ndebele language is closer to isiZulu. It is likely that this is due to this group being descendants of Mzilikazi (who fled from the Zulus). Transvaal Ndebele is spoken in South Africa, and this group are descendants of Musi (Skhosana, 2009). The focus of this study is Transvaal Ndebele. A brief history of this group is discussed in the remainder of this subsection.

Transvaal Ndebele speakers are divided into two groups: Northern and Southern Ndebele. Both groups are descendants of Chief Musi; however, following his death, his six sons split, and each amassed their own following. The Southern Ndebele group were followers of Manala, Nzunza and Mhwaduba (Skhosana, 2009). The Northern Ndebele group were followers of Mthombeni or Gegana (Skhosana, 2009). These two groups settled in different areas before they were brought back together by the apartheid government, as such, there are some differences between their languages, Skhosana (2009) provides a detailed discussion on the

history of the Ndebele and the differences between the two groups. This study focuses on Transvaal Ndebele as a whole, which includes the three dialects: Nzunza, Manala and Northern Ndebele.

3.3. Phonemic inventory

3.3.1. Vowels

IsiNdebele has five simple vowels, with two having variant forms. The seven vowels of isiNdebele are: /a/, /e/, /i/, /o/, /u/, [ɛ], [ɔ]. The last two vowels are allophones of /e/ and /o/ respectively (Skhosana, 2009). A description of isiNdebele vowels is given below with examples.

[a]- low vowel

(69) sala [sala] ‘remain’

[e]- closed mid-high front vowel

(70) ikesi [ik’esi] ‘paraffin lamp’

[ɛ]- open mid-low front vowel

(71) lelo [lɛlɔ] ‘that one’

[i]- high front vowel

(72) lilizela [lilizɛla] ‘applause’

[o]- closed mid-high back vowel

(73) ikosi [ik’osi] ‘chief’

[ɔ]- open mid-low back vowel

(74) bona [bɔna] ‘see’

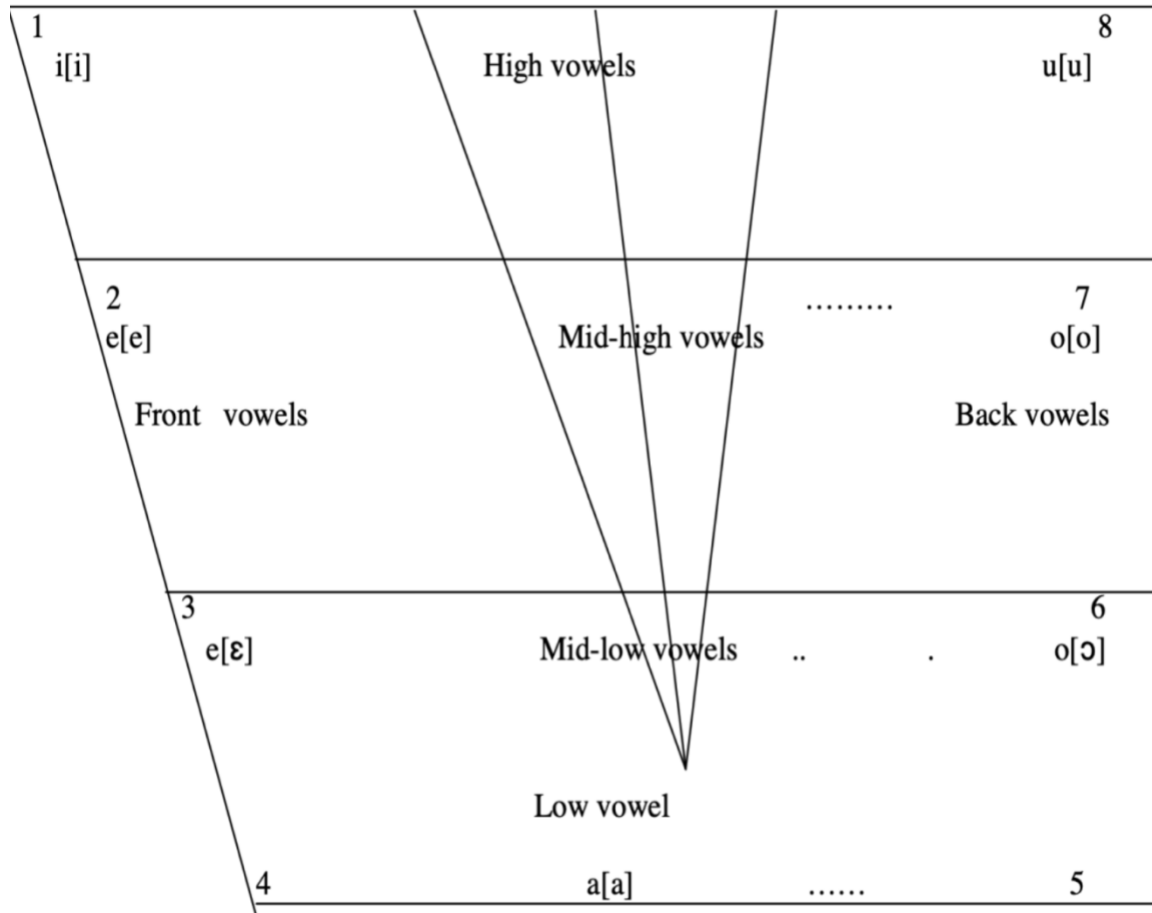
[u]- back high vowel

(75) khulu [k^hulu] ‘big’

(Mahlangu, 2007:8)

Figure 1 below provides the articulatory qualities of the vowels as explained above.

Figure 1: isiNdebele vowel chart



(Skhosana, 2009:44)

3.3.2. Consonants

IsiNdebele consists of 50 consonants (including 9 clicks) (Mahlangu, 2007). Complex consonants, in the form of prenasalised consonants, are permitted (Skhosana, 2009). Complex consonants occupy a single C slot, unlike complex clusters (CC) which occupy more than one C slot (Vratsanos and Kadenge, 2017). Complex clusters are not permitted in isiNdebele. Table 1 below summarizes the consonant inventory of isiNdebele.

Table 1: IsiNdebele consonant inventory

	<u>Bilabial</u>	<u>Labio-dental</u>	<u>Alveolar</u>	<u>Pre-palatal</u>	<u>Velar</u>	<u>Glottal</u>
<u>Plosives</u>	p' b p ^h b̥		t' d t ^h d̥		k' g k̥ g̥ k ^h	
<u>Implosives</u>	ɓ					
<u>Fricatives</u>		f v	s z ʃ ʒ ɬ ɮ	x		ɦ
<u>Affricates</u>		ɱcpf ɱɸv	ts' dz tʃ' dʒ tʃh tsh	tʃ dʒ tʃh	kxh	
<u>Nasals</u>	m		n	ɲ	ŋ	
<u>Trills</u>			r			
<u>Liquids</u>			l			
<u>Glides</u>				j	w	

(adapted from Mahlangu, 2007:45-46)

Table 2 provides the nine click sounds in isiNdebele, their classification and examples.

Table 2: Click sounds in isiNdebele

<u>Click sound</u>	<u>Classification</u>	<u>Example</u>	<u>Gloss</u>
[ɿ]	dental click	[/aɓanga/] cabanga	‘think’
[ʰɿ]	aspirated dental click	[/ʰaʰa/] chacha	‘loosen’
[g]	voiced dental click	[/gina/] gcina	‘end’
[ŋ]	nasalized dental click	[ŋ/ama] ncama	‘be determined’
[ʔ]	palato-alveolar click	[i!iniso] iqiniso	‘truth’

[^h]	aspirated palato-alveolar click	[isi! ^h ɛma] isiqhema	‘group’
[!g]	voiced palato-alveolar click	[isi!gila] isigqila	‘slave’
[ŋ!g]	Voiced nasalized palato-alveolar click	[uŋ!gɔŋ!gɔtʃhe] ungqongqotjhe	‘minister’
[ŋ]	Lateral click	[ŋ//afa]	‘click of annoyance’

(adapted from Mahlangu, 2007)

It should be noted that click sounds are only found in the Southern Ndebele variation of Transvaal isiNdebele (Skhosana, 2009).

3.4. Syllable structure

IsiNdebele follows a strict CV syllable structure. V only syllables are permitted word-initially. IsiNdebele has open syllables; therefore, codas are not permitted. Complex onsets are also not permitted in isiNdebele (Khan, 2016). Syllabic consonants are permitted, nasals such as /n/, /m/ and /ŋ/ can behave as syllabic nuclei and liquids can be syllabic in Northern Ndebele (Jiyane, 1994; Skhosana, 2009). The permitted syllable structures are CV and V. IsiNdebele permits long vowels. Syllables in isiNdebele must be minimally disyllabic.

Syllable structure provides the background for markedness. This study focuses on ghost segments and their relation to markedness; therefore, an exploration of the syllable structure as a level of phonological analysis is important to this study.

3.5. Morphosyntactic aspects

IsiNdebele is an agglutinative language, meaning it has a strong morphology which it uses to create sentences, this is a typical characteristic of Nguni languages (Ziervogel, 1959). The morphosyntactic aspects of isiNdebele are relevant for this study because they govern phonological processes in the language, such as epenthesis and vowel coalescence. This is

unsurprising because morphology and phonology are inextricably interconnected in Bantu languages in general. IsiNdebele is made up of noun classes which contain noun class prefixes, this is given in table 3 below.

Table 3: IsiNdebele Noun classes

Class		Allomorphs	Class		Allomorphs
1	umu-	um-,	2	aba-	be-, ba-
1a	u-	i-	2a	abo-	bo-
3	umu-	m-, mu-	4	imi-	mi-
5	ili-	l-, lu-, il-, li-	6	ama-	ma-, ame-
7	isi-	si-	8	izi-	ii-, ti-, iin
9	n-	i([n])-	10	izi-	ti-, ii-, tin, iin
14	ubu-	bu-, u-			
15	uku-	ku-, ukw-			
16	pha-	phe-			
17	ku-	phe-			

(adapted from Skhosana, 2009 and Ziervogel, 1959)

Various concord markers are utilized in isiNdebele. These are given in table 4 below.

Table 4: isiNdebele Concord markers

	Subject	Enumerative	Possessive	Adjective	Relative
1 st pers sg.					o-/engi-/egi- lo a-/ legi-
1 st pers pl.					esi-/aba- lesi si-
2 nd pers sg.					o- lo a-
2 nd pers pl.					eni-/eli-/aba- leli li-/ laba ba-

Class 1	u-	mu-/ wu-	wa(ka)-	om(u)-	o-/ lo a-
Class 2	ba-	ba-	ba-	aba-/ baba-	aba-/ laba ba-
Class 3	u-	mu-/wu-	wa(ka)-	om(u)-	o-/ lo o-
Class 4	i-	mi-/yi-	ya-	emi-	e-/ le e-
Class 5	li-	li-	la-	eli-/ leli-	eli-/ leli li-
Class 6	a-	ma-	wa-/a-/ya-	ama-	a-/ la a-
Class 7	si-	si-	sa-	esi-/ sesi-	esi-/ lesi si-
Class 8	zi-	zi-	za-/ta-	ezi-/ teti-	ezi-/ eti-/ leti ti-
Class 9	i-	yi-	ya-	e-	e-/ le e-
Class 10	zi-	zi-	za-/ta-	ezi-/ teti-	ezi-/ eti-/ leti ti-
Class 14	bu-	bu-	ba-	obu-/ bobu-	obu-/ lobu bu-
Class 15	ku-	ku-	kwa-	oku-/ koku-	oku-/ loku ku-

(adapted from Ziervogel, 1959; Skhosana, 2009; and Jiyane, 1994)

3.6. Summary of chapter

This chapter provided a brief discussion on the background of isiNdebele. This discussion included a historical background, phonemic inventory, syllable structure and morphosyntactic aspects. The structural aspects discussed in this chapter inform the discussion on ghost segments in isiNdebele. These aspects provide a foundation from which all processes discussed take place. This provides some important background for the various morphophonological processes which are discussed in this study.

Chapter 4: Methodology

4.1. Introduction

This chapter provides the methodological approaches used in this study. The sources of the data, how it was verified, and the theoretical frameworks are discussed in this chapter.

4.2. Sources of data

The data for this study was collected from various sources. The first source for the data is previous studies done on isiNdebele. This includes Jiyane's (1994) work on the grammar of isiNdebele, supplemented by Skhosana's (2009) work on Northern and Southern Ndebele. One isiNdebele dictionary was utilized: isiNdebele/English isihlathululi-Magama dictionary. Lastly, the data is supplemented by my own knowledge of isiNdebele.

Jiyane (1994) provides an in-depth analysis of the grammar of isiNdebele. He looks at the various morphological word groups, demonstrating the various morphosyntactic contexts in the language. Since this study looks at various morphophonological contexts for the presence of ghost segments, Jiyane's (1994) work is very useful. Skhosana (2009) supplements this work by discussing the differences between Northern and Southern isiNdebele, and the study provides data from both variants of isiNdebele which make up Transvaal Ndebele. These two studies are the main sources of data.

In collecting the data, I focused on nouns, verbs, adjectives, pronouns, adverbs. These are the contexts that specifically show the various processes I discuss in this thesis. I looked at how these word categories were formed and processes that occurred in this formation.

4.3. Data verification

No participants were consulted during this study. The data collected was verified by me. I am a native speaker of isiNdebele and have verified the data based on my knowledge and use of the language. Furthermore, the radio station IKwekwekzi FM, provided knowledge that I am

not familiar with, based on how other speakers use the language. Because no participants were used in this study, ethical clearance was not required.

4.4. Theoretical framework

There are two theoretical frameworks which have been used in this study: Optimality Theory and Feature Geometry. The first framework aids in showing how ghost segments affect markedness in the language by providing a constraint hierarchy which can predict the behaviour of ghost segments. Feature Geometry is used to show the phonological structure of ghost segments in relation to normal non-ghost segments.

4.4.1. Optimality Theory

Optimality Theory is a theoretical framework developed by Prince and Smolensky (2004). OT posits that language is a system of universal constraints which are structural requirements that can be satisfied or violated by the output form (Kager, 1999). Universal grammar (UG) is the basis of OT, Prince and Smolensky (2004) argue that UG is a set of constraints that are found in all the world's languages (Kager, 1999). The universal constraints are violable indicating that violation is permitted but must be minimal. Constraints are conflicting, meaning you cannot satisfy one without violating another. Constraints are universal, what is not universal is the ranking of these constraints, this results in cross-linguistic differences (Prince and Smolensky, 2004).

There are two main tenets of OT: markedness and faithfulness. Markedness refers to the structural well-formedness of the output form. A marked structure is rare and creates linguistic differences while an unmarked structure is found in most languages. For example, all languages prefer the CV syllable structure. Faithfulness, on the other hand, refers to the congruency between the input and output form. Faithfulness is best achieved by restricting the addition or removal of elements in the output form (Kager, 1999). Markedness and faithfulness conflict, satisfying one violates the other.

The ranking of constraints is the source of language variation. As such languages rank constraints based on what is important in each language, higher ranked constraints dominate and are the most important. Violating high ranked constraints incurs a fatal cost to harmony, these constraints make the decision regarding the optimal candidate (Prince and Smolensky, 2004). Low ranking constraints can be violated without incurring a fatal cost to harmony. Violation is unavoidable; therefore, the optimal candidate incurs the least serious violation and is the most harmonic with a set of constraints.

There are mechanisms in place to guide the relationship between the input and output form. The generator (GEN) provides a set of candidates which are the possible output forms. The evaluator (EVAL) is utilized to select the optimal output. The EVAL selects the optimal output based on the constraint ranking (Kager, 1999).

OT is perfect for this study as it shows the ranking of universal constraints in isiNdebele. The use of OT predicts the behaviour of ghost segments in the language and thus provides a constraint ranking for these segments. Furthermore, repair strategies that may be utilized in the process discussed in this study are accounted for using OT. The secondary theoretical framework Feature Geometry is discussed in the next section.

4.4.2. Feature Geometry

To show the structure of ghost segments in relation to normal segments, FG is utilized. FG is a generative grammar theory developed by Clements and Hume (1995). This theory visually represents the distinctive phonetic features using tree diagrams. The features used in the tree diagrams are universal, every language consists of these distinctive features (Clements and Hume, 1995). Distinctive features are arranged in a hierarchy in the tree diagram. FG can visually represent both phonological process but also the structure of sounds.

Melodic features are represented at the root tier while metric segments are found on the skeleton (Clements and Hume, 1995). This is relevant for this study because it provides a visual representation of ghost segments in isiNdebele.

4.5. Summary of chapter

This chapter has discussed the data collection and analytical tools used in this study. The chapter began with a discussion of the sources of data and verification processes. The chapter provided a detailed explanation of the theories utilized in this study (OT and FG). The next chapter begins with an analysis of ghost segments in isiNdebele.

Chapter 5: Ghost segments

5.1. Introduction

As mentioned in the second chapter of this thesis, Nguni (and isiNdebele by extension) has three ghost vowels: [a], [i], and [u] and three ghost consonants: [b], [j] and [w] (Sibanda, 2011). This chapter focuses on the behaviour of these ghost segments by looking at three morphophonological processes, namely, high vowel elision, vowel hiatus resolution, and minimality effects.

