Palatalization and other non-local effects in Southern Bantu Languages

Gloria Baby Malambe

Department of Phonetics and Linguistics

University College London

Thesis submitted to the University of London in partial fulfilment of the requirements for the degree of Doctor of Philosophy

2006

UMI Number: U592274

All rights reserved

INFORMATION TO ALL USERS
The quality of this reproduction is dependent upon the quality of the copy submitted.

In the unlikely event that the author did not send a complete manuscript
and there are missing pages, these will be noted. Also, if material had to be removed,
a note will indicate the deletion.

UMI U592274
Published by ProQuest LLC 2013. Copyright in the Dissertation held by the Author.
Microform Edition © ProQuest LLC.
All rights reserved. This work is protected against
unauthorized copying under Title 17, United States Code.

ProQuest LLC
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106-1346

Abstract

Palatalization in Southern Bantu languages presents a number of challenges to phonological theory. Unlike 'canonical' palatalization, the process generally affects labial consonants rather than coronals or dorsals. It applies in the absence of an obvious palatalizing trigger; and it can apply non-locally, affecting labials that are some distance from the palatalizing suffix. The process has been variously treated as morphologically triggered (e.g. Herbert 1977, 1990) or phonologically triggered (e.g. Cole 1992). I take a phonological approach and analyze the data using the constraint-based framework of Optimality Theory. I propose that the palatalizing trigger takes the form of a lexically floating palatal feature [cor] (Mester and Itô 1989; Yip 1992; Zoll 1996).

The study locates siSwati palatalization within its broader Southern Bantu context. In my analysis I show that the behaviour of the other selected Bantu languages' palatalization follows from an analysis parallel to siSwati. Palatalization in all the languages involves an attempt to link the V-Place [cor] to a labial in the passive, diminutive, and locative and in addition, to an alveolar in the diminutive. The [cor] either palatalizes the root-final labial, as in [kʰipʰa] > [kʰiʃʷa] 'remove', or may surface as /i/ in the passive, as in [pʰa] > [pʰiwa] 'give'. Realization of the [cor] feature is dependent on language-specific differences. The languages investigated are compared within an Optimality Theory framework, showing that their differences follow from universal constraint re-rankings.

I also include in this study other processes that are related to long distance palatalization: vowel harmony/co-articulation and tonal phonology. These processes show us that long distance effects are not peculiar to palatalization, since vowel harmony/co-articulation may also involve non-adjacent segments. Tone shift and tone spread may result in tone being realized syllables away from its underlying source. The vowel facts and some of the tonal facts of siSwati have been investigated phonetically. It is argued that while Sesotho shows true vowel harmony, siSwati is still at the co-articulation stage. This difference is also modelled as re-ranking in an Optimality Theory grammar.

Acknowledgements

I would like to thank the following people who have provided me with some form of support in the period that has led to the completion of this dissertation.

First and foremost, I would like to express my sincere and deepest gratitude to my supervisor, Moira Yip, for her constant and efficient guidance throughout the preparation of this thesis. It is difficult to imagine how this work could have been completed without her invaluable comments, insightful remarks and suggestions. I also had the benefit of her unfailing support, encouragement, kindness, and everlasting patience. I needed these in ample proportions for my stay in the United Kingdom as it was the most difficult time in my life.

I am also grateful to John Harris for reading parts of my work and for his suggestions to improve it. I would also like to thank Yi Xu for providing useful suggestions and references on Chapter 6. Many thanks also go to Steve Nevard for making the acoustic recordings and for providing information on these recordings. Also for the related computer help he gave me when I needed it; also to Molly Bennett and Stefanie Anyadi, for lending an ear when I needed it.

My four years in the UK would not have been the same without the company of friends, and the other students in the PhD room. They made life bearable: Nick Allot, Eric Carlson, Dorota Glowacka, Alison Hall, Vikki Janke, Segomotso Keakopa, Nancy Kula, Eirini Sanoudaki, Mary Pearce, Peter Sebina, Hitoshi Shiraki, Marco Tamburelli, Nina Topintzi, Rob Truswell, Hiroyuki Uchida, and Reiko Vermeulen. Eric many thanks for making the Praat programme at least manageable. Nina and Mary thank you for always being there for me. As for Mary, I don't know where to start... I think she was God sent. Thank you very much for everything.

I am grateful for financial support from the Association of Commonwealth Universities that enabled me to carry out my research. I am also grateful to the Graduate School (UCL) for the financial support in my final year.

I would like to thank Laura Downing and Francis Katamba for taking time to read my work and share their ideas with me. Finally, I thank members of my family for their support and belief in me. To everyone, ngiyabonga kakhulu 'Thank you very much'

TABLE OF CONTENTS

Abstract iii
Acknowledgements iv
Table of Contents v
List of figures xii
List of tables xiii

Chapter 1 Introduction 1

1.1 Introduction to the chapter 4
1.2 Palatalization in siSwati 4
1.2.1 Basic Facts 4
1.2.2 Previous accounts 5
1.2.3 Analysis 6
1.2.3.1 The Passive 6
1.2.3.2 Nominal palatalization 8
1.2.3.3 Passivised reduplicated forms 8
1.3 A typology of palatalization in Southern Bantu 9
1.3.1 Basic facts 9
1.3.2 Previous accounts 10
1.3.3 Analysis 11
1.3.3.1 Setswana 11
1.3.3.1.1 Minimality in siSwati vs. Setswana 11
1.3.3.1.2 Palatalization 12
1.3.3.1.3 Root-medial labials 12
1.3.3.2 Tshivenda 13
1.3.3.3 Xitsonga 13
1.3.3.4 Sesotho 14
1. 4 Other non-local processes 14
1.4.1 Vowel harmony 14
1.4.1.1 Basic facts 14
1.4.1.2 Previous accounts 15
1.4.1.3 Typology and analysis 16

1.4.2 Tonal phonology 18
1.4.2.1 Basic facts 18
1.4.2.2 Previous analysis 18
1.4.2.3 Analysis 19
1.5 The theoretical framework 20
1.5.1 Featural affixes 20
1.5.2 Feature geometric representation of palatals 21
1.5.3 Optimality Theory 22
1.5.3.1 Background 23
1.5.3.2 Alignment 23
1.5.3.3 Root/affix faithfulness 24
1.5.3.4 Factorial typology 25
1.5.3.5 Optionality 25
1.6 Summary 26

Chapter 2 The structure of siSwati 36

2.1 Segmental structure 36
2.1.1 SiSwati inventory 37
2.1.2 Feature geometric representation of palatals and labials 38
2.2 Syllable structure 51
2.3 Vowel hiatus 53
2.3.1 Vowel Deletion 53
2.3.2 Labialization 53
2.3.3 Vowel coalescence 53
2.3.4 Glide formation 54
2.3.5 Glide Insertion 54
2.4 Suprasegmental structure 55
2. 5 Evidence for a minimality constraint 55
2.5.1 Imperatives 56
2.5.2 Pronouns 56
2.5.3 Monosyllabic loan words 57
2.5.4 Reduplication 57
2.5.5 Hypocoristic names 58
2.3 Summary 58

Chapter 3 The passive **59**

3.1 SiSwati verb 59
3.2 Aspects of palatalization in the passive 60
3.2.1 Data survey 61
3.2.2 Representation of the passive suffix 64
3.3 Optimality Theory analysis 66
3.3.1 The basic constraints 66
3.3.2 Root-final labials: Loss of root [labial] feature 69
3.3.3 Alveolar and velar consonants 71
3.3.4 Root-medial labials 73
3.3.5 Root-initial labials 75
3.3.6 Monosyllabic verb roots 76
3.3.7 VC verb roots 79
3.4 Passive of reduplicated verbs 82
3.4.1 Reduplication 82
3.4.2 An OT analysis of reduplication 83
3.4.2.1 CVC verb roots 85
3.4.2.2 CVCVC verb roots 86
3.4.2.3 CVCVCVC verb roots 87
3.4.2.4 C roots 88
3.4.2.5 VC roots 89
3.4.2.6 Difference between VC and (V)CVC roots 91
3.4.3 Passive of reduplicated verbs 93
3.4.3.1 Analysis of passivised reduplicated forms 94
3.4.3.1.1 CVC roots 95
3.4.3.1.2 Root-medial labials 96
3.4.3.1.3 C-roots 96
3.4.3.1.4. VC roots 98
3.5 Summary 99

Chapter 4 Nominal palatalization **101**

4.1 SiSwati nominal classification 101
4.2 An overview of the morphological context 103
4.2.1 Locative 103

4.2.1.1 Data survey 103
4.2.2 Diminutive 104
4.2.2.1 Data survey 105
4.3 OT analysis of nominal palatalization 107
4.3.1 Consonantal changes 107
4.3.1.1 Stem-final labials 107
4.3.1.2 Stem-initial labials 109
4.3.1.3 Stem-medial labials 110
4.3.1.4 Stem-final dorsals 111
4.3.1.5 Stem-final alveolar 111
4.3.2 Vowel quality 114
4.3.2.1 Labialization 114
4.3.2.2 Backness 115
4.3.2.3 Height 115
4.3.2.3 Vowel Deletion 117
4.4 Summary 118

Chapter 5 A typology of palatalization in Southern Bantu languages 119

5.1 Setswana 119
5.1.1 Segmental inventory 119
5.1.2 Palatalization in Setswana 120
5.1.3 The passive 121
5.1.3.1 Data survey 121
5.1.3.2 Analysis 124
5.1.3.2.1 Non-labial root-finally 124
5.1.3.2.2 Root-final labial 125
5.1.3.2.3 Root-medial labial 126
5.1.4 Diminutive 127
5.1.4.1 Data survey 127
5.1.4.2 Analysis 130
5.1.4.2.1 Labial consonant root-finally 130
5.1.4.2.2 Labial vowel root- finally 130
5.2 Palatalization in Tshivenda 132
5.2.1 Segmental inventory 132
5.2.2 The passive 133

5.2.2.1 Analysis 135
5.2.3 Diminutive and Locative 137
5. 3 Xitsonga 137
5.3.1 Segmental inventory 138
5.3.3 The passive 139
5.3.3.1 Analysis 139
5.3.4 The diminutive 142
5.3.4.1 Data survey 142
5.3.4.2 Analysis 144
5.3.5 The locative 145
5.3.5.1 Data survey 146
5.3.5.2 Analysis 147
5.4. Sesotho 147
5.4.1 Segmental inventory 148
5.4.2 Passive 149
5.4.2.1 Data survey 149
5.4.2.2 Analysis 151
5.4.3 Diminutive 152
5.4.3.1 Data survey 153
5.4.3.2 Analysis 154
5.5 Summary 156

Chapter 6 Non-local processes 158

6.1 Vowel harmony 158
6.1.1 Assimilation 162
6.1.2 Difference between co-articulation and harmony 163
6.1.3 Similarities observed between vowel harmony and co-articulation 165
6.1.3.1 From co-articulation to harmony 166
6.1.4 Experiment 168
6.1.4.1 Speakers 168
6.1.4.2 Sample 169
6.1.4.3 Procedure 169
6.1.4.4 Acoustic analysis 170
6.1.4.5 Significance level 175
6.1.5 Results 178

6.1.6 Discussion 181
6.1.7 Comparative analysis 183
6.1.8 Feature representation 184
6.1.8.1 A summary of the analyses. 187
6.1.9 O T analysis 189
6.1.10 Stages in the development of harmony 196
6. 1.11 Summary 198
6.2 Tonal phonology 198
6.2.1 Morphological domains 201
6.2.2 Data and generalizations 202
6.2.3 Low-toned verbs 203
6.2.4 High–toned verbs 204
6.2.4.1 One High tone in the input 204
6.2.4.2 Two adjacent High tones in the input 207
6.2.4.3 Two non-adjacent High tones 208
6.2.4.4 One of the High tones is outside the Macrostem 209
6.2.4.5 Three High tones in the input 210
6.2.5 Experiment 211
6.2.5.1 Materials 212
6.2.5.2 Subjects 212
6.2.5.3 Recording 212
6.2.5.4 F_0 extraction and measurement 213
6.2.5.5 Analysis and results 213
6.2.6 Discussion 217
6.2.7 Analysis 218
6.2.7.1 Creissels' analysis 219
6.2.7.2 Optimal Domains Theory (ODT) analyses 220
6.2.8 A new alignment approach 221
6.2.8.1 Phrase-medial forms 221
6.2.8.1.1 One H tone in the input 222
6.2.8.1.2 Adjacent H tones: Anti-Meeussen's rule applies 224
6.2.8.1.3 Two non-adjacent H tones 225
6.2.8.2 Phrase-final forms 228
6.2.8.2.1 One H tone in the input 229
6.2.8.2.2 Two non-adjacent H tones 230
6.2.8.2.3 Adjacent tones: Anti-Meeussen's Rule applies 231

6.2.9 Evidence for fusion in the PhWd 231
6.2.10 Summary 236

Chapter 7 Conclusions 237

7.1 Proposals and conclusions 237
7.2 Suggestions for future research 239

References 241

Appendices 253

Appendix A (Chapter 2) 253
Sesotho complex segments vs plain segments 253

Appendix B (Chapter 6: Section 6.1) 255
A list of siSwati words used with the carrier sentence: 255
Ngitsi ... kahle 'I say... well'. 255

Appendix C (Chapter 6: section 6.2) 258
SiSwati verbal phrases 258

LIST OF FIGURES

Figure 1-1 Southern Bantu languages: Adapted from Ethnologue (see footnote 2) 3
Figure 2-1 Spectrogram for the Sesotho word /mʊlapo/ 'river' 43
Figure 2-2 Spectrogram for the Sesotho word /bʊtʃʷ-a/ 'be moulded' 43
Figure 2-3 Spectrogram for the Sesotho word / fɛptʃʷ-a/ 'be fed' 44
Figure 6-1 Mean value for vowels /E/ and /O/ when produced before [-high] and [+high] vowels: Speaker D-S. 171
Figure 6- 2 Mean value for vowels /E/ and /O/ when produced before [-high] and [+high] vowels: Speaker VE-M. 172
Figure 6-3 Mean value for vowels /E/ and /O/ when followed by a coronal consonant, produced before [-high] and [+high] vowels: Speaker VE-M. 173
Figure 6- 5 F1 values for /o/ before [-high] and [+high] vowels at 50ms intervals: Speaker NM-D. 176
Figure 6-6 F1 values for the nearest /e/ before [-high] and [+high] vowels at 50ms intervals: Speaker NM-D 177
Figure 6-7 F2 values for the second /e/ before [-high] and [+high] vowels at 50ms intervals: Speaker D-S. 178
Figure 6-8 F1 values for /o/ before [-high] and [+high] vowels at 50ms intervals: Speaker NM-D. 180
Figure 6-9 F1 values, at 50ms intervals, for an underlying /aa/ produced as a barred [i], (represented as [i] on the graph), before the suffix /-u/ and as /aa/ before a suffix with a [-high] vowel /-an/. (Data from Pearce, to appear). 181
Figure 6- 10 /nikusebénte:le/: phrase-final form - tone is realized on the antepenultimate syllable. /nikusebentéla .../: phrase-medial form - tone is realized on the penultimate syllable. 214
Figure 6- 11 /atáwúbóna/: underlying HLH results in tone spreading vs. /likuliméla/: underlying HH results in second tone shifting to the penult. 215
Figure 6-12 /li[kuliméla.../: phrase-medial position (shift) vs. /li[kúlímele/: phrase-final position (spreading) 216
Figure 6-13 /nitawubóna/: No leftward movement of tone */nitawúbona/ 217
Figure 6-14 /liyákúsébéntela/ 218

LIST OF TABLES

Table 2-1 Phonemic inventory of siSwati 37
Table 2- 2 A summary of palatalization 40
Table 4-1 Noun class prefixes in siSwati 102
Table 5-1 The phonemic inventory of Setswana consonants 120
Table 5- 2 The consonant inventory for Tshivenda (source: Poulos (1990)) 133
Table 5-3 Xitsonga consonant inventory 138
Table 5-4 Sesotho consonant inventory 148
Table 6-1 Data from 3 generations of Charmey speakers (Gauchat 1905:205) cited in Romaine (1989) 167
Table 6-2 The total number of tokens for each vowel at different environments.... 169
Table 6-3 P-values for each speaker for both F1 and F2 values for the mid vowels, calculated from the whole data. * $p < 0.05$, significant. 175
Table 6-4 A summary of the harmony facts about siSwati, isiZulu, and Sesotho ... 183

CHAPTER 1

INTRODUCTION

Palatalization is a very common process across languages and exhibits wide variation in its target, the triggering environment, and the output of palatalization. According to Bhat (1974), palatalization is not just one process but a cover term for different processes. He describes three kinds of palatalization: the fronting of velars when followed by front vowels or the palatal glide [y]; the change of dental or alveolar consonants to palato-alveolar or prepalatal in the context of front vowels and [y] and an addition of a secondary palatal articulation to any consonant in the contexts of front vowels and [y]. What is common to all three processes is that high front vowels trigger palatalization and the resultant feature – a palatal – is either a primary articulation or a secondary one.

Palatalization in Southern Bantu presents a number of challenges to phonological theory. For a start, unlike 'canonical' palatalization, the process generally affects labial consonants rather than coronals or dorsals. Moreover, it is morphologically conditioned, being restricted to certain suffixes; it typically applies in the absence of an obvious palatalizing trigger; and it can apply non-locally, affecting labials that are some distance from a palatalizing suffix.

It has proved problematic to accommodate all of these effects within traditional serial-derivational approaches. The process has been variously treated as morphologically triggered (e.g. Herbert 1977, 1990), or phonologically triggered. In the latter case, various analyses have been proposed, including assimilation (Khumalo 1988), dissimilation (Doke 1954; Gorecka 1989; Beckman 1993), segment fusion (Stahlke 1976; Gorecka 1989), or segment incompatibility (O'Bryan 1974; Kunene 1991; Cole 1992).

If palatalization is viewed as the dissimilation of a labial segment and a /w/ (probably an Obligatory Contour Principle effect), as in Doke and Beckman's analysis, palatalization would be expected in all words with a sequence / [labial] w/ such as /eɓ+w-a/ 'steal pass.', but the result is [eɓiw-a]. On the other hand, if palatalization is an assimilation process, there is no reason why the vowel /i/, which

is well-known for triggering palatalization in many languages, would not trigger it in /eɓiw-a/.

This thesis presents an analysis of palatalization in siSwati and other Southern Bantu languages. The claim is that palatalization is fundamentally phonological in nature and that its apparently non-phonological or 'unnatural' effects can be treated in terms of ranked constraints. The relevant constraints reflect the competing demands that phonological and lexical-morphological pressures make on phonological output. I propose that the palatalizing trigger takes the form of a lexically floating palatal feature. In support of this analysis, I draw on a range of evidence, including prosodic minimality, vowel coalescence, vowel gliding, vowel deletion, and reduplication. All of these phenomena reflect the intervention of phonological constraints which help determine how the palatal component of the relevant suffixes is phonetically expressed. The proposal made is that the behaviour of the other Southern Bantu languages' palatalization follows from an analysis parallel to siSwati.

In addition to palatalization, this study investigates vowel harmony and tonal phonology. The three topics in this thesis were selected because they are the three apparent cases of the mobility of features in siSwati. In the passive the palatal trigger may move into the root to be realized if there is no palatalizable segment on the right edge of the root; tone shifts from its underlying source to the rightmost possible position, generally the penultimate (or antepenultimate phrase-finally). In vowel harmony a vowel feature may exert its influence on another vowel skipping the slot filled by a consonant; root mid vowels had been reported to take their ATR value from the following vowel. This study has shown that featural mobility is indeed found in palatalization and in tonal phonology, but that the putative vowel harmony is not featural mobility at all, but only co-articulation as the experimental results make clear. Analytically, the two cases of real mobility are both argued to use right alignment of the relevant features. The illusory mobility is compared to a real vowel harmony system, isiZulu, in which the ATR feature is indeed mobile, and in which right alignment again plays a key role.

The study is built upon an analysis of a group of languages, which I broadly refer to as Southern Bantu languages. These languages fall under Guthrie's (1967) South Eastern Zone. The languages are: Xitsonga, Tshivenda, Sesotho, and

Setswana.[1] The map in Figure 1.1 illustrates the main areas where these languages are spoken.

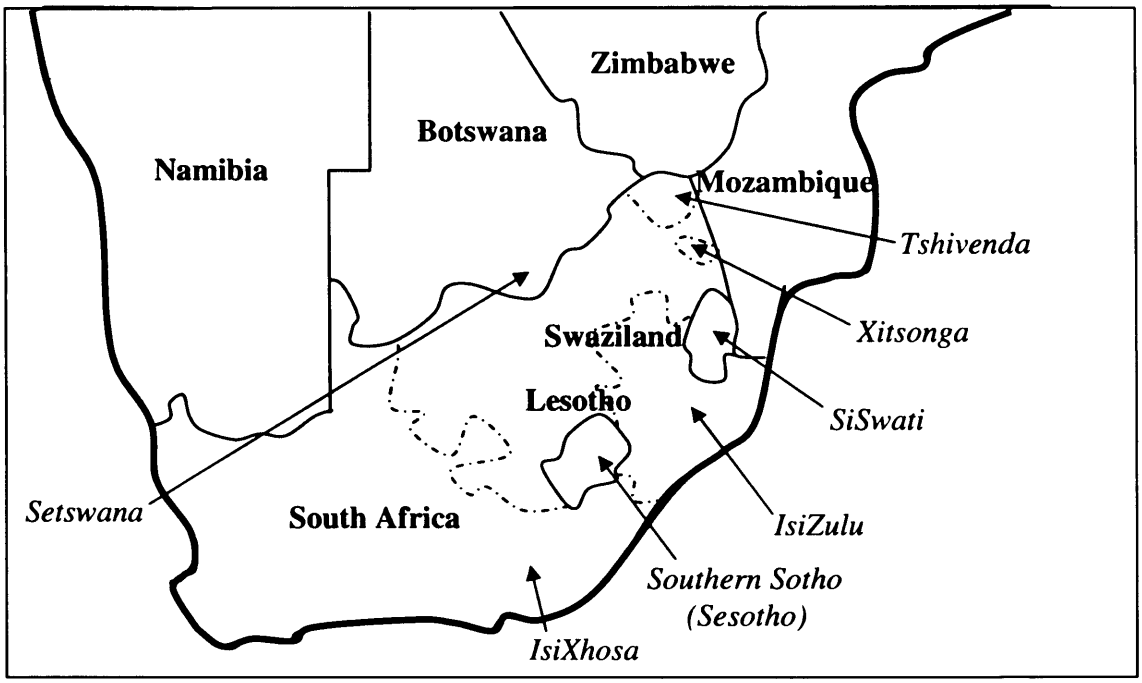


Figure 1-1 Southern Bantu languages: Adapted from Ethnologue (see footnote 2)

SiSwati is a Bantu language of the Nguni group of languages, spoken mainly in Swaziland and also in some parts of South Africa. Swaziland is located between South Africa and Mozambique and has a population of 1,174,000, according to the 2005 estimates. It is an official language in Swaziland (along with English) and one of the 11 official languages in South Africa. It has about 1.5 million speakers (Ethnologue)[2]. Note that dialectal differences do exist in the language. The dialect that is spoken in South Africa has been influenced by the other South African languages spoken in that country. Within Swaziland there are different dialects spoken as well. The southern part of the country has been subjected to isiZulu influence while the Eastern part has been influenced by the Shangaan/Xitsonga spoken in Mozambique. The examples that I present and analyze in this thesis are from siSwati as spoken in the central part of Swaziland which has had less influence

[1] In this study, I adopt the method of attaching prefixes to the names of languages, for example, siSwati, Sesotho. The prefixes used are proper to the languages concerned (i.e. as used by native speakers).

[2] Internet version: http://www.sil.org/ethnologue/ accessed on 12/06/2006.

from the other Southern Bantu languages comparatively. Looking at the data in the standard published sources, my assumption is that they all look at the South African variety. Nonetheless, where there are differences in the data which might influence the analysis I will indicate.

1.1 Introduction to the chapter

This chapter sets out the issues under investigation, and the theoretical framework that I adopt in this study. First, I discuss palatalization in siSwati (Section 1.2). Then, in Section 1.3, I present a typology of palatalization in Southern Bantu. Next, I discuss other non-local processes in the context of siSwati in Section 1.4. Section 1.5 presents the theoretical framework within which I analyse the data. Lastly, in Section 1.6, I summarize and present an overview of the study.

1.2 Palatalization in siSwati

1.2.1 Basic Facts

Palatalization in siSwati occurs when the passive, locative and diminutive morphemes are suffixed to verb roots and nominal stems, respectively. The passive is formed by suffixing /-w/ or /-iw/ to the verb, depending on the size of the root: when the root is CVC or longer, /-w/ is suffixed (1a); when the root is (V)C /-iw/ is suffixed (1b). The locative is formed by a circumfix /e...ini/eni/ to the noun (2), while the diminutive is formed by suffixing /-ana/ to the noun (3). It is common for these suffixes to trigger palatalization of a root/stem-final labial plosive, as in (1a, 2, and (3a). In the diminutive, stem-final alveolar plosives and affricates may be palatalized as well (3b). In the formation of the passive, root-medial labials may undergo palatalization (4).

Passive	(1a)	ɬeɓ-a	ɬetʃʼʷ-a	'gossip'
		gidʒim-a	gidʒiɲʷ-a	'run'

	(1b)	eɓ-a	eɓ-iw-a	'steal'
		p^h-a	p^h-iw-a	'give'
Locative	(2)	um-k^humbi	em-k^huɲʤ-ini	'ship'
		im-boɓo	em-botʃ'-eni	'hole'
Diminutive	(3a)	um-k^humbi	um-k^huɲʤ-ana	'ship'
		im-vilop^{h}u	im-viloʃ-ana	'envelope'
		li-gaba	li-gaʤ-ana	'carry-pot'
	(3b)	si-k^haʦ^{h}i	si-k^haʃ-ana	'time'
		li-bodo	li-boʤ^w-ana	'pot'

Root-medial labial in passive

(4)	k^humul-a	k^huɲul^w-a	'undress'
	seɓent-a	setʃ'ent^w-a	'work'

1.2.2 Previous accounts

There is a fairly extensive literature on palatalization of the Southern Bantu languages; yet, none has been able to successfully bring all instances of palatalization together under one rule. These include assimilation (Khumalo 1988; Ohala 1978), dissimilation (Doke 1954; Gorecka 1989; Beckman 1993), segment fusion (Stahlke 1976; Gorecka 1989), and segment incompatibility (O'Bryan 1974; Kunene 1991; Cole 1992).[3] I present a brief discussion of some of these analyses next.

Doke (1954) attributes palatalization in the passive to the process of dissimilation, since as it happens most of the Southern Bantu languages do not permit a sequence of a labial + w. The underlying ill-formed sequence is resolved by palatalizing the labial. Doke's analysis is based on the assumption that the passive morpheme is /-w/, and that nominals that palatalize are those that end in round vowels. His analysis works well for the passive (ignoring the other problems mentioned earlier) and for those nouns whose final vowel is [round]. However, as Herbert (1977) observes, palatalization of labials occurs irrespective of the final

[3] For an Autosegmental analysis of palatalization in siSwati passive, see Malambe 1999. An OT analysis of the passive is discussed in Malambe 2004 on which chapter 3 of this thesis is based, although greatly revised. Chen and Malambe 1998 present an OT analysis of the passive, locative and diminutive in siSwati.

vowel. In siSwati for example, nouns which end in the vowel /a/ may undergo palatalization as well, for example /li-gaba/ → li-gadʒ-ana 'small carry-pot'.

Khumalo (1988), on the other hand, suggests that palatalization results from assimilation; the labial consonant assimilates to the following palatal vocoid. In his analysis, the suffixes are understood to be /iw/ (passive), -ini (locative), and /-yana/ (diminutive). Again, ignoring non-local palatalization, Khumalo's analysis, in addition, involves arbitrary processes. For example, nouns that end in round vowels undergo different processes before assimilation takes place; first, the round vowel glides to /w/. Then, it dissimilates from the labial consonant to become a palatal glide, and, finally, the palatal glide triggers assimilation.

Stahlke's (1976) perspective on palatalization is that it results from segmental fusion. He observes that since palatalization in Setswana involves deletion of the vowel which conditions it, it cannot be assimilatory, but is a merger of the two segments involved. Like the previous accounts, Stahlke's analysis does not cater for those nouns which end in the vowel /-a/.

In this study, I provide a unified explanation of palatalization in Optimality Theory. I argue that since the trigger is no longer observed in some of the suffixes and also since palatalization surfaces non-locally in some of the morphemes, the feature must be floating. The different patterns therefore follow from a single underlying palatal feature. The typology which results from this analysis correctly accounts for the other languages associated with palatalization. I believe that this framework makes possible an insightful account of the complicated and at times puzzling facts of palatalization.

1.2.3 Analysis

I also take a phonological approach and analyse the data using the constraint-based framework of Optimality Theory (OT). In the following sections, I present a preview of an OT analysis of palatalization.

1.2.3.1 The Passive

From the data on the passive, we observe two things: (i) the affix either labializes the root-final consonant (1a, 4), or adds the segment [w] (1b); (ii) the affix either

palatalizes the root consonant (1a, 4), or adds the segment [i] (1b). The assumption is that the processes in (i) involve the feature Lab, while those in (ii) involve the feature Cor. Therefore, I propose that the passive has a labial feature [lab] which always aligns with the right edge of the stem and the palatalizing trigger takes the form of a lexically floating palatal feature [cor] (see section 2.1.2 for a detailed discussion on the representation of the palatal trigger). For (V)C roots, I propose that the features [lab] and [cor] appear as independent segments to fulfill a two-syllable minimal requirement for words in siSwati, /eɓ-a/ > [eɓ-iw-a] (Downing 1994, 1997). OT uses constraints to account for these facts: For example, realization of the morpheme is through a constraint that ensures that an underlying morpheme is realized on the surface e.g., a constraint like 'Realize morpheme' (a proper formulation of the different constraints is presented in the relevant chapters).

In (V)C roots, the features [cor] and [lab] appear as independent segments to augment the roots. I argue that the facts follow from a minimal requirement for all words in siSwati; MINIMALITY. However, not all roots require augmentation as we see in (1a); those roots already fulfill the bisyllabic requirement. Therefore, there should be a constraint that regulates augmentation: 'No more insertion'. To achieve the required results, OT makes use of constraint ranking. Each violation of a constraint is avoided. However, the violation of a higher-ranked constraint is worse than a violation of a lower-ranked constraint. Since it is more important to have roots that are minimally two syllables, 'MINIMALITY' is ranked above 'No more insertion'. Avoidance of epenthesis on longer roots requires that 'No more insertion' be ranked above the constraint that requires that morphemes be realized: the language would rather not realize the feature than realize it as the vowel [i]. This is what we observe in roots that do not have a labial consonant (not included in the sample data), for example, /sit'-a/ > [sit'ʷ-a] 'help' and not *sit'iwa or *sitʃʷa.

An alignment constraint enforces realization of the morpheme on the right edge. However, there are instances when the [cor] feature is misaligned where, as in (4), it moves to a medial labial because the final consonant is not palatalizable. In contrast, the [lab] does not move into the root because it can always be realized at the right edge as secondary articulation on any consonant. Since it is more important to realize the morpheme than have proper alignment, 'Realize morpheme' is ranked above the alignment constraint.

1.2.3.2 Nominal palatalization

In nominals we see a similar pattern, so the same constraints account for the locative and diminutive forms. However, medial root labials are not palatalized in these forms, for example /li-kʰaɓetʰe > e-kʰaɓetʰ-eni/ and not */e-kʰatʃ'etʰ-eni/. In nominals, aligning the morpheme with the right edge takes priority over realizing it. To account for this asymmetry, the constraint 'Realize morpheme' is subdivided into three, such that the differences observed in the different morphemes (passive, locative, diminutive) are accounted for. The asymmetry is then resolved by ranking 'Realize Passive' above the alignment constraint, while 'Realize Locative' and 'Realize diminutive' are ranked below this constraint.

1.2.3.3 Passivised reduplicated forms

There are instances when even the [lab] feature may seem to be realized root-medially. This is observed in passivised reduplicated forms, discussed shortly. Before I present a brief preview of my analysis of these forms, a word on reduplication is in order. There is a fairly extensive literature on Bantu reduplication. In siSwati, reduplication has been analysed by Peng (1991); Kiyomi and Davis (1992); and Downing (1994, 1997). Reduplication in siSwati involves copying the first two syllables of the word. McCarthy and Prince (1993) refer to the original word as the BASE and the copied part as the REDUPLICANT. These terms have since been used widely in the analysis of reduplication. I follow the same practice in this thesis. Recall that the passive morpheme has the features [cor] and [lab]. The constraints that we have developed so far suggest that the features of the morpheme are normally right-aligned, although on root-medial labials the [cor] moves into the root. [Lab] never does this, so the expectation is that the verb /ɬeɓ-a/ would surface as */ɬeɓ-a-ɬetʃʷ-a/. However, this is not the case, as I illustrate with the examples in (5). In the examples, the reduplicant is underlined and a dash separates morphemes.

(5)	a.	ɬeɓ-a	<u>ɬetʃ'ʷa</u> -ɬetʃ'ʷ-a	'gossip
		hamb-a	<u>haɲdʒʷa</u>- haɲdʒʷ-a	'go'
	b.	dʒaɓul-a	<u>dʒatʃ'u</u>-dʒatʃ'ulʷ-a	'be happy'
		seɓent-a	<u>setʃ'e</u>-setʃ'entʷ-a	'work'

In the reduplicated forms both the base and reduplicant realize the [lab] morpheme even though the context for passivisation is not met in the reduplicant. According to Kager (1999), such behaviour results from 'overapplication' of a process. Seemingly, passivisation 'over applies' in the (5a, b) forms: Underlyingly, there is a single [cor] feature and a single [lab] feature; thus, the expectation is that on the surface the feature [cor] would palatalize only one segment; likewise, the [lab] would appear only once. However, the base and reduplicant both surface with the morpheme features (5a). Even more puzzlingly we observe the same thing with the feature [cor] but not with [lab] in (5b). I argue that all these facts follow from the need to keep the reduplicant identical to the base. Next, consider the monosyllabic roots in (6).

(6)	pʰ-a	pʰayi-pʰ-iw-a	'give'
	ɬ-a	ɬayi-ɬ-iw-a	'eat'

Reduplication also has an interesting interaction with augmentation. I mentioned that sub minimal roots need to be augmented to at least two syllables. In (6) there is augmentation in both the reduplicant and the base, but by different segments: the base is augmented by the features of the morpheme while the reduplicant has suffixed the syllable /yi/. To account for this behaviour, then, I will adopt one of the 'Output-to-Output' constraints in this thesis; this is to say the output is similar to another output. Kager (1999) makes use of such constraints in his analysis of i-Syncope in Palestinian Arabic. The next section adds further support and further dimension to the discussion on palatalization.

1.3 A typology of palatalization in Southern Bantu

1.3.1 Basic facts

Factorial typology in OT postulates that different grammars result from a re-ranking of the same constraints. This thesis supports this claim, with illustrations from selected Southern Bantu languages. First, consider the data in (7), which illustrates examples of palatalization, in the passive, in the different languages. I repeat the siSwati data for ease of reference.

(7)

a. SiSwati:	ɬeɓ-a	ɬetʃ'^{w}-a	'gossip'
	gub-a	guʤ^{w}-a	'dig'
	gamul-a	gaɲul^{w}-a	'break'
b. Setswana:	bop-a	botʃ^{w}-a /bop-iw-a	'be moulded'
	xap-a	xatʃ^{w}-a/xap-iw-a	'be plundered'
	lemʊxa	lemʊx^{w}a/lemʊxiwa	'recognize'
c. Sesotho:	ɬonɪp^{h}-a	ɬonɪʧ^{hw}-a/ɬonɪp^{h}ʃ^{w}-a	'honour'
	rɔb-a	rɔʤ^{w}-a/rɔbʤ^{w}-a	'break'
	bʊp'il^{w}-e	*bʊpʃil^{w}e/*bʊʧil^{w}e	'mould'
d. Xitsonga:	lum-a	lum-iw-a	'bite'
	b-a	b-iw-a	'hit'
e. Tshivenda:	tap'-a	tap^{v}-a/ tap'iwa	'flick'
	k^{h}op^{h}-a	k^{h}op^{hv}-a/k^{h}op^{h}iwa	'break off'

Recall that passive formation in siSwati results in a change of a labial segment to a palatal (7a). A similar change is observed in Setswana (7b) and optionally Sesotho (7c). The other option, observed in Sesotho, retains the labial and surfaces with both the palatal and the labial as a consonant cluster (7c). In Xitsonga (only in the locative and diminutive) and Tshivenda, on the other hand, the labial segment is realized with a palatal secondary articulation (as seen in (7e) for Tshivenda). In addition to segmental changes, Setswana and Tshivenda optionally suffix /-iw/ even on longer roots. There is no palatalization of labials in Xitsonga but suffixation of /-iw/ to any size of root.

1.3.2 Previous accounts

Previous accounts of palatalization in these languages have been briefly discussed in section 1.2.2.

1.3.3 Analysis

The claim of this thesis is that the behaviour of palatalization in the other Bantu languages follows from an analysis parallel to siSwati. In all the languages, palatalization involves an attempt to link the [cor] feature to a labial in the passive, diminutive, and locative, and, in addition, to an alveolar in the diminutive. The crucial assumption made is that the actual phonetic realization depends on language-specific differences in the interpretation of phonological structure (Kochetov 1998). These languages are compared within an Optimality Theory framework, in which I demonstrate that their differences follow from a re-ranking of the constraints already developed for siSwati, and not from different underlying forms. The rest of the section presents the OT analysis.

1.3.3.1 Setswana

The difference between siSwati and Setswana is that in Setswana:

(8) (i) /-iw/ is always acceptable even on longer roots;
(ii) labials palatalize only when root-final.

1.3.3.1.1 Minimality in siSwati vs. Setswana

Epenthesis on longer roots in siSwati had to be prevented by ranking 'No more insertion' above 'Realize morpheme'. In Setswana, longer roots are augmented. I account for this behaviour by ranking 'No more insertion' on a par with 'Realize morpheme'. In the case of equally-ranked constraints, which I discuss in section 1.5.3.5, the violations act as though they are violations of one constraint. In this case, the assumption is that the higher-ranked constraint, 'No palatal secondary articulation' rules out the other possible form [p^y], for example. Since both languages augment sub-minimal roots, 'MINIMALITY' remains above 'No more insertion' even in Setswana.

1.3.3.1.2 Palatalization

In siSwati only one output form is accepted: palatalization of the labial. In Setswana, there is both palatalization of the labial and optional epenthesis on longer forms. Again, I account for this optionality by ranking 'No more insertion' on a par with the constraint that requires faithfulness to the underlying labial segment: 'FAITHLABIAL'. The result is that Setswana has the three constraints: 'No more insertion', 'Realize morpheme', and 'FAITHLABIAL', equally-ranked, and all ranked below 'No palatal secondary articulation'.

1.3.3.1.3 Root-medial labials

As noted earlier, siSwati palatalizes root-medial labials, whereas Setswana does not. I propose that this difference results from the relative ranking of the alignment constraint with 'Realize morpheme'. In siSwati, 'Realize morpheme' is ranked above the alignment constraint, whereas in Setswana, where aligning the morpheme with the right edge is more important, the opposite ranking holds.

From the above discussion, we conclude that siSwati and Setswana do not assume different underlying forms but a re-ranking of the same constraints as illustrated below.

The following rankings account for the differences in the two languages.

(i) ''No more insertion' on a par with 'Realize morpheme': epenthesis is allowed even on longer roots (Setswana).

(ii) 'No more insertion' above 'Realize morpheme': epenthesis is not allowed on longer roots (siSwati).

(iii) 'Alignment constraint' above 'No more insertion' on a par with 'Realize morpheme': the affix will always show up on the right edge of the root (Setswana).

(iv) 'No more insertion' above 'Realize morpheme' above 'Alignment constraint': affix will move into the root to be realized (siSwati).

1.3.3.2 Tshivenda

In Tshivenda, the passive is formed by either suffixing /-iw/ or /-w/ to the verb root. The main difference between siSwati and Tshivenda is the realization of the [cor] on root-final labials. The morpheme appears as a secondary articulation to the labial [pʸ]. A summary of the relationship between siSwati and Tshivenda is presented below:

- As in Setswana, in Tshivenda the /-iw/ is suffixed even on longer roots.
- The [cor] feature is realized as a secondary articulation in Tshivenda, whereas in siSwati it displaces the labial consonant and is primary articulated.

In siSwati, there is no palatal secondary articulation. Nevertheless, labial secondary articulation is accepted. So a constraint that bans the combination labial + palatal is one of the important constraints in the language, i.e. high-ranked in OT terms. Since Tshivenda realizes the feature as secondary articulation instead and optionally accepts /-iw/: 'No more insertion' and 'No secondary palatal' should be on a par. Further, the labial consonant does not undergo any changes in Tshivenda; therefore, 'FAITHLABIAL' should be ranked above 'No more insertion' and 'No secondary palatal'. The result is the mini grammars represented in (9).

(9) *SiSwati*: 'No secondary palatal' above 'No more insertion' above 'FAITHLABIAL'.
Tshivenda: 'FAITHLABIAL' above 'No more insertion' on a par with 'No secondary palatal'.

1.3.3.3 Xitsonga

From (7d), we notice that Xitsonga forms the passive by suffixing /-iw/ to any size of root. Further, there is no palatalization of labials. This is different from the rest of the languages. According to proponents of Lexicon Optimisation, in the absence of empirical evidence for one input form over another, we should select an input that is closest to the output (Kager 1999:33). With this background, I alternatively suggest that a Xitsonga learner would posit /-iw/ as the underlying form. The other

alternative being that this language has the same underlying morpheme as the other languages. Whichever view I take, ranking all the constraints that result in palatalization above 'No more insertion' achieves the correct results.

1.3.3.4 Sesotho

Palatalization in Sesotho is not so different from siSwati, taking into consideration the argument that I present in Chapter 2: that the Sesotho [ptʃʷ] and siSwati [tʃʷ] are phonologically the same, and that the differences lie in the timing of gestures in the phonetic component. The other difference is that a root-medial labial is not palatalized in Sesotho. I have already mentioned that I account for this behaviour by ranking the alignment constraints higher than the constraints that require the morpheme to be realized. The same holds for Sesotho.

1. 4 Other non-local processes

I also include in this thesis other processes that are related to long distance palatalization: vowel harmony/co-articulation and tonal phonology. The processes are included to demonstrate that long distance effects in siSwati are not peculiar to palatalization: vowel harmony/co-articulation also affects non-adjacent segments. Tone shift and tone spread may result in tone being realized syllables away from its underlying source. I first present a brief discussion on vowel harmony, followed by tone.

1.4.1 Vowel harmony

1.4.1.1 Basic facts

Mid-vowel assimilation in Southern Bantu languages operates within the word, whereby the mid vowels [ɛ] and [ɔ] are raised to [e] and [o] respectively when preceding high vowels.

SiSwati

(10)	ɬɛɠ-a	ɬeɠ-is-a	'laugh'
	pʰɛɠ-a	pʰeɠ-is-a	'cook'
	k'ɔp'-a	k'op-is-a	'copy'
	ɓɔpʰ-a	ɓopʰ-is-a	'tie'

IsiZulu

(11)	ŋgɛn-a	ŋgen-is-a	'enter'
	pʰɛk-a	pʰek-is-a	'cook'
	ɓɔpʰ-a	ɓopʰ-is-a	'tie'
	pʰɔl-a	pʰol-is-a	'cool v.'

Sesotho

(12)	mu-hwɛ	'father-in-law'	lɪ-qheku	'old person'
	mʊ-nyakɔ	'door'	mʊ-lomʊ	'mouth'

1.4.1.2 Previous accounts

Previous accounts of the behaviour of siSwati mid vowels / ɛ, ɔ / before / a, e, o / and before / i, u / show conflicting results. According to Ziervogel and Mabuza (1976), Canonici (1994), Taljaard and Snyman (1993) and Taljaard, Khumalo and Dlamini (1991), siSwati mid vowels remain open mid [ɛ, ɔ] before [-high] vowels but are raised to close mid [e, o] when preceding high vowels (10), suggesting that siSwati has a vowel height assimilation and/or ATR assimilation. However, Kockaert (1997), in his acoustic analysis of the same vowels in the same environments, disputes this description. He concludes that there is no significant difference in the F1, F2, and F3 frequency values of these vowels. The results of the experiment that I conducted support neither view; based on these results, I argue, in this thesis, that while Sesotho and isiZulu have vowel harmony, siSwati has co-articulation.

In the experimental study I use two main criteria to distinguish between harmony and co-articulation: (i) the position where formant values change during the production of the vowel; if the change affects the whole vowel, I consider that to be

evidence of vowel harmony, whereas if it affects only part of the vowel, in particular the part closest to the trigger, I conclude that it results from co-articulation. (ii) I use the significance of difference in the mean values (for each speaker's production) of F1 and to a lesser extent F2.

According to Xu and Liu's (in press) segmental theory, the second vowel in a CVCV string begins 50ms before the end of the preceding vowel. This idea is in line with most studies which suggest that the effects of co-articulation are seen at around the middle of the vowel. Based on the above observations, I took measurements at 50ms intervals.

The results of the experiment confirmed that the phonological environment does influence the quality of siSwati mid vowels: both mid vowels were raised as well as fronted before the high vowel /i/. However, this difference cannot be considered as evidence for vowel harmony, as claimed by Ziervogel & Mabuza and others. First, and crucially, the maximal difference in the formant values was reached only at around 50ms in most of the vowels, suggesting only a phonetic change. If the change had been that of harmony, the whole vowel would have been affected. Secondly, the quality difference is not significant for all the speakers. The conclusion is that the difference is evidence of co-articulation.

1.4.1.3 Typology and analysis

I also use OT to account for the difference between the behaviour of vowels in siSwati and those for isiZulu. Both siSwati and isiZulu have a phonemic 5-vowel system. The [-ATR] mid vowels /ɛ ɔ/ raise to [+ATR] [e o] in front of [+ATR] high vowels through the process of assimilation, resulting in a 7-vowel system in isiZulu since the process is phonological. SiSwati retains its 5-vowel system since the process is only phonetic. I therefore assume that [ATR] is the feature assimilated in isiZulu, although I discuss the arguments for and against this view in Chapter 6. My central point remains that there are grounds for saying that the process has been phonologized in isiZulu and remains phonetic in siSwati.

The analysis is therefore based on the assumption that isiZulu has vowel harmony while siSwati does not. I demonstrate in the analysis that an interaction of constraints can account for the differences between vowel harmony and no harmony. I also consider and account for the possible intermediate stage, which was revealed

by the production of both co-articulation and harmony by some of the siSwati speakers.