5.2. High vowel elision

High vowel elision is the tendency for languages to delete high vowels in certain phonological contexts (Harford and Malambe, 2015). Harford and Malambe (2015) highlight the conditions under which vowel elision can occur: (1) the vowels must be [+high], (2) the vowel is not found in a prominent syllable, and (3) the high vowel is only elided in functional morphemes. While these conditions are for SiSwati, they are also applicable to other Nguni languages, isiNdebele included. Like SiSwati, optional high vowel elision in isiNdebele usually occurs in fast speech, especially in the case of interconsonantal high vowel elision (Skhosana, 2009). Before discussing the ghost aspect of high vowels, it is important to discuss the various contexts whereby a high vowel is deleted in isiNdebele.

Nguni languages are made up of different noun classes. Nouns are placed into these different noun classes based on their category. Each noun class has a specific noun class prefix. IsiNdebele and other Nguni languages have a pre-prefix or augment preceding the noun class prefix (Mudzingwa and Kadenge, 2014). While isiZulu and Southern Ndebele contain augments in all noun classes, most Tekela languages such as Siswati and Northern Ndebele do not contain augments in all noun classes (see Harford and Malambe, 2011 for a discussion on the pre-prefix in SiSwati). The noun classes that are of interest in this section are noun classes 1 and 3. Noun class 1 is the human class and includes nouns that signify human beings in the singular form (Jiyane, 1994). Class 3, on the other hand, is the “natural phenomena” class. In addition, this noun class includes nouns that signify a variety of objects (Jiyane, 1994). The

noun class prefix for both these noun classes is mu-. The examples below illustrate nouns in these noun classes.

(76) /u + mu + ⁿtu/ > [u.mu.ⁿtu]

AUG-NC1-Person 'person'

(77) /u + mu + t^hwa/ > [u.mu.t^hwa]

AUG-NC1-bushman 'bushman'

(78) /u + mu + fi/ > [u.mu.fi]

AUG-NC1-dead person 'deceased'

(79) /u + mu + t^hi/ > [u.mu.t^hi]

AUG-NC3-tree 'tree'

(80) /u + mu + no/ > [u.mu.no]

AUG-NC3-finger 'finger'

(81) /u + mu + lwa/ > [u.mu.lwa]

AUG-NC3-ant 'ant'

The noun stems given in the examples above are all monosyllabic, meaning they consist of only one syllable. With monosyllabic stems, the full form of the noun class prefix surfaces. However, there is an obligatory process in Bantu languages which shortens this form known as mu-reduction (Kadenge, 2014, 2015; Persohn, 2019; Kadenge and Chebanne, 2017). In this process, the high round vowel of the class prefix is obligatorily elided. In the examples above the class prefix is not reduced; however, when the noun stem is more than one syllable the prefix is reduced to [m-] (Kadenge and Chebanne, 2017). This process is illustrated in the examples below.

(82) /u + mu + sana/ > [u.ṁ.sa.na]

AUG-NC1-boy ‘boy’

(83) /u + mu + fazi/ > [u. ṁ.fa.zi]

AUG-NC1-woman ‘woman’

(84) /u + mu + jeni/ > [u.ṁ.je.ni]

AUG-NC1-visitor ‘visitor’

(85) /u + mu + t^huⁿzi/ > [u. ṁ.t^hu.ⁿzi]

AUG-NC3-shade ‘shade’

(86) /u + mu + lilo/ > [u.ṁ.li.lo]

AUG-NC3-fire ‘fire’

(87) /u + mu + lomo/ > [u.ṁ.lo.mo]

AUG-NC3-mouth ‘mouth’

The examples above illustrate that the high vowel is deleted when the stem is polysyllabic while it is maintained with monosyllabic stems. When the high vowel is deleted, the remaining nasal of the class prefix is resyllabified into a syllabic nasal, for example the word ‘umsana’ will be syllabified as [u.ṁ.sa.na], with the nasal being syllabic. Unlike iKalanga and Setswana (Kadenge and Chebanne, 2017), the remaining nasal does not assimilate its place of articulation to the following consonant. Furthermore, post-nasal hardening (a process whereby liquid consonants are hardened following a syllabic nasal) does not occur in isiNdebele. This is typical of Nguni languages, homorganic assimilation and hardening does not occur in isiZulu

(Kadenge, 2015). This is true for Southern Ndebele; however, Northern Ndebele behaves differently.

According to Ziervogel (1959) and Skhosana (2009), mu-reduction of the class 3 prefix is not productive in Northern Ndebele. The prefix is only reduced before the bilabial fricative and before the bilabial plosive /p/. When the stem begins with any other consonant, the mu prefix is retained, it is possible this is motivated by OCP constraints which prohibits similar features from being next to each other. Examples (88) to (90) show the context where mu reduction fails to occur in the Northern dialect.

(88) /mu + b^hala/ → [mub^halo] *[mb^halo]

NC3-literature 'literature'

(89) /mu + laⁿdu/ → [mulaⁿdu] *[mlaⁿdu]

NC3-case 'case'

(90) /mu + fuⁿdisi/ → [mufuⁿdisi] *[mfundisi]

NC1-preacher 'preacher'

When the initial consonant is the bilabial fricative /β/, this bilabial assimilates to the nasality of the remaining nasal, this only occurs with this consonant; the voiceless bilabial plosive does not undergo assimilation. Examples (91)-(93) illustrate the process of mu- reduction in the Northern dialect. Examples (91) and (92) which involve the bilabial fricative show the intermediary stage of the process which is when the class prefix is reduced.

(91) /mu + βati/ → [mβati] → [ṁ.ma.ti]

NC1-carpenter 'carpenter'

(92) /mu + βala/ → [mβala] → [ṁ.ma.la]

NC3-colour

‘colour’

(93) /mu + p^{hi}ini/ →

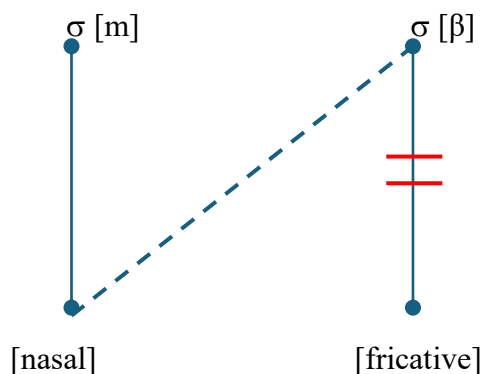
[m.p^{hi}i,ni]

NC3-axe handle

‘axe handle’

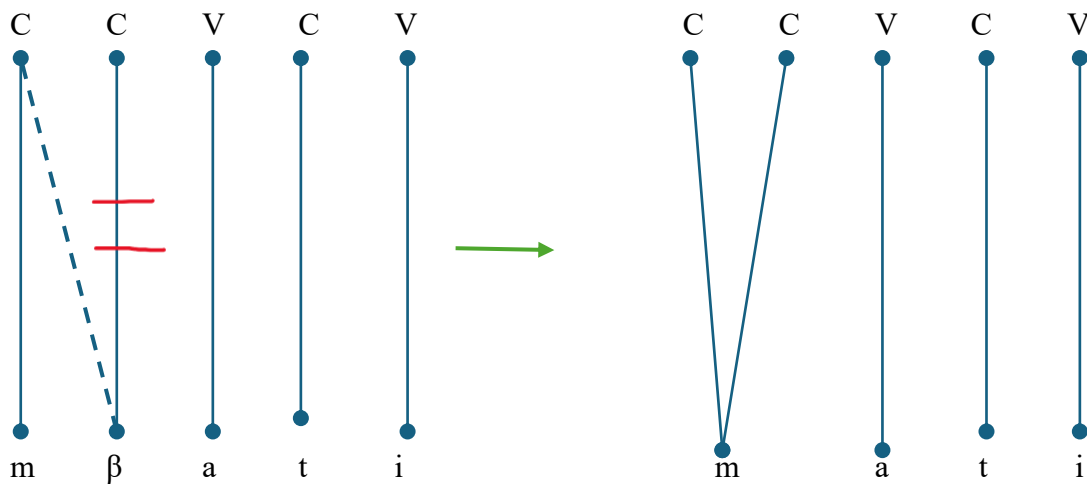
Unlike Southern Ndebele, one sees assimilation whereby the consonant of the stem takes on the nasality of the remaining nasal. From the data, this assimilation seems to occur only when the initial consonant of the stem is the voiced bilabial fricative /β/. It should be noted that the remaining nasal becomes syllabic after the high vowel has been deleted. When the stem begins with the voiceless bilabial plosive /p/ and the devoiced bilabial plosive, there is no assimilation; however, the remaining nasal is syllabic. Figure 2 below illustrates this process of nasal assimilation; this is a process of progressive nasal assimilation, meaning the nasal spreads its nasality to the fricative not the other way around.

Figure 2: Progressive nasal assimilation in Northern Ndebele



From Figure 2, the voiced bilabial fricative is delinked from its [-nasal] node and relinked to the [+nasal] node of the nasal that remains after mu-reduction. According to Lahiri and Hankamer (1988), a geminate derived from assimilation has multiple links, this means that the resulting [m] is linked to two root nodes. Figure 3 illustrates this process in isiNdebele for clarity.

Figure 3: Geminate formation in Northern Ndebele



Using autosegmental phonology (a branch of FG), it is evident that the resultant nasal derived from the nasal assimilation is a long consonant sound (a geminate) and a monosegmental geminate with multiple links to the root node (Lahiri and Hankamer, 1988).

This instance of high vowel elision is obligatory in Southern Ndebele and occurs under specific conditions in Northern Ndebele. Furthermore, what differs is the treatment of the remaining nasal and the surrounding consonants in the two dialects.

Secondly, high vowels in isiNdebele are elided to resolve hiatus when forming nouns and verbs. This is attested in many languages, whereby the high vowels delete when they are the first in a sequence of two vowels (Harford and Malambe, 2015). In isiNdebele, this process occurs when forming nouns in noun classes 7, 8, and 15 which contain high vowels in their class prefixes. When these class prefixes are juxtaposed with a noun stem beginning with a vowel, hiatus occurs. IsiNdebele resolves this hiatus by deleting the first vowel which is a high vowel, this is illustrated in examples (94)- (96) below. This process of high vowel elision to resolve hiatus will be discussed in detail in section 5.3.1

(94) /i + si + ono/ → [i.so.no]

AUG-NC7-sin 'sin'

(95) /i + zi + aga/ → [i.za.ga]

AUG-NC8-proverb ‘proverbs’

(96) /u + ku + ɔⁿda/ → [u.kɔ.ⁿda]

AUG-NC15-be lean ‘to be lean’

It has already been shown that in noun classes 1 and 3, high vowel elision is obligatory with polysyllabic noun stems; however, isiNdebele permits optional high vowel elision which usually occurs during fast speech. These high vowels are elided interconsonantly during fast speech. As mentioned earlier, according to Harford and Malambe (2015), high vowels are elided between consonants during fast speech. In addition, interconsonantal vowel elision could be a generational process whereby older generation speakers avoid it while it is common in the younger generation (Blust, 2001). This elision also known as syncope is found in isiNdebele. Even in fast speech, there are limitations to where and when a high vowel can be elided, these limitations are discussed in detail in the next section. Unlike mu-reduction, this process of syncope is optional.

Like mu-reduction, optional syncope does not occur when the noun stem is monosyllabic, this indicates that even in fast speech, the stem must be minimally disyllabic. From the data, syncope occurs with nouns in classes 4, 7, and 14. The examples below illustrate syncope in each of these noun classes and illustrates where this process fails to occur.

(97) /i + mi + t^het^ho/ → [i.mi.t^he.t^ho] [im’t^het^ho]

AUG-NC4-law ‘laws’

(98) /i + mi + t^hi/ → [i.mi.t^hi] *[im’t^hi]

AUG-NC4-tree ‘trees’

(99) /i + si + biⁿdi/ → [i.si.bi.ⁿdi] [is’biⁿdi]

AUG-NC7-liver ‘liver’

(100) /i + si + tʃa/ → [i.si.tʃa] *[is'tʃa]

AUG-NC7-dish 'dish'

(101) /u + bu + suku/ → [u.bu.su.ku] [ub'suku]

AUG-NC14-night 'night'

(102) /u + bu + ʎe/ → [u.bu.ʎe] *[ub' ʎe]

AUG-NC14-beauty 'beauty'

The three contexts in which high vowels are elided in isiNdebele have been provided: mu-reduction, vowel elision to repair hiatus, and optional syncope. The next section illustrates, using OT, how these vowels alternate with zero and are thus ghost vowels and how they influence or are influenced by markedness constraints.

5.2.1. Ghost vowels and high vowel elision

Based on the discussion above, it is clear the high vowels, [i] and [u], are ghost vowels. These vowels alternate with zero. This is unsurprising because, according to Iskender (2008), high vowels are universally preferred for alternation. Similarly, Iskender (2008) notes that high vowels always alternate with zero unless blocked by higher ranking constraints. In the case of isiNdebele, the high vowel alternates with zero and is deleted unless blocked by minimality constraints which are undominated in the language. This constraint remains undominated in both obligatory and optional elision.

The constraint that is related to the elision or parsing of ghost vowels is PARSE-GHOST (given in 103) which is a faithfulness constraint that bans the deletion of ghost segments. This constraint is low-ranking in isiNdebele.

(103) PARSE-GHOST

Do not skip over ghost (deletion of ghost segments banned).

(Yang, 2004)

With regards to mu-reduction, the above constraint is dominated by a markedness constraint which prohibits the combination of the labial nasal and the high rounded vowel, this OCP-driven constraint is given in (104) below.

(104) *[MU]

Co-occurrence of [m] and [u] is prohibited.

(Kadenge and Chebanne, 2017:184)

Tableau 2 below illustrates the interaction of these two constraints when the noun stem is disyllabic. In all examples, syllable boundaries are shown using a period.

Tableau 2: Mu-reduction of disyllabic noun stem in Southern Ndebele

/u-mu-sana/	*[MU]	PARSE-GHOST
a.  [u.m.sa.na]		*
b. [u.mu.sa.na]	*!	

Candidate (a) deletes the high vowel and violates PARSE-GHOST, since this is a low-ranking constraint, this candidate emerges as the winner and is the optimal candidate. Candidate (b) maintains the high vowel which is a fatal violation of *[MU] and is therefore eliminated. This indicates that in isiNdebele, the high round ghost vowel is deleted to avoid a marked [mu] structure. The high rounded labial vowel's labial feature is absorbed by the labial nasal; this indicates that labiality is a floating feature. A discussion of floating features is beyond the scope of this work and is only mentioned briefly.

Mu-reduction fails to occur when the noun stem is monosyllabic, this indicates that the high-ranked OCP driven markedness constraint is outranked by a constraint which demands that words in isiNdebele be minimally disyllabic, and this constraint is defined in (105). In all instances, this constraint is undominated.

(105) WORDMINIMALITY (MINWORD)

Words must be minimally disyllabic

(Kadenge, 2015)

Tableau 3 shows the interaction of the three constraints above when the noun stem is monosyllabic.

Tableau 3: Mu-reduction of monosyllabic noun stem

/u-mu- ⁿ tu/	MINWORD	*[MU]	PARSE-GHOST
a. [u.ᵐ. ⁿ tu]	*!		*
b.  [u.mu. ⁿ tu]		*	

Candidate (a) satisfies *[MU] by deleting the high vowel; however, this fatally violates MINWORD which is undominated, this candidate is eliminated. Candidate (b) is the optimal candidate even though it violates *[MU]; however, this is a non-fatal violation and serves to satisfy the higher ranked constraint.

The ghost vowel is deleted when the stem is disyllabic and maintained when the stem is monosyllabic. This shows that MINWORD is undominated. The same analysis can be taken for nouns in class 3 (illustrated in tableau 4 for disyllabic stems and tableau 5 for monosyllabic stems).

Tableau 4: Mu-reduction for disyllabic nouns in class 3

/u-mu-lomo/	MINWORD	*[MU]	PARSE-GHOST
a.  [u.ᵐ.lo.mo]			*
b. [u.mu.lo.mo]		*!	

Candidate (a) is the optimal candidate; it violates the low-ranked PARSE-GHOST constraint to satisfy high-ranking constraints. Candidate (b) is disqualified for fatally violating the markedness constraint *[MU].

Tableau 5: Mu-reduction of monosyllabic nouns in class 3

/u-mu-t ^{hi} /	MINWORD	*[MU]	PARSE-GHOST
a. [u.ᵐ.t ^{hi}]	*!		*
b. [u.mu.t ^{hi}]		*	

The first candidate does well to elide the high vowel to satisfy *[MU] but this results in a fatal violation of MINWORD, this candidate is eliminated. The second candidate emerges as the winner as it satisfies the undominated MINWORD constraint. The constraint ranking thus far is given in (106) below.

(106) MINWORD >> *[MU] >> PARSE-GHOST

The constraint ranking given above (106) yields an incorrect optimal candidate in Northern Ndebele, which permits the presence of [mu]; therefore, the constraint militating against this configuration is low-ranked in Northern Ndebele, and the constraint PARSE-GHOST is high ranking. Tableau 6 shows the constraint ranking for mu-reduction in Northern Ndebele.