In both siSwati and IsiZulu, high vowels and low vowels never change their [ATR] specification: assimilation i) is always anticipatory, ii) is induced by only high vowels, and iii) targets only mid vowels. To ensure that both high and low vowels maintain their [ATR] specifications in the output, we need to add to the grammar what OT refers to as markedness constraints that are specific to height/[ATR] combinations: informally, 'No [-ATR] high vowels' and 'No [+ATR] low vowels'

I follow Beckman (1997) in her analysis of Shona vowel harmony, in that harmony results from spreading of the feature that is harmonized: ATR, in the case of isiZulu. Notice that in isiZulu, the only time the mid vowels surface as [+ATR] is when [+ATR] spreads from a following vowel, and the [-ATR] from the mid vowel disappears. So the output has only one [ATR] specification instead of two. So if we penalize each [+ATR] or [-ATR] specification and rank this high in isiZulu but not in siSwati, we can achieve this result.

Finally, in the intermediate stage, which is characterized by optional harmony, where, for example, both /bemisa/ and /bɛmisa/ would be possible output forms, the grammar would have the constraint that penalizes [-ATR] vowels on a par with the one that penalizes [+ATR] mid vowels.

1.4.2 Tonal phonology

1.4.2.1 Basic facts

Like most Bantu languages, siSwati is a tone language that uses changes in fundamental frequency in order to convey lexical and grammatical meaning. SiSwati has a surface two-tone system. Nonetheless, it has been suggested in the literature that, although phonetically there is high vs. low tone, phonologically there is only one tonal contrast in Bantu Languages, high vs. toneless (Downing 1990, Myers 1997, 1998, Hyman 2000, Cassimjee & Kisseberth 1998, 2001, Creissels 1999, Yip 2002). The low tone occurs at the end of the phonology to supply any still toneless syllable with a tonal specification.

A High tone may originate from any of the morphemes in a word, and either shift or spread to the right of where it originated from either, to the penultimate or the antepenultimate syllable. This is the general pattern in Nguni languages. Examples are presented in (13). In the examples, the source of the High tone is underlined and its surface position is shown by the acute accent, and a colon marks a lengthened vowel.

(13)	H	L	L		'They are V...ing'	
	ɓa̲	ya	ɬaɠul-a	>	ɓa̲-ya-ɬáɠu:l-a	'weed'
	ɓa̲	ya	ɬaɠul-is-an-a	>	ɓa̲-ya-ɬaɠul-ís-a:n-a	'weed + caus.'

1.4.2.2 Previous analysis

Tone in Nguni languages has been previously analyzed by Doke (1967), Rycroft (1981), Khumalo (1987), Cassimjee (1998), Cassimjee & Kisseberth (1998), Creissels (1999) and Downing (1990, 2001), among others. While the other analyses are rule-based, Cassimjee, Cassimjee & Kisseberth and Downing use the Optimal Domains Theory (ODT).

1.4.2.3 Analysis

Although ODT can derive the correct results, I do not adopt this theory in the analysis of tone in siSwati. I use a more standard OT approach. The ODT analysis is not rejected on empirical grounds: my argument, in this thesis, is that alignment constraints play a role in the behaviour of both tone and palatalization in the passive.

The tonal behaviour in siSwati has also been investigated phonetically, mainly to confirm the generalizations that have already been suggested in the literature. The experiment was designed to answer the following questions: i) Does the position of the same word in an utterance determine the surface realization of tone? ii) Is there a leftward shift of tone? iii) Does adjacency of tone vs. non-adjacency make a difference in the surface realization? iv) Does the morphological domain determine surface realization of tone? The morphological domains that are of interest in this analysis are the Macrostem and the Phonological Word.

According to Hyman and Ngunga (1994) and Myers (1994), the verbal phrase in Bantu languages could be divided into different morphological domains: a Macrostem and a Phonological word. The Macrostem (henceforth MStem) is the part that consists of the verb root plus suffixes and in addition the object marker. For example, /ɓa̱-[yi̱-nátsʰ-ile]/ 'They drank it'. Square brackets indicate the MStem boundary on the example. The Phonological word (henceforth PhWd), on the other hand, includes morphemes within and outside the MStem. According to Myers, dividing a verb into these two components is useful in defining the domain of phonological rules. In his analysis of tone in Shona, he observes that the domain of Meeussen's Rule is the PhWd, while that of fusion is the MStem. Tonal behaviour in siSwati supports the idea that surface tone may be influenced by the morphological domain of the underlying tone.

I have mentioned the idea that long distance effects and the other processes that I discuss result from alignment constraints. Tone is also attracted to the right edge of the word; the penult or antepenult always surface with tone that may have originated several syllables away from this position.

1.5 The theoretical framework

1.5.1 Featural affixes

The proposal advanced in this thesis is that palatalization is triggered by a featural affix. Featural morphemes are common cross-linguistically and have been argued for by Mester and Itô 1989, Yip 1992, Akinlabi 1996, and Zoll 1996, among others. Featural morphemes need to dock onto some segment in order to be realized. In Chaha, for example, the third person singular object is indicated by labialization on the verb (14).

Chaha

(14)	nœkœb	nœkœb^{w}	'find'
	mœkœr	mœk^{w}œr	'burn'

The object affix in Chaha has been analysed as a floating [+round] feature (McCarthy 1983, Zoll 1996). This feature associates with the rightmost labializable segment, either labial or dorsal. If there is no such consonant, [round] has nowhere to dock. The process of palatalization in siSwati is similar to labialization in Chaha (see (15)).

SiSwati

(15)	ɬeɓ̲-a	ɬetʃ'^{w}-a	'gossip'
	seɓent-a	setʃ'ent^{w}-a	'work'

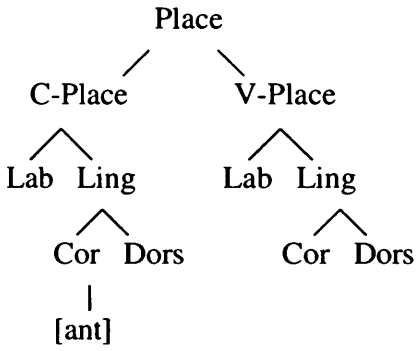
I propose that the [cor] feature, like the [round] feature in Chaha, is also a floating [cor] feature that attaches to the rightmost labial segment. The feature is part of particular morphemes and does not belong to any segment.

1.5.2 Feature geometric representation of palatals

In this thesis, I adopt the feature geometry model proposed by Clements (1989), Hume (1994), and Clements and Hume (1995). In this model, vowels and consonants are classified by a single set of place features: Labial, Coronal and Dorsal, but under V-Place and C-Place nodes respectively. The coronal node further dominates the feature [anterior]. Palatalization in Southern Bantu languages is a central argument for this theory. Crucially, the passive has either [i], or /p/ → [tʃ], and using this geometry does both with one feature. In consonants, Cor characterizes alveolar and palatals. In vowels, Cor characterizes front vowels, especially /i/.

Following Lass 1976, Browman & Goldstein 1989, and Clements & Hume 1995, I also group coronals together with velars under the Lingual node. This means that in my system the Coronal node is dominated by a Lingual node. The relevant geometry is shown in (16). (See section 2.1.3, for the motivation of a lingual node).

(16)

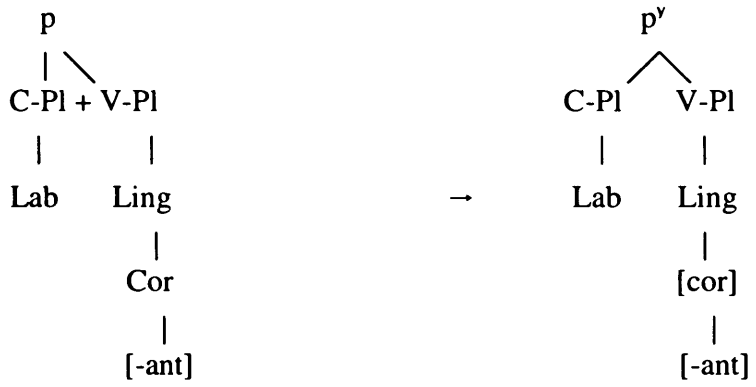


The feature [anterior] is contrastive only for C-Place Coronal. It distinguishes between alveolars, which are [+anterior], and palatals, which are [-anterior]. The V-Place Cor is redundantly [-anterior]. I assume that the trigger of palatalization is a coronal feature [cor] under the V-Place node. Palatalization in Southern Bantu languages involves an attempt to link the V-Place coronal to a labial in the passive, diminutive, and locative, and, in addition, to an alveolar in diminutive forms. Labialization results from a V-Place Lab linking onto a C-Place node.

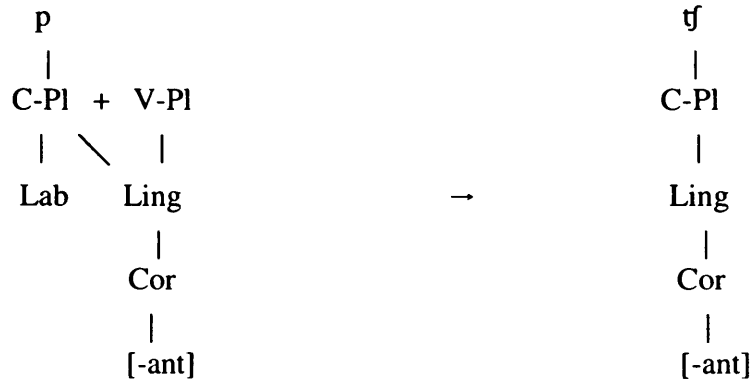
In siSwati, Setswana, and optionally in Sesotho, the [cor] is promoted to the primary place feature of consonants, that is, the consonant's minor articulation is de-linked and copied under its C-Place node, according to Clements's (1986) proposal. This could be interpreted as a V-Place [cor] spreading to the Lab node to produce a

secondary articulation on the labial (see (17)). The change of a labial to a palatal involves the Ling node spreading to the C-Place Lab (see (18)).

(17) p → pʸ



(18) p → ʧ



1.5.3 Optimality Theory

In the thesis, I examine several phonological phenomena within an Optimality Theoretical framework. In this section, I do not give a detailed discussion of OT but discuss only those issues that are relevant to my analysis: the reader is therefore referred to the original work of Prince & Smolensky (1993), as well as the introductions by Archangeli & Langendoen 1997, Kager 1999, and McCarthy 2002.

1.5.3.1 Background

Optimality Theory (Prince & Smolensky 1993, McCarthy & Prince1993) conceives of the grammar as a hierarchy of ranked and violable constraints relating input and output. In my analysis, I adopt the Correspondence version of Optimality Theory, following work by McCarthy & Prince (1995, 1999). Correspondence Theory is a theory of faithfulness. The notion of correspondence is designed to capture the identity relation between input and output and between base and reduplicant. McCarthy and Prince (1995) formally define the correspondence relation as in (19).

(19) Correspondence

Given two strings S_1 and S_2, correspondence is a relation $\mathcal{R}$ from the elements of S_1 to those of S_2. Elements $\alpha \epsilon S_1$, and $\beta \epsilon S_2$ are referred to as correspondents of one another when $\alpha \mathcal{R} \beta$.

Correspondence constraints can hold between any two representations, for example between an underlying representation and a candidate (such as /kʰipʰa + [cor][lab]/ and [kʰiʃʷa] 'be removed'), between two parts of a candidate (such as base and reduplicant RED=BASE), or even between a candidate and another well-formed word of the language (such as the (V)C-roots in siSwati, where the passivised reduplicant shows similarities to the unpassivised reduplicant). Examples of such cases are discussed in detail in the thesis.

1.5.3.2 Alignment

Generalized alignment is a family of well-formedness constraints that govern positions or constituent edges in morphological or phonological processes (McCarthy and Prince 1993b). The Align family of constraints requires that the domain of a feature extend to the edge of a constituent, for example the edge of the root or the word. Consider the Generalized Alignment schema (20) and its interpretation (21).

(20) Generalized Alignment schema:

ALIGN (Category_1, Edge_1; Category_2, Edge_2)

Where $Category_1$ and $Category_2$ are either grammatical or prosodic categories, and $Edge_1$ and $Edge_2$ can be either left or right.

(21) Interpretation
For all instances of $Category_1$, there exists some instance of $Category_2$, and $Edge_1$ of $Category_1$ lines up with $Edge_2$ of $Category_2$.

The Align family of constraints requires that the domain of a feature extend to the edge of a constituent, for example, the edge of the root or the word. In tone, for example a fully faithful output would retain a subject marker tone on that particular morpheme, e.g. *[ɓá̲-ya-ɬaɠul-a]; while an output respecting alignment must violate faithfulness by assigning the affix tone to the stem [ɓa̲-ya-ɬáɠul-a] 'They are weeding'. I demonstrate the effect of alignment constraints throughout the discussions in the thesis

1.5.3.3 Root/affix faithfulness

Work in phonology and morphology consistently recognizes that affixes show a strong tendency to be less marked than roots cross-linguistically. Within Optimality Theory, this observation has been dealt with through a universally-fixed ranking $\text{FAITH}_{\text{ROOT}}$ >> $\text{FAITH}_{\text{AFFIX}}$ (McCarthy & Prince 1995), which states that faithfulness to root material, universally, is more important than faithfulness to affix material. Different processes in siSwati support the phonological importance of roots over affixes. In tone, input and output faithfulness is observed more on the MStem than the PhWd; there is no spreading of tone in the MStem although it is observed in the PhWd. In siSwati, the contrast is not so much Root-Affix as Stem/affix, assuming that Myers' MStem is a type of stem. Disregarding the other processes, consider the data in (22), where the source of H tone is underlined while the surface tone is indicated by an acute accent mark.

(22)	MStem		'You (pl.) are V...ing it.'
a.	ni-ya-[yi̲-se̲ɓent-a	>	ni-ya-[yi̲-se̲ɓé: nt-a 'work'
	ni-ya-[yi̲-pʰe̲keletel-a	>	ni-ya-[yi̲-pʰe̲keléte:l-a 'accompany'

b.	PhWd		'They V... ed it.'	
	a-[yi-natsʰ-ile	>	a-[yí-nátsʰ-i: le	'drink'
	a-[yi-natsʰ-is-is-ile	>	a-[yí-nátsʰ-ís-ís-i: le	'drink + intens.'

In (22a), both H tones originate within the MStem, while in (22b) the other tone is outside the MStem. As I will explain in detail in Chapter 6, spreading, as in (22b), always involves insertion of additional association lines in comparison to movement, as in (22a), and is therefore a greater violation of the Faithfulness constraint, *ASSOCIATE .

1.5.3.4 Factorial typology

Factorial typology postulates that differences between languages are due to different rankings of a single set of universal constraints (Kager 1999: 34). In this study I demonstrate that palatalization in the other Southern Bantu languages can be accounted for by a re-ranking of the same constraints that account for the siSwati grammar, and that the underlying representations are the same.

1.5.3.5 Optionality

Equal ranking of constraints may account for free variation or optionality in grammar. In Optimality Theory, optionality may result when a single input is mapped into two outputs, each of which is grammatical. This may result from extra grammatical factors. For example, in Setswana, the use of the different forms of the passive depends on dialect. Different ways of how to account for this phenomenon have been discussed in the literature. One proposal is: co-phonologies, where each grammar selects its own optional candidate by it own ranking (Inkelas 1993). However, this proposal runs into the problem of re-introducing strata in phonological systems. The other proposal is known by different names and may be interpreted differently: crucial non-ranking (Antilla 1997), co-ranking or equal ranking (Crowhurst 2001, Crowhurst & Michael 2005, and Topintzi 2006). In these proposals, a single constraint hierarchy is maintained. The constraints that are

equally-ranked are separated by a comma, which indicates a tie between the constraints. However, the comma is also subject to different interpretations. In Antilla's understanding, given two constraints, C1 and C2, it would make no difference in the output whether C1 was ranked above C2 or C2 was ranked above C1. However, in the other interpretation, by Crowhurst and others, C1 and C2 do not produce two grammars. Their idea is that both constraints are simultaneously evaluated; the violations incurred act as if they were the violation of one constraint. In the following chapters, I adopt the second interpretation of the comma. In the data, either a higher-ranked constraint makes the decision, as in the Setswana examples in (7b), or at times, it is a lower-ranked constraint that breaks the tie between the equally-ranked constraints. Examples of such are seen in Chapter 6, where I discuss the behaviour of monosyllabic roots in tone assignment.

1.6 Summary

The focus of this thesis is to motivate a floating [cor] feature as the trigger of palatalization in Southern Bantu languages. Processes considered are passive, locative, and diminutive. In Chapter 2, I first present the basic structure of siSwati, then the feature geometry that I adopt in this thesis. In Chapter 3, I demonstrate how this feature geometry can account for palatalization in the passive. In Chapter 4, I analyze nominal palatalization in siSwati to further substantiate the argument that palatalization is triggered by a floating [cor] feature. In Chapter 5, I discuss a typology of palatalization in Southern Bantu languages to show that the labial palatalization facts in these languages are exactly the same apart from the lexical properties of the affixes involved. Finally, in Chapter 6, I discuss palatalization in the context of other non-local phonological processes in siSwati: (i) vowel harmony and (ii) tonal phonology. In Chapter 7, I summarize and conclude the thesis.

CHAPTER 2

THE STRUCTURE OF SISWATI

This chapter presents the basic structure of siSwati, namely, segmental structure, syllable structure and minimal word constraints. The morphological structure of the verb is deferred till Chapter 3 where I investigate the formation of the passive from verbs, while the structure of nouns is discussed in Chapter 4 together with the analysis of palatalization of nominals. First, I present the segmental inventory of siSwati. Then, I discuss the feature geometry that I adopt in this thesis. Based on this feature geometry, I present featural representations of both the underlying and surface segments that are involved in palatalization in all the languages that I investigate. I also look into the strategies that are used to resolve an unacceptable syllable structure in siSwati, namely; vowel hiatus. Finally, I discuss prosodic minimality effects, to show how phonology and morphology interact on producing the correct output form.

2.1 Segmental structure

In this section I present the phonemic inventory of both consonants (see Table 2-1) and vowels (see (1)) in siSwati. I also look into some suggestions about the phonetic realizations of the vowels.

2.1.1 SiSwati inventory

	Bila bial	Labio-dental	Dental	Alveolar	Post-alveolar	Palatal	Velar	Glottal
Stops Aspirated	p^h			t^h			k^h	
Voiced	b			d			g	
Ejective	p'			t'			k'	
Implosive	ɓ						ɠ	
Affricates				ʦʰ ʣ	ʧ' ʤ			
Fricative		f v		s z	ʃ (ʒ)			h ɦ
lateral				ɬ ɮ l		ʟ		
Nasals	m			n		ɲ	ŋ	
Approxi mants						y	w	
Clicks			ǀ ǀʰ gǀ					

Table 2-1 Phonemic inventory of siSwati

( ) represents a phoneme that has limited use.

SiSwati has a five vowel system as illustrated in (1).

(1) i u

ɛ ɔ

a

However, according to Ziervogel (1952), Ziervogel and Mabuza (1985), Canonici (1994), Taljaard and Snyman (1991) and Taljaard, Khumalo and Dlamini (1993), siSwati has seven vowels at the phonetic level. They claim that the open mid vowels /ɛ, ɔ/ are raised to close mid [e, o] when preceding the high vowels /i, u/ (e.g. /ɬɛʃa/ 'laugh' → [ɬeʃ-is-a] 'cause to laugh', / ɓɔpʰa 'tie' → [ɓopʰ-is-a] 'cause to tie').

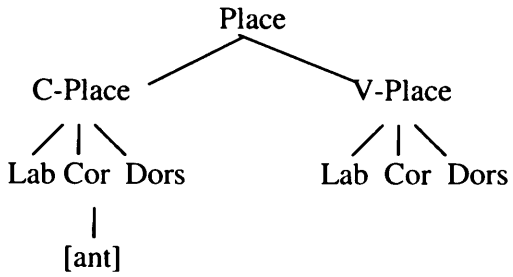
Kockaert (1997), though, disputes this description. In his acoustic analysis of the same vowels in the same environments, concludes that there is no significant difference in the F1, F2, and F3 frequency values of these vowels. A detailed discussion of the behaviour of mid vowels in siSwati is provided in Chapter 6, section 6.1.

As in most Bantu languages, in siSwati, the vowel in the penultimate syllable of the word is always lengthened when the word is in utterance-final position. I do not mark this predictable vowel length in the examples of data that I present in this thesis, except in chapter 6 where it interacts with tone. Vowel length is therefore non-contrastive and predictable. Nonetheless, it will be shown that this lengthening is significant since it interacts with tone. Tone shift and tone spread, which would otherwise surface on the penult, avoid this lengthened syllable in phrase-final forms; hence, it is retracted to the antepenult. For a detailed discussion of this phenomenon, see Chapter 6, section 6.2. In the next section I consider features of palatalization and labialization.

2.1.2 Feature geometric representation of palatals and labials

In this thesis I adopt the feature geometry model proposed by Clements (1989), Hume (1990), and Clements & Hume (1995). In this model vowels and consonants are classified by a single set of place features; Labial, Coronal and Dorsal. The coronal node is further dominated by the feature [anterior]. This feature distinguishes between coronals that are produced on the frontmost part of the alveolar ridge and those produced at about the corner of this ridge (Keating 1988:41). The relevant geometry is shown in (2).

(2)



The feature [anterior] is contrastive for only C-Place Coronal. It distinguishes between alveolars, which are [+anterior], and palatals, which are [-anterior]. The V-

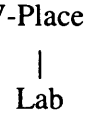
Place Cor is redundantly [-anterior]. When a C-Place Cor dominating [-ant] appears in the structure, the articulation depends on language-specific preferences for co-coordinating the body and tip/blade of the tongue, yielding a range of possible specific phonetic realizations. (See Chapters 3 to 5 for detailed discussions). The idea that front vowels and palatals share a common feature is not a new idea (Hume 1990, Lahiri & Evers 1991, Keating 1988, and Clements & Hume 1995). Clements & Hume, for example, observe that in many languages coronal consonants become [-ant] before front vowels.

Palatalization in Southern Bantu languages is a central argument for this theory. Crucially, the passive has either [i], or /p/ → [ʧ], and using this geometry does both with one feature. In consonants Cor characterizes alveolar and palatals. In vowels Cor characterizes front vowels, especially /i/.

With that basis I, therefore, assume that the trigger of palatalization is a coronal feature Cor under the V-Place node. And that Cor dominates a [-ant] node. This feature will be represented as [cor] throughout the thesis. In addition, I argue that in the system that I propose, the Coronal node is dominated by a Lingual node, which will be discussed shortly. The palatal trigger is represented in (3). The labialization feature is a V-Place Labial [lab] (see (4)).

(3)

(4)



Palatalization in Southern Bantu languages involves an attempt to link the V-Place Cor to a labial, in the passive, diminutive, and locative, and in addition, to an alveolar in diminutive forms. Labialization results from a V-Place Lab linking onto a C-Place node. A summary of palatalization in these languages is presented in Table 2-2.

Process	Input	SiSwati	Setswana	Tshivenda	Xitsonga	Sesotho
Passive	p[cor][lab]	ʧʷ	ʧʷ	pʸ	piw	ʧʷ/pʧʷ
Diminutive	p[cor]ana	ʧ	ʧʷ	--	bʸ	ʧ
Passive	t[cor][lab]	tʷ	Tʷ	tʷ	tiw	tʷ
Diminutive	t[cor]ana	ʧ	ʧ	--	t	ʧ
Passive	k[cor][lab]	kʷ	kʷ	kʷ	kiw	kʷ
Diminutive	k[cor]ana	k	k	--	k	k

Table 2- 2 A summary of palatalization

The feature representation of the relevant underlying segments is shown in (5).