Tableau 6: Failure of Mu-reduction in Northern Ndebele

/mu + fu ⁿ disi/	PARSE-GHOST	*[MU]
a. [ᵐ.fu. ⁿ di.si]	*!	
b. [mu.fu. ⁿ di.si]		*

Candidate (a) which deletes the ghost vowel is eliminated for its fatal violation of PARSE-GHOST. Candidate (b) which remains fully faithful, only violates *[MU], it is the optimal candidate. The re-ranking of the constraints given in (106) yields a different optimal candidate in the northern dialect; the constraint ranking for Northern Ndebele is given in (107). MINWORD remains undominated in this dialect.

(107) MINWORD >> PARSE-GHOST >> *[MU]

It is now important to discuss, using OT, the effects of mu-reduction on the rest of the word. It has been shown that in Southern Ndebele, the remaining nasal is syllabic, homorganicity and post-nasal hardening do not occur. In Northern Ndebele, on the other hand, there is progressive nasal assimilation of the bilabial fricative which occurs after mu-reduction; however, the data indicates that no post-nasal hardening occurs. Therefore, there are two different constraint rankings for the two dialects of isiNdebele.

As noted, after mu-reduction, the remaining nasal is resyllabified, this indicates that the constraint which bans complex onsets is banned, this is given in (108) below.

(108) *COMPLEX

Complex onsets are prohibited.

(Kager, 1999)

This constraint is high ranking in isiNdebele. In addition to this constraint, the remaining nasal does not fuse with the following consonant (creating pre-nasalized consonants). This means the constraint ALIGNSTEM-L (given in 109) is high-ranking. Tableau 7 provides an analysis of the effects of mu-reduction.

(109) ALIGNSTEM-L

The left edge of a stem must coincide with the left edge of a syllable.

(Kager, 1999)

Tableau 7: resyllabification of the nasal after mu-reduction in Southern Ndebele

/u-mu-t ^h u ⁿ zi/	*COMPLEX	NOCODA	*[MU]	ALIGNSTEM-L	PARSE-GHOST
a. [um.t ^h u. ⁿ zi]		*!			*
b. [u.mu.t ^h u. ⁿ zi]			*!		
c. [u.mt ^h u. ⁿ zi]	*!				*

d. [u. ^m t ^h u. ⁿ zi]				*!	*
e. [u.m.t ^h u. ⁿ zi]					*

Candidate (a) fatally violates NOCODA, a constraint that bans codas, this constraint is high-ranking. The second candidate (b) which does not delete the high vowel fatally violates *[MU], this candidate is disqualified. Candidate (c) resyllabifies the remaining nasal as an onset which creates a complex onset which is banned by *COMPLEX, this violation is fatal. Candidate (d) fatally violates AlignStem-L by creating a pre- nasalized onset. The final candidate deletes the high ghost vowel in violation of PARSE-GHOST, and resyllabifies the remaining nasal as syllabic; although this candidate violates PARSE-GHOST, the violation is inconsequential, therefore this candidate is the optimal candidate.

Three additional constraints should be introduced. These constraints account for the behaviour of the remaining nasal in relation to the rest of the word, heterorganic assimilation and nasal assimilation. These constraints which are introduced below are Identity-IO (place) nasals, Agree (place) NC, and NOGEM.

(110) Identity-IO (place) Nasals

Corresponding input and output nasals have the same value for the feature (place).

(Kadenge, 2015:98)

(111) Agree (place) NC

Adjacent output segments have the same value for the feature (place) in NCs.

(Kadenge, 2015:98)

(112) NOGEM

No multiple links from root node to higher tier (no geminates allowed).

(Kar, 2008:112)

The first constraint above requires the features of place in the input and output to be the same, it bans homorganicity. The agree constraint enforces homorganicity of place. The final constraint bans geminates from forming. There are two different constraint rankings for Southern Ndebele and Northern Ndebele, this is illustrated in the tableaux below.

Tableau 8: NC behaviour in Southern Ndebele

/u-mu-t ^h ala/	Ident-IO (place) Nasal	NOGEM	Agree (nasal) NC
a. [u.ŋ.t ^h a.la]	*!		
b.  [u.m.t ^h a.la]			*
c. [u.m.ma.la]		*!	

Candidate (a) whereby the remaining nasal assimilates its place of articulation to the following nasal is disqualified for a fatal violation of Ident-IO (place). Candidate (b) does not undergo homorganicity and this is a violation of Agree (nasal) which is a low-ranking constraint; this violation serves to satisfy higher-ranked constraints. This candidate is the optimal candidate. Candidate (c) fatally violates NOGEM by creating a nasal geminate, this candidate is disqualified.

In Northern Ndebele, the constraint Ident-IO (place) Nasal remains high ranked while Agree (nasal) NC also remains low-ranked, therefore these are not given in the tableau below. The constraint NOGEM is low-ranking to allow for the formation of the nasal geminates. The constraint *[mβ], which prohibits the combination of the nasal and bilabial fricative, is high ranked.

Tableau 9: NC behaviour in Northern Ndebele

/mu-βati/	*[mβ]	NOGEM
a. [m. βa.ti]	*!	
b.  [m.ma.ti]		*

The first candidate is eliminated for fatally violating the constraint that militates against the juxtaposition of /m/ and /β/. The second candidate satisfies the high-ranked constraint by creating a nasal geminate, this violates NOGEM which is ranked low. This is the optimal candidate.

This is not the only instance of geminate formation in Northern Ndebele. When the vowels /i/, /e/, or /u/ occur between two lateral liquids, these vowels are deleted. The first liquid in the sequence becomes syllabic. Example (113) to (115) show this.

- (113) /lilaŋa/ > [l̥.la.ŋa] ‘sun’
 (114) /ye^mbulula/ > [ye.^mbu.l̥.la] ‘dig up’
 (115) /mulilo/ > [mu.l̥.lo] ‘fire’

This suggests that a constraint which ensures that a liquid is not followed by a vowel *[Liquid.Vowel] is high-ranking but not undominated. This constraint cannot be undominated because there are cases where a liquid is followed by a vowel. Tableau 10 illustrates geminate formation in Northern Ndebele.

(116) *[Liquid.Vowel]

A liquid cannot be followed by a vowel.

Tableau 10: Geminate formation in Northern Ndebele

/li-laŋa/	*[Liquid.Vowel]	NOGEM	PARSE-GHOST
a.  [l̥.la.ŋa]		*	*
b. [li.la.ŋa]	*!		

Candidate (b) is disqualified for fatally violating *[Liquid.Vowel] by remaining fully faithful. Candidate (a) is the optimal candidate and violates NOGEM to satisfy the high-ranking constraint. As shown in the tableau, the first candidate deletes the ghost vowel, but this deletion is inconsequential and serves to satisfy the markedness constraint.

The behaviour of Northern Ndebele has clear influences from its Northern Sotho neighbours (examples of this are given in the comparison section) (Skhosana, 1998). Using OT, one can

see that the re-ranking of constraints creates differences between dialects of the same language as shown in the data. The constraint rankings for the two dialects are presented below.

(117) Southern Ndebele:

MINWORD, *COMPLEX, NOCODA, **NOGEM**, Ident-IO (place) nasal >> *[MU],
ALIGNSTEM-L >> **PARSE-GHOST**, Agree (place) NC.

Northern Ndebele:

MINWORD, *COMPLEX, NOCODA, Ident-IO (place) nasal, *[mβ] >>
*[Liquid.Vowel], ALIGNSTEM-L >> **PARSE-GHOST** >> *[MU], **NOGEM**, Agree
(place) NC.

The next section provides an analysis of interconsonantal high vowel elision or syncope. The analysis illustrates that this process is optional; thus, there are two constraint rankings for fast-speech and normal speech.

5.2.2. Ghost vowels and Interconsonantal high vowel elision

Another context where high vowels are deleted is the process of syncope. Syncope is the deletion of segments in a syllable (Gouskova, 2008). This process is influenced by economy effects which is a preference for the most minimal or simple form of a word; therefore, this process always occurs unless blocked by higher ranked constraints (Gouskova, 2008). In isiNdebele this process is productive with high vowels in the noun class prefixes of classes 4, 7, and 14. Harford and Malambe (2015) provide the contexts where syncope cannot occur; (1) the high vowel is in a prominent position and (2) the high vowel is in a lexical morpheme. In isiNdebele, the high vowels of the prefix are elided provided the prefix is not in the penultimate syllable.

A constraint which bans the presence of a high vowel is relevant for this discussion. The constraint is provided in (118) below.

(118) *V[+hi]

Assign a violation mark to a [+hi] vowel.

(Harford and Malambe, 2015)

The interaction of this constraint and the PARSE-GHOST constraint differs in fast speech and slow speech. In slow and formal speech, the high vowels are not deleted which means that *V [+hi] is ranked low; however, in fast speech, this constraint is ranked highly. The following two tableaux illustrate syncope in slow speech and fast speech.

Tableau 11: Slow speech, PARSE-GHOST >> *V[+hi]

/i-si-k ^h e.t ^h u/	PARSE-GHOST	*V[+hi]
a.  [i.si.k ^h e.t ^h u]		*
b. [i.s_.k ^h e.t ^h u]	*!	

Candidate (a) violates the low-ranked *V[+hi] constraint by remaining fully faithful to the input, this is the optimal candidate. Candidate (b) fatally violates the PARSE-GHOST constraint which in this instance is high-ranked. Should the ranking of these two constraints be reversed, a new optimal output is selected, and this output is used during fast speech, the next tableau illustrates this.

Tableau 12: Fast speech, *V [+hi] >> PARSE-GHOST

/i-si-k ^h e.t ^h u/	*V [+hi]	PARSE-GHOST
a. [i.si.k ^h e.t ^h u]	*!	
b.  [i.s_.k ^h e.t ^h u]		*

In fast speech, the optimal candidate is the candidate that deletes the ghost vowel; this is candidate (b). The first candidate is disqualified for maintaining the high vowel and fatally violating *V[+hi].

The two constraints below govern the contexts underwhich high vowels can undergo syncope.

(119) MAX/PROM

Parse a vowel in a prominent syllable.

(Harford and Malambe, 2015)

(120) MAX/LEX

Parse a vowel in a lexical morpheme.

(Harford and Malambe, 2015)

These constraints are high ranked because you cannot delete a vowel in a prominent syllable or in a lexical morpheme. The tableau below which follows the ranking of fast speech illustrates the interaction of these constraints.

Tableau 13: syncope in isiNdebele

/isi-bi ⁿ di/	MAX/PROM	MAX/LEX	*V[+hi]	PARSE-GHOST
a. [i.si.bi. ⁿ di]			*!	
b.  [i.s_.bi. ⁿ di]				*
c. [i.si.b_ ⁿ di]	*!	*!	*!	
d. [i.si.bi. ⁿ d_]		*!	*!	

Candidate (a) fatally violates *V[+hi] by remaining fully faithful. Candidate (b) is the optimal candidate and only violates PARSE-GHOST. Candidate (c) deletes a high vowel in the penultimate syllable and in the lexical morpheme, this violates the two high-ranked constraints, this candidate is disqualified. The last candidate deletes a vowel in the lexical morpheme and is eliminated by MAX/LEX.

The high vowels that are elided alternate with zero, this indicates that when the high vowel is deleted, zero (Ø) is what remains in its place. The high vowels alternate with zero unless blocked by high ranked constraints such as MINWORD, found in a prominent position or in the lexical morpheme. A constraint which militates against having zero in the output form is NOZERO, this constraint is defined in (121).

(121) NOZERO

No scale containing x implies that $\emptyset$ is more harmonic than x.

(Gouskova, 2003:3)

This constraint must be low-ranking for the vowels to alternate with zero. Tableau 14 provides an analysis of syncope, indicating where zero is found.

Tableau 14: high vowel zero alternation in isiNdebele

/u-bu-suku/	MAX/PROM	MAX/LEX	*V[+hi]	PARSE-GHOST	NOZERO
a. [u.bu.su.ku]			*!		
b. [u.b $\emptyset$.su.ku]				*	*
c. [u.bu.s $\emptyset$.ku]	*!	*!			*

The first candidate is eliminated for being fully faithful thus fatally violating *V[+hi]. The second candidate is the optimal candidate even though it violates two constraints, since these are low-ranking, the violation is inconsequential. The third candidate violates the two high-ranking constraints by deleting a high vowel in a prominent position in the lexical morpheme. The tableau above illustrates that the deletion of the high vowel leaves zero which is allowed in isiNdebele provided higher ranked constraints are satisfied.

The constraint ranking for syncope in isiNdebele is given below.

(122) MAX/PROM, MAX/LEX >> *V[+hi] >> PARSE-GHOST, NOZERO.

The examples in this section and the previous one were nominals, the same analysis applies to other word categories such as verbs and adjectives. The next section provides a comparison of isiNdebele and other Bantu languages.

5.2.3. IsiNdebele and other Bantu languages: A comparison

This section aims to situate isiNdebele within the broader context of Bantu languages. This is done by comparing the two strategies discussed in this section with other languages. This

section considers strategies used by four other languages (Siswati, isiZulu, ChiShona, and Setswana) when dealing with optional and obligatory vowel elision.

IsiZulu, a Nguni language spoken in the KwaZulu Natal province of South Africa, is the closest relative to isiNdebele. IsiZulu also undergoes obligatory high vowel elision in the form of mu-reduction. Examples (123) and (124) show the retention of the high vowel in the class prefix of monosyllabic stems while examples (125) and (126) show the reduction of the mu class prefix.

(123) /u-mu- ⁿ tu/	→	[u.mu. ⁿ tu]
AUG-NC1-person		‘person’

(124) /u-mu- ^{thi} /	→	[u.mu. ^{thi}]
AUG-NC3-tree		‘tree’

(125) /u-mu-fazi/	→	[u.ᵐ.fa.zi]
AUG-NC1-wife		‘wife’

(126) /u-mu-fula/	→	[u.ᵐ.fu.la]
AUG-NC3-river		‘river’

(127) /u-mu-gidi/	→	[u.ᵐ.gi.di]
AUG-NC3-feast		‘feast’

When mu-reduction occurs in isiZulu, the remaining nasal is resyllabified and becomes a syllabic nasal. Furthermore, there is no homorganic assimilation (as shown in example 127), the resultant NC cluster is heterosyllabic, and there is no post-nasal hardening (Kadenge, 2015). The behaviour of the resultant NC cluster in isiZulu and isiNdebele is different from that of chiNambya, a Shona language spoken in Zimbabwe.

ChiNambya, undergoes mu-reduction in classes 1 and 3. Examples (128) to (131) illustrate this process.

- (128) /u-mu-bali/ → [u.^mba.li]
 AUG-NC1-secretary ‘secretary’
- (129) /u-mu-ti/ → [u.ⁿti]
 AUG-NC3-tree ‘tree’
- (130) /u-mu-sitʃana/ → [u.ⁿsi.tʃa.na]
 AUG-NC1-girl ‘girl’
- (131) /u-mu-lomo/ → [u.ⁿdo.mo]
 AUG-NC3-mouth ‘mouth’

In chiNambya, after mu-reduction, the remaining nasal is not syllabic and it assimilates to the place of articulation of the following consonant (Kadenge, 2015). Example (131) shows that post-nasal hardening occurs whereby the liquid consonant that follows the remaining nasal is hardened (Kadenge, 2015). Interestingly, monosyllabic noun stems also undergo mu-reduction (129), Kadenge (2015) posits that the augment is part of the prosodic word and therefore counts for minimality. This is unlike the augment in isiNdebele and isiZulu which is not part of the prosodic word and therefore does not contribute to minimality (Kadenge, 2015).

A comparison of high vowel elision is incomplete without comparing isiNdebele with languages that have influenced it such as Setswana and Sesotho. In the formation of Nasal Consonant clusters (such as the result of mu-reduction) Setswana and Sesotho exhibit a similar pattern as chiNambya; there is homorganic place assimilation, post-nasal strengthening and post-nasal devoicing (Matlhaku, 2020).

- (132) /n + bona/ > [ṁ.po.na]
 OM-see ‘see me’
- (133) /n + thusa/ > [ṁ.t^hu.sa]
 OM-help ‘help me’
- (134) /m + pho/ > [ṁ.p^ho]
 NC6-give ‘gift’

(135) /n + dʒela/ > [ɲ.dʒe.la]
 OM-eat 'eat for me'

Interestingly, these languages undergo geminate formation (like Northern Ndebele). This occurs when the nominal prefix *mo-* is added to verbs to form deverbal nouns (Nkolola-Wakumelo and Matlhaku, 2012). Examples (136) and (137) illustrate this process of geminate formation.

(136) /mo-badi/ > [mbadi] > [m̩.ma.di]
 NP-read 'reader'

(137) /mo-busi/ > [mbusi] > [m̩.mu.si]
 NP-lead 'leader'

The constraint NOGEM is low-ranking in Sesotho/Setswana. Northern Ndebele and the Sotho languages have the same constraint ranking when it comes to geminate formation, but Southern Ndebele re-ranks the NOGEM constraint so that it is non-violable and high-ranking.

The table below provides a summary of the differences between isiNdebele and the other Bantu languages discussed above.