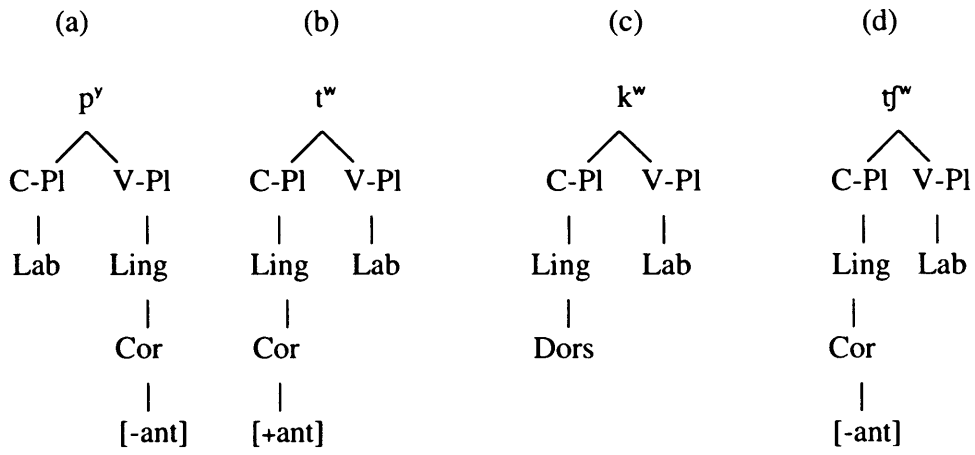
(5)

p	t	k	ʧ
|	|	|	|
Lab	Ling	Ling	Ling
	|	|	|
	Cor	Dors	Cor
	|		|
	[+ant]		[-ant]

Notice that, in (5), both /t/ and /ʧ/ share the feature Cor but differ in their specifications for the feature [anterior]. Remember that alveolars have their constriction on the front part of the alveolar ridge and therefore anterior, while in the production of palatals the blade of the tongue touches just behind the alveolar ridge; hence, Cor and [-ant]. This distinction will be crucial in the analysis of palatalization of alveolars in diminutive forms, discussed in Chapter 4. The same segments; /t/ and /ʧ/, also form a class with the velar segment /k/. All three segments are characterized by the feature Ling. It has been suggested in the literature that coronals and dorsals be grouped together under the same node, a Ling node, since they both involve the tongue in their articulation (Lass 1976, Browman & Goldstein 1989, and Clements & Hume 1995). Furthermore, it has been observed that these segments behave as a natural class in certain phonological contexts. Clements & Hume mention that in Mandarin Chinese lingual obstruents (velar, uvular, retroflex, and dental) are replaced by laminal alveolars before high front vowels [i, ü] while labials occur freely in the same position.

The only segment that palatalizes in passive formation is the labial. The rest of the segments, all of which are Lingual, just labialize (see (6)).

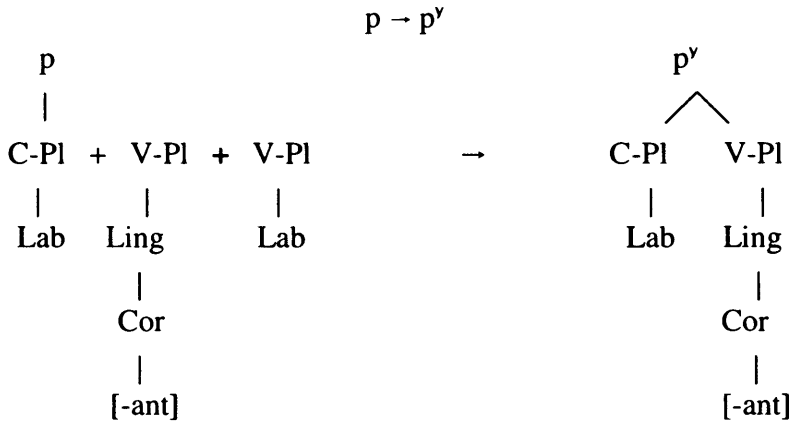
(6) Representation of output forms in the passive



The representations in (6) show us that in passive formation the [cor] may become a secondary feature to the labial (see (6a), or it may be primary articulated as represented in (6d), or it may not be realized at all (see 6 (b and c)).

In Tshivenda and Xitsonga, for example, the [cor] becomes a secondary feature to the labial (see (7)).

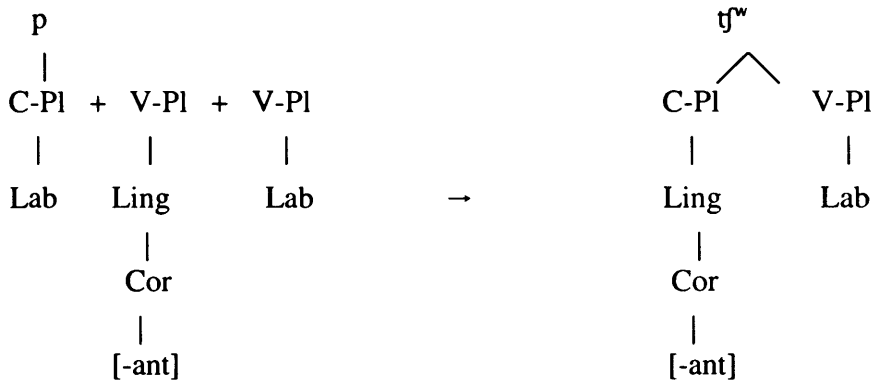
(7)



This results from the spreading of all the features of the palatal trigger onto the labial. Since the labial retains its place of articulation, the Ling node must link under its V-Place node to be secondary articulated. The lack of labialization of the labial will be discussed later.

In siSwati, Setswana, and optionally in Sesotho the [cor] is promoted to the primary place feature of the labial, that is, the consonant's minor articulation is de-linked and copied under its C-Place node (Clements 1986). In that case the primary place feature disappears (see (8)).

(8) $p \rightarrow t\int^w$



In Sesotho, however, there is an alternative pronunciation to [tʃʷ], [ptʃʷ]. It has been observed and argued in the literature that segments like [ptʃʷ] are not to be treated as complex segments but clusters (Doke 1954, Herbert 1977, Maddieson 1984, Ladefoged & Maddieson 1996). In support of their argument, Ladefoged & Maddieson use examples from Sepedi. They argue that the Sepedi segments are not doubly-articulated, as observed by Lombard (1985) and others, but clusters. Ladefoged & Maddieson observe that since the duration in the production of these segments is longer than that of their comparable single segments, then they must be clusters. They consider duration to be a key factor in distinguishing clusters from single segments. Moreover, they observe that this duration is not different from the duration of English heterosyllabic clusters in words like *caption or topsheet.* True complex segments, like those found in Ewe, according to them, show no significant difference in time from their single segments. In the spectrographic analysis of these Ewe segments they noticed that the mean duration of the sound [kp] was 174 ms while [k] and [p] were 142ms and 158ms, respectively.

However, from an experimental study which I conducted for words with similar segments in Sesotho; 'clusters' and single segments, the results showed a not-so-different pattern from the Ewe examples.[4] For the experiment in Sesotho, I obtained a short list of words from Doke & Mofokeng (1967), which were confirmed by the speaker before recording. The words included, plain and complex segments, for example, [p], [tʃʷ], and [ptʃʷ]. The list of words may be found in appendix A.

[4] The words were produced by Monica Harris, a Sesotho native speaker from Lesotho.

Figures 2-1, 2-2, and 2-3, provide spectrograms for the words /mʊlapo/ 'river', /bʊtʃʷ-a/ 'be moulded', and / fɛptʃʷ-a/ 'be fed', respectively .

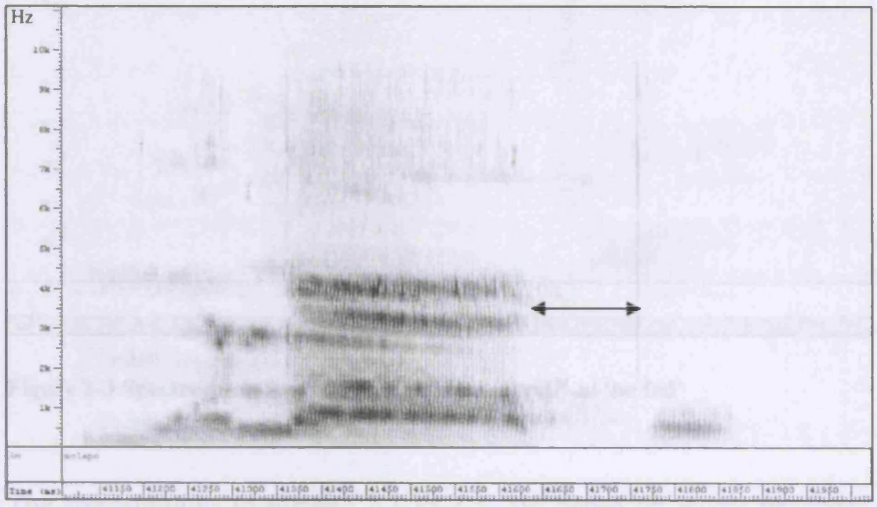


Figure 2-1 Spectrogram for the Sesotho word /mʊlapo/ 'river'

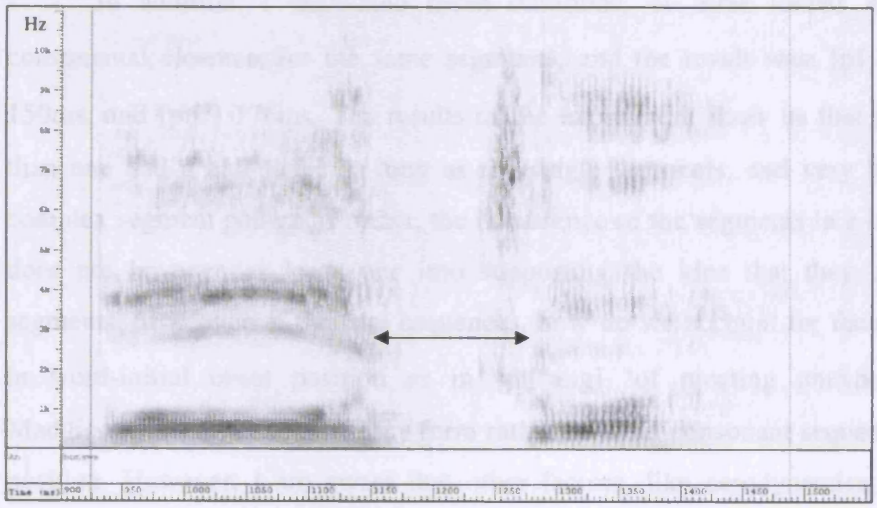


Figure 2-2 Spectrogram for the Sesotho word /bʊtʃʷ-a/ 'be moulded'

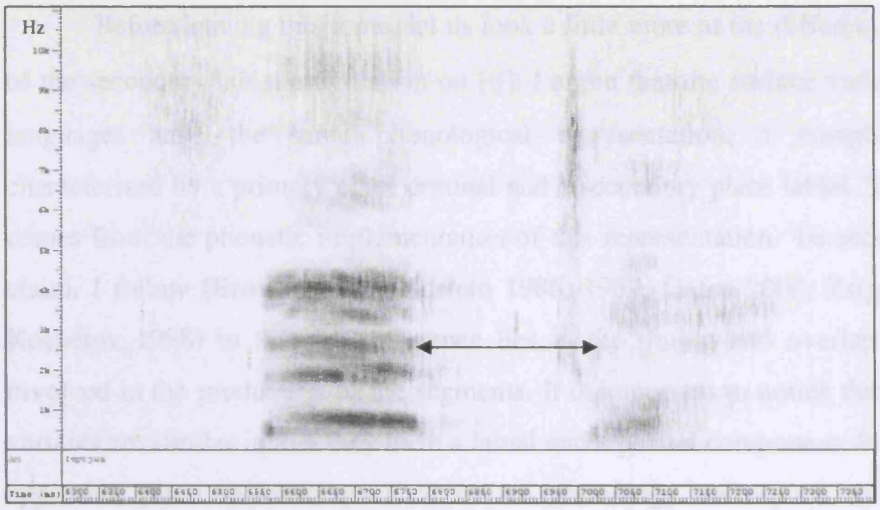


Figure 2-3 Spectrogram for the Sesotho word / fɛptʃʷ-a/ 'be fed'

The spectrograms in Figures 2-1 to 2-3, are based on words produced in isolation. The arrows indicate the consonantal closures of the segments [p], [tʃʷ], and [ptʃʷ], respectively.

In addition, I calculated mean durations, of three tokens each, of the consonantal closures, for the same segments, and the result was: [p] 128ms, [tʃʷ] 150ms, and [ptʃʷ] 176ms. The results of the experiment show us that [ptʃʷ] is less than one and a half times as long as the single segments, and very like the Ewe complex segment pattern. Further, the occurrence of the segments in a language that does not have codas leads one into supporting the idea that they are complex segments. Moreover, if they are sequences, how do we account for their occurrence in word-initial onset position as in [ptʃʷang] 'of meeting unexpectedly'. As Maddieson (2003) concedes, they form rather unusual consonant sequences in onset position. However, I am aware that other factors, like aerodynamics, need to be taken into consideration in this kind of analysis. The release burst before the affricate, for example, shows us that the production is not simultaneous. Nonetheless, I assume that [ptʃʷ] and [tʃʷ] are phonologically the same, as in (8), but [ptʃʷ] is moving towards a cluster-like surface form. Maybe over time it will behave phonologically like a cluster. The phonetic distinction between the two sounds will therefore not be considered in the purely phonological analysis in chapter 5.

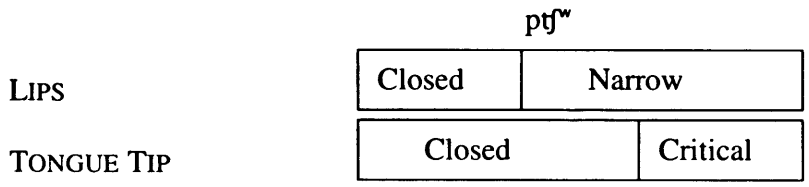
Before leaving this topic, let us look a little more at the different realizations of the secondary labial articulation on [tʃ]. I argue that the surface variants in these languages have the same phonological representation; a complex segment characterized by a primary place coronal and a secondary place labial. The diversity comes from the phonetic implementation of this representation. To account for this claim, I follow (Browman & Goldstein 1986, 1989, Gafos 2002, Zsiga 1997, and Kochetov 1998) in that the difference lies in the timing and overlap of gestures involved in the production of the segments. It is important to notice that the surface variants are similar in that they have a labial and a palatal component. In the gestural approach, place features specified in the phonology correspond to articulatory gestures.

The gestural theory will not be used to analyze the whole palatalization data. It will be used only to further support the idea that the segments [ptʃʷ] and [tʃʷ] are phonologically the same. Before I provide an analysis of these segments, I briefly discuss some basic notions of articulatory gestures which I assume in the gestural account of these segments. Gestures characterize movements within the vocal tract (Browman & Goldstein 1989). These movements are characterized by a set of variables: First, the constriction made by the different set of articulators; Constriction Degree. The Constriction Degree may be either closed, as in the production of stops, critical for fricatives, or it may be narrow in the production of approximants. The second variant is the position where the constriction is located in the vocal tract; Constriction Location. The location could be at different places of articulation; at the lips for labials or at the tongue tip in the production of alveolars and palatals. The state of gestures changes over time (Gafos 2002). As it develops we may identify different positions. For example; (i) the onset of movement towards the target; (ii) the achievement of the target; and (iii) the point in time when active control of the gesture ends.

Having presented the relevant features of the theory, I now return to the discussion of the segments [ptʃʷ] and [tʃʷ]. The difference between these segments lies in the timing and overlap of gestures involved in their production. I adopt the box notation in the representation of the gestures (Browman & Goldstein, Gafos, and Kochetov). In the box notation the length of the box indicates duration of the gesture. However, the notion of time is relative. It does not refer to time as measured in

milliseconds, for example. Furthermore, the model's representation of the gestures is not based on observed articulatory movements, which I did not have access to. Nonetheless, it is entirely possible that the gestures which are based on X- ray tracings or palatograms behave in a similar way to the ones illustrated below. In this analysis I consider only the articulatory gestures that are relevant to the production of [ptʃʷ] and [tʃʷ]; the Lips and the Tongue Tip gestures. (9) illustrates the gestural score for [ptʃʷ].

(9)



In the production of [ptʃʷ], as represented in (9), I argue that the onset of movement for the Lips and the Tongue Tip gestures is simultaneous. At the onset of movement the lips are closed for the production of the stop and at the same time the Tongue Tip acquires a closed position for the production of [t]. Since the gestures are simultaneous, the first phase involves the production of [pt]. As the gesture progresses the closure at the lips weakens, that is, it becomes narrow to produce the approximant. The Tongue Tip gesture is still in a closed position and remains so for the second phase which involves the production of [tʷ]. This is followed by a critical constriction at the Tongue Tip resulting in [ʃ]. The lip closure remains narrow as the /w/ is produced. This leads to the third and final phase, the production of [ʃʷ]. Since the gestures are effected by separate articulators, realization of one gesture cannot be affected by the concurrent gesture (Browman & Goldstein 1989). The result is a simultaneous production of all the segments that make up the sound. Production of an equivalent consonant cluster also involves three phases. There is a difference though. The [p] and [t] are produced separately and at different onsets of time. The first phase involves the production of the [p] at the lips. After the lips have reached their target then the Tongue Tip gesture is activated for the second phase to produce the [t]. Finally, the lips and Tongue Tip gestures are activated simultaneously to

produce [ʃʷ]. Next, I discuss the production of [ʧʷ]. The gestural score is provided in (10).

(10) ʧʷ

LIPS	Narrow	
TONGUE TIP	Closed	Critical

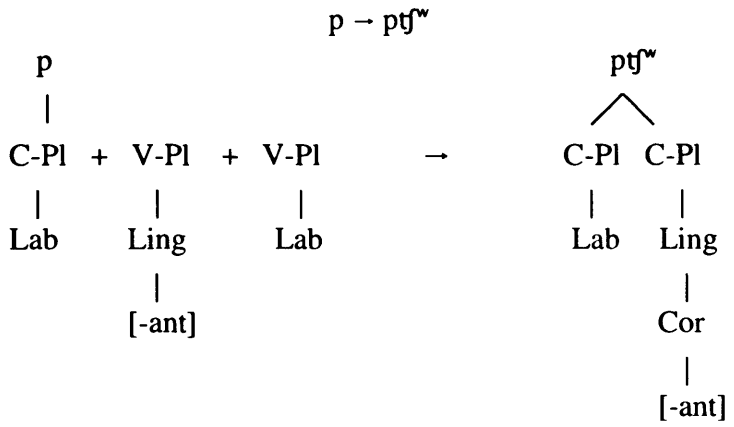
The spectrograms in Figures 2-2 and 2-3 showed us that there was no critical difference in the duration of [ʧʷ] and [pʧʷ], respectively. This is supported by the similarities found in the gestural scores of these two sounds. Similar to [pʧʷ], in the production of /ʧʷ/ the onset of movement for the Lips and Tongue Tip gestures coincides. However, for the Lips gesture, the constriction degree is narrow from the onset up to the end of the gesture. This is to effect the production of the approximant. The Tongue Tip gesture, on the other hand, starts off as closed to produce the [t]; which means there is a simultaneous production of [tʷ] from the onset of the gesture. While the Lips gesture is still at a narrow constriction, the Tongue Tip gesture is followed by a critical position for the production of [ʃ]. With both gestures being activated, this leads to the production of [ʃʷ].

The above discussion has shown us that the changes in the patterns of overlap between gestural units can produce different types of phonetic realizations. Nonetheless, the phonetic realization of the two segments has been captured by a combination of the same gestures. In the articulation of both segments the Lips and Tongue Tip gestures are involved. In addition, the onset of the gestures in both segments is simultaneous. The only difference is in the Constriction Degree at the lips; it is closed at the onset for the production of [pʧʷ] whereas it is narrow for [ʧʷ]. Nevertheless, the gesture responsible for the production of the secondary lab is activated at the same time in both segments. In addition, the behaviour of the Tongue Tip gesture is the same in the articulation of these segments; it is closed at the onset and narrows at the release. Thus a difference in overlap in Sesotho is not enough to

cause a phonological distinction between the two segments. I attribute the difference to speaker variation. Therefore it cannot be distinctive in the language.[5]

One might alternatively imagine that [ptʃ] has a C-Place Lab accomplished by promotion of the V-Place Cor to a C-Place node and preservation of the primary place of the labial. The output is a segment with two primary places of articulation[6]. This though results in what phonetically represents a consonant cluster. Under this different view, Sesotho [ptʃʷ] looks like this:

(11)



Coronal promotion and preservation of the primary place of the target segment en route to loss of primary Lab is rare. I have argued that this is <u>not</u> an accurate description of modern Sesotho. However, I follow Ohala (1978:372) who considers it as an intermediate stage of palatalization. To support his argument he provides examples from a Romance dialect where the sequence of a labial and a high front vocoid becomes an alveopalatal in Ganoese and neighbouring dialects. He further provides examples from Bantu languages where the same sequence results in different forms for different languages. For example, the Proto Bantu word /*biad/ 'plant v.' becomes /βyal-/ in Konde; /bzar-/ in Sena; and /ʤal-/ in Southern Sotho (Sesotho). If it is assumed, as Ohala has suggested, that the [ptʃʷ] is an intermediate stage in the derivation of [tʃʷ] then it fits the explanation that it is the older speakers that use this form. The younger speakers will obviously use the form as found in Ohala's final stage [tʃʷ]. Nonetheless, I have already shown in the above discussion

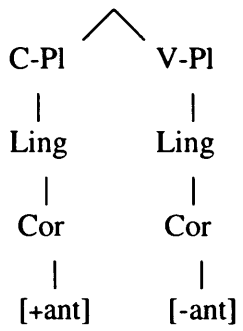
[5] According to my informant, the 'clusters', like [ptʃʷ], are prevalent with the older generation. The younger generation uses the alternate form, for example [tʃʷ].

[6] Approximants such as /w/ are not considered to be segments with two closures (Ladefoged and Maddieson 1996:328). Therefore the conditions on complex segments apply only to C-Place segments.

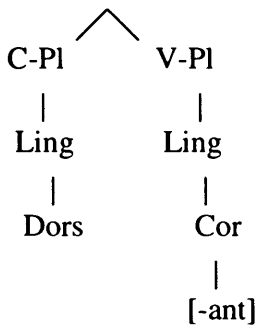
that the so-called consonant cluster is phonologically not different from the other sounds that result from labial palatalization. The language has moved on and does not realize it as a consonant cluster.

I now turn to inputs with alveolar and velar consonants. The [cor] feature is not realized on alveolar and velar consonants in the passive and locative, that is, it has no [t^{y}] or [k^{y}][7]. The representations of [t^{y}] and [k^{y}] are illustrated in (12) and (13) respectively.

(12)



(13)



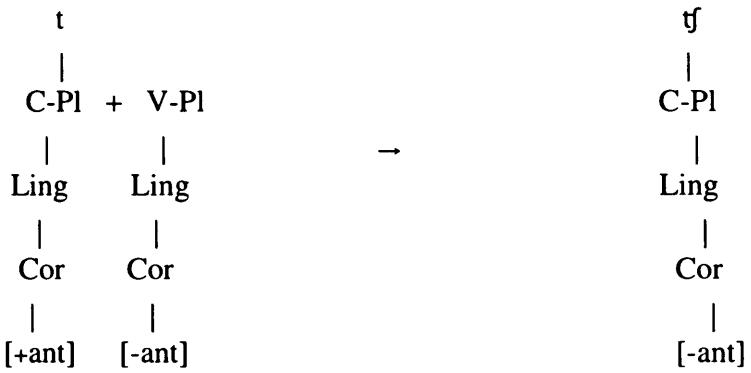
Notice that in the ill-formed representations in (12) and (13) the C-Place and V-Place nodes both dominate the feature Ling; the result is a complex segment formed from two lingual articulators. I argue that the ill-formedness is related to the restriction on the occurrence of complex segments from the same node, and therefore propose that a constraint *LINGLING, in Optimality Theory, is ranked high in these languages. Recall that there was no labialization of labials in (7). The result would have been a complex segment formed from two labial articulators violating another constraint, which I will refer to as, *LABLAB. Now, compare these segments with the other complex segments [t^{w}] and [k^{w}] in (6b) and (6c) respectively. These are accepted by the grammar since they result from different articulators; lingual and labial. The constraint *LINGLAB must therefore be low-ranked in these languages.