Table 5: Comparison of NC behaviour

	Southern Ndebele	Northern Ndebele	isiZulu	ChiNambya	Sesotho/ Setswana
Syllabic Nasal	X	X	X		X
Homorganicity				X	X
Nasal assimilation		X			X
Post-nasal devoicing					X
Post-nasal hardening				X	X

Nguni languages exhibit the same pattern as isiNdebele when it comes to optional syncope. The same rules apply for isiZulu and SiSwati; the deleted vowel must be a high vowel, the

vowel must not be in a prominent position or a lexical word (Harford and Malambe, 2015). The examples below illustrate this process in the Nguni languages.

(138) /si- ɭaɭa/ NC7-tree	→	[s' ɭa.ɭa] 'tree'	[Siswati]
(139) /nge-ku-ha ^m ba/ COP-INF-go	→	[ngek'ha ^m ba] 'by going'	[Siswati]
(140) /ŋi-ja-boŋa/ SM-DJ-thank	→	[ŋ'jaboŋa] 'thank you'	[IsiZulu]
(141) /i-si-tulo/ AUG-NC7-chair	→	[is'tulo] 'chair'	[IsiZulu]

A discussion of the ghost element of the high vowels in other Nguni languages is beyond the scope of this study and will be the subject of future research. The next section discusses a second morphophonological process which is relevant in the discussion of ghost segments.

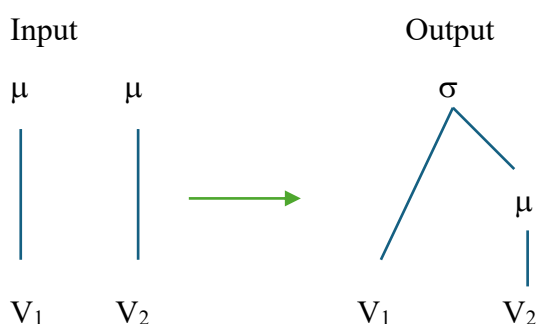
5.3. Vowel hiatus resolution

Vowel hiatus occurs when two heterosyllabic (different syllables) vowels are adjacent to each other (V₁.V₂) (Vratsanos and Kadenge, 2017). This configuration is disallowed in many languages including Nguni languages such as isiNdebele and isiZulu. Languages make use of different strategies to repair this illegal configuration. These strategies include glide formation, glide insertion, diphthongization, vowel coalescence, secondary articulation, and vowel elision (Casali, 1997). IsiNdebele makes use of five of these strategies; glide formation, glide insertion, secondary articulation, vowel coalescence, and vowel elision (Skhosana, 2009). This section discusses each of these strategies and illustrates under which condition each strategy is used, this includes an OT analysis. The next section focuses on two of these strategies which give evidence of ghost segments in the language.

5.3.1. Vowel hiatus repair strategies

Glide formation is a process whereby a high vowel loses its moraicity and changes into a glide (Mtenje-Mkochi, 2015). This process occurs when V_1 is a high vowel and is onsetless. This is the preferred hiatus resolution strategy cross-linguistically as this strategy results in only the loss of a mora (Mudzingwa and Kadenge, 2011). In this process, labial vowel /u/ becomes the labial glide [w] while the coronal vowel /i/ becomes palatal glide [j]. The figure below illustrates, using FG, the process of glide formation. The high vowel loses its moracity and becomes a glide.

Figure 4: Glide formation



(Mudzingwa and Kadenge, 2011)

In isiNdebele, glide formation occurs when V_1 is a high vowel /u/ or /i/ and the low vowel /a/ followed by the low vowel /a/ and the mid vowel /o/. These contexts are found in the formation of the possessive concord and absolute pronouns. Examples (142) - (144) illustrate the process of glide formation when forming a possessive concord. The possessive concord is formed by putting together the subject concord and possessive formative (Subject concord + possessive formative = possessive concord).

- | | | | | | | |
|-------|-----|---|-----|---|------|----------------------------|
| (142) | /u/ | + | /a/ | > | [wa] | (wami) |
| (143) | /i/ | + | /a/ | > | [ya] | (yami) |
| (144) | /a/ | + | /a/ | > | [wa] | (wak ^{he} / yami) |

Of interest in isiNdebele, is the formation of the labial glide from the low pharyngeal vowel /a/; Northern Ndebele forms the palatal glide in the same context. Glide formation also occurs when the absolute pronoun is formed. This pronoun is formed by adding the class concord, pronominal root and suffix -na (class concord + pronominal root + suffix -na). Examples (145)-(147) illustrate this.

(145) /u + o + na/ > [wona]

(146) /i + o + na/ > [jona]

(147) /a + o + na/ > [wona]

Once again, the low vowel /a/ forms the labial glide [w] in Southern Ndebele and the palatal glide [j] in Northern Ndebele. This is unique to isiNdebele, as most languages delete the low vowel or coalesce it with the following vowel in a hiatus context (Tzanakakiz, 2019; Vratsanos and Kadenge, 2017; Kadenge, 2015). In isiNdebele, this low vowel behaves like the high labial vowel. This differs from the assumptions posed by Rosenthal (1997) who states that mid-vowels are likely to behave like high vowels. Moreover, of more relevance to this study, this pattern suggests an underlying high vowel in these forms which results in a glide forming (Skhosana, 2009).

This process is guided by the constraint NO-HIATUS which is undominated in this language. This constraint militates against hiatus in any context. Furthermore, the constraint MAX (μ) is low-ranking, this is shown by the loss of a mora in glide formation. There is no compensatory lengthening (the lengthening of V_2 to make up for the loss of a mora); therefore, *V: is undominated in this language. These constraints are defined below.

(148) NO-HIATUS (* $V_1.V_2$)

A sequence of two vowels across a syllable boundary is prohibited.

(Kager, 1999)

(149) MAX-IO (μ)

Every input mora has a correspondent in the output.

(Kadenge and Simango, 2014)

(150) *V:

No long vowels.

(Mudzingwa and Kadenge, 2011)

Tableau 15 gives an analysis of glide formation when forming the absolute pronoun. This tableau shows the interaction of the three constraints in selecting the optimal candidate.

Tableau 15: Glide formation

/u + o + na/	NO-HIATUS	*V:	MAX-IO (μ)
a. [u.o.na]	*!		
b. [wo.na]			*
c. [wo:.na]		*!	

Candidate (a) is fully faithful and maintains hiatus, this is in fatal violation of the undominated NO-HIATUS constraint. The second candidate resolves hiatus by forming a glide from the high vowel, this results in the loss of a mora and violates MAX-IO (μ), since this is a low-ranking constraint, the violation is minimal. The second candidate is the optimal candidate. The third candidate does well to form a glide; however, to compensate for the lost mora, this candidate lengthens V₂, which fatally violates *V: since isiNdebele does not contain long vowels. This tableau shows that when V₁ is high or the low vowel /a/, and onsetless, a glide is formed resulting in the loss of a mora. When V₁ contains an onset, a different strategy is employed, secondary articulation.

Secondary articulation involves the loss of a mora and root node. This process occurs when the high vowel is preceded by a consonant. If glide formation were to take place, this would result in a complex onset which is prohibited in this language. In secondary articulation, the V-place features of the high vowel are linked to the preceding consonant, therefore if the high vowel is coronal, that feature is linked to the preceding consonant resulting in a palatalized consonant and the labial vowel yields a labialized consonant (Kadenge and Chebanne, 2017). IsiNdebele only allows labialization in this context, therefore, when V₁ is a coronal vowel, this vowel undergoes deletion instead of secondary articulation.

Secondary articulation is evident in the formation of the diminutive. The diminutive is formed by suffixing -ana to a noun stem. Examples (151) to (153) illustrate secondary articulation in isiNdebele.

(151) /i.loko + ana/ > [i.ⁿlo.k^wa.na]
NC9-head-DIM ‘small head’

(152) /mu.ⁿru+ ana/ > [mu.ⁿr^wa.na]
NC1-person-DIM ‘baby’

(153) /k^hulu + ana/ > [k^hul^wana]
big-DIM ‘fairly big’

The constraint which prohibits complex onsets is *COMPLEX and has been defined in (108), this constraint is undominated. Secondary articulation results in the loss of a mora and root node; therefore, a new constraint which prohibits the deletion of a root node can be introduced, MAX-IO(RT), defined below. Tableau 16 shows the interaction of constraints. IsiNdebele never utilizes compensatory lengthening, therefore the constraint militating against this is not included in the next tableaux as its presence is redundant.

(154) MAX-IO (RT)

Every input root node has a correspondent in the output.

(Kadenge and Simango, 2014)

Tableau 16: Secondary Articulation

/mu ⁿ ru + ana/	NO-HIATUS	*COMPLEX	MAX-IO(RT)	MAX-IO (μ)
a. [mu. ⁿ ru.ana]	*!			
b. [mu. ⁿ rwa.na]		*!		*
c.  [mu. ⁿ r ^w a.na]			*	*

Candidate (a) does not resolve hiatus and is disqualified for fatally violating NO-HIATUS. Candidate (b) undergoes glide formation, which fatally violates *COMPLEX, as it results in a complex onset. The final candidate is the optimal candidate as it labializes the consonant preceding the high vowel in violation of the two low-ranked constraints.

There are cases when secondary articulation fails to occur. The data indicates that when the high labial vowel is preceded by a bilabial consonant and followed by a labial or rounded vowel, the high vowel is deleted. This is given in example (155) below.

(155) /bu + o + na/ > [bona] *[b^wona] ‘them’

This indicates that there is some constraint which prohibits labializing a labial consonant followed by a labial vowel. This is an OCP constraint, and it prohibits a sequence of identical features. This constraint is defined below.

(156) OCP

A sequence of identical features is prohibited.

(Vratsanos and Kadenge, 2017)

This constraint is high ranking. Tableau 17 illustrates this.

Tableau 17: Behaviour of absolute pronoun [bona]

/bu + o + na/	NO-HIATUS	*COMPLEX	OCP	MAX-IO (RT)	MAX-IO (μ)
a. [bu.o.na]	*!				
b. [bwo.na]		*!	*!		*
c. [b ^w o.na]			*!	*	*
d.  [bo.na]				*	*

Candidates (a) to (c) are all disqualified for fatally violating NO-HIATUS, *COMPLEX, and OCP, respectively. The final candidate deletes the high vowel to satisfy the high-ranking OCP constraint, this candidate is the optimal candidate.

The next repair strategy involves inserting a glide to repair hiatus. According to Mudzingwa (2017), this is not necessarily a case of insertion but instead a case of spreading. The V-place features of V₂ provide the feature for the epenthetic segment (Mudzingwa, 2017). When V₂ is a labial vowel, the labial glide is inserted and when V₂ is a coronal vowel, the palatal glide is inserted. This supports Mudzingwa's (2017) argument that these vowels spread their V-place features onto the epenthetic segment. The ghost glides, however, are not the result of spreading but of the surfacing of these ghost segments, this is discussed in detail in the next section. Examples (157) to (159) illustrate.

- | | | | |
|--|---|--|---------------------|
| (157) /ba + i + bonile/ | > | [ba.yi.bo.ni.le] | ‘they have seen it’ |
| (158) /a + u + k ^h a ^m bi/ | > | [a.wu.k ^h a. ^m bi] | ‘you are not going’ |
| (159) /gu + up ^h i/ | > | [gu.wu.p ^h i] | ‘which one is it’ |

The data above supports the idea of spreading since the V-place features of V₂ spread to form the glides. The constraint that militates against spreading is given in (160) below. Tableau 18 illustrates glide insertion

(160) UNIQUE

∀x, where x is a feature or class node, x must have a unique segmental anchor y.

(Mudzingwa, 2017)

Tableau 18: Glide Insertion

/ba + i +bonile/	NO-HIATUS	MAX-IO (RT)	UNIQUE
a. [ba.ji.bo.ni.le]			*
b. [ba.i.bo.ni.le]	*!		
c. [bi.bo.ni.le]		*!	

Candidate (a) is the optimal candidate. It violates UNIQUE by spreading the V-place features of V₂, but this serves to satisfy high-ranking constraints. Candidates (b) and (c) are eliminated for fatally violating NO-HIATUS and MAX-IO (RT), respectively.

When low vowel /a/ is juxtaposed with /a/, /u/, and /i/, vowel coalescence occurs. Vowel coalescence involves these two vowels coalescing with each other to produce a non-high vowel. The resultant non-high vowel is identical to V₂ (the high vowel) in all respects except height (Vratsanos and Kadenge, 2017). The coalescence pattern for isiNdebele is given below.

(161) /a/ + /a/ > [a]

(162) /a/ + /i/ > [e]

(163) /a/ + /u/ > [o]

Examples (164) to (166) gives examples of this process.

(164) /na + ugogo/ > [no.go.go] ‘with grandmother’

(165) /na + indoda/ > [ne.ⁿdo.da] ‘with the man’

(166) /na + amanzi/ > [na.ma.ⁿzi] ‘with water’

The constraint UNIFORMITY prevents the merging of two segments, this is low-ranking in isiNdebele. An additional constraint *C^s is important for this discussion. This constraint prohibits pharyngealized consonants. Tableau 19 provides a constraint interaction of vowels undergoing coalescence.

(167) UNIFORMITY

A segment in the output cannot have more than one correspondent in the input.

(Kager, 1999)

(168) *C^ϕ

No pharyngealized consonants

(Mudzingwa and Kadenge, 2014)

Tableau 19: Vowel coalescence

/na + ugogo/	NO-HIATUS	*C ^ϕ	MAX-IO (RT)	MAX-IO (μ)	UNIFORMITY
a. [na.u.go.go]	*!				
b. [n ^ϕ u.go.go]		*!	*	*	
c. [no.go.go]			*	*	*

Candidates (a) and (b) are disqualified for fatally violating NO-HIATUS AND *C^ϕ respectively. Candidate (c) violates three low-ranking constraints, but this violation serves to satisfy high-ranking constraints; therefore, this is the optimal candidate. The analysis in the tableau can be applied to the other coalescence patterns as well. This process also illustrates the interaction between ghost segments and markedness, this is discussed in detail in the next section.

When the repair strategies discussed above fail to occur due to high-ranking markedness constraints, a final strategy is employed: elision. This strategy was briefly discussed in section 5.2.

Vowel elision is the complete deletion of one of the vowels in hiatus. This involves the loss of all the features of the vowel; mora, root node and place features (Vratsanos and Kadenge, 2017). When other repair strategies are blocked, the final strategy is vowel elision. This includes the elision of a high vowel that comes before a low vowel or mid vowel when palatalization is blocked, and elision of a low vowel when coalescence is not possible. Regarding the choice between which vowel is deleted, isiNdebele patterns similarly to other

Bantu languages by deleting the first vowel (V₁) in a sequence of two vowels (Casali, 1997). This process is illustrated in the examples below.

(169) /de + ana/	>	[da.na]	‘tallish’
(170) /zi + o + na/	>	[zo.na]	‘absolute pronoun 8’
(171) /bili + ana/	>	[bi.la.na]	‘diminutive of two’
(172) /na + omukxulu/	>	[no.mu.kxu.lu]	‘and the big one’
(173) /ya + e ^{mb} hi/	>	[ye. ^m b ^h i]	‘bad’
(174) /na + ende/	>	[ne. ⁿ de]	‘with the tall one’
(175) /uga + e ⁿ ḡuni/	>	[u.ge. ⁿ ḡu.ni]	‘at the house’

In heterosyllabic hiatus, isiNdebele prefers to delete the first vowel. Interestingly, when forming the copulative from adjectives, words that end in vowels are juxtaposed with words that begin with vowels. IsiNdebele prefers to delete V₂ in this case, such that the second word becomes consonant initial. This is shown in (176) and (177). It must be noted that this hiatus is not of interest to this study.

(176) /umntazana omk ^h ulu/	>	[u.m. ⁿ ta.za.na m.k ^h u.lu]	‘the girl is big’
(177) /isitḡa esile/	>	[i.si.tḡa si.ḡe]	‘the dish is beautiful’

Since V₁ is the vowel that isiNdebele prefers to delete, there must be a constraint which ensures that a candidate that deletes the first vowel is the winner. This constraint is ANCHOR L, this constraint is defined below.

(178) ANCHOR L

Any root node to the left edge of a morpheme in the input has a correspondent root node in the output.

(Mudzingwa and Kadenge, 2011)

Furthermore, to prevent the formation of palatalized outputs, the constraint *C^j is also vital and is high ranked in the language.

(179) *C^j

No palatalized consonants

(Mudzingwa and Kadenge, 2011)

Tableau 20 provides an OT analysis of vowel elision.

Tableau 20: Vowel elision in isiNdebele

/si + osa/	NO-HIATUS	*COMPLEX	*C ^j	ANCHOR L	MAX-IO (RT)	MAX-IO (μ)
a. [si.o.sa]	*!					
b. [s ^j o.sa]			*!		*	*
c. [si.sa]				*!	*	*
d. [so.sa]					*	*
e. [sjo.sa]		*!				*

Candidate (a) is eliminated for fatally violating NO-HIATUS. The second candidate employs secondary articulation, but palatalized consonants are prohibited in this language, this candidate is also eliminated. Candidate (c) does well to delete a vowel to repair hiatus; however, it makes the wrong choice in which vowel to delete and fatally violates ANCHOR L by deleting V₂. Candidate (d) deletes V₁ and only violates the low-ranking constraints to satisfy high-ranking ones, this is the optimal candidate. Candidate (e) forms a glide and fatally violates *COMPLEX.