In diminutive forms there is palatalization of both labials and alveolars. I assume that palatalization in both types of segments is also triggered by a V-Place Cor. Palatalization of labials results from a similar process to that of passives, without the labialization (see (8)), while that of an alveolar is provided by the schematic representation in (14).

---

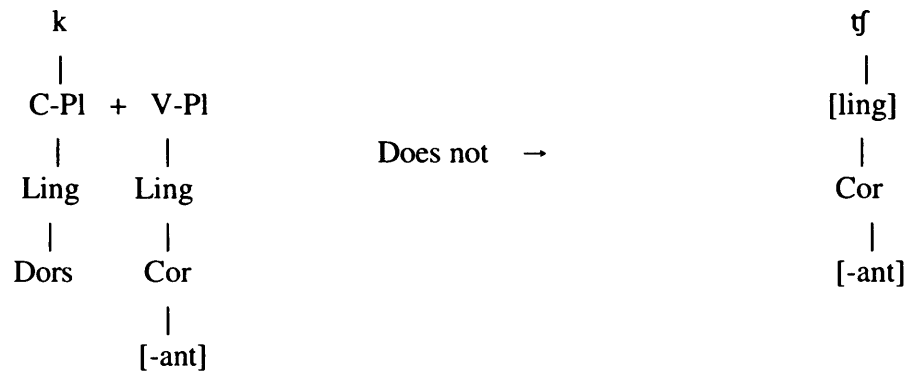
[7]In diminutives /t/ → [ʧ]. The representation of this process will be provided shortly.

(14) t → ʧ



The process involved in (14) is the same as that of labial palatalization. The features of the palatal trigger spread to the alveolar's C-Place, instead of the labial, in this case. The result is a Cor dominated by a [-ant]. There is no spreading of the V-Place coronal to a C-Place dorsal in all the languages that I investigate, that is, velars do not end with Ling Ling, like (13) (see (15))[8].

(15) *k → ʧ



The above feature geometry model will be able to account for the outputs of palatalization as observed in the passive, diminutive and locative. In all three processes a V-Place Cor links to the target's C-Place node. Different languages differ in the way the [cor] links to the target segment. It may replace the target's C-Place features or it may be superimposed onto the C-Place, thereby being secondary articulated. In the analyses in Chapters 3, 4, and 5, the inputs and outputs will be assumed to have the features motivated in this section, and the differences between

[8] Motivation for the lack of palatalization in velars will be provided under the analysis in Chapter 3.

languages and different affixes will be attributed to other properties of the Optimality Theory grammars.

2.2 Syllable structure

As typical of Bantu languages, siSwati displays an open syllable structure consisting of a vowel which may be preceded but never followed by a consonant (C)V. In addition to this, the language has a syllabic nasal [m].

SiSwati has, in addition to the segments shown in Table 2-1, prenasalised segments.[9] These are phonetic units which are characterized by a raising of the velum during the articulation of the consonant. The two components of the unit are always homorganic (Herbert 1995). The treatment of prenasalised consonants within the phonological literature has much in common with the analysis of other complex units, most particularly, affricates. However, there is no concrete agreement on the representation of these segments in Bantu languages, in general.

Nasal + consonant (henceforth NC) sequences, in Bantu, have been interpreted as either clusters of homorganic nasal plus consonant, and are sometimes analysed as unitary segments.[10] Different criteria have been used to distinguish the two. One criterion, according to Herbert, is duration: prenasalised consonants exhibit the surface length of single consonants whereas NC sequences present the surface duration of two segments. Examples of other criteria are; if an NC sequence is to be interpreted as a unitary segment, (i) it should occur in word-initial position; (ii) there should be no separate tones for the N and C in a cluster; (iii) in reduplication, the NC should be copied as a unit; and (iv) it should not result from concatenation of different morphemes. Another argument put forward to support a prenasalised segment in Bantu languages is the fact that they have an open syllable structure; hence, they cannot have codas. Nonetheless, Downing (2005) does not consider a general syllable structure to be a strong argument. She argues that cross-linguistically, there are languages which allow codas in certain positions only: this could be the case in Bantu languages. Hyman (2003) suggests a diachronic

[9] I do not include these segments in the phonemic inventory provided in Table 2.1 because of the controversy surrounding their representation, as the following discussion reveals.

[10] For a discussion on the difference between prenasalized segments and NC clusters in Bantu, see Kula (2002), Downing (2005), Hyman (2003), among others.

explanation for the appearance of NC sequences in initial position. He observes that in Proto Bantu nouns and verbs did not begin with NC segments, so the languages which show up with such segments must have lost the root-initial syllable. In support of his argument he cites an example from Kalanga, /ngina/ 'enter' which is derived from Proto-Bantu /*jingid-/. For siSwati, though, one is tempted to treat these segments as unitary. Apart from nominal classes 9 and 10, where the N and C are separated by a morpheme boundary, they conform to all the above conditions.

Having said all that, the difference in the representation of NC segments will not affect the analysis of the issues that are investigated in this thesis. I therefore do not provide a formal analysis of these segments in siSwati.

Consonants, in siSwati, may also be realized with labial secondary articulation, but not palatal. Like NC sequences, there are different interpretations of a consonant + glide sequence; it is either interpreted as forming an off-glide to the preceding consonant [C^w], as I have represented them here, or it is syllabified as part of an onset to form a consonant-glide sequence [Cw]. Those who argue for a consonant-glide sequence (Maddieson 1992, Myers 1990), propose that since the consonant and glide are produced as a sequence, their phonological representation should also reflect their phonetic representation (Downing 1996). However, for NC sequences and affricates in Shona, Myers proposes that as the language does not allow consonant clusters in its syllable structure these contour segments should be analysed as unit segments. In Setswana, Herbert (1977) argues that the use of /w/ in conjunction with a consonant represents a unit articulation since labializations runs throughout the consonant. I have no phonetic evidence on the proper representation of these segments in siSwati. However, for phonological reasons, I will treat the sequence as a labialization of the preceding consonant: They can be used word-initially ($s^weŋk'$-a 'dress up'), they can be reduplicated as a unit (k^{hw}el-a → k^{hw}el-a-k^{hw}el-a 'climb a little'. A more detailed study of their status in siSwati is a subject for future research. Therefore, because of their controversial status in Bantu in general, such forms are also not included in the segmental inventory.

2.3 Vowel hiatus

Many languages do not tolerate vowel hiatus. Potential vowel hiatus between morphemes in siSwati is always resolved using one of several strategies. The choice between these strategies is influenced by a number of factors as we shall see in Chapter 4, where I discuss nominal palatalization. Vowel hiatus, in siSwati, is also seen in reduplication of vowel-initial roots, which I discuss in Chapter 3. The reason behind this is that, in general, languages do not like onsetless syllables. So, if a language has neither long vowels nor diphthongs, the vowels have to be reduced to one in one way or the other. Examples of strategies to resolve hiatus in siSwati are presented next.

2.3.1 Vowel Deletion

In a sequence of vowels, one vowel may be deleted; for example, in diminutive forms (see (17)).

(17)	li-ɦeʤe-ana	→	li-ɦeʤ-ana	'small gate'
	li-buɓesi-ana	→	li-buɓes-ana	'small lion'

2.3.2 Labialization

If the preceding vowel, in a sequence ends in a round vowel, there will be labialization. This is a common occurrence in locatives and diminutives, as we shall see in Chapter 4. Examples are provided in (18).

(18)	ɓu-so-ana	→	ɓu-sʷ-ana	'small face'
	t'in-ɮu-ana	→	t'in-ɮʷ-ana	'small houses'

The round vowel, instead of deleting, as in (17), retains its labial feature and labializes the preceding consonant.

2.3.3 Vowel coalescence

Vowel coalescence corrects a vowel sequence structure by fusing the two offending vowels. This results in features of both vowels being realized in the resultant vowel.

This process may be seen in the formation of demonstrative pronouns. These pronouns are formed by prefixing the formative /la-/ to a vowel subject marker (SM). Examples are provided in (19).

(19)	Formative		SM		Pronoun	
	la	+	u	→	lo	'this one'
	la	+	i	→	le	'these'

The vowel /o/ in the demonstrative /lo/ has the [+back] feature of the SM /u/ and the [-high] feature of the vowel /a/. The /e/ in /le/ has the [-back] feature of the SM /i/ and the [-high] feature of /a/.

2.3.4 Glide formation

Glide formation may occur when the vowels /i, u/ are followed by other vowels, for example, when a vowel subject marker precedes a vowel-initial verb root (VR), as shown in (20):

	SM		VR			
(20)	u	+	eɓ-a	→	weɓ-a	'he/she steals...'
	i	+	eɓ-a	→	yeɓ-a	'it steals...'

The high vowel desyllabifies and reassociates with the following syllable as its onset. The labial vowel /u/ becomes the labio-velar glide /w/ while the Cor vowel /i/ becomes the Cor glide /y/.

2.3.5 Glide Insertion

The language may also resolve hiatus by inserting a glide between two vowels. This is a common process observed in reduplication, when the verb root begins with a vowel

(21)				
	akʰ-a	→	akʰa-y-akʰa	*akʰaakʰa
	eɓa	→	eɓa-y-eɓa	*eɓaeɓa

2.4 Suprasegmental structure

SiSwati is a tone language, with a High tone underlyingly, and the Low tone filled in by default (see section 6.2 for a full discussion of tone in siSwati).

2. 5 Evidence for a minimality constraint

Within standard Prosodic Morphology (McCarthy & Prince 1993/2001, cf. Downing 1994, 1997) a minimal word is a binary foot, either bimoraic or bisyllabic. A degenerate foot is completely banned as a possible minimal word, the reason being that it fails to satisfy foot binarity (Ola 1995). McCarthy & Prince (1993/2001) argue that this falls out from the Prosodic Hierarchy:

(22) Prosodic Hierarchy (McCarthy & Prince 1993/2001)

Prosodic Word
|
Foot
|
σ
|
μ

From the above hierarchy, McCarthy & Prince observe that, each element must contain at least one of the units it immediately dominates. As a result each Phonological Word must contain at least one stress foot and each stress foot must contain minimally (and maximally) two syllables. Most languages obey this foot-binarity constraint, for lexical content words. Even in languages without stress-based alternating rhythmic feet there is still evidence from minimality for some kind of foot (Herman 1996). In most Bantu languages for example, monosyllabic stems are augmented in order to fulfil a minimality requirement of the language. Park (1995) gives examples from Swahili where submininal words are expanded to meet the minimal word length (see (23)).

(23)	mi	>	mimi	'I'
	si	>	sisi	'we'

The above words are reduplicated to meet the binarity requirement for Swahili words.

Likewise siSwati requires that a word be minimally two syllables. A range of processes provide evidence for this generalisation in siSwati.

2.5.1 Imperatives

Imperatives consist of bare (unprefixed) verb stems.

(24)	hamb-a	hamb-a	'Go!'
	gidʒim-a	gidʒim-a	'Run!'

However, monosyllabic stems only become meaningful imperatives when combined with the morpheme /-ni/ to make them bisyllabic (see (25)).

(25)	p^h-a	→	p^ha-ni	'Give!'
	f-a	→	fa-ni	'Die!'

2.5.2 Pronouns

The absolute pronoun is monosyllabic and to make it pronounceable, an additional syllable /-na/ is suffixed (see (26)).

(26)	ye-na	'him/her'.
	ɓo-na	'them'

Evidence that the /-na/ is not part of the pronoun comes from derivation of other grammatical categories from this pronoun. Both adverbs and possessives fail to insert the /-na/ after prefixing their different formatives to the absolute pronoun (see (27)).

(27)	Absolute pronoun	Adverb	Possessive
	t'o-na 'them 10pl.'	ku-t'o 'at/on them 10pl.' *ku-t'o-na	ya-t'o 'theirs 10pl.' * ya-t'o-na
	ɓo-na 'them 2pl.'	ku-ɓo 'at/to them 2pl.' * ku-ɓo-na	ya-ɓo 'theirs 2pl.' * ya-ɓo-na

The demonstrative pronoun may also provide evidence for a bisyllabic minimality constraint in the language. An optional /-na / is suffixed to monosyllabic pronouns.

(28)	lo	→	lo-na	'this one 1sg.'
	le	→	le-na	'this one 9sg.'

However, in bisyllabic pronouns suffixation results in ill-formedness, e.g. /lesi/ 'this one 8sg.' becoming *lesi-na.

2.5.3 Monosyllabic loan words

A CVC loan word is expanded to two syllables when borrowed into siSwati, while in Yoruba, the final consonant is deleted. The Yoruba data is from (Ola 1995). Compare the two languages in (29).

(29)	English	Yoruba	SiSwati
	'to pump'	pó	pompa
	'to pass'	pá	phasa

The reason for augmentation, in siSwati, is not to have an open syllable, as the equivalent forms from Yoruba show. This language truncates the loan words, where siSwati adds a vowel. Example from nouns, also confirm the binarity requirement of words in the language. I do not have Yoruba equivalents for the nouns, though.

(30)	English	SiSwati
	'key'	si-khiya
	'tea'	li-tiya

2.5.4 Reduplication

The reduplicant in siSwati is realized as a two syllable prefix. In the following examples the reduplicant is underlined.

(31)	pʰeɠ-a	pʰeɠa- pʰeɠ-a	'cook a little'
	memet-a	meme-memeta	'shout a little'

Monosyllabic stems are expanded by infixing an extra syllable /yi/ between the stems, so that the prefix is now two syllables.

(32)	pʰ-a	pʰa-yi-pʰ-a	'give a little'
	ɬ-a	ɬa-yi-ɬ-a	'eat a little'

2.5.5 Hypocoristic names

Hypocoristic names provide additional evidence for the validity of the two-syllable minimal restriction. The names are never shortened to one syllable or to three as the examples in (33) show.

(33)	Nhlanhla	→	Nhlanhla	*Nhla	
	Sandile	→	Sandi	*Sa	
	Thembisile	→	Thembi	*The	*Thembisi
	Nompumelelo	→	Mpumi	* No	*Nompume

2.3 Summary

In this chapter, the feature geometry adopted in this thesis has been presented and argued for. It was shown that a feature geometry that unifies consonants and vocoids is crucial for the palatalization observed in Southern Bantu languages since the [cor] either appears as a vowel, [i], or as a palatal consonant. In the next chapter, I demonstrate how this feature geometry can account for palatalization in the passive.

CHAPTER 3

THE PASSIVE

We saw in Chapter 1 that some phonological features may function as grammatical morphemes, for example, the third masculine object in Chaha which is triggered by a [+round] feature. In this chapter, I discuss palatalization in siSwati, and argue that palatalization in this language is triggered by a floating palatal feature [cor]. To illustrate this proposal, this chapter discusses the passive, which has, in addition, the feature [lab] as part of the morpheme. The feature geometry presented in Chapter 2 illustrated how a model that represents both consonants and vowels with the same feature was an advantage to the analysis of the passive: the [cor] feature may either appear as a consonant or as a vowel, depending on prosodic requirements. This chapter also includes a discussion of the interaction between the passive and reduplication, where I show that the need for identity between the base and reduplicant may lead to 'overaplication' of the passive process. I use the framework of OT to analyze the data and demonstrate that an interaction of morphological and phonological constraints achieve the expected results.

3.1 SiSwati verb

Central to the discussion of the passive and tonal phonology, which I discuss in Chapter 6, is the verb root; hence, an outline structure of the verbal complex is essential. SiSwati displays a (C)V structure and is a typical Bantu language in that it is highly agglutinative. Morphemes can be affixed either before or after the verb root. According to whether the action expressed by the verb is positive or negative, the verb will have the structure in (1).

(1)

NEG-	SM - TAM_1-	[OM-	Verb root-	D-suffixes-	TAM_2-
	Final vowel (FV)]$_{MStem}$				
a-	ɓa-	no-	[si-	bal- el-	a] $_{MStem}$
NEG	SM 2 pl	FUT(neg,)	OM 7 sg	write appl.	FV

'They will not write for us'

In (1), NEG is the position for the negative marker, which may be used with the final vowel /a/, as the example in (1). Nonetheless, the vowel /-i/ replaces the vowel /-a/ in negative forms. SM and OM refer to the subject and object markers respectively which are based on a nominal classification system. The OM slot may also be filled in by a reflexive marker /-ti-/. These two morphemes may not co-occur. TAM is the slot for tense-aspect-mood. In siSwati the future tense occupies the TAM_1 slot, while the past and perfect tenses occupy the TAM_2 slot. D-suffixes is reserved for the derivational suffixes which are optional. The final vowel slot is generally, filled in by the vowel /a/, nonetheless, it may be filled in by the vowel /-e/, when, for example, the verb is in the positive subjunctive mood or it may be filled in by the vowel /-i/ in most negative forms. Note that the template is subject to co-occurrence restrictions; not all slots can be filled in at the same time.

It is a well-known fact about the Bantu verb phrase that, for purposes of phonological analysis, it allows different morphological domains. According to Hyman and Ngunga (1994), Myers (1994) the verbal phrase in Bantu languages could be divided into a Macrostem and a Phonological word: the Macrostem is the part that consists of the verb root plus suffixes and in addition the object marker. The Phonological word includes the Macrostem plus morphemes before the object marker. For example, the word /ɓa-ya-si-fundz-el-a/ 'They read for us' would have the structure /[[ɓa-ya[si-fundz-el-a]$_{MStem}$]$_{PhWd}$. In his (1998) paper, Myers further groups the morphemes before the Macrostem under what he refers to as an Inflectional Stem (tense, aspect and modality). A combination of morphemes from the two stems comprises a Phonological Word. According to Myers, dividing a verb into these two components is useful in defining the domain of phonological rules. In Chapter 6, I show that the differences in tonal behaviour of the siSwati verb may also be influenced by the morphological domain of the underlying tone.

3.2 Aspects of palatalization in the passive

The passive has two allomorphs which are determined by two factors: (i) prosodic minimality and (ii) the place value of either a root-final or a root-medial consonant. The morpheme /-iw-/ is suffixed to C verb roots and to VC roots, while /-w-/ is suffixed to roots longer than (V)C. Root-final labials and root-medial labials surface

with palatalization in addition to the suffixation of /-w-/. Root-initial labials are impervious to palatalization. Palatalization and the morpheme /-iw-/ never co-occur. The following data, (2) to (5) is grouped according to the shape of the root while (6) through (8) is presented according to the position of the labial consonant on the verb root.

3.2.1 Data survey

Verb roots consisting of a single consonant take the allomorph /-iw-/:

(2)	ɬ-a	ɬ-iw-a	'be eaten'
	p^h-a	p^h-iw-a	'be given'
	v-a	v-iw-a	'be heard'
	mb-a	mb-iw-a	'be dug'

The same allomorph is selected by VC roots:

(3)	eɓ-a	eɓ-iw-a	'be stolen'
	ak^h-a	ak^h-iw-a	'be built'
	os-a	os-iw-a	'be grilled'
	al-a	al-iw-a	'be refused'

Roots longer than (V)C take the allomorph /-w-/, which appears as secondary labial on the stem-final consonant. This is true of both C-initial (see (4)) and V-initial roots (see (5)).[11]

(4)	ɬeɠ-a	ɬeɠ^w-a	'be laughed at'
	$p^h$is-a	$p^h$is^w-a	'be brewed'
	sit'-a	sit'^{w}-a	'be helped'

(5)	embes-a	embes^w-a / mbes^w-a	'be covered'
	eluɠ-a	eluɠ^w-a / luɠ^w-a	'be woven'
	ep^hu-l-a	ep^hul^w-a / p^hul^w-a	'be broken'

When the verb root ends in a bilabial consonant there is a change of primary place of articulation of this segment to a palatal. Representative data are given in (6).

(6)			
	kʰam-a	kʰaɲʷ-a	'be throttled'
	ɬeɓ-a	ɬetʃʼʷ-a	'be gossiped about'
	gub-a	gudʒʷ-a	'be dug'
	kʰipʰ-a	kʰiʃʷ-a	'be removed'

This holds also for borrowed words, examples of which appear in (7).

(7)			
	rab-a	radʒʷ-a	'be erased'
	tʰayipʰ-a	tʰayiʃʷ-a	'be typed'
	k'op'-a	k'otʃʷ-a	'be copied'
	mp'omp'-a	mp'oɲtʃʷ-a	'be pumped'

Labial consonants may also palatalize even when they are not root-final. (8) shows examples of CVCVC verb roots with a medial labial consonant.

(8)			
	futfumet'-a	futfuɲet'ʷ-a	'be warmed up'
	sipʰul-a	siʃulʷ-a	'be uprooted'
	kʰumul-a	kʰuɲulʷ-a	'be undressed'
	seɓent-a	setʃ'entʷ-a	'be worked'
	dʒaɓul-a	dʒatʃ'ulʷ-a	'be glad about'

Root-initial labials do not palatalize in siSwati, as illustrated in (9).

(9)			
	ɓiŋelel-a	ɓiŋelelʷ-a	'be greeted'
	ɓit'-a	ɓit'ʷ-a	'be called'
	mboɲ-a	mboɲʷ-a	'be covered'
	pʰeɠ-a	pʰeɠʷ-a	'be cooked'

Ziervogel & Mabuza (1976) consider the change of /tsʰ, dz/ to [tf, dv] as induced by the passive morpheme (see (10)).

(10)			
	kʰetsʰ-a	kʰetfʷ-a	'choose'
	pʰindz-a	pʰindvʷ-a	'repeat/add'

[11] These longer verb roots may begin with vowels, but unlike VC roots they may discard the vowel, resulting in alternatives, one with an initial vowel and the other without (Ziervogel and Mabuza 1976: 75).

Although this change is observed in the passive, it not specific to this morpheme but is observed in the language in general. /ʦʰ, dz/ becomes [tf, dv] when followed by a Lab vocoid. The change when passivized is due to the labial portion of the passive morpheme. The examples in (11) illustrate the point.

(11)	(a)	ʦʰaʦʰ-a	'take'	
		ʦʰel-a	'pour'	
		ʦʰinʦʰ-a	'touch'	
		gidz-a	'dance'	
		lomu-dze	'the tall one'	
		dziliʃ-a	'fall'	
	(b)	tfos-a	'fry'	*ʦʰos-a
		tfuʦʰ-a	'move'	*ʦʰuʦʰa
		dvons-a	'pull'	*dzons-a
		dvum-a	'thunder'	*dzum-a

The phonemes /ʦʰ, dz/ are used only when the following vowel is /a, e, i/ as illustrated in (11a) while [tf, dv] is used with labial vocoids as in (11b).

The segmental alternations which occur under labial palatalization are summarised in (12).

(12) Segmental alternations in labial palatalization

Input	Output
p'	ʧ'
pʰ	ʃ
b	ʤ
ɓ	ʧ'
m	ɲ

The passive can co-occur with other extensions. Palatalization occurs even if other morphemes intervene between the root and the passive morpheme. In (13) palatalization occurs across the causative /-is-/ and the applicative /-el-/.

(13) Be V...(+caus.) (+appl.)

gub-a	gub-is-a	gudʒ-isʷ-a	'dug'
	gub-is-el-a	gudʒ-is-elʷ-a	'dug'
seɓent-a	seɓent -is-a	setʃ'ent-isʷ-a	'work'
	seɓent -is-el-a	setʃ'ent -is-elʷ-a	'work'

The general preferred order of the suffixes in most Bantu languages is causative, applicative, reciprocal, and passive (Mchombo 2002). Nguni languages, including siSwati, depart from this, preferring causative, applicative, passive, and reciprocal.

When there is a sequence of labials in a word, not including the initial labial which never palatalizes in the language, one of two things may happen: either both consonants are palatalized or one, the rightmost consonant. The choice of which one to palatalize depends on speaker preference. Consider the examples in (14).

(14)			
	pʰapʰam-a	pʰaʃaɲ-isʷ-a	'be awoken'
		pʰapʰaɲ-isʷ-a	'be awoken'
	pʰupʰum-a	pʰuʃuɲ-isʷ-a	'be overflown'
		pʰupʰuɲ-isʷ-a	'be overflown'

The verbs in (14) are intransitive and require the addition of an extension in order to be passivised; hence, the addition of the causative extension to the verb roots.

3.2.2 Representation of the passive suffix

As argued for, earlier, the passive morpheme is a featural affix divided into two parts. One is a palatal feature Cor [–ant], which docks onto the rightmost labial consonant and causes it to palatalize. The other part consists of a labial feature [lab] which appears as a /w/. Both features of the morpheme attach to the root-final consonant, if that consonant is a labial.As a reminder, in Chapter 2 I presented arguments in favour of the proposal that the palatal trigger is a V-Place Cor, and therefore dominating [-ant]. Consequently a change of the labial in the passive which is prompted by a V-Place Cor [-ant] results in a segment that is also C-Place Cor [-ant]. Consider the representation of the labial /b/ in /gub-a/ 'dig' and the palatal [dʒ] in the passivized form [gudʒʷa] 'dig pass.' in (15).

(15)

guba	→	gudʒʷ-a
C-Place + V-Place	=	C-Place
| |		|
Lab Cor		Cor
|		|
[-ant]		[-ant]

The idea that front vowels and palatals share a common feature has been extensively discussed in the literature. From now on, unless crucial to the discussion, the palatal trigger will be represented as [cor] and [-ant] will be omitted from the tableaux. The [cor] feature may attach to root-medial labials if there is no labial consonant on the right edge of the root. But the feature [lab] is always realized on the right edge of the root. We will see, in section 3.3, that ranking of a constraint MAX-PASS above ALIGN-R makes it possible for the [cor] feature to be realized either at the right edge or medial part of the root.

Featural morphemes are common cross-linguistically (Akinlabi 1996, Zoll 1996). For example, Japanese mimetics have a palatal feature (Mester and Itô 1989). The Yanggu diminutive is a floating feature (Yip 1992), which according to Yip has a bipartite morpheme consisting of /[lat] r/, with the [lateral] feature floating and the rhotic having its own root node. Yawelmani has a floating glottal feature. In Chaha the third masculine object is indicated by a [+round] feature (Akinlabi 1996 and the references cited therein).

For the C and VC roots, I argue in this thesis that both features of the morpheme appear as independent segments to fulfil a prosodic requirement (Zoll 1996), in this case the minimal size of a word. Words in siSwati should be minimally two syllables. Independent evidence for a minimality constraint in siSwati is discussed in section 2.5. Sub-minimal roots do not show palatalization but the vowel /i/ instead. I assume that this is also a realization of the palatal feature, as both palatal consonants and front vowels share the feature [coronal]. The /w/, on the other hand, has the feature [lab], and either causes secondary labialization or occupies the required onset position of the following syllable of the sub-minimal root.

The claim that front vowels are coronal is supported on both phonetic and phonological grounds (Clements & Hume 1995). Hume (1994) observes that for German and Hungarian the front vowel constrictions appear comparable to those involved in the production of palatal consonants. Both the vowel /i/ and palatals involve raising the tongue blade in their articulation (see Mester and Itô 1989, Clements & Hume 1995, Broselow & Ndiyondagara 1989, and Keating 1991). Clements and Hume in addition observe a phonological relationship between front vowels and coronals. Slavic palatalization of velars [k, g, x] to [č, ž, š,] occurs before front vowels and glides [i, e, y]. Another example is Cantonese: if the onset and coda of a given syllable are both coronal, any non-low vowel must be one of the front vowels [i, e, ü, ö].

3.3 Optimality Theory analysis

3.3.1 The basic constraints

I begin with a brief overview of the analysis. Labials are the segments most susceptible to palatalization in Southern Bantu languages. I assume that this is the result of constraints selecting the most or least favoured segment types in a language. (Un)markedness of segment types can be achieved by assuming the following constraints (16 to 18) and their ranking (19) (Prince and Smolensky 1993):

(16) *LAB: Do not parse Lab into a place node.
(17) *DOR: Do not parse Dor into a place node.
(18) *COR: Do not parse Cor into a place node.

(19) *LAB, *DOR >> *COR

The idea is that all associations are disfavoured as expressed in the constraints in (16 to 18), some more than others (19). However, these are balanced by the faithfulness constraints MAX-F, which prohibit deletion of features, and DEP-F, which block epenthesis of features (McCarthy and Prince 1995b). I propose the following faithfulness constraints (20 to 23) and ranking (24) for siSwati:

(20) MAX-Dorsal (MAX C-PL DOR[12]): Input primary dorsal place features have output correspondents.

(21) MAX-Coronal (MAX C-PL COR): Input primary coronal place features have output correspondents.

(22) MAX-Labial (MAX C-PL LAB): Input primary labial place features have output correspondents.

(23) DEP-F: Output features have input correspondents.

(24) MAX C-PL DOR, MAX C-PL COR >> MAX C-PL LAB >> *LAB

Ranking MAX C-PL LAB above *LAB means that, outside passivisation, the language prefers to retain the labial feature rather than change it to the least marked coronal. The tableau in (25) illustrates this point.

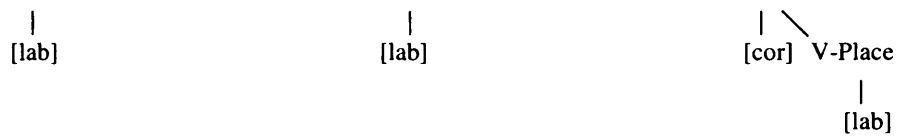
(25)

/ Pl, Lab /	MAX C-PL DOR	MAX C-PL COR	MAX C-PL LAB	*LAB
a.[ ]			*!	
b. [cor]			*!	
☞c. [lab]				*

Candidates (25 (a & b)) are both ruled out by MAX C-PL LAB because the feature [lab] has been deleted or replaced by [cor], respectively. Candidate (25c), on the other hand, shows us that it is better to retain the feature.

[12] The place feature in 17-19 refers to the C-Place. Consider the following representation which involves a [lab] feature:

a. C-Place e.g [p] b. V-Place e.g [u] c. C-Place e.g.[tʃʷ]



I use MAX-C- PL LAB, to refer to (a). A segment affected in passive formation has the structure in (a). It surfaces as a labialized palatal as represented by the structure in (c). It is necessary to make this distinction since later on in Chapter 4, where I discuss the locative and diminutive, we see phonological changes involving both vowels and consonants; the vowels will be represented by the structure in (b).

However, when the input contains a floating [cor] from some morpheme, as is the case in passive formation, that [cor] needs to be realized, and this may over-ride MAX C-PL LAB and result in deletion of the input labial feature, as in /seɓent-a/ → [setʃ'entʷ-a] 'work pass.'. I therefore include MAX-MORPHEME (26), in the analysis to ensure realization of the morpheme.

(26) MAX-MORPHEME (MAX-MORPH): All features associated with the morpheme in the input should be realized in the output. (This is a cover term for a set of three constraints (see 27 to 29)).

In fact, MAX-MORPHEME will be subdivided into three to cater for all the processes that I discuss: passive, locative, and diminutive.

(27) MAX-PASSIVE (MAX-PASS): All features associated with the passive morpheme in the input should be realized in the output.

(28) MAX-LOCATIVE (MAX-LOC): All features associated with the locative morpheme in the input should be realized in the output.

(29) MAX-DIMINUTIVE (MAX-DIM): All features associated with the diminutive morpheme in the input should be realized in the output.

The workings of MAX-PASS are illustrated in section 3.3.2 in the case of root-final labials, where MAX-PASS dominates MAX C-PL LAB. However, MAX-PASS comes below MAX C-PL DOR and MAX C-PL COR, so that /gig-a/ → [gigʷ-a] *gidʒʷ-a.

The passive morpheme always shows up on the rightmost labial even when that labial is not final. I assume that this is a result of competition between a constraint that requires the suffix to be properly situated at the right edge of the stem (alignment) and the constraints that preserve coronals and dorsals. The alignment constraint, adapted from McCarthy and Prince (1993), is defined in (30).

(30) ALIGN ([cor] [lab] L, Stem, R) (ALIGN-R): The morpheme must be realized on the right edge of the stem.

The effects of ALIGN-R will be seen on root-medial labials discussed in section 3.3.4.

3.3.2 Root-final labials: Loss of root [labial] feature

The data in (6 and 7) illustrate that root-final labials palatalize in passive forms. Examples of the data are repeated in (31).

(31)	ɬeɓ-a	ɬetʃʼʷ-a	'be gossiped about'
	kʰipʰ-a	kʰiʃʷ-a	'be removed'

Ranking MAX-PASS above MAX C-PL LAB will force the input labial to change its place of articulation to a coronal. (32), formalises the analysis.

(32) Loss of root [labial] feature

/kʰulum[cor][lab]-a/	MAX-PASS	MAX C-PL LAB
a. kʰulum-a	*!	
☞b. kʰuluɲʷ-a		*

In (32), candidate (32a) has kept the input labial at the expense of realizing the morpheme and therefore incurs a fatal violation of MAX-PASS. Candidate (32b) realizes the morpheme by replacing the labial with a coronal. This results in MAX C-PL LAB being violated. However, the violation is minimal as MAX C-PL LAB is ranked below MAX-PASS. One other potential candidate would be one that realizes the coronal as a secondary articulation to the labial consonant that is a V-Place coronal as opposed to a C-Place coronal. This candidate would satisfy both MAX-PASS and MAX C-PL LAB, and hence perform better than the optimal candidate. However, the language prohibits coronal secondary articulation on any segment, though it does allow labialization of non-labial segments.

Nonetheless, there are languages that accept coronal secondary articulation. I, therefore, assume that cross-linguistically, there is a family of constraints which regulate the combination of C-Place and V-Place features. Some combinations are acceptable while others are not, depending on the language particular grammar. Most Southern Bantu languages, for example, do not allow a combination that involves two labial or two lingual places of articulation. This means that the grammar of the

language ranks the feature combination constraints, which I refer to as, *LINGLING, in (33) and *LABLAB, in (34), top in the hierarchy.

(33) *LINGLING: No segment with C-Place Lingual and V-Place Lingual.
(34) *LABLAB: No segment with a C-Place Labial and V-Place Labial.

Included in this family of constraints are also those that prohibit combinations that use different articulators: *LABLING, in (35) and *LINGLAB in (36).

(35) *LABLING: No segment with a C-Place Labial and V-Place Lingual
(36) *LINGLAB: No segment with a C-Place Lingual and V-Place Labial.

Since the [cor] does not appear as secondary articulation in siSwati and is classified as a lingual in the feature system that I am using, *LABLING must be ranked high as well. *LABLAB should be ranked low, to allow Lab Lab sequences outside passivization. A sequence of labials in the passive will be ruled out by MAX-PASS. This leads to the ranking in (37).

(37) *LINGLING, *LABLING >>*LINGLAB, *LABLAB

Together with MAX C-PL LAB in (22), this provides us with an account of why the [cor] does not surface as a secondary articulation, as illustrated in the following tableau (38). More examples will be discussed under the passivisation of roots containing velar and alveolar consonants which I discuss shortly.

(38) Failure of [cor] secondary articulation

/kʰulum[cor][lab]-a/	*LABLING	MAX-PASS	MAX C-PL LAB	*LABLAB	*LINGLAB
a. kʰulumʸa	*!				
b. kʰulumʷa		*!		*	
c. ☞b. kʰulɲʷa				*	*

Candidate (38a) combines features from different places of articulation; C-Place Labial and V-Place Lingual, but because such a combination is not allowed in the language, it incurs a fatal violation of *LABLING. Candidate (38b), on the other hand, does not palatalize the root-final labial, but simply labializes it, violates the

constraint MAX-PASS since the [cor] part of the morpheme is not realized. Although the winning candidate also combines features from different places of articulation, it has the opposite combination: a C-Place Lingual and a V-Place labial. This combination is allowed in the language, hence the position of the constraint in the hierarchy. The next section discusses passivisation in root-final alveolar and velar consonants.

3.3.3 Alveolar and velar consonants

Alveolar and velar consonants do not palatalize in siSwati, as shown in the examples in (4 and 5) repeated in (39).

(39)			
	ɬeɡ-a	ɬeɡʷ-a	'be laughed at'
	fut'-a	fut'ʷ-a	'be resembled by'

The constraints MAX C-PL DOR and MAX C-PL COR make sure that the coronal and velar places of articulation specified in the input reach the output. (See section 4.3.1.5 for a detailed discussion on why alveolars palatalize in the diminutive but not in the locative and passive). Secondary coronal articulation on these segments will be prevented from appearing in the output by the constraint *LINGLING since the floating [cor] is dominated by the Lingual node as well. [13] One other way in which the [cor] could be realized, without violating the above constraints, would be for it to appear as a separate segment with its own root node. However, this would create a consonant cluster; a structure not allowed in the language, as already discussed in section 2.2. The constraints NO-CODA, in (40), and *COMPLEX ONSET, in (41), added to the normal phonological grammar in an undominated position, result in open CV syllables.

(40) NO-CODA: Syllables are open.

(41) *COMPLEX ONSET: Onsets are simple.

[13] Zoll (1996), in her analysis of floating features makes use of the general constraint: Segment Structure Constraint to govern possible feature combinations in a particular language. I use the constraint specific to coronal secondary articulation instead, since the ranking of MAX C-PL COR and MAX C-PL DOR above MAX-PASS prevents the [cor] from being realized on dorsals and alveolars.

The ranking as developed so far is given in (42). In the following ranking and tableau (43), I use the shorthand *CC to represent the constraints in (40 and 41).

(42) *CC, *LINGLING, *LABLING, MAX C-PL DOR >> MAX-PASS >> MAX C-PL LAB >> *LABLAB, *LINGLAB *LAB.

Tableau (43) shows only candidates with proper alignment.

(43) Failure of palatalization on dorsals

/gig[cor][lab]-a /	*CC	*LINGLING	MAX C-PL DOR	MAX-PASS
a.gigdʒʷ-a	*!			
b.gigʸ-a		*!		* [lab]
c. gidʒʷ-a			*!	
☞ d.gigʷ-a				* [cor]

Candidate (43a) has realized the [cor] feature as a separate segment, but in that way it creates a consonant cluster with the root-final dorsal and this results in a violation of *CC. This candidate violates both constraints under *CC depending on how one syllabifies the cluster. If, for example, the cluster is heterosyllabic, NOCODA would be violated. If, on the other hand it is tautosyllabic, then *COMPLEX ONSET would rule the candidate out. (43b) realizes the [cor] as a secondary articulation to the velar. Consequently, a violation of the higher-ranked *LINGLING is incurred. Further, this candidate does not realize the [lab] part of the morpheme hence the violation of MAX-PASS. (43c) realizes both features of the morpheme. Moreover, the features are realized in a similar manner to root-final labials; hence, one would expect this candidate to win. However, replacing a dorsal with a coronal leads to a fatal violation of MAX C-PL DOR since dorsals are immune to palatalization in siSwati and MAX-PASS is ranked below MAX C-PL DOR. This ranking also explains why candidate (43d) is the winner even though it does not realize the [cor] part of the morpheme. In addition to the violation of MAX-PASS, the optimal candidate also violates *LINGLAB, which is not shown in this tableau. This further justifies the ranking of this constraint low in the hierarchy, in particular below MAX C-PL DOR. One other potential candidate is one that realizes both features of the morpheme as independent segments */gig-iw-a/. This candidate would satisfy all the constraints in

(43) and therefore perform better than the optimal candidate. However, including the constraint DEP-μ, and ranking it above MAX-PASS, rules this candidate out. See section 3.3.6, for a motivation of this constraint.

3.3.4 Root-medial labials

As we have already seen, in (6 and 8), the [cor] can only replace labials in the passive. Moreover, in root-medial labials with non-labials finally, only the [cor] works its way into the base. The labial remains on the right edge of the root /gamula/ → [gaɲulʷa] 'break (pass.)'. This results from alignment constraints competing with the constraints that preserve coronals and dorsals. ALIGN-R treats the morpheme as a suffix, but the morpheme content is a feature. Violation of this constraint is incurred if one of or all the features of the morpheme are not aligned with the right edge of the stem. Each intervening segment will count as a separate violation. In (44), I analyse candidates with a root-medial input. Root medial labials show the dominance of MAX-PASS over ALIGN-R. In the sections that follow I do not discuss candidates which violate the *CC constraints.

(44) Palatalization on root-medial labials

/ gamul[cor][lab]-a /	MAX C-PL COR	MAX-PASS	ALIGN-R
a. gamuλʷ-a	*!		
b. gamulʷa		*! [cor]	
c. gaɲʷula			**!
☞ d. gaɲulʷ-a			*

The input in (44) does not have a labial segment root-finally, but instead, a coronal. The only labial segment is on the root-medial syllable. In such forms, realizing the morpheme is more important than proper alignment. Candidate (44a) which, realizes the [cor] on the input final coronal results in a violation of MAX C-PL COR. Input coronal segments should not be deleted in passive formation. To avoid a violation of MAX C-PL COR and to obey ALIGN-R, candidate (44b) does not realize the [cor] feature at all. MAX-PASS is therefore violated, as it requires both features to be realized. However, REALIZE AFFIX, as used in the literature, would qualify this candidate as optimal. This constraint requires that the morpheme be realized in the output, just like MAX-PASS. But for REALIZE AFFIX, it could be one or all the

features of that particular morpheme, satisfaction is guaranteed. In the Yanggu diminutive, for example, which has a bipartite morpheme ([lat] r) (Yip 1992), outputs with either the lateral or rhotic do satisfy REALIZE AFFIX. In siSwati both features of the morpheme need to be realized. It is for this reason that I use the constraint MAX-MORPHEME, in this case MAX-PASS. Ussishkin (2005), in his analysis of Modern Hebrew uses the constraint MAX-AFFIX; instead, which also requires that all the features of the affix be realized in the output. For example, in his derivation, by addition of an affix /hi...i/, of the word *higdil* 'he enlarged' from the base *gadal* 'he grew'; a candidate like **higadal*, although having realized the prefix /hi/, is ruled out by MAX-AFFIX since the remaining /i/ part of the affix has not been realized.

I return to the candidates in (44). We have mentioned that the [cor] feature can move into the root but the [lab] feature does not have to move because it can always be realized at the right edge and be a secondary articulation on any consonant. Candidate (44c), which misaligns both features, incurs two violations of ALIGN-R, while the optimal candidate has only one. The violation is fatal for candidate (44c), while it is minimal for the optimal candidate. (44 (b and d)) motivate the ranking of MAX-PASS above ALIGN-R; hence, (44d) is the winner. Recall that secondary palatalization, as in [lʸ], is not allowed in siSwati, so the [cor] must move into the root to be realized. Another candidate [gamʷulʸa] would violate *LINGLING and the low-ranked *LABLAB.

In (45), I analyze candidates whose input has a labial segment both medially and finally (ignoring the initial labial which never palatalizes in the language: see section 3.3.5 on root-initial labials, which I discuss shortly).

(45)

/pʰapʰam[cor][lab]a/	MAX-PASS	ALIGN-R
a. pʰaʃamʷa		*!
b.☞ pʰapʰaɲʷa		

ALIGN-R prohibits misalignment of the morpheme with the right edge of the stem. In (45a) the [cor] docks onto the root-medial labial, and skips the labial on the right edge of the root. This leads to a fatal violation of ALIGN-R. There is no reason for the [cor] to move into the root in this candidate since there is a palatalizable segment

on the right edge of the root. Compare this candidate with the candidate in (44d), where the root-final segment was not a labial and therefore not palatalizable. The [cor] had to move into the root to dock onto the labial segment. Candidate (45b), on the other hand, realizes the morpheme on the root-final labial and therefore satisfies ALIGN-R[14].

3.3.5 Root-initial labials

Root-initial labials are not palatalized in siSwati, as the examples in (46) show. And with no labial consonant anywhere else in the word, the [cor] fails to appear.

(46)	pʰeʃ-a	pʰeʃʷ-a	*ʃeʃʷ-a	'be cooked'
	bal-a	balʷ-a	*ʤalʷ-a	'be written'

Root-initial syllables resist phonological change in most languages (Downing 1998b). This has been attributed to a positional faithfulness constraint which requires that an output segment in the initial position of a word should remain faithful to the input (Beckman 1997; Kager 1999, cf Zoll 1996 for a different view). Beckman advocates the use of such constraints where neutralisation of segments in certain positions occurs. She further adds that ranking of these constraints should be such that the specific positional constraint is ranked higher than the general faithfulness constraint. This enables the initial syllable to retain its input features while change is allowed elsewhere. For the forms in (46), I use the same constraints suggested by Kager.

The constraint in (47) is added to the analysis and is placed in an undominated position in the constraint hierarchy since it is not violable in the language.

(47) IDENT-Pl, [$_{\sigma 1}$: An output segment in the root-initial syllable has the same value for place of articulation as its input correspondent.

The crucial ranking is between IDENT-Pl,[$_{\sigma 1}$ and MAX-PASS.

---

[14] There is yet another candidate, which I do not include in the above tableau, one that palatalizes both labials. This form is optionally accepted in siSwati. I assume that palatalization of both labials results from spreading of the [cor] feature from the root-final labial. Spreading of features in siSwati also includes tonal features which I discuss in Chapter 6.

marked vowel /i/, but after labial consonants /u/ is inserted, as the examples in (50) demonstrate. Epenthetic vowels are underlined.

(50)	box	[li-boʃisi]
	towel	[li-tʰawula]
	christmas	[kʰisimusi]
	stove	[si-t'ofu]
	tafel (Afrik.)	[li-t'afula]

In some cases, the insertion of the vowel /u/ is not to break consonant clusters but to replace a vowel that follows a labial consonant if that vowel is not /u/ in the donor language, e.g. /kʰisimusi/ 'christmas'. But in the passive the vowel that is used in augmenting monosyllabic roots is always /i/ even after labials, as in / pʰ-iw-a/ 'give'. Since the vowel is invariant, it means it must have a lexical source, the passive morpheme in this case.

The features of the morpheme only appear as independent segments to augment the subminimal roots. Independent evidence for a minimality constraint in siSwati has been discussed in section 2.2.1. The discussion supports the requirement for a minimality constraint in the language. The MINIMALITY constraint, in (51), is added to the constraint hierarchy to account for augmentation in monosyllabic roots. This is not done through the insertion of a default syllable, though, but through the features of the passive morpheme appearing as individual segments.

(51) MINIMALITY (MIN): A word must be minimally a foot.

To regulate epenthesis, we also need the faithfulness constraint DEP-μ in (52), which prohibits epenthesis of a mora in the output form.

(52) DEP-μ: Output moras have input correspondents.

DEP-F, which requires that output features have input correspondents, is also included in the analysis to ensure that only the features of the morpheme are used to augment the subminimal roots.

In (53) I analyze an input with a monosyllabic root. In this tableau I have omitted the constraint IDENT-Pl,[$_{\sigma 1}$.