Most Nguni languages prohibit hiatus in any context. The Northern Ndebele dialect patterns differently. This language allows hiatus, and this configuration is maintained except when forming the possessive concord, diminutive, absolute pronouns, and the copulatives (Skhosana, 2009). Examples (180)- (183) illustrate this.

(180) /u + omukxulu/ > [u.o.mu.kxu.lu] ‘he is a big one’

(181) /gu + up ^{hi} /	>	[gu.u.p ^{hi}]	‘which one is it’
(182) /ku + i + tolo/	>	[ku.i.to.lo]	‘yesterday’
(183) /lo + a + lima/	>	[lo.a.li.ma]	‘the one who ploughs’

Speakers of the language either maintain hiatus or use the words after they have undergone glide formation, secondary articulation or glide insertion. The alternative forms are given below.

(184) /u + omukxulu/	>	[wo.mu.kxu.lu]	‘he is a big one’
(185) /gu + up ^{hi} /	>	[gu.wu.p ^{hi}]	‘which one is it’
(186) /ku + i + tolo/	>	[ku.ji.to.lo]	‘yesterday’
(187) /lo + a + lima/	>	[lo.wa.li.ma]	‘the one who ploughs’

This difference between Southern Ndebele and the Northern dialect results in the re-ranking of NO-HIATUS in Northern Ndebele, instead of being an undominated constraint, this constraint is low-ranking. Given example (184) whereby glide formation is expected, this language maintains the hiatus. Tableau 21 illustrates the constraint re-ranking in this language.

Tableau 21: Vowel hiatus in Northern Ndebele

/u + omukxulu/	MAX-IO (μ)	MAX-IO (RT)	NO-HIATUS
a. [u.o.mu.kxu.lu]			*
b. [wo.mu.kxu.lu]	*!		
c. [o.mu.kxu.lu]	*!	*!	

The first candidate which remains fully faithful is the winner, since NO-HIATUS is ranked low. Candidates (c) and (d) which form a glide and delete V₁ respectively, are eliminated for fatally violating the faithfulness constraints. Northern Ndebele ranks faithfulness to the input above markedness. Hiatus is only resolved in functional words or prefixes but is always maintained in lexical words. It should be noted that Northern Ndebele speakers do resolve the hiatus in some cases. The constraint ranking for both dialects is given below.

(188) Southern Ndebele:

NO-HIATUS, *V:, *COMPLEX, *C⁵, *Cⁱ, ANCHOR L >> OCP >> **MAX-IO (RT)**,
MAX-IO (μ), UNIFORMITY, UNIQUE.

Northern Ndebele

MAX-IO (μ), **MAX-IO (RT)**, *V:, *COMPLEX >> OCP, UNIFORMITY, UNIQUE
>> **NO-HIATUS**

This section has briefly discussed how isiNdebele deals with vowel hiatus. The section also provided simplified OT analyses. The next section discusses vowel hiatus (a marked configuration) and ghost segments, both vowels and consonants.

5.3.2. Vowel hiatus and ghost segments

IsiNdebele ghost segments interact with markedness in three hiatus repair strategies: vowel coalescence, glide insertion and glide formation. The ghost segments in these strategies affect markedness and are affected by markedness. The ghost aspect of these three strategies is discussed in detail in this section.

In Nguni languages, coalescence is a productive repair strategy and is found in this language family. Southern Ndebele is no different. Vowel coalescence is found under similar conditions as previously discussed: when the low vowel /a/ is juxtaposed with /u/, /a/, and /i/. Examples (164)-(166) above illustrate this, these examples are repeated in (189)-(191) below.

- | | | | |
|----------------------------------|---|--------------------------|--------------------|
| (189) /na + ugogo/ | > | [no.go.go] | ‘with grandmother’ |
| (190) /na + i ⁿ doda/ | > | [ne. ⁿ do.da] | ‘with a man’ |
| (191) /na + ama ⁿ zi/ | > | [na.ma. ⁿ zi] | ‘with water’ |

In Northern Ndebele, on the other hand, this process (as previously understood) is replaced by the “substitution of e” rule. According to Skhosana (2009) this rule operates when the vowel of the formative is juxtaposed with a noun in all noun classes, when this occurs the vowel of

the formative is replaced by the mid vowel [e]. He notes that this rule does not occur with class 1a nouns. The following examples ((192)-(196)) illustrate the “substitution of e” rule for different noun classes, and the last example illustrates where this rule fails to occur.

(192) /na + mu ⁿ ru/	>	[ne.mu. ⁿ ru]	‘with a person’
(193) /ga + ⁿ tro/	>	[ge. ⁿ tro]	‘by something’
(194) /sa + ⁿ duna/	>	[se. ⁿ du.na]	‘of a headman’
(195) /ja + mufati/	>	[je.mu.fa.ti]	‘of a woman’
(196) /muti wa + baba /	>	[mu.ti wa.ba.ba]	‘my father’s home’

This rule is present in all Tekela languages which include Siswati (Skhosana, 2009). I argue that this is not a substitution rule whereby the low vowel is replaced by a mid-vowel, instead, I suggest that the vowel of the formative coalesces with the pre-prefix /i/ which is a ghost vowel. This coalescence fails to occur with nouns in class 1a because this noun class does not have a pre-prefix. With this argument, the examples above can be re-written to include the ghost vowel in (197)-(200) below (the ghost vowel is put in brackets).

(197) /na + (i)mu ⁿ ru/	>	[ne.mu. ⁿ ru]	‘with a person’
(198) /ga + (i) ⁿ tro/	>	[ge. ⁿ tro]	‘by something’
(199) /sa + (i) ⁿ duna/	>	[se. ⁿ du.na]	‘of a headman’
(200) /ja + (i)mufati/	>	[je.mu.fa.ti]	‘of a woman’

The above examples show that the presence of ghost vowels can create marked structures which the language conspires to repair. Although, the surface form does not show these ghost vowels, they are present at a subsegmental level, and this presence is perceived in the processes that occur in forming words. In analyzing the ghost augment in ChiShona, Mudzingwa and Kadenge (2013) suggest that the ghost augment “comprises floating V-place features” (pg. 91). In isiNdebele, the V-place feature in question is the feature [coronal] for the high vowel /i/. The coalesced [e], like in ChiShona, retains the place features of the ghost pre-prefix and the height features of the formative vowel.

A few constraints related to this need to be introduced at this point in the discussion. The first constraint (*FLOAT) prohibits floating features, the second constraint militates against the movement of features and the docking of features on an existing root node (NO-FLOP). MAX (MEL) prohibits the deletion of melodic subsegments while DEP (SKEL) prohibits the addition of a skeletal subsegment (Lindsey, 2019). These constraints are defined below.

(201) *FLOAT

Floating features are prohibited.

(Mudzingwa and Kadenge, 2013)

(202) NO-FLOP

Let [F] be a feature (autosegment) in the output representation, and let [F'] be the input correspondent of that feature. If the output feature [F] is dominated by a root node (segment) X, then the input feature [F'] must likewise be dominated by a root node (segment) X', where X' is the input correspondent of X.

(Mudzingwa and Kadenge, 2013)

(203) MAX (MEL)

Assign one violation for every melodic subsegment present in the input that is absent in the output.

(Lindsey, 2019:26))

(204) DEP (SKEL)

Assign one violation for every skeletal subsegment present in the output that is absent in the input.

(Lindsey, 2019:26)

Tableau 22 illustrates the various options available in dealing with the floating feature and how the constraint hierarchy selects the optimal strategy.

Tableau 22: Coalescence of ghost vowel and formative

/na + ^{COR} mu ⁿ ru/	NO-HIATUS	*FLOAT	MAX (MEL)	DEP (SKEL)	NO-FLOP
a. [na. ^{COR} mu. ⁿ ru]		*!			
b. [na.i.mu. ⁿ ru]	*!			*	
c. [ne.mu. ⁿ ru]					*
d. [na.mu. ⁿ ru]			*!		

Candidate (a) maintains the floating feature, this fatally violates *FLOAT which militates against floating features. The second candidate (b) violates DEP (SKEL) by inserting a skeletal subsegment, this results in hiatus, this candidate violates the high-ranking constraint NO-HIATUS. Candidate (c) is the optimal candidate; this candidate coalesces the floating or melodic feature with the formative thus violating NO-FLOP. The last candidate deletes the floating feature completely and this fatally violates MAX (MEL), this candidate deletes a melodic subsegment. The above tableau shows that in isiNdebele, the floating features are allowed to interact with existing root nodes, the language does not delete the floating feature but rather docks it onto an existing root node. In this case, isiNdebele prefers to maintain the melodic subsegment rather than to add a skeletal subsegment. This analysis is the same for all other floating V-place features. The fact that MAX (MEL) outranks DEP(SKEL) indicates that the high coronal vowel is a martyr ghost (Lindsey, 2019). This ghost segment does not surface if its presence creates a marked structure which in this case is vowel hiatus.

According to Sibanda (2011), the imperative in Nguni languages and isiNdebele, cannot have an onsetless syllable. This is accounted for by the data, whereby vowel initial imperatives in Southern and Northern Ndebele begin with a semi-vowel onset. The glides /j/ and /w/ occur before [-round] and [+round] vowels respectively. Contrary to Mudzingwa's (2017) argument that this is an instance of spreading, this thesis and Sibanda (2011) argue that this is the ghost consonants surfacing to repair a marked structure. Examples (205) and (208) show this process.

(205) /-akha/ > [ja.k^ha] 'build'

(206) /-osa/	>	[wo.sa]	‘roast’
(207) /-ati/	>	[ja.ti]	‘know’
(208) /-oŋa/	>	[wo.ŋa]	‘preserve’

The data above indicates that the constraint ONSET is high ranking in isiNdebele, especially in the formation of the imperative. In addition to this, this constraint is undominated in Northern Ndebele which does not allow onsetless verb stems (Skhosana, 2009). The constraint ONSET is defined below.

(209) ONSET

Syllables must have an onset.

(Mudzingwa and Kadenge, 2011)

To yield the correct output, DEP (SKEL) must be dominated by ONSET and dominate MAX (MEL). Tableau 23 illustrates this.

Tableau 23: Ghost glides of the imperative

/ (j) -ak ^h a /	ONSET	DEP (SKEL)	MAX (MEL)
a. [a.k ^h a]	*!		*
b.  [ja.k ^h a]		*	

The first candidate deletes the melodic subsegment present in the input, this fatally violates ONSET and violates MAX (MEL) and is eliminated. The second candidate inserts a skeletal subsegment by realizing the ghost glide this violates DEP (SKEL) which militates against the surfacing or addition of a ghost segment and its skeletal subsegment. This is the optimal candidate. According to Skhosana (2009) Southern Ndebele permits vowel initial verb stems; therefore, the constraints in the tableau are reversed and this yields candidate (a) being the optimal candidate. The ghost glides surface for no other reason than to repair the marked structure above. The ghost glide behaves as a hero ghost which saves the word from being onsetless.

The above discussion does not relate much to the repairing of vowel hiatus in isiNdebele but just illustrates the ghost glide surfacing. There are peculiar instances where vowel coalescence is expected but instead glide insertion occurs, this is shown in the examples below.

- (210) /a + a + βili/ > [a.wa.βi.li] *[aβili] ‘it does not boil’
 (211) /a + a + sebenzi/ > [a.wa.se.be.ⁿzi] *[asebeⁿzi] ‘they do not work’

The examples are not the typical environment for glide insertion or spreading. The vowels present do not contain the features necessary to create a labial glide. It would be expected that coalescence would occur; however, as shown above, this creates an ungrammatical form. Therefore, the glide that is inserted is a ghost glide which surfaces to repair hiatus. The tableau below shows the relevant constraints and their interaction.

Tableau 24: Ghost glide and vowel hiatus

/a-(w)a- βili/	NO-HIATUS	UNIFORMITY	DEP (SKEL)	MAX (MEL)
a. [a.a.βi.li]	*!			*
b. [a.βi.li]		*!		*
c. [a.wa.βi.li]			*	

Candidate (a) fatally violates NO-HIATUS, this candidate deletes the melodic subsegment. The second candidate does well to repair the hiatus by coalescing the vowels; however, the constraint UNIFORMITY is high-ranking in this case, and this is not the optimal candidate, furthermore, this candidate deletes the melodic subsegment. With the last candidate, the ghost glide surfaces, violating the low-ranking constraint, this is the optimal candidate.

It was briefly mentioned that glide formation is not expected with the low vowel /a/, the data indicates that in Southern and Northern Ndebele the output is a glide when two low vowels are juxtaposed (212 and 213). Skhosana (2009) agrees that this unusual pattern may indicate that there is an underlying high vowel, this thesis takes the same approach.

- (212) /a + a/ > [wa] [wa.k^he] ‘his/hers’ (Southern Ndebele)

(213) /a + a/ > [ja] [ja.mi] ‘mine’ (Northern Ndebele)

The examples above are repeated below to show the ghost vowel.

(214) /a + (u) + a/ > [wa]

(215) /a + (i) + a/ > [ja]

Given the presence of the ghost vowels, there is hiatus between three vowels. I argue that to yield the optimal result, hiatus is first resolved between V1 and V2.

(216) /a/ + /u/ > [o]

(217) /a/ + /i/ > [e]

The juxtaposition of V1 and V2 is the context for coalescence; therefore, the two vowels coalesce to form the mid vowels. This still leaves hiatus between the product of coalescence and V3; to resolve this, the language uses glide formation.

(218) /o/ + /a/ > [wa]

(219) /e/ + /a/ > [ja]

This shows that there is an intermediary process that leads to the formation of a glide. Due to this, an OT analysis is not provided because OT deals with the input and output only and does not account for any intermediate stage.

A combined constraint ranking for the behaviour of ghost segments in both Southern and Northern Ndebele is given below. It should be noted that there are two different constraint rankings for hero and martyr ghosts. The difference between the two rankings is given in bold.

(220) Martyr ghost:

NO-HIATUS, *FLOAT, ONSET >> UNIFORMITY, **MAX (MEL)** >> NO-FLOP, **DEP (SKEL)**.

(221) Hero ghost:

NO-HIATUS, *FLOAT, ONSET >> UNIFORMITY, **DEP (SKEL)** >> NO-FLOP, **MAX (MEL)**.

5.3.3. IsiNdebele and other Bantu languages: A comparison

This section compares vowel hiatus resolution in isiNdebele with four Bantu languages: ChiShona, Xitsonga, Tshivenda, and Luganda.

Xitsonga is a Southern Bantu language spoken predominantly in Limpopo, South Africa and Mozambique. Vowel hiatus is a dispreferred configuration in this language, the language utilizes various strategies to resolve hiatus: glide formation, secondary articulation, vowel elision, and coalescence (Vratsanos and Kadenge, 2017). As with isiNdebele, glide formation is the preferred strategy because it is the most faithful to the input. Glide formation in Xitsonga occurs when a high vowel is followed by a [+round] or [-round] vowel (222 and 223). The high vowel must not be preceded by a consonant (Vratsanos and Kadenge, 2017). The initial high vowel changes into a glide when this occurs, this glide becomes an onset for V2. There is no compensatory lengthening in Xitsonga; therefore, the mora is lost completely. Max (μ) is low-ranking (Vratsanos and Kadenge, 2017).

(222) /i-e-na/	>	[je.na]	‘him’
(223) /u-o-na/	>	[wo.na]	‘it’

Secondary articulation is used when a vowel is preceded by a consonant, glide formation is blocked as it results in a complex onset which is prohibited in Xitsonga (Vratsanos and Kadenge, 2017). Unlike isiNdebele, Xitsonga permits both labialization and palatalization. A [+round] vowel yields labialization and a [-round] vowel yields palatalization, this is shown in (224) and (225) below. The constraint which prohibits palatalization (*C^j) is low-ranking in Xitsonga.

(224) /ʃi-poto-ana/	>	[ʃi.po.t ^w a.na]
---------------------	---	-----------------------------

NC7-pot-DIM ‘small pot’

(225) /ʃi-tʃuri-ana/ > [ʃi.tʃu.r̥a.na]

NC7-mortar-DIM ‘small mortar’

Xitsonga follows the same coalescence pattern as that found in isiNdebele, a low vowel juxtaposed by a high vowel results in a mid-vowel, (226 and 227) (Vratsanos and Kadenge, 2017). When all other strategies are blocked vowel elision is employed as a final strategy, V1 is the most common vowel to be deleted when vowel elision occurs (228 and 229) (Vratsanos and Kadenge, 2017).

(226) /la-u-ku/ > [lo.ku]

REV-V-PREF ‘this’

(227) /ma-ino/ > [me.nu]

NC6-tooth ‘teeth’

(228) /va-aki/ > [va.ki]

NC2-builder ‘builders’

(229) /ʃi-mbuti-ana/ > [ʃi.mbu.ta.na]

NC7-goat-DIM ‘small goat’

Like isiNdebele, chiKaranga (a dialect of ChiShona) does not permit palatalization; therefore, when the high vowel /i/ is juxtaposed with another vowel, this vowel is deleted instead of palatalization occurring, this is because the constraint banning palatalization is high-ranking in Karanga (Mudzingwa and Kadenge, 2011). The process of labialization and deletion where palatalization occurs in Xitsonga is illustrated in (230) and (231) below.