(53)

/ ɮ[cor][lab]-a /	MIN	DEP-μ	MAX-PASS	DEP-F
a. ɮ^{w}-a	*!		*	
b. ɮ-aw-a		*	*! [cor]	*
c. ɮ-uw-a		*	*! [cor]	
☞ d. ɮ-iw-a		*		

Candidate (53a) is ruled out by a minimality requirement. Two syllables are required for siSwati words to be pronounceable. This candidate also violates IDENT-Pl,[$_{\sigma 1}$, which is not included in the tableau. This candidate has, in addition, labialized the input segment. Candidates (53 (b, c & d)) have inserted a mora each, and therefore tie on DEP-μ. The tie is determined by MAX-PASS for both candidates (53 (b and c)). These candidates have not realized the [cor] part of the morpheme as required by MAX-PASS. Candidate (53b) has inserted an additional feature, hence the violation of DEP-F. (Another candidate, /p^{h}uya/, is discussed shortly). The ranking of MIN above DEP-μ is justified if we consider (53a) vs (53d). DEP-μ should be ranked above MAX-PASS. Consider the following tableau with a two syllable input.

(54)

/gig[cor][lab]-a/	*LINGLING	MAX C-PL DOR	DEP-μ	MAX-PASS
a. gig^{y}-a	*!			
b. gidʒ^{w}-a		*!		
c. gig-iw-a			*!	
☞ d. gig^{w}-a				*

Candidates (54a) and (54b) violate the constraints *LINGLING and MAX C-PL COR respectively, as already discussed in (43). Candidate (54c) unnecessarily adds a mora to the already minimal word and therefore loses over (54d) although not having realized all the features of the morpheme.

From our discussion so far, we have seen that both features of the passive morpheme may appear simultaneously, as in / k^{h}iʃ^{w}a/ 'remove pass'. In the forms where the labial consonant is root-medial, the [cor] moves into the base to dock on the labial consonant, while the [lab] remains in the stem-final position, e.g. gaɲul^{w}a 'break pass'. In such forms, the sequence of the features is [cor][lab]. For the monosyllabic roots where the features appear as independent segments, as in /p^{h}iwa/

'give pass', the sequence is the same, [cor] followed by a [lab]. Seemingly, the features are not only floating but follow a certain order, which is preserved in the input. Therefore, in order to preserve this sequence even in the output we need to add in our analysis the constraint LINEARITY, in (55).

(55) LINEARITY: If *a* precedes *b* in the input, then *b* cannot precede *a* in the output.

Candidates like /p^{h}uya/ and /p^{hw}ia/, which would otherwise compete with the optimal candidate, with both features of the morpheme having been realized, would be ruled out by the constraint, LINEARITY, as in both candidates the order of the features is reversed. /p^{hw}ia/ would also be ruled out by an undominated constraint in the language, NOHIATUS, which prohibits a sequence of vowels.

3.3.7 VC verb roots

In (53), I repeat examples from VC roots already presented in (3).

(56)	eɓ-a	eɓ-iw-a	'be stolen'
	ak^{h}-a	ak^{h}-iw-a	'be built'

The forms in (56) behave like the monosyllabic roots in (49) above. The suffix appears as two independent segments with separate root nodes, and yet these forms already have two syllables, hence augmentation is not expected. The question then would be, why for example should the [cor] not dock onto the labial consonant in /eɓa/ 'steal'. What we have to note about these forms is that the root-initial syllable lacks an onset, and this is what makes them different from the other bisyllabic stems that have been discussed so far. Such syllables are said to be disfavoured. Kiyomi and Davis (1992) in their analysis of siSwati reduplication treat the vowel of an onsetless syllable as extraprosodic. They assume that the VCVC base stems, for example, include an 'invisible' initial vowel that is ignored in the reduplication process: /elap^{h}a → elap^{h}a-lap^{h}a / ' heal a little'. The basic idea is that elements that occur at the edges of words may be ignored for certain prosodic phenomena (Hayes 1985 and McCarthy and Prince 1986/1996). Davis (1988) in his analysis of Aranda stress assignment observes that stress shifts to the second syllable if the first one

does not have an onset. Downing (1994) in her discussion on reduplication of onsetless syllables in siSwati observes that these stems infix /-y-/ between the reduplicant and the stem; /eɓa → eɓayeɓa/ 'steal a little'. This she explains as the need for the syllable to have an onset.

To account for the forms in (56) then, I first use the constraints that I have used to account for the other bisyllabic forms, and show that this fails to select the correct output. Thereafter, I use a modified version of some of the constraints. Tableau (57) evaluates candidates from a VC verb root. In the following tableau, and the rest of the thesis, I use the symbol '☹' to mark the candidate incorrectly chosen under a particular ranking.

(57)

/eɓ[cor][lab]-a /	MIN	IDENT-Pl,[σ1	DEP- μ	MAX-PASS
a.eɓʷ-a				*! [cor]
☹ b.etʃ'ʷ-a				
c.etʃ'-iw-a			*!	
d.eɓ-iw-a			*!	

The grammar that we have created so far chooses (57b) over the intended winner, (57d). All the candidates satisfy MIN as they all have two syllables each and they also satisfy IDENT-Pl,[σ1 vacuously; our IDENT-Pl,[σ1 refers to the onset of the initial syllable and this particular root does not have an onset on the initial syllable. Candidate (57 (c and d)) violate one of the high-ranked faithfulness constraints DEP-μ, which prohibits epenthesis. To get the correct form, we need to modify our MIN constraint. Downing (1998b) in her analysis of root-initial onsetless syllables in some Bantu languages distinguishes between a morphological stem (M-STEM) and a phonological stem (P-STEM). According to her, a P-STEM is different from an M-STEM in that a P-STEM should have an onsetful syllable. In line with her understanding of these stems, I modify the MIN constraint to be as expressed in (58).

(58) MIN (P-STEM): A phonological stem should be minimally two syllables.

Consequently, satisfying MIN requires that both syllables of the stem have onsets. IDENT-Pl,[σ1 refers to the onset of the initial syllable of a P-STEM. ALIGN-L (P-

STEM,C) in (59) makes sure that the left edge of the prosodic stem is aligned with a root consonant.

(59) ALIGN-L (P-STEM,C) - ALIGN-L : The left edge of the prosodic stem should be aligned with a consonant.

With these modifications and additional constraints, we can be in a position to account for the correct output form. In the following tableau '{}' indicates the P-STEM edge.

(60)

/eɓ[cor][lab]-a/	ALIGN-L	MIN	IDENT- Pl,[$_{\sigma 1}$	DEP-μ	MAX-PASS
a.{eɓ^{w}-a}	*!				*
b.e{ʧ'^{w}-a}		*!			
c.e{ʧ'-iw-a}			*!	*	
☞d.e{ɓ-iw-a}				*	

Candidate (60b) now loses over the optimal candidate because it violates the modified MIN constraint which, requires that a phonological stem be minimally bisyllabic. (60a) incurs a fatal violation of ALIGN-L, while candidate (60b) is ruled out by not having the required minimal stem. The overall constraint system as developed so far is provided in (61).

(61) MAX C-PL DOR *CC, *LINGLING, *LABLING, IDENT Pl,[$_{\sigma 1}$, MIN, ALIGN-L >> MAX C-PL COR >> DEP-μ >> MAX-PASS >> DEP-F >> MAX C-PL LAB >>*LAB >> ALIGN-R

This completes the analysis of the passive in general. In the section that follows I investigate the behaviour of the passive in reduplicated environments.

3.4 Passive of reduplicated verbs

Reduplicated verbs may also be passivised in siSwati. As an introduction to the discussion and analysis of passivised reduplicated forms, I first discuss siSwati reduplication in general.

3.4.1 Reduplication

SiSwati reduplication has previously been analysed by Peng (1991); Kiyomi and Davis (1992); and Downing (1994, 1997). In siSwati, reduplication involves copying the first two syllables of the base. This has been analysed as a foot-shaped template. To meet this requirement, C and VC roots are augmented to two syllables. /y-/ is prefixed to VC roots, and C roots epenthesise a suffixal /-yi/. In the following example, the reduplicant is underlined, and a dash separates morphemes.

The CVC roots in (62) show total reduplication in view of the fact that the entire word is reduplicated. However, this is because the root plus the final vowel /-a/ equal the required size of a reduplicant in siSwati.

(62)

		V... a little
ɬeɓ-a	ɬeɓa-ɬeɓ-a	'gossip'
ɮal-a	ɮala-ɮal-a	'play'

The CVCVC roots, on the other hand, show partial reduplication since the root is now more than two syllables.

(63)

		V... a little
gidʒim-a	gidʒi-gidʒim-a	'run'
seɓent-a	seɓe-seɓent-a	'work'

The roots in (64) are disyllabic, but different from those in (62) in that the first syllable does not have an onset; hence, a /y/ is inserted between the base and the reduplicant to avoid the hiatus.

(64) V... a little

os-a	osa-yos-a	'grill'
eɓ-a	eɓa-yeɓ-a	'steal'
eŋgǀ-a	eŋgǀa-yeŋgǀ-a	'pass by'

The monosyllabic roots in (65) further confirm the disyllabic nature of the reduplicant. Segmental material from these roots is not enough for the required size of the reduplicant. The root is, therefore augmented to two syllables by inserting another syllable /yi/. Notice that in (64), the /y/ was not inserted to add to the number of syllable, but only to avoid a sequence of vowels which is not allowed in the language.

(65)

		V... a little
ɮ-a	ɮayi-ɮ-a	'eat'
p^h-a	p^hayi-p^h-a	'give'

In the (V)CVC forms, the initial vowel is ignored and the following CVCa is reduplicated.

(66)

		V... a little
(e)lap^h-a	elap^{h}a-lap^h-a	'heal'
(e)mbes-a	embesa-mbes-a	'cover'

If we compare the extended VC roots with the (V)CVC forms in (66), the syllable structure ends up being the same: VCVC. But notice that in the reduplicated forms in (67), the vowel is still retained.

(67)

		V... a little
os-el-a	osa-yos-el-a	'grill for'
ak^h-el-a	ak^{h}a-yak^{h}e-l-a	'build for'

In the next section I provide an OT analysis of the above forms.

3.4.2 An OT analysis of reduplication

The above data show that the reduplicant is a disyllabic prefix. The disyllabic size of the reduplicant is evidence of the minimal prosodic word of siSwati. All words are minimally two syllables in the language. Evidence for a minimality constraint in the

language has already been discussed in Chapter 2, section 2.5. In this section, I employ McCarthy & Prince's (1994a, b and 1995) Correspondence Theory of reduplication to analyse the data. They argue that the shape invariance of the reduplicant is a result of interaction between well-formedness constraints and constraints of reduplicative identity. I have mentioned that siSwati does not have a stress-based rhythmic foot; nonetheless, there is evidence for some kind of foot in the language. The size of the reduplicant is one example of such evidence. A reduplicant equals a disyllabic foot. To account for the foot binarity of the reduplicant, I use the constraint FT-BIN (68), used by McCarthy & Prince as well as Kager in their analysis of reduplication in Diyari.

(68) FT-BIN: Feet are binary under syllabic or moraic analysis.

Downing (1994, 1997), in her analysis of siSwati reduplication, uses the constraint RED=FT, in addition to the constraints that are specific to siSwati and the other Bantu languages that she compares it with, namely Kinande and Kikuyu. In my analysis, I depart from Downing and show that the general constraints used by McCarthy & Prince can account for reduplication in siSwati as well. McCarthy & Prince postulate that the broad typological differences and similarities among patterns of reduplication in the world's languages can be achieved by re-ranking the following types of constraints: well-formedness constraints, faithfulness constraints and base-reduplicant identity constraints (Kager 1999:200). The disyllabic size and prefixal position of the reduplicant in siSwati follows, in addition to FT-BIN, from the following constraints: ALIGN-R (RED, FT), defined in (69), and ALL-FT-LEFT, in (70).

(69) ALIGN-R (RED, FT): The right edge of the reduplicant should be aligned with the right edge of the foot.

(70) Align (Ft, L, PrWd, L) - ALL-FT-LEFT: Every foot stands in initial position in the Prosodic Word.

ALIGN-R (RED, FT) makes sure that the feet are final in the prosodic word, while ALL-FT-LEFT ensures that the reduplicant consists of only one foot. Both Downing's and McCarthy & Prince's analyses achieve the same results. In addition to the above

constraints, I include the following constraints, also from McCarthy & Prince: MAX-IO, (71), which enforces correspondence between the input and the base. PARSE-SYLL (72) and MAX-BR (73) are also included in the constraint hierarchy. I motivate the ranking of the constraints as I discuss each candidate set.

(71) MAX-IO: Every segment of the input has a correspondent in the output.

(72) PARSE-SYLL: Every syllable belongs to some foot.

(73) MAX-BR: Every segment of the base has a correspondent in the reduplicant.

3.4.2.1 CVC verb roots

The following tableau illustrates reduplication of a CVC verb root.[15]

(74)

/RED-ɬeɓ-a/	FT-BIN	MAX-IO	PARSE-SYLL	MAX-BR
a.(ɬe)-(ɬeɓ-a)	*!			*
b.ɬe-(ɬeɓ-a)			*!	*
☞ c. (ɬeɓa)-(ɬeɓ-a)				

Candidate (74a) deletes some segments from the input and is left with one syllable which is parsed into a degenerate foot. This, results in a violation of FT-BIN, which requires that feet be binary. Candidate (74b), like (74a), has a monosyllabic reduplicant, but the difference is that in (74b) the reduplicant has not been footed to avoid a violation of FT-BIN. However, a syllable left unparsed results in a violation of PARSE-SYLL. The candidate therefore loses on that account. The optimal candidate in (74c) satisfies all constraints in the tableau. The syllables have been parsed into well-formed feet. The constraints and candidates in the above tableau do not give us a ranking argument. The constraints could be ranked in any order, and the same candidate would win. The constraint MAX-IO is satisfied by all candidates: its role will be illustrated shortly. CVCVC roots are considered next.

[15] Here, I do not consider any candidate with footing across the reduplicant-base boundary. I return to this issue shortly.

3.4.2.2 CVCVC verb roots

The analysis of candidates from the CVCVC roots motivates the ranking MAX-IO above PARSE-SYLL and PARSE-SYLL above MAX-BR. Recall that, in siSwati, MAX-BR is low-ranked to avoid complete reduplication. The following candidates are evaluated by using the same constraints as those used for the candidates in (74). The crucial ranking is: FT-BIN, MAX-IO >> PARSE-SYLL >> MAX-BR.

(75)

/RED-gidʒim-a/	FT-BIN	MAX-IO	PARSE-SYLL	MAX-BR
a.(gi)- (gidʒi)m-a	*!		*	*
b.(gidʒi)-(gidʒi)		*!		
c.(gidʒi)ma-(gidʒi)m-a			**!	
☞d.(gidʒi)-(gidʒi)m-a			*	*

(75a) violates FT-BIN since feet are supposed to be two syllables. Candidate (75b) has all its syllables parsed into well-formed feet. This has been achieved through deletion of root segments from the input. However, MAX-IO requires that input segments be preserved in the base. (75b) therefore incurs a fatal violation of this constraint. Candidate (75c) is a perfect copy of the base, but in that way it involves an extra PARSE-SYLL violation (or of FT-BIN if the syllable /ma/ were to be parsed into a foot). Incomplete copying in (75d) avoids the unparsed syllable, and hence incurs only one violation of PARSE-SYLL. In that way, it performs better than all the other candidates. There is yet another candidate which needs to be considered: a candidate similar to (75c) but different in that all the syllables are parsed into well-formed feet. Using the same constraints as those in (75), this candidate would perform better than (75d), the optimal output. The following tableau shows this result formally.

(76)

/RED-gidʒim-a/	FT-BIN	MAX-IO	PARSE-SYLL	MAX-BR
a.(gidʒi)-(gidʒi)m-a			*!	*
☹b.(gidʒi)(ma-gi)(dʒim-a)				

Candidate (76a) loses on PARSE-SYLL because the final syllable of the base is left unparsed, whereas (76b) has parsed all the syllables by feet. However, what we

notice in (76b) is that the second foot incorporates syllables from both the reduplicant and the base. This makes the final syllable of the reduplicant the beginning of a foot. Since it is the final syllable, it should be at the end of the foot. A constraint that will ensure that the reduplicant is properly aligned with the foot even on the right edge is ALIGN-R (RED, FT), defined in (69). The constraint is unviolated and will therefore be among the undominated constraints in the hierarchy. This constraint requires that the reduplicant should begin simultaneously with a foot.

In (77), I evaluate the same candidates with ALIGN-R(RED, FT) included in the tableau.

(77)

/RED-gidʒim-a/	FT-BIN	MAX-IO	ALIGN-R(RED, FT	PARSE-SYLL	MAX-BR
a.(gidʒi)(ma-gi)(dʒim-a)			*!		
☞ b.(gidʒi)-(gidʒi)m-a				*	*

Candidate (77a) now loses over candidate (77b) because of the misalignment of the final syllable of the reduplicant with the right edge of the foot.

3.4.2.3 CVCVCVC verb roots

CVCVCVC roots are considered next. In order to deal with them, we need to add one more constraint to our analysis. The problem is that the grammar, so far, predicts full reduplication. Tableau (78) illustrates how a candidate with full reduplication would perform better than the optimal candidate.

ALIGN-R (RED, FT) is irrelevant in the evaluation of the following forms and will not be included in (78); neither will the candidates that violate it.

(78)

/RED-ɬaɓelel-a/	FT-BIN	MAX-IO	PARSE-SYLL	MAX-BR
a.(ɬaɓe)-(ɬaɓe)(lel-a)				*!
☹ b.(ɬaɓe)(lela)-(ɬaɓe)(lel-a)				

The constraints that we have so far used for the other even-paired stems choose the candidate with total reduplication as the winner. This is because the syllables can all

be parsed into well-formed feet, satisfying FT-BIN and PARSE-SYLL, unlike in the odd-paired forms where one syllable is bound to be left out. Since the reduplicant is a prefix, we need a constraint that will make sure that it occupies the initial position in the word. ALL-FT-LEFT defined in (70) will ensure that the feet are left-aligned and prefer the candidate with exactly one foot at the left edge. I assume the base and reduplicant are separate Prosodic Words.

ALL-FT-LEFT should crucially dominate MAX-BR and PARSE-SYLL to prevent full copying of material from even-numbered base stems. The next tableau evaluates the same input as in (78) with ALL-FT-LEFT included in the tableau.

(79)

/RED-ɬaɓelel-a/	FT-BIN	MAX-IO	ALL-FT-LEFT	PARSE-SYLL	MAX-BR
a(ɬaɓe)(lela)-(ɬaɓe)(lel-a)			**!		
☞ b.(ɬaɓe)-(ɬaɓe)(lel-a)			*		*

The optimal candidate has one foot that is not aligned with the left edge, but (79a), as a result of full copying, ends up with two misaligned feet and therefore loses over (79b) by having more violations of ALL-FT-LEFT. The ranking of ALL-FT-LEFT above MAX-BR results in partial reduplication.

3.4.2.4 C roots

So far we have seen that if the root is CVC or larger: the base provides enough segments to fill the disyllabic reduplicant. But for C roots: the base does not have enough segmental material to fill the required two syllables, so the strategy is to fill it in by default segments. /yi/ is suffixed to monosyllabic roots, violating the anti-epenthesis constraint DEP-BR (80).

(80) DEP-BR: Every segment of the reduplicant has a correspondent in the base.

This means that DEP-BR must be crucially ranked below FT-BIN to force epenthesis. (81) evaluates an input from a C root.

(81)

/RED-pʰ-a/	FT-BIN	ALIGN-R(RED, FT)	ALL-FT-LEFT	MAX-BR	DEP-BR
a. (pʰa)-pʰ-a	*!				
b. (pʰa-pʰ-a)		*!			
☞c.(pʰayi)-pʰ-a					*

The importance of ranking FT-BIN above DEP-BR is illustrated by candidates (81a) and (81c). (81a) is faithful to the base; no additional segmental material has been added to the root, but this leads to an insufficient reduplicant; as a result, FT-BIN is violated. The C roots further confirm the dominance of FT-BIN in the language. The constraint should not be violated even at the expense of the faithfulness constraint DEP-BR. Candidate (81b) avoids a violation of FT-BIN by footing the monosyllabic reduplicant together with the one syllable root. Although this results in a binary foot, it leads to a violation of ALIGN-R (RED, FT). The right edge of the reduplicant is no longer aligned with the right edge of the foot.

3.4.2.5 VC roots

VC roots would be expected to satisfy the binary foot requirement in the reduplicant since, including the final vowel, the root has two syllables. There is a problem though, as seen from the reduplicated forms from this type of root. As in the C roots, there has been augmentation of the base, which is prefixal in this case, providing an onset to an already existing syllable (eɓa → eɓayeɓa 'steal a little'). If the root is reduplicated as it is, it creates a hiatus at the reduplicant-base boundary, violating the constraint NOHIATUS (82).

(82) NOHIATUS: A sequence of vowels is prohibited.

Conversely, other analyses do not consider the /y/ as epenthetic (Meinhof 1932, Borowsky 1983, Katamba 1985, Hyman & Katamba 1999) . Meinhof for example observes that in Proto-Bantu the vowel-initial roots began with a glide which has now been deleted at the beginning of a word in some present day Bantu languages. In Luganda, it has been suggested that the strong consonants arose in compensation

for the deleted glide (*PB ku-yiba 'steal' → ku-bba; yi-ta 'kill'→ tta) (Katamba 1985). However, in siSwati, there is no synchronic evidence that the glide that I claim to have been inserted might have been there originally. If that was the case one would expect the glide to surface, not only in the above environment but in all non-word-initial environments to resolve hiatus, however, this is not the case (si-eɓ-a kudla > s-eɓ-a kudla *si-y-eɓ-a kudla) 'we are stealing food'[16].

SiSwati has a very strong tendency to avoid hiatus, which is not restricted to reduplication but applies to other parts of the language's derivational morphology. Glide-insertion is a very common strategy for hiatus resolution (see section 2.3 on the different strategies to resolve hiatus in the language). DEP-IO, (83), is included to regulate epenthesis of elements to the base.

(83) DEP-IO: Every segment of the output has a correspondent in the input.

It has been established that FT-BIN is one of the undominated constraints in the grammar and will therefore no longer be included in the tableaux that follow, as well as the candidates that violate it. Only the relevant constraints are included in the evaluation of candidates from a VC input.

(84)

/RED-eɓ-a/	MAX-IO	ALIGN-R (RED,FT)	NOHIATUS	PARSE-SYLL	DEP-IO
a.(eɓa)-ɓ-a	*!			*	
b.(eɓ-e)ɓ-a		*!		*	
c. (eɓa)-(eɓ-a)			*!		
d. ☞(eɓa)-(yeɓ-a)					*

So as not to create a sequence of vowels, candidate (84a) deletes the root-initial vowel from the base, but doing so results in a violation of MAX-IO. Input material should be preserved in the base. (84b) achieves the binary foot by incorporating material from the base; however, this results in a violation of ALIGN-R (RED, FT) since the right edge of the reduplicant no longer coincides with the right edge of the foot. Candidate (84c); which reduplicates the base as it is, results in a sequence of vowels at the base-reduplicant boundary. The language prohibits hiatus; hence, this

[16] SiSwati does have the form /si-yeɓ-a/ in its lexicon but with a progressive meaning.

candidate incurs a fatal violation of the constraint NOHIATUS. Candidate (84d) avoids hiatus by inserting a glide between the reduplicant and the base. Although this leads to a violation of DEP-IO, the ranking of this constraint below NOHIATUS results in candidate (84d) becoming the most harmonious.

Roots longer than VC also have an optional initial vowel. However, in the reduplicated forms of these roots, the base loses this vowel. In the next section, I discuss the difference between VC and (V)CVC roots.