(230) /mu-ana/ > [m^wa.na]

NC1-child ‘child’

(231) /mi-oto/ > [mo.to] *[m^joto]

NC4-fire ‘fires’

Karanga does not permit long vowels; therefore, there is no compensatory lengthening in this language (Mudzingwa and Kadenge, 2011). This is not the case with Luganda (Bantu language spoken in Uganda) where vowel length is contrastive, whichever strategy is employed to resolve hiatus is accompanied by compensatory lengthening (Kadenge and Simango, 2014). Luganda utilizes secondary articulation (labialization and palatalization), and vowel elision (among other processes). Examples (232) to (234) illustrates this, tableau 25 shows the constraint interaction in Luganda.

- (232) /mu-a-lab-a/ > [m^wa:.la.ba] ‘you saw’
 (233) /li-ato/ > [l̪a:.to] ‘boat’
 (234) /ba-a-lab-a/ > [ba:.la.ba] ‘they saw’

Tableau 25: Compensatory lengthening in Luganda

/li-ato/	NO-HIATUS	MAX-IO (μ)	*COMPLEX	MAX-IO (RT)	*V:
a. [l̪a.to]		*!		*	
b. [li.a.to]	*!				
c. [lja.to]		*!	*!	*	
d. [l̪a:.to]				*	*

Candidate (a) does well to palatalize; however, this candidate fatally violated MAX-IO (μ) by deleting a mora. The second and third candidates are eliminated for fatally violating NO-HIATUS and *Complex, respectively. The final candidate undergoes secondary articulation and lengthens the vowel to compensate for the lost mora, this violates *V:, a low-ranking constraint. This candidate is the optimal candidate.

Like Northern Ndebele, Tshivenda permits hiatus in specific contexts: in the verbal word (Tzanakakis, 2019). The hiatus that occurs across the PreStem and MacroStem and across word boundaries is tolerated in the language (Tzanakakis, 2019). Examples (235) to (237) show the contexts where vowel hiatus is tolerated in Tshivenda.

- (235) /ri-a-mu-diβa/ > [ri.a.mu.di.βa]
 SC-TNS-OC-know 'we know him'
- (236) /u-a-u-z^wima/ > [u.a.u.z^wi.ma]
 SC-TNS-OC-hunt 'he hunts it'
- (237) /u-i-r^wa/ > [u.i.r^wa]
 INF-OC-hit 'to hit it'

According to Tzanakakis (2019), Tshivenda has a co-phonology which does not allow hiatus in nominals and one that tolerates this configuration in verbal words. Table 6 below provides a summary of the main differences between hiatus resolution strategies across the Bantu languages discussed.

Table 6: Differences and similarities in hiatus resolution

	Southern Ndebele	Northern Ndebele	Xitsonga	Karanga	Luganda	Tshivenda
Palatalization	No	No	Yes	No	Yes	Yes
Labialization	Yes	Yes	Yes	Yes	Yes	Yes
Compensatory lengthening	No	No	No	No	Yes	No
Hiatus tolerance	No	Yes	No	No	No	Yes

The next section discusses the minimality effects of isiNdebele. The vowel that is inserted to resolve minimality is scrutinized.

5.4. Minimality effects

Languages place a restriction on the minimal word size permitted. Most Bantu languages place a bisyllabic or disyllabic minimal word restriction, meaning words in these languages must be

made up of two syllables or more (Tzanakakis, 2019). Words that meet this requirement are considered well-formed words. Languages make use of various strategies to ensure that words are minimally disyllabic; epenthesis or blocking (Park, 1995). Epenthesis involves the addition of a syllable to a subminimal (less than two syllables) word, this syllable serves no morphological or semantic purpose and is only added to satisfy a phonological requirement (Park, 1995). Processes such as syncope and mu-reduction are blocked if they result in a subminimal output form, this is referred to as blocking (Park, 1995).

This section discusses strategies used by isiNdebele when dealing with subminimal words. It should be noted that isiNdebele is a minimally disyllabic language, meaning words in this language must be a minimum of two syllables long; therefore, this section does not aim to prove this point but instead discusses strategies used to ensure that this requirement is met (Downing, 1999).

As stated above, isiNdebele requires a well-formed PWord to be at least two syllables long (Downing, 2003). This section uses evidence from the imperative, passive construction, and reduplication to illustrate how this requirement is maintained in isiNdebele. After a discussion of the minimality effects in isiNdebele, the next section discusses the relationship between ghost segments and minimality.

5.4.1. PWord and PStem

A discussion of minimality and other phonological effects is incomplete without a discussion of PWord and PStem. PWord or Prosodic word matches the lexical word, this includes the fully inflected aspect of the lexical word. The PWord is subject to minimality constraints (Downing and Kadenge, 2020). PStem, which is a constituent of PWord, is the stem of a word. The stem is “a lexical item specified for syntactic category” (Downing and Kadenge, 2020:438). This distinction is important because some of the contexts for minimality discussed below are conditioned by PStem or PWord. (238) below illustrates PWord and PStem as is used in this thesis.

(238) (PWord Prefixes (PStem Root + Suffixes))

(Downing and Kadenge, 2020:439)

5.4.2. Strategies to maintain minimality

The imperative form of the verb is the best word type to test minimality effects in any language. The imperative involves only the root and final vowel of the verb, there are no prefixes or suffixes; there is no inflected material (Tzanakakis, 2019). The table below shows the infinitive and imperative forms of verbs in isiNdebele.

Table 7: Imperatives in isiNdebele

Infinitive	Imperative	Gloss
(239) [ku-ɬala]	[ɬala]	‘sit’
(240) [uku-vuka]	[vuka]	‘wake up’
(241) [ku-tʰa ⁿ da]	[tʰa ⁿ da]	‘love’
(242) [uku-kʰa ^m ba]	[kʰa ^m ba]	‘walk’
(243) [ku-ɟala]	[ɟala]	‘play’

Disyllabic imperative verbs have no epenthesis; however, monosyllabic imperative verbs have /i- / or /yi-/ epenthesis, this vowel and the glide is known as the stabilizer and serves no other purpose except to create disyllabic forms (Park, 1995). This vowel is epenthesized as a prefix to the verb root. The table below shows monosyllabic verbs in the infinitive and imperative forms to illustrate this epenthesis.

Table 8: Monosyllabic imperatives in isiNdebele

Infinitive	Imperative	Gloss
(244) [ku-ɟa]	[iɟa]/ [jiɟa]	‘eat’
(245) [ku-pʰa]	[ipha]/ [jipʰa]	‘give’
(246) [ku-ja]	[ija]	‘go’

(247) [ku-za]	[iza]	‘come’
---------------	-------	--------

The monosyllabic verb roots are stabilized by the high vowel or can also be stabilized by the combination of the high vowel and palatal glide. Epenthesizing /i-/ to polysyllabic stems yields ungrammatical forms. This indicates that this vowel is there not to serve any morphological function but to maintain disyllabicity. There is no epenthesis in the infinitive form which indicates that the infinitive marker already contributes to minimality (Kadenge and Mathangwane, 2017). The epenthetic material adds a syllable to the monosyllabic root thus satisfying minimality. According to Downing (2001), the epenthesis of a syllable ensures that the PWord is minimally disyllabic, this creates a misalignment between PWord and the morphological word or MWord; this misalignment is acceptable because it serves to create a well-formed word.

The constraints given in (248) below and (105) above are relevant for a discussion on PWord minimality. IsiNdebele and many other Bantu languages such as ChiShona prefer to violate faithfulness by epenthesizing a syllable to maintain well-formedness.

(248) DEP-IO

Every element in the output has a correspondent in the input (No epenthesis)

(Kager, 1999)

(249) IDENT-MORPH

No augmentation of minimally well-formed forms

(Magongo, 2024)

An OT analysis of the disyllabicity of the imperative is provided in the two tableaux below. The first tableau (26) illustrates the treatment of disyllabic imperatives, while tableau (27) illustrates the treatment of monosyllabic verb roots.

Tableau 26: Disyllabic imperative in isiNdebele

/!ala/	MIN-WD	NO-HIATUS	IDENT-MORPH	DEP-IO

a. [la.la]				
b. [i.la.la]			*!	*
c. [la.la.i]		*!		*

Candidate (a) remains fully faithful and violates no constraints; this is the optimal candidate. The second candidate which undergoes /i-/ epenthesis violates DEP-IO and fatally violates IDENT-MORPH which prohibits augmenting a well-formed form such as the disyllabic verb root in the tableau. The third candidate violates NO-HIATUS (introduced in (148)) by suffixing the vowel. This indicates that in isiNdebele, the preference is to prefix the epenthetic syllable.

Tableau 27: Monosyllabic verb roots

/ ʒa/	MIN-WD	NO-HIATUS	IDENT-MORPH	DEP-IO
a. [ʒa]	*!			
b. [i.ʒa]				*
c. [ʒa.i]		*!		*

Candidate (a) undergoes no augmentation and fatally violates MIN-WD. This candidate is not a well-formed PWord. The second candidate, the optimal candidate, violates DEP-IO by augmenting the high vowel /i/. The final candidate suffixes the epenthetic segment in fatal violation of NO-HIATUS.

Another context to test for minimality effects in isiNdebele is the passive construction. The passive extension is /-iw/ and its allomorph is /-w/, these two allomorphs are used in different contexts (Jiyane, 1994). Ndebele scholars such as Jiyane (1994) and Skhosana (2009) agree that the passive extension with the vowel is used for all monosyllabic verb roots and for vowel initial roots, while the second allomorph is used in all other contexts. Examples (250) to (253) illustrate the use of the -w allomorph of the passive extension.

(250) /vala/	>	[va.l ^w a]	‘be closed’
(251) /sela/	>	[se.l ^w a]	‘get drunk’
(252) /t ^h ala/	>	[t ^h a.l ^w a]	‘get divorced’

(253) /xatʃa/ > [xa.tʃ^wa] ‘get broadcasted’

The examples below illustrate the use of the -iw allomorph in monosyllabic and vowel initial verb roots.

- (254) /ɬa/ > [ɬi.wa] ‘be eaten’
 (255) /aba/ > [a.bi.wa]/[ja.bi.wa] ‘be distributed’
 (256) /azi/ > [a.zi.wa]/[ja.zi.wa] ‘be known’
 (257) /tʰi/ > [tʰi.wa] ‘be said’
 (258) /tʰo/ > [tʰi.wo] ‘be said’

The vowel initial verbs can also be realized with an initial glide when turned into the passive form. Since the passive extension /-iw/ is used with monosyllabic roots, this indicates that it is used to satisfy minimality. It ensures that the passive form is minimally disyllabic. Magongo (2024) argues that when forming the passive form, monosyllabic verb roots first undergo /i-/ epenthesis to create a well-formed PWord, this is then followed by the formation of the passive. This process of augmentation is blocked when the PWord is well-formed. Downing (2001) posits that the passive construction is a PStem, and the PStem has the same minimal requirements as the PWord. As such, she introduces a constraint (259) which states that the PStem is coextensive with a foot (disyllabic by nature)

(259) PStem = Foot

PStem is coextensive with a Foot

(Downing, 2001:49)

Tableau 28: Passive construction with disyllabic verb roots

/val-iw-a/	PStem=Foot	IDENT-MORPH	MAX-IO
a. [va.li.wa]		*!	
b. [va.l ^w a]			*

The first candidate is fully faithful, and maintains the high vowel, since this is already a well-formed PWord, it fatally violates IDENT-MORPH. The second candidate is the optimal candidate, it deletes the high vowel in violation of MAX-IO.

Tableau 29: Passive construction with monosyllabic verb roots

/k-iw-a/	PStem=Foot	IDENT-MORPH	MAX-IO
a.  [ki.wa]			
b. [kwa]	*!		*

Candidate (a) is fully faithful and violates no constraints; this is the optimal candidate. The second candidate deletes the high vowel and wounds up fatally violating PStem=Foot and MAX-IO.

When the passive is formed from a verb root ending in a bilabial sound, the passive extension undergoes palatalization. This is interesting for this study because it relates to floating features, as mentioned before floating features are beyond the scope of this paper and will be discussed in future research. Examples (260) to (265) illustrates this process of palatalization. A brief discussion of this process is given in the next section.

(260) /kapa/	[ka.tʃ ^w a]	‘get chopped’
(261) /pompa/	[po. ⁿ tʃ ^w a]	‘get pumped’
(262) /zuma/	[zu.n ^w a]	‘get hunted’
(263) /luba/	[lu.tʃ ^w a]	‘get peeled off’
(264) /baʔa/	[ba.dʒ ^w a]	‘get excreted’
(265) /k ^h upa/	[k ^h u.tʃ ^h w ^w a]	‘get taken out’

Reduplication is another test for minimality. Reduplication on verbs indicates continuous or repetitive actions (Tzanakakis, 2019). It is used to emphasize an action and can also be used for nouns. Reduplication in isiNdebele, according to Jiyane (1994), does not emphasize but rather indicates a diminution of the verb. In the reduplication of a polysyllabic verb root, the base is made up of the full form of the verb while the reduplicant contains the first two syllables of the verb root (266). Disyllabic verb roots undergo full reduplication, meaning the reduplicant is the full form of the verb (268). Downing (1999) and Inkelas and Zoll (2000) argue that with

polysyllabic roots, only the first two syllables are reduplicated. Monosyllabic verb roots, when reduplicated, include an epenthetic segment /-ji/ between the base and reduplicant (269)

(266) /gidzima/	[gi.dzi .gi.dzi.ma]	‘run a little’
(267) /p ^h uŋula/	[p^hu.ŋu .p ^h u.ŋu.la]	‘reduce a little’
(268) /la ^m ba/	[la.^mba .la ^m ba]	‘wash a little’
(269) /fa/	[fa.ji .fa]	‘die a little’

The conjunctive affix /-yi-/ is affixed between the two verb roots in (269). This indicates that only minimally disyllabic roots can be reduplicated. The affix creates disyllabicity. It is important to note that the affix is affixed to the reduplicant which has minimality restrictions, the base form has no minimality restrictions on it and remains monosyllabic (Inkelas and Zoll, 2000). Reduplication best illustrates the notion of a well-formed PStem (Downing, 2005; Tzanakakis, 2019). The RED PStem must be minimally and maximally disyllabic, it is for this reason that only the first two syllables of a polysyllabic verb root are reduplicated (Jiyane, 1994).

(270) RED [σσ]

The reduplicant must be minimally disyllabic

(Magongo, 2024:94)

Tableau 30: Reduplication of polysyllabic verb roots

/RED-gidzima/	RED [σσ]	IDENT-MORPH	DEP-IO
a. [gi.dzi.ji .gi.dzi.ma]		*!	*
b.  [gi.dzi .gi.dzi.ma]			

Candidate (a) fatally violates IDENT-MORPH by adding an affix to an already well-formed form. The second candidate satisfies all constraints and is the optimal candidate.

Tableau 31: Reduplication of monosyllabic verb root

/RED-fa/	RED [σσ]	IDENT-MORPH	DEP-IO
a. [fa .fa]	*!		

b.  [fa.ji.fa]			*
---	--	--	---

Candidate (b) augments an affix and ensures that the reduplicant is well-formed, this violates DEP-IO, this candidate is the optimal candidate. Candidate (a) fatally violates RED [$\sigma\sigma$] because the reduplicant is sub-minimal.

This section illustrated using examples the various strategies used by isiNdebele to maintain word minimality. The discussion centered around the ways PWord and PStem are adjusted to be well-formed. Both the PWord and PStem in isiNdebele must be minimally disyllabic.

5.4.3. Minimality effects and Ghost segments

Of interest to the notion of ghost segments is the use of the epenthetic vowel when augmenting the monosyllabic imperative. I argue that like previous ghost vowels discussed, this vowel is a ghost vowel that alternates with zero. I argue that this epenthetic segment is typically absent and surfaces to repair minimality. Scholars agree that the epenthetic segment serves no morphological or semantic purpose and can be considered a zero segment morphologically (Kadenge and Mathangwane, 2017; Park, 1995). Without this epenthetic segment, the monosyllabic verb roots are subminimal. Using Lindsey's (2019) classification, this epenthetic segment /ji-/ or /i-/ is a hero ghost that surfaces to rescue the word from subminimality.

The constraint DEP (GHOST) militates against the surfacing of a ghost segment, this constraint is low-ranking in isiNdebele. Using these insights, a new OT analysis is provided in tableau 32 below.

(271) DEP (GHOST)

The ghost segment in the output must have a correspondent in the input (no epenthesis).

Tableau 32: Hero ghost in the imperative (monosyllabic)

/kʰa/	MINWD	DEP (GHOST)
a. [kʰa]	*!	
b.  [i.kʰa]		*

Candidate (a) fatally violates MINWD. To satisfy the high-ranking markedness constraint, candidate (b) violates DEP (GHOST) by allowing the ghost vowel to surface. Tableau 33 below shows that other high-ranked constraints prevent the surfacing of the ghost, especially when the verb is already well-formed.

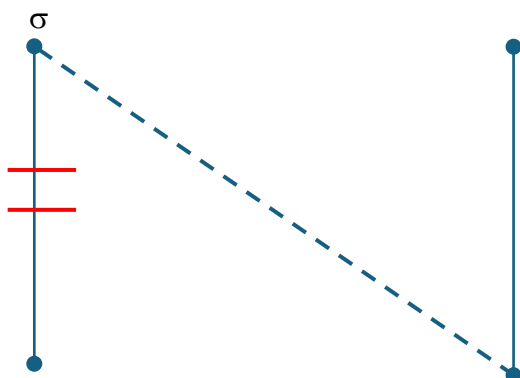
Tableau 33: Failure of ghost surfacing in well-formed words

/k ^h a ^m ba/	MINWD	IDENT-MORPH	DEP (GHOST)
a. [i.k ^h a. ^m ba]		*!	*
b.  [k ^h a. ^m ba]			

In candidate (a) the ghost vowel surfaces and incurs a non-fatal violation of DEP (GHOST), this surfacing incurs an even more fatal violation of IDENT-MORPH which prohibits augmenting a well-formed word. Candidate (b) emerges as the winner by violating no constraints.

When undergoing palatalization, I argue that this feature is floating and docks onto the labial thus changing it into a palatal. Like Chaha, there are restrictions for this process. Only verb roots which end in a labial sound undergo palatalization, all other verbs do not undergo this process. The figure below provides an illustration of palatalization in the passive in isiNdebele. It is not clear why this process occurs, the answer to that is beyond the scope of this paper.

Figure 5: Palatalization in the passive



[+labial]

[+palatal]

Figure 4 above shows that the floating palatal feature (lacks a root node), docks onto the root node of the labial consonant. This labial consonant loses its labiality by being delinked from the labial feature.

The data and arguments posed above make it clear that hero ghosts surface only when necessary, they do not surface if a word is already well-formed.

5.4.4. IsiNdebele and other Bantu languages: A comparison

Other Bantu languages make use of different strategies to maintain or achieve minimality. In the imperative form, isiNdebele prefixes the epenthetic vowel, other languages suffix in the same form. Table 9 illustrates the differences between different Bantu languages when forming the imperative.

Table 9: The imperative of ‘eat’ in Bantu languages

Language	Imperative ‘eat!’
IsiNdebele	[i.ɬa]
ChiZezuru	[i.dʲa]
Siswati	[ɬa.ni]
Xitsonga	[dʲa.na]
Kiswahili	[ku-la]
Ikalanga	[i-ja]

(adapted from Magongo, 2024 and Tzanakakis, 2019)

The table shows that languages such as SiSwati and Xitsonga suffix the epenthetic segment to create a well-formed imperative

In the formation of the passive form, SiSwati follows the same pattern as isiNdebele whereby /-w/ is used with polysyllabic verb roots (272), and /-iw/ is used in monosyllabic roots (273)

(Magongo, 2024). Setswana, on the other hand, permits the use of the /-iw/ form in polysyllabic roots in addition to monosyllabic verb roots (274) (Magongo, 2024).

(272) /gamul-w-a/ break-PASS-FV	>	[ga.mu.l ^w a] ‘be broken’	[siSwati]
(273) /v-w-a/ hear-PASS-FV	>	[vi.wa] ‘be heard’	[siSwati]
(274) /tɬab-iw-a/ stab-PASS-FV	>	[tɬa.bi.wa] ‘be stabbed’	[Setswana]

Reduplication of a monosyllabic stem is dealt with in a similar way in isiZulu (275) and SiSwati (276) which both insert /-ji/ between the reduplicative and base form (Magongo, 2024). Languages such as Tshivenda (277) copy the base as is when forming the reduplicative. ChiNdau inserts a low vowel /a/ in the reduplicative thus making it disyllabic (278). Lastly, Kinande doubles the root when forming the reduplicative (279) (Magongo, 2024).

(275) /-ma/	>	[ma.ji .ma]	‘stand’	[isiZulu]
(276) /-fa/	>	[fa.ji .fa]	‘die’	[siSwati]
(277) /-sɛa/	>	[sɛ.a .sɛ.a]	‘laugh’	[Tshivenda]
(278) /-r ^j a/	>	[r^ja.a .r ^j a]	‘eat’	[ChiNdau]
(279) /-swa/	>	[swa.swa.swa]	‘grind’	[Kinande]

5.5. Discussion

This chapter has provided a detailed discussion of three phonological processes; high vowel elision, hiatus resolution, and minimality effects. From these processes, five ghost segments were found, [a], [i], [u], [j], and [w]. The chapter analyzed how these ghost segments interact with markedness. This section provides a summary of the findings discussed in this chapter and uses those findings to classify the ghost segments using Lindsey’s (2019) classification of ghost segments.

The high vowels in high vowel elision delete in polysyllabic noun stems and are maintained for monosyllabic stems. Furthermore, when undergoing syncope in fast speech, the high vowels are optionally deleted in non-prominent positions and in functional morphemes. According to Iskender (2008), high vowels alternate with zero, these two high vowels alternate with zero in the said contexts. In syncope, this alternation results in zero remaining in the output (in violation of NOZERO). The high vowels are typically present and delete if they violate markedness constraints such as *[MU] and V [+hi]; therefore, these can be classified as martyr ghosts which sacrifice themselves to maintain structural well-formedness.

In vowel hiatus resolution, the ghost vowels delete to resolve hiatus and in effect rescue the word from being ungrammatical. Furthermore, the ghost glides surface where coalescence is expected to resolve hiatus. The high vowel /i/ is perceived in the surrounding environment of the formative juxtaposed with a noun, this presence creates hiatus which is resolved by coalescence. In this process, the ghost glides surface to maintain well-formedness; therefore, the ghost glides are hero ghosts that rescue the words from vowel hiatus. The hero ghost glides also surface to provide an onset to onsetless imperatives in isiNdebele. The ghost vowels which are present at a subsegmental level, are deleted and are martyr ghosts that are sacrificed to maintain well-formedness.

The ghost segment [ji] is a hero ghost which surfaces to maintain minimality requirements in the language. The segment surfaces to ensure that monosyllabic verb roots are well-formed PWords and PStems.

Floating features have been identified in isiNdebele in the palatalization of the passive form. This section did not discuss this in detail, as this is beyond the scope of this paper. Whether the floating features have the same classification as latent segments is not clear. What is clear is that this palatal floating feature only docks onto labial consonants. This is a topic that requires further research. Table 10 provides a summary of the findings in this chapter regarding ghost segments.

Table 10: Summary of ghost segment behaviour

Ghost segment	Process	Classification
[i], [u]	High vowel elision	Martyr

[i], [u], [a]	Hiatus resolution	Martyr
[i], [ji]	Minimality effects	Hero
[j], [w]	Hiatus resolution	Hero
[j], [w]	Imperative formation	Hero

The constraint hierarchy for the two main dialects of isiNdebele is given below.

(280) Southern Ndebele:

MINWORD, *COMPLEX, NOCODA, NOGEM, Ident-IO (place) nasal, MAX/PROM, MAX/LEX, NO-HIATUS, V:, *C^ɛ, *C^j, ANCHOR L >> *[MU], ALIGNSTEM-L, OCP >> PARSE-GHOST, Agree (place) NC. >> *V[+hi] >> PARSE-GHOST, NOZERO, MAX-IO (RT), MAX-IO (μ), UNIFORMITY, UNIQUE.

(281) Northern Ndebele

MINWORD, *V:, *COMPLEX, NOCODA, Ident-IO (place) nasal, MAX/PROM, MAX/LEX, *[mβ]>>OCP, *[Liquid.Vowel], ALIGNSTEM-L, MAX-IO(μ), MAX-IO (RT)>>PARSE-GHOST >>*[MU], NOGEM, Agree (place) NC. >> *V[+hi] >> NOZERO, UNIFORMITY, UNIQUE >> NO-HIATUS

At this point, it is important to provide a structural explanation of ghost segments in isiNdebele. Ghost segments can either be melodic or skeletal segments; melodic segments are only specified for melodic features such as vowel quality and featural specifications while skeletal segments are specified for metrical features such as moras and C and V slots (Lindsey, 2019). The hero ghosts in isiNdebele are melodic segments because they involve vowel quality and featural specifications of labiality and palatalization. The martyr ghosts are skeletal segments because their behaviour has to do with the mora.

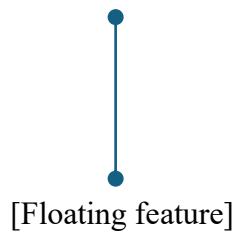
Using FG, latent segments (ghost vowels and consonants) have a root node; however, they have no link to their root node. When they surface that link is created. Floating features, which were not discussed in this thesis, have no root node and usually they dock onto an existing root node (a neighbouring root node). Figures 6 and 7 illustrate the structure of latent segments and floating features, respectively.

Figure 6: Latent segment

σ

[ghost segment]

Figure 7: Floating feature



5.6. Summary of chapter

This chapter discussed three phonological processes: high vowel elision, hiatus resolution, and minimality effects. These processes were discussed in detail and a comparison of isiNdebele and other Bantu languages was provided to situate isiNdebele within the broader scope.

The ghost segments present in the language were sifted in these processes and an OT analysis of ghost behaviour was provided. It was found that ghost segments affect and are affected by markedness. The pattern suggests that the ghost vowels surface as martyr ghosts which

alternate with zero and sacrifice themselves for structural well-formedness. The ghost glides, on the other hand, are typically hero ghosts which surface to rescue the words.

The findings in this chapter shed light on the dialectal differences between Southern and Northern Ndebele; Southern Ndebele behaves more like Nguni languages while Northern Ndebele patterns more with Sotho languages. Furthermore, Southern Ndebele places markedness above faithfulness and deletes or inserts segments to maintain structural well-formedness. Northern Ndebele seems to value faithfulness over markedness, this was evident in the retention of the mu prefix and the tolerance of hiatus in some contexts. It is clear from this chapter that ghost segments exist and are an integral part of markedness in isiNdebele and other languages.

Chapter 6: Conclusion and Recommendations for further study

6.1. Conclusion

Chapter 1 introduced the study. The chapter began with an introduction to ghost segments followed by the problem statement which showed how this study contributes to ghost segments and African linguistics. The second chapter of this thesis critically discussed the literature on ghost segments. This discussion included literature on ghost segments in global languages, African languages, and Nguni. The chapter also showed the relevance of conducting a phonological study on isiNdebele by discussing studies done on the language. Chapter 3 provided a linguistic background on isiNdebele, with discussions on the history of the language, phonemic inventory, syllable structure and morphosyntax. The fourth chapter discussed the methodology utilized in this study; this included data collection methods and theoretical framework utilized in the analysis of the data. Chapter 5 provided a critical analysis of the data and formed the crux of this study. This chapter is a concluding chapter which summarises the findings of the entire study and provides recommendations for future research.

The research set out to unmask ghost segments in South African isiNdebele. The study aimed to find the relationship between ghost segments and markedness to classify these ghost segments as either hero or martyr ghost segments. The study made use of three phonological processes to identify ghost segments and their relationship to markedness. The study focused on three phonological processes: high vowel elision, hiatus resolution, and minimality effects.

The data analyzed in this study was taken from previous studies of Jiyane (1994) and Skhosana (2009) who have done extensive work on the grammar of isiNdebele. The data was verified by me, a speaker of isiNdebele. I also made use of the radio station IKwekwezi FM to verify if the data was still relevant for today. The study made use of the Optimality theory framework; this theoretical framework was useful for this study as it provided constraints which interact to yield different outcomes. The use of OT was able to show the relationship between ghosts and markedness and to classify ghost segments using constraint rankings. Furthermore, Feature geometry was used to illustrate some processes and to illustrate the structure of ghost segments.

High vowel elision was shown to be either obligatory or optional. Mu-reduction is an obligatory high vowel elision process. The high ghost vowel of the class prefix is deleted with all noun

stems except monosyllabic nouns. It was shown that Northern Ndebele prefers to maintain the vowel, furthermore, in cases where the nasal precedes a bilabial fricative, the nasality spreads to the fricative, creating a nasal geminate. Syncope is an optional process that usually occurs during fast speech. The data indicated that syncope is blocked when the high vowel is in a prominent position, a lexical morpheme or in a monosyllabic stem. Since the vowel alternates with zero, syncope results in zero being in the output, a violation of NOZERO. Based on their interaction with markedness in this process, the ghost vowels are classified as martyr ghosts which sacrifice themselves to maintain well-formedness.

Vowel hiatus is a dispreferred configuration. Vowel hiatus resolution strategies utilized by isiNdebele were discussed in detail. It was found that isiNdebele makes use of five strategies when resolving hiatus: glide formation, glide insertion, secondary articulation, vowel coalescence, and vowel elision. The preferred strategy is glide formation as it results in only the loss of a mora (it yields the most faithful output). Secondary articulation involves only labialization in this language. It was shown that unlike Southern Ndebele, Northern Ndebele maintains hiatus in every context except in the possessive concord, diminutive, absolute pronoun and copulatives. Even when hiatus is maintained, other speakers resolve hiatus in their speech. The ghost segments are evident in vowel coalescence whereby the low vowel /a/ of the formative is juxtaposed with the ghost vowel /i/ resulting in coalescence. This process was previously understood as a substitution rule whereby the low vowel was substituted with the mid vowel [e]. The ghost glides surface in a context where coalescence is the expected hiatus resolution strategy, the glides surface to rescue the word from hiatus; therefore, the ghost glides are identified as hero ghosts.

Strategies utilized by isiNdebele to maintain disyllabicity were discussed. Evidence from the imperatives, passive and reduplication were presented to illustrate how isiNdebele ensures that PWords and PStems are well-formed. When the verb root is subminimal, isiNdebele epenthesizes /i/ or /ji/ to create a well-formed PWord when forming the imperative. Epenthesizing these to a polysyllabic root result in an ungrammatical form. The passive is made up of two allomorphs, /iw/ and /w/, the former is used with monosyllabic verb roots and onsetless roots, while the latter is used with all other verb roots. Reduplication in isiNdebele has minimality restrictions; the reduplicate must be minimally and maximally disyllabic. Given this restriction, when reduplicating a polysyllabic root, only the first two syllables are reduplicated, and a syllable /ji/ is epenthesized to a monosyllabic root.

The epenthetic segments involved in minimality effects were identified as ghost segments. These ghost segments /i/ and /ji/ surface to rescue the word from subminimality; therefore, these ghost segments have been identified as hero ghosts.

All the data presented in this thesis was compared to data from other Bantu languages such as isiZulu, ChiShona, Xitsonga, Tshivenda, SiSwati, Luganda, chiNdau, Setswana, Sesotho, and Kinande. This comparison showed that isiNdebele fits well into the language family, many strategies used in the language are found in neighbour languages. This comparison also showed that Southern Ndebele patterns with the Nguni language family while Northern Ndebele patterns with the Sotho language family. This helped to situate isiNdebele within Bantu language typology.

The data indicates that ghost vowels in isiNdebele behave as martyr ghosts except for the ghost vowel /i/ which functions in minimality effects, while the ghost consonants (glides) are hero ghosts. Using OT, this thesis was able to predict and unmask the behaviour of ghost segments. Given two constraints DEP (SKEL) and MAX (MEL), when DEP (SKEL) outranks MAX (MEL), the ghost segment in question is a hero ghost. The reverse ranking of these two constraints yields martyr ghosts.

6.2. Recommendations for further study

Although it is hoped that the analysis presented here is thorough and the research presents a comprehensive account of ghost segments in isiNdebele, there are still unanswered questions and areas which require further research and analysis. Firstly, this thesis did not delve into vowel epenthesis and its relation to ghost segments. Future research can delve into this process using both native phonology and loanword phonology, does the epenthetic vowel alternate with zero in both processes? This question can be answered in future research.

A brief discussion of floating features was given in this paper; however, the actual functioning of these features was not given. Future research does well to unmask the behaviour of floating features to predict their functioning. Future research can delve into the relationship that exists between floating features and markedness, if such a relationship exists. Furthermore, previous

research indicates that floating tones exist in Bantu languages; therefore, an analysis on these floating tones in isiNdebele and other Nguni languages is useful for future research. Lastly, the ghost segment /ab/ was not discussed in this thesis. A discussion on where this ghost segment occurs and its relationship to markedness is worthy of future research.

6.3. Summary of chapter

This chapter presented a conclusion of this study by presenting the major findings found in this study. Furthermore, recommendations for future research into ghost segments were provided.

7. Reference List

- Blust, R. (2001). Some remarks on stress, syncope, and gemination in Mussau. *Oceanic Linguistics*, 40(1) 143–150.
- Casali, R. F. (1997). Vowel elision in hiatus contexts: Which vowel goes? *Language*, 73(3), 493–533.
- Clements, G. N., & Hume, E. V. (1995). The internal organization of speech sounds. In J. Goldsmith (ed.), *The handbook of phonological theory*. (pp. 245–306). Blackwell.
- Downing, L. J. (1999). Prosodic stem ≠ prosodic word in Bantu. *Studies on the Phonological Word*, 174, 73–98.
- Downing, L. J. (2000). Satisfying minimality in Ndebele. *ZAS Papers in Linguistics*, 19, 23–39.
- Downing, L. J. (2001). Ungeneralizable minimality in Ndebele. *Studies in African Linguistics*, 30(1), 34–58.
- Downing, L. J. (2003). Compounding and tonal non-transfer in Bantu languages. *Phonology*, 20(1), 1–42.
- Downing, L. J. (2005). On the ambiguous segmental status of nasals in homorganic NC sequences. In M. van Oostendorp and J. van de Weijer (eds.), *The Internal Organization of Phonological Segments*, (pp. 183–216). De Gruyter Mouton.
- Downing, L. J., & Kadenge, M. (2015). Prosodic stems in Zezuru Shona. *Southern African Linguistics & Applied Language Studies*, 33(3), 291–305.
- Downing, L. J., & Kadenge, M. (2020). Re-placing PStem in the prosodic hierarchy. *The Linguistic Review*, 37(3), 433–461.
- Enguehard, G., & Faust, N. (2018). Guttural Ghosts in Modern Hebrew. *Linguistic Inquiry*, 49(4), 685–721. https://doi.org/10.1162/ling_a_00287.
- Gouskova, M. (2003). *Deriving economy: Syncope in Optimality Theory*. (Unpublished Doctoral thesis). University of Massachusetts Amherst.

- Hansson, G. Ó. (2005). *Latent segments in Yowlumne: An epiphenomenon of template satisfaction?* In S. Armoskaite and J. Thompson (eds.), *Proceedings of the 10th Workshop on structure and Constituency in the Languages of the Americas, WSCLA X, Vancouver*. 109–122.
- Harford, C. & Malambe, G. B. (2011). The Nominal Preprefix in SiSwati: A mixed system. Paper presented at the XI Conference of the Linguistics Association of SADC Universities (LASU), University of Zambia, Lusaka.
- Harford, C., & Malambe, G. B. (2015). Optimal register variation: High vowel elision in siSwati. *Southern African Linguistics and Applied Language Studies*, 33(3), 343–357.
- Hristovsky, G. (2021). Vowel-Zero Alternation in Root-Final Obstruent–Sonorant Clusters in Modern Bulgarian: Is [ə] an Epenthetic Vowel or a Vocalised Yer? *Slavonica*, 26(2), 164–173.
- Inkelas, S., & Zoll, C. (2000). Reduplication as morphological doubling. *Manuscript, University of California, Berkeley and Massachusetts Institute of Technology*.
- İskender, H. İ. (2008). *Vowel-zero alternation in Turkish*. (Unpublished Master's thesis). Boğaziçi University.
- Jiyane, D. (1994). *Aspects of isiNdebele grammar*. (Unpublished Master's thesis). University of Pretoria. Pretoria.
- Kadenge, M. (2010). Hiatus contexts and hiatus resolution strategies in Zezuru. *Southern African Linguistics & Applied Language Studies*, 28(1), 1–11.
- Kadenge, M. (2014). Comparing nasal-obstruent clusters derived from /mu-/ reduction in Shangwe and Zezuru: An Optimality Theory analysis. *Language Matters*, 45(1), 40–62.
- Kadenge, M. (2015). The augment and {mu-} reduction in Bantu: An Optimality Theory analysis. *South African Journal of African Languages*, 35(1), 93–104.

- Kadenge, M., & Chebanne, A. M. (2017). Hiatus resolution and /mu/prefix reduction in iKalanga. *South African Journal of African Languages*, 37(2), 173–186.
- Kadenge, M., & Mathangwane, J. (2017). Minimality in iKalanga. *Language Matters*, 48(1), 126–146.
- Kadenge, M., & Simango, S. R. (2014). Comparing vowel hiatus resolution in ciNsenga and chiShona: An Optimality Theory analysis. *Stellenbosch Papers in Linguistics Plus*, 44, 105–127.
- Kager, R. (1999). *Optimality theory*. Cambridge university press.
- Kar, S. (2008). Gemination in bangla: An optimality theoretic analysis. *Dhaka University Journal of Linguistics*, 1(2), 87–114.
- Khan, T. (2016). *IsiZulu adoptives from English and Afrikaans: An optimality theory analysis*. (Unpublished Master's thesis). University of the Witwatersrand. Johannesburg.
- Lahiri, A. & Hankamer, J. (1988). The timing of geminate consonants. *Journal of Phonetics*, 16(3), 327-338.
- Lindsey, K. L. (2019). *Ghost elements in Ende phonology*. (Unpublished Doctoral thesis). Stanford University.
- Mabena, C. S. (2020). *Terminology Development in Isindebele: Challenges and Solutions*. (Unpublished Master's thesis). University of Pretoria. Pretoria.
- Magongo, V. M. (2024). Minimality in siSwati. (Unpublished Master's thesis). University of the Witwatersrand. Johannesburg.
- Mahlangu, K. S. (2007). *Adoption of loan words in isiNdebele*. (Unpublished Master's thesis). University of Pretoria. Pretoria
- Mahlangu, K. S. (2016). Language contact and linguistic change: The case of Afrikaans and English influence on isiNdebele. *South African Journal of African Languages*, 36(1), 25–31.

- Mashiyane, J. Z. (2002). *Some sociolinguistic aspects of Southern Ndebele as spoken in South Africa*. (Unpublished Master's thesis). University of Zululand. Durban.
- Matlhaku, K. (2020). Nasal Consonant Sequences in Setswana. *MUN Occasional Student Papers in Linguistics*, 3, 1-20.
- Mndawe, I. (2018). Noun valency in isiZulu and Southern isiNdebele. *South African Journal of African Languages*, 38(3), 343–348.
- Mudzingwa, C. (2010). *Shona morphophonemics: Repair strategies in Karanga and Zezuru*. (Unpublished Doctoral thesis). The University of British Columbia. Vancouver.
- Mudzingwa, C. (2017). Spreading as a hiatus resolution strategy in Shona. *Language Matters*, 48(1), 147–177.
- Mudzingwa, C., & Kadenge, M. (2011). Comparing hiatus resolution in Karanga and Nambya: An optimality theory account. *Nordic Journal of African Studies*, 20(3), 203-240.
- Mudzingwa, C., & Kadenge, M. (2013). An analysis of the ghost augment in chiShona. *South African Journal of African Languages*, 33(1), 87–93.
- Mudzingwa, C., & Kadenge, M. (2014). Coalescence as a hiatus resolution strategy in chiKaranga—a dialect of chiShona. *South African Journal of African Languages*, 34(2), 127–136.
- Nkolola-Wakumelol, M., Rantsoz, L., & Matlhaku, K. (2012). Syllabification of consonants in Sesotho and Setswana. In H. S. Ndinga-Koumba-Binza and S. E. Bosch (eds.), *Language Science and Language Technology in Africa*. (61-82). Sun Press
- Odden, D. (1988). Floating tones and contour tones in Kenyang. *Studies in African Linguistics*, 19(1), 1–34.
- Paradis, C., & El Fenne, F. (1995). French verbal inflection revisited: Constraints, repairs and floating consonants. *Lingua*, 95(1), 169–204.

- Park, J.-I. (1995). Minimality effects in Swahili. In A. Akinlabi (ed.), *Theoretical Approaches to African Linguistics* (pp. 295–312). Africa World Press.
- Park, J.-I. (1997). Disyllabic requirement in Swahili morphology. *University of Pennsylvania Working Papers in Linguistics*, 4(2), 245–259.
- Paster, M. (2003). Floating tones in Gã. *Studies in African Linguistics*, 32(1), 18–39.
- Persohn, B. (2019). /mu/ and mu-reduction in Nyakyusa. *South African Journal of African Languages*, 39(2), 191–203.
- Prince, A., & Smolensky, P. (2004). *Optimality Theory: Constraint interaction in generative grammar*. Blackwell Publishing
- Remijsen, B., & Ayoker, O. G. (2020). Floating quantity in Shilluk. *Language*, 96(3), 135–156.
- Rubach, J. (2016). Polish yers: Representation and analysis. *Journal of Linguistics*, 52(1), 421–466.
- Showalter, S. D. (2007). *Ghost consonants: The glottal stop in Kaansa*. In D. L. Payne and J. Pena (eds.), *Selected Proceedings of the 37th Annual Conference on African Linguistics*. (pp. 96–110). Somerville.
- Skhosana, P. (1998). *Foreign interferences in the sound, grammatical and lexical system of Southern Ndebele*. (Unpublished Master's thesis). University of Pretoria. Pretoria.
- Skhosana, P. B. (2009). *The linguistic relationship between Southern and Northern Ndebele*. (Unpublished Doctoral thesis). University of Pretoria. Pretoria.
- Szpyra, J. (1992). Ghost segments in nonlinear phonology: Polish yers. *Language*, 277–312.
- Tzanakakis, A. (2019). *Noun-Verb asymmetry in Tshivenda vowel hiatus resolution*. (Unpublished Master's thesis). University of the Witwatersrand. Johannesburg.
- Ulfsbjorninn, S. (2020). Segment–zero alternations in Galician definite article allomorphy: Floating consonants at the left-edge of morphemes. *Acta Linguistica Academica*, 67(1), 155–170.

- Van Warmelo, N. J. (1930). *Transvaal Ndebele Texts* (Issue 1). Government printer.
- Vratsanos, A., & Kadenge, M. (2017). Hiatus resolution in Xitsonga. *Stellenbosch Papers in Linguistics Plus*, 52, 175–196.
- Vratsanos, A. (2018). *Some repair strategies in Xitsonga*. (Unpublished Master's thesis). University of the Witwatersrand. Johannesburg.
- Wilkes, A. (1997). Language contact and language change—The case of Southern Transvaal Ndebele. *South African Journal of African Languages*, 17(2), 75–80.
- Yang, S.-Y. (2004). Latent segments in the English indefinite article. *Language and Information Society*, 6, 68–83.
- Yende, W. S. (2023). An Optimality Theory analysis of loanwords in isiNdebele. (Unpublished Honour's thesis). University of the Witwatersrand. Johannesburg.
- Ziervogel, D. (1959). *A Grammar of Northern Transvaal Ndebele: (a Tekela Nguni Dialect Spoken in the Pietersburg and Potgietersrus Districts of the Transvaal Province of the Union of South Africa)*. JL van Schaik.
- Zimmermann, E. (2018). Gradient symbolic representations and the typology of ghost segments. *Proceedings of the annual meetings on phonology*. 1-12.
- Zoll, C. (1994). Subsegmental parsing: Floating features in Chaha and Yawelmani. *Phonology at Santa Cruz*, 3, 1-26.
- Zoll, C. C. (1996). *Parsing below the segment in a constraint-based framework*. (Unpublished Doctoral thesis). University of California, Berkeley.

8. Appendices

Appendix 1: Minimality Data

IsiNdebele	English
ukuhlala	to sit
ukudla	to eat
ukuthanda	to love
ukuvuka	to wake up
ukupha	to give
hlala	sit
idla/yidla	eat
thanda	love
vuka	wake up
ipha/ yipha	give
gijima	run
hlamba	wash
fa	die
phungula	reduce
gijigijima	run a little
hlambahlamba	bath a little
fayifa	die a little
phunguphungula	reduce a little
dliwa	be eaten
mbiwa	be dug
phiwa	be given

akhiwa	be built
abiwa	be distributed
thiwa	be said
valwa	be closed
selwa	get drunk
katjwa	get chopped
kotjwa	get copied
khujhwa	get taken out
hlotjwa	get peeled off
bhajwa	get excreted
lanjwa	get hungried
pontjwa	get pumped
zunywa	get hunted
vunywa	get sung

Appendix 2: High vowel elision

umuntu	person
umuthwa	bushman
umsana	boy
umfazi	woman
umufi	deceased
umyeni	visitor
umloyi	wizard
utlhorhoroji	poker
umuthi	tree
umumbu	maize
umuno	finger
umuhlwa	ants
umthubi	milk of cow
umthondo	urine
umthofi	lead
uthunzi	shade
umlilo	fire
umbani	lightning
umbuso	kingdom
umlambo	river
umthombo	fountain
umwuma	wild fig tree
umnghabhani	acacia
umrula	marula fruit
umthala	stick grass
umhlanga	reed
umlomo	mouth
umlenze	leg
umkhono	arm
umgogodlha	backbone
umbala	shin bone
umseme	mat
umncamo	bead
umkgadi	sleeping blanket made of leather
umlalezi	grindstone
umthala	galaxy (milky way)
umzimba	body
umsebenzi	work
umuzi	home
mmati	carpenter
mmoni	seer

mmali	counter
mmono	idea
mmala	colour
mmoya	wind
mphini	axe handle
mphako	food for journey
mubhede	bed
mubhalo	writing
llanga	sun
mullo	fire
phutulla	wrap out
yembulla	dig out

imithi	trees
imithetho	laws
imilambo	rivers
imilomo	mouths
imikhaza	ticks
imirhoba	valleys
imizi	villages
imithandazo	prayers
isibindi	liver
isitja	dish
isihlalo	chair
isabelo	homeland
isono	sin
isazi	expert
iseluleko	advice
isifuba	chest
isibhono	umbilical hernia
isithende	heel
isikhethu	ndebele language
izitja	dishes
izipho	gifts
izifu	traps
izaga	proverbs
izono	sins
izondlo	maintenances
izifo	deaths
izikgwa	forest
iziqu	degrees
ubuso	face
ubusuku	night
ubukhulu	greatness
ubuhle	beauty
ubude	length
ububhunubhunu	nakedness
ubunzima	blackness
ubuloyi	witchcraft
ukudla	food
ukukhamba	to walk
ukona	to sin
ukonda	to be lean
ukosa	to roast
ukondla	to nourish
ukoma	drought/thirst
ukwanda	to multiply
ukwaba	to distribute
ukwena	to marry

ukweba	to steal
--------	----------

omncani	young/small
omude	tall
omutja	new
omdala	old
omuhle	good
omumbi	ugly
omkhulu	big
omnengi	much/many
omunye*	one

Appendix 3: Vowel Hiatus data

nogogo	with grandmother
nendoda	with man
namanzi	with water
nemunru	with a person
yemufati	of a woman
senduna	of a headman
gentro	by something
phekana	cook each other
rhwalana	lie to each other
qalana	look at each other
thandana	love each other
hlekana	laugh at each other

a + umu	omu
a + aba	aba
a + u	o
a + abo	aba
a + umu	omu
a + imi	emi
a + (i)li	eli
a + ma	ama
a + isi	esi
a + izi	ezi
a + I (n)	e(n)
a +	ezi
a + ubu	obu
a + uku	oku

sosa	roast
nomkhulu	and the old one
ngendlini	in the house
loke	whole/all
lami	my/mine
nomukxulu	and the big one
yembhi	band

nende	tall
nebovu	red
nolula	easy
komunandi	nice
tigesibayeni	in the kraal
ugendluni	in the house
gepolokwane	around polokwane

bona
lona
sona
zona
bona
khona

wa	wami, wakhe
ya	yabo
amagama wakababa	my father's words
mavi yami	my words
inhlokwana	small head
ntwana	small thing
umntwana	baby
indlwana	small house
munrwana	baby
wona	that
yona	the

ncanyana	a little bit
khulwana	fairly big
thathwana	diminutive of 3
hlanywana	diminutive of 5
thandathwana	diminutive of 6

wa
ya
kwa
wa
wona
yona

wona

bayibonile	they have seen it
awukhambi	you are not going
awasebenzi/ akasenbenzi	they do not work
awabili/ akabili	it does not boil
uwomukxulu	he is a big one
guwuphi	which one is it
iyekxhulu	it is a big one

u.omukxulu	he is a big one
iekxulu	it is a big one
uomunandi	it is a nice one
ietimunandi	they are the nice ones
guuphi	which one is it
naiyise	with his father
guiyise	it is his father
loalima	who ploughs
kuitolo	yesterday



14 April 2025

Re: Miss Wandile Yende (2396216)

Waiver letter number: HREC�MW25/05/03

To whom it may concern,

Miss Yende is a registered master's student at the School of Language, Literature and Media Studies at the University of Witwatersrand, Johannesburg. This letter is to confirm that, at the time of writing, Miss Yende does not need ethical clearance for the study entitled "*Unmasking ghost segments in South African IsiNdebele*". This decision has been reached based upon a description of the project supplied by Miss Yende to the University Human Research Ethics Committee (Non-Medical), which has been evaluated by the Chairs and Deputy Chairs. If, however, Miss Yende changes the methods of data collection and analysis for this study, this decision may no longer be valid. If such changes take place, this should be communicated to the University Human Research Ethics Committee (Non-Medical) as soon as possible. This waiver letter is valid until 13 April 2028.

Please feel free to contact me should you require any further information.

Thank you.

Yours sincerely,
S Schoeman

Shaun Schoeman (Administrative Officer)

Solomon Mahlangu House, 10th Floor, Room 10004, Jorissen Street, Braamfontein, Johannesburg
Private Bag 3, Wits 2050

T + 27(0)11 717 1408 | E Shaun.Schoeman@wits.ac.za | hrec-medical.researchoffice@wits.ac.za

www.wits.ac.za/research/about-our-research/ethics-and-research-integrity/