3.4.2.6 Difference between VC and (V)CVC roots

As already mentioned, there is a difference between VC and (V)CVC verb roots when it comes to reduplication. Although the longer roots may also begin with a vowel, e.g. /(e)lapʰ-a/ 'heal', I argue that this vowel is not part of the root. This explains why it can be discarded, depending on speaker (Ziervogel & Mabuza 1976). This also explains why the output of reduplication for the verb /(e)lapʰ-a/ 'heal' is not /elayelapʰ-a/. Compare with /eɓ-a/, which becomes [eɓa-yeɓ-a]. The language reduplicates the first two syllables of the root. In the case of /(e)lapʰ-a/, the initial vowel does not count. Various types of evidence can be adduced to support this argument. One type of evidence comes from imperative formation from these types of roots. Examples are given in (85).

(85)	a.	(e)lapʰ-a	yelapʰa ~ lapʰa		'Heal!'
		(e)tsamel-a	yetsamela ~ tsamela		'Bask!'
	b.	eɓ-a	yeɓa	*ɓa	'Steal!'
		os-a	yosa	*sa	'Grill!'
	c.	os-el-a	yosela	*sela	'Grill for...!'
		akʰ-el-a	yakʰela	*kʰela	'Build for...!'
		eɓ-el-a	yeɓela	*ɓela	'Steal for...!'

In the (V)CVC verb roots (85a), there is an option of either leaving the initial vowel as it is, or discarding it altogether. But for the VC roots (85b) the vowel is never lost, otherwise an ill-formed output results. One might assume that the ill-formedness is due to their subminimality. However, if we consider the extended roots in (85c), we

find that the reason for the ill-formedness in (85b) has little to do with subminimality. If subminimality was the reason for the ill-formedness, one would expect forms like /*sela/ (85c) to be well-formed, since it has the required two syllables. Nonetheless, deletion of the vowel in the extended roots still produces ill-formed words. Compare the (85c) roots with those in (85a): deletion of the vowel in (85a) does not make any difference; the forms remain well-formed, whereas deletion leads to ill-formedness in (85c).

The other type of evidence comes from the use of these verb roots with the progressive marker /ya/. /ya/ is usually affixed between the subject marker and the verb root. (86) illustrates the use of the morpheme /ya/ with roots commencing in either a consonant or a vowel.

(86) a. hamb-a u-ya-hamb-a
'He is walking'

b. (e)tsam-el-a u-y-etsam-el-a/ u-ya-tsam-el-a
'He is basking'.

c. eɓ-a u-y-eɓa *u-ya-ɓa
'He is stealing'.

In (86a), /ya/ is affixed between the SM /u/ and a consonant-initial root, while it precedes a polysyllabic vowel-initial root, in (b). In (86b), hiatus is resolved by deleting either the morpheme vowel or the root vowel. In (86c), again, the /ya/ precedes a vowel-initial root, this time a bisyllabic one. Observe that in this form only one output form is acceptable; where the morpheme vowel has been retained. This implies that the vowel in (86c), is part of the root.

The (V)CVC verb roots should therefore be treated like any other consonant-initial root in reduplication.

Returning to reduplication, what is important in siSwati reduplication is that the initial two syllables of a root must be reduplicated. In /eɓ-a/ 'steal'; the /e/ has to be reduplicated since it is part of the root, and the insertion of /y/ is conditioned by the syllable structure of the language (NOHIATUS). So for this reason I will not consider a separate discussion for the (V)CVC roots. I now move on to discuss the passive of reduplicated verbs.

3.4.3 Passive of reduplicated verbs

The earlier discussion on the passive has shown us that root-final and root-medial labials palatalize in passives, and also that the final consonant appears with a labial secondary articulation. The data from passivised reduplicated forms show a similar pattern in that the labial palatalizes, and labial secondary articulation generally appears on the final consonant. However, since these are reduplicated forms, base-reduplicant identity also plays a role in the choice of the correct output. The next sets of forms are reduplicated verbs with the passive suffix. In these forms, the labial of both the base and reduplicant is palatalized. This is true of roots with a root-final labial (see (87)) and roots with a root-medial labial (see (88)).

(87)			Being V...(-en) a little
	ɬaɓ-a	ɬatʃʷa - ɬatʃʷa	'stab'
	kʰipʰa	kʰiʃʷa- kʰiʃʷa	'remove'
	tʰayipʰ-a	tʰayi-tʰayiʃʷ-a	'type'
(88)	seɓent-a	setʃ'e-setʃ'entʷ-a	'work'
	kʰumul-a	kʰuɲu- kʰuɲulʷ-a	'undress'
	kʰupʰuɠ-a	kʰuʃu-kʰuʃuɠʷ-a	'ascend'

The passive of C and VC roots with augmented roots are given in (89) and (90), respectively. Note that, even though reduplicated, they still take the longer allomorph.

(89)			Being V...(-en) a little
	ɮ-a	ɮayi-ɮ-iw-a	'eat '
	pʰ-a	pʰayi-pʰ-iw-a	'give'
	kʰ-a	kʰayi-kʰ-iw-a	'pick'
(90)	yeɓ-a	eɓa-yeɓ-iw-a	'steal'
	yakʰ-a	akʰa-yakʰ-iw-a	'build'
	os-a	osa-yos-iw-a	'grill'

In (87) the passivised reduplicated CVC root appears with the two features of the passive morpheme on both the base and the reduplicant. Note that in the reduplicated form there is full reduplication and hence the base and reduplicant both have the [lab] part of the morpheme root-finally. However, reduplication in longer roots is different.

(91) Being V...(-en) a little

ɬonipʰ-a	ɬoni- ɬoniʃʷ-a	'respect'
kʰulum-a	kʰulu-kʰuluɲʷ-a	'speak'

In (91) the input has partial reduplication as the root is longer than two syllables. The labial therefore appears on the base only. Likewise, the passive morpheme is realized only on that labial consonant.

(92) Being V...(-en) a little

kʰumul-a	kʰunu- kʰuɲulʷ-a	'undress'
seɓent-a	setʃ'e-setʃ'entʷ-a	'work

In (92) the labial consonant appears root-medially on the base and is final on the reduplicant. The [cor] feature is realized on both the base and reduplicant. However, the [lab] feature does not appear with the underlying labial consonant of either the base or the reduplicant, as was the case for the CVC roots in (87) above; instead, it appears on the final consonant of the base.

3.4.3.1 Analysis of passivised reduplicated forms

The natural assumption, based on (87 and 88), would be that these forms are built by first creating the passive, followed by reduplication so /kʰipʰ-a → kʰiʃʷa → kʰiʃʷa-kʰiʃʷa/ 'remove'. However, the forms in (86 and 87) cast doubt on that type of analysis since, if that was the case; the result for /pʰ-a/, for example, would be */pʰiwa-pʰiw-a/, not [pʰayi-pʰiw-a].

We mentioned earlier that the passive morpheme may move into the root and cause misalignment of the morpheme with the right edge of the stem. That is why in the evaluation of the candidates in passive formation, ALIGN-R (PASS), was dominated by MAX-PASS. The result of that ranking was a change of the labial consonant, not only at the edge but medially as well. ALIGN-R (PASS) and MAX-PASS will obviously also play a role in the analysis of the forms in (87 to 91).

3.4.3.1.1 CVC roots

To remind ourselves, in the passive, the [cor] feature replaces the non-root-initial labial consonant, whereas the feature [lab] always appears on the final consonant of the verb-stem, irrespective of C-Place. This is not what happens in (87), since both the reduplicant and the base realize the morpheme. This suggests that the rule over-applies in the reduplicant, to force identity with the base. Enforcing identity between the base and the reduplicant, in turn, results in overapplication of the passive rule. To capture the process of 'over-application' in Malay nasal harmony, Kager ranks the constraint IDENT-BR above IDENT-IO. In the analysis of the forms in (87), I use the same constraints and ranking as Kager. Because of the need to change the feature specification of the [labial] to [coronal], IDENT-BR, in (93), is highly ranked, while IDENT-IO, in (94), is ranked below IDENT-BR to allow a minimal violation of this constraint by the optimal candidate.

(93) IDENT-BR: Correspondents in base and reduplicant have identical features.

(94) IDENT-IO: Correspondents in input and output have identical features.

MAX-IO, already discussed, is included to enforce input-output identity. This is one of the undominated constraints in the reduplication hierarchy. The interaction of these constraints is shown in (95), where a reduplicated CVC verb root is evaluated.

(95)

/RED-ɬeɓa[cor][lab]/	MAX-IO	IDENT-BR	IDENT-IO
a.ɬeɓa- ɬeɓ-a	*!		
b. ɬeɓa- ɬetʃ'ʷ-a		*!	*
☞c. ɬetʃ'ʷa- ɬetʃ'ʷ-a			*

The ranking of these constraints enforces complete identity between the base and the reduplicant. Candidate (95a) does not realize the morpheme at all, and therefore incurs a fatal violation of MAX-IO or MAX-PASS (not included in the tableau). Candidate (95b); which realizes the morpheme on the base only, is ruled out by IDENT-BR. Candidate (95c) over-applies passivisation: the features of the morpheme are realized on both the reduplicant and the base. However, it survives since identity between the base and the reduplicant is important.

3.4.3.1.2 Root-medial labials

In root-medial labials; it is only the [cor] feature that appears on both the reduplicant and the base. The [lab] feature shows only on the final syllable of the base. I use the same constraints as in (95) to account for these forms as well. Since they have a labial root-medially, and since MAX-PASS outranks ALIGN-R, the labial is always palatalized. But unlike the CVC forms, where the labial was root-final, in these forms, the labial does not get labialized, but only palatalized. IDENT-BR prevents the [lab] from being realized on the final consonant of the reduplicant.

(96)

/RED-seɓent [cor][lab]-a/	MAX-IO	IDENT-BR	IDENT-IO
a. seɓe- seɓent-a	*!		
b. seɓe- seɓentʷ-a	*!		
c. setʃ'ʷe-setʃentʷ-a		*!	
d. seɓe-setʃ'entʷ-a		*!	
☞e. setʃ'e-setʃentʷ-a			

Candidate (96a) does not realize the morpheme features [cor] and [lab] and in that way violates MAX-IO. (96b) improves on candidate (96a) by realizing the [lab] part of the morpheme. It still incurs a violation of MAX-IO, since both features of the morpheme need to be realized on these forms. Candidate (96c); which has the final consonant of both the base and reduplicant labialized, just as in the CVC roots, loses, because labializing the reduplicant's palatal /tʃ'/ does not lead to identity, as was the case in CVC roots. The reduplicant has a labialized palatal, while the base has a labialized alveolar. IDENT-BR is therefore violated. Candidate (96d) is also ruled out by IDENT-BR. Finally, candidate (96e) has realized both features without violating IDENT-BR, hence the winner.

3.4.3.1.3 C-roots

Monosyllabic reduplicated roots are also evidence for the reduplicant being a separate PrWd in siSwati. Realizing the passive morpheme results in augmentation of the subminimal base as in /ɮ-a/ → [ɮayi-ɮ-iw-a] 'eat a little (pass.)'. What we

observe in these forms, though, is that the base and reduplicant are not identical, violating the constraint IDENT-BR. Both the base and the reduplicant are augmented, but by different phonological properties. For the CVC roots, we observed that there was perfect identity. This we explained as overapplication of the passive rule: /ɬeɓ-a → ɬetʃ'ʷa-ɬetʃ'ʷ-a/ 'gossip (pass.)'. If the rule was to overapply on the C roots, the output would be: */ɮiwa -ɮ-iw-a/. To account for the mismatch in the observed output, we need a constraint that should be ranked above IDENT-BR to avoid identity between the base and the reduplicant. Kenstowicz (1996), in his analysis of Italian s-voicing and Korean cluster-simplification, observed that the process could be best accounted for by the constraint BASE-IDENTITY. In both cases, the output showed similarities to another morphologically related output instead of the input. Kager (1999) also makes use of such constraints in his analysis of i-Syncope in Palestinian Arabic. He refers to this type of constraint and others similar to it, Output-to-Output correspondence constraints.[17] In siSwati the reduplicant in the output form of [ɮayi-ɮiwa] 'eat a little (pass.)' is also identical to a morphologically related word, the output of reduplicated /ɮ-a/ 'eat'. To account for the C roots then, I employ the BASE-IDENTIY constraint defined in (97) below. To enforce minimality, MIN will be included in the analysis of the C roots.

(97) BASE-IDENTITY (BASE-IDENT): Given an input structure [X Y]; output candidates are evaluated for how well they match [X] and [Y] if the latter occur as independent words (Kenstowicz 1996).

Tableau (98) illustrates the interaction of these constraints.

IDENT-IO has no role to play in the evaluation of these forms since the decision on the optimal candidate lies on the higher ranked constraints. It is therefore not included in the tableau as are the candidates that violate it.

[17] Output-to-Output correspondence constraints have been widely used in the literature, at times under specific names, for example, Paradigm Uniformity (Steriade 1996), Uniform Exponence (Kenstowicz 1994, 1997).

(98)

/RED-ɮ [cor][lab]-a/ Base: ɮayi-ɮ-a	MIN	MAX-IO	BASE-IDENT	IDENT-BR
a. ɮʷa -ɮʷ-a	*!	*[cor]	*	
b.ɮayi-ɮ-a		*![cor][lab]		*
c ɮayi- ɮayi		*![lab]		
d.ɮiwa-ɮayi		*![lab]	*	
e ɮiwa-ɮiwa			*!	
☞ f.ɮayi- ɮiwa				*

In candidate (98a), the reduplicant is less than a foot, and therefore incurs a violation of MIN. Candidates (98 (b, c and d)) are ruled out by MAX-IO. The input [cor] has not been realized in (98b), and (98 (c and d)) realize only one feature, the [cor]. The ranking of BASE-IDENT above IDENT-BR leads to candidate (98e) losing over candidate (98f).

3.4.3.1.4. VC roots

Passivisation of VC roots is similar to that of C roots in that the features of the morpheme are realized only on the base and not on the reduplicant. The reduplicant retains its identity with its non-passivised reduplicated form; thereby satisfying BASE-IDENT. In (99), I evaluate a VC root with different possible outputs. The candidates have all realized the morpheme, although in different ways. In the following tableau '{}' indicates the P-STEM edge.

(99)

/eɓ [cor][lab]-a/ Base: eɓ-a-y-eɓ-a	IDENT-Pl,[σ1	ALIGN-L	NOHIATUS	BASE-IDENT	IDENT-BR
a. eɓ-a-y-e{ʧʷ-a}	*!				*
b. eɓ-a-y-{eʧʷ-a}		*!			*
c. eɓ-a-e{ɓ-iw-a}			*!		*
d. eɓ-iw-a-y-e{ɓ-iw-a}				*!	
e. ☞eɓ-a-y-e{ɓ-iw-a}					*

I have argued that the initial vowel on VC roots is part of the root; for this reason, it is part of the morphological stem. However this vowel is outside the phonological stem (see discussion on MSTEM vs. PSTEM under section 3.3.7). This leaves the

PSTEM with one syllable and, as in C roots, augmentation of the root is necessary. In candidate (99a), both features of the morpheme have been realized. However, replacing the root-initial labial with a [cor] in this candidate results in a violation of IDENT-Pl,[$_{\sigma 1}$. Candidate (99b), like (99a), does not augment the base but, instead, incorporates the root vowel into the base. Although the stem then becomes disyllabic, the constraint ALIGN-L is violated since the PSTEM now begins with a vowel. ALIGN-L requires that a PSTEM begins with a consonant. Candidate (99c) improves on both (99 a & b) in that the place of articulation of the initial syllable of the PSTEM is left unchanged. Nevertheless, there is a problem with this candidate: there is a sequence of vowels at the reduplicant-base boundary. A violation of NOHIATUS is therefore incurred. Candidate (99d), which overapplies the rule, satisfies all the constraints that have been violated by the other candidates, including the one violated by the optimal candidate. However, enforcing identity between the base and the reduplicant, results in a mismatch between the reduplicant and the base from another morphologically related output. This leads to a violation of the constraint BASE-IDENT. The optimal candidate (99e) violates IDENT-BR, but because this constraint is ranked lower than BASE-IDENT, it becomes the winner.

3.5 Summary

In this chapter I demonstrated how a floating [cor] feature can adequately account for palatalization in the passive, generally, as well as in reduplicated forms. I have also shown that ranking of the constraint MAX-PASS above ALIGN-R results in the misalignment of the [cor] feature in root-medial labials. Although MAX-PASS enforces realization of the passive morpheme, I have demonstrated that the high ranking of both MAX C-PL DOR and *LABLING prevents dorsals from realizing the [cor] part of the morpheme. While VC roots satisfy the bisyllabic minimality requirement of words in siSwati, they still augment their root in passivisation and reduplication, for example. The proposal advanced for this irregularity was that, although the initial vowel of these forms is part of the M-STEM, it does not count as part of the P-STEM; hence, the need to be augmented. In the next chapter I consider palatalization in nominals; where, I assume that, just like in the passive, palatalization is triggered by a floating [cor] feature.

CHAPTER 4

NOMINAL PALATALIZATION

The foregoing analyses of the passive illustrated that palatalization is triggered by a floating [cor] feature. In this chapter I focus on palatalization in locative and diminutive to further demonstrate that palatalization in these forms is induced by a floating [cor] feature as well. First, I present an overview of the morphological context in which nominal palatalization is found in siSwati, then, a discussion and an OT analysis of the two aspects of nominal palatalization is offered. Before I proceed with the discussion, a brief note on terminology is in order. Here, the term nominal refers to nouns; at times in the literature, it is used as a collective term to designate both nouns and pronouns. In this study, I use the terms nominal and noun interchangeably. The verb root refers to the irreducible element of the verb, at times called the radical by some other Bantu linguists. The other term is the stem, which I use to refer to the non-prefix element of the nominal, or the verbal root with suffixes. Before I discuss the locative and diminutive, I briefly discuss the morphology of nouns in siSwati.

4.1 SiSwati nominal classification

SiSwati shares most of the basic structural properties that distinguish the Bantu languages from other language families. One of these is the noun class system. Nouns are different from verbs in that they maintain, at the minimum, a bimorphemic structure. This consists of the nouns having a nominal stem and a nominal prefix. Nouns are categorized into classes on the basis of their prefixes. Bleek (1862), known for his classification of Southern Bantu languages, organized Bantu nouns into 18 classes, while Guthrie (1967-1971) proposed 19 classes for Proto-Bantu. SiSwati groups its noun classes up to class 15. However, classes 12 and 13 are not present in this language: these are the classes that mark the diminutive in other Bantu languages. In siSwati the diminutive is marked by means of a suffixal morpheme /-ana/. The classes 16, 17, and 18 mark the locative in other Bantu

languages. Although siSwati employs the use of a circumfix /e...ini/ to indicate the locative, the prefixes /ku-/ and /ka-/ are used with nouns in classes 1a and 2a (ku-malume 'to uncle', /ka-malume 'at uncle's place). A few nouns in classes 1 and 2 also optionally use these prefixes, for example /ku-mfana ~ e-mfan-eni/ 'at the boy'. According to Ziervogel & Mabuza (1976), remnants of class 16 may be seen in words like /pʰansi/ 'down' and /pʰanɮe/ 'outside'. More than one convention exists for labeling and referring to these noun classes. The system adopted in this study is the one developed by Meinhof (1932). In this system, each noun class is referred to by number; where an odd class number expresses the singular and an even class number the plural. Table 4-1 below sets out the noun class prefixes and provides examples for the respective classes. In class 9 and 10 the nasal '-N' is unspecified for place of articulation. It assimilates to the place of articulation of the following consonant. In the examples, I use a hyphen to separate a prefix from its stem.

Class	Prefix	Example	
1.	um(u)-	um-fana	'boy'
2.	ɓa-	ɓa-fana	'boys'
1a.	-	malume	'uncle'
2a.	ɓo-	ɓo- malume	'uncles'
3.	um(u)-	umu-ʦi	'medicine'
4.	imi-	imi-ʦi	'medicines'
5.	li-	li-ʧ'e	'stone'
6.	ema-	ema-ʧ'e	'stones'
7.	si-	si-ɬaɬa	'tree'
8.	ti-	ti-ɬaɬa	'trees'
9.	iN-	iɲ-ʤa	'dog'
10.	tiN-	tiɲ-ʤa	'dogs'
11.	lu-	lu-ʦi	'stick'
10.	tiN-	tin-ʦi	'sticks'
14.	ɓu-	ɓu-ɬalu	'beads'
15.	ʛu-	ʛu-ɮa	'food'

Table 4-1 Noun class prefixes in siSwati

Some loan nouns may appear with a vowel-only prefix as in /i-kʰapʰetʰi/ 'carpet'; i-raba 'rubber'. These nouns are grouped under class 5 since they have their plural in class 6.

4.2 An overview of the morphological context

4.2.1 Locative

Locatives are derived from nouns by either prefixing /e-/, /ɠu-/, /ɠa-/ to the noun or by using the circumfix /e...eni/ini/. It is in the circumfixed forms that we find palatalization of labials, which are realized as palatals. Illustrative data are given in (1 to 4).

4.2.1.1 Data survey

Stem-final labials palatalize in locative forms. This we observed in the passive as well.

(1)			On/ in/ at the N...
	li-tf[18]umbu	e- tfuɲʤ-ini	'intestine'
	li-pʰapʰu	e-pʰaʃ-ini	'lung'
	um-lomo	e-m-loɲ-eni	'mouth'
	iŋ-guɓo	e-ŋ-guʧ'-eni	'blanket'
	umkʰumbi	e-m-kʰuɲʤ-ini	'ship'
	um-ɬambi	em-ɬaɲʤ-ini	'herd of cattle'
	um-timba	e-m-tiɲʤ-eni	'body'
	si-kʰumba	esi-kʰuɲʤ-eni	'skin'

However, there are cases where palatalization does not occur even when the noun ends in a labial consonant (see (2)).

(2)			
	lu-nʷaɓu	elu-nʷaɓ-ini	'chameleon'
	iŋ-kʰomo	e-ŋ-kʰom-eni	'cow'
	um-ŋgǀʷaɓo	em-ŋgǀʷaɓ-eni	'funeral
	um-soɓo	em-soɓ-eni	'solanum nigrum'
	iŋ-guluɓe	eŋ-guluɓ-eni	'pig'
	li-gama	e-gam-eni	'word/name'
	um-tsʰimba	em-tsʰimb-eni	'bridal party'

The locative does not exhibit the same non-local palatalization as the passive (see (3)).

[18] /tf/ is an allophone of the phoneme /tsʰ/. It occurs only before labial vowels.

(3)

			On/ in/ at the N...
iŋ-komat'i	e-ŋ-komat'-ini	*e-ŋkoɲat'-ini	'cow'
li-t^{h}ip^{h}ot^{h}i	e-t^{h}ip^{h}ot^{h}-ini	*e-t^{h}iʃot^{h}-ini	'teapot'
li-guɲumeŋ|e	e-guɲumeŋ|-eni	* e-guɲuɲeŋ|-eni	'blackberry'

As in the passive, alveolar consonants (4) and velar consonants (5) do not palatalize in locative forms.

(4)

		On/ in/ at the N...
li-bodo	e-bod^{w}-eni[19]	'pot'
li-k^{h}ala	e-k^{h}al-eni	'nose'
si-k^{h}atsi	e-si-k^{h}ats-ini	'time'
li-gede	e-ged-eni	'gate'
si-godzi	e-si-godz-ini	'region'

(5)

si-ɓuʤo	e-si-ɓuʤ^{w}-eni	'mirror'
li-saʤa	e-saʤ-eni	'bag'
lu-gu	e-lug^{w}-ini	'wave'
li-ɦeʤe	e-ɦeʤ-eni	'gate'

Fricatives, although labial do not palatalize in siSwati. According to Ziervogel and Mabuza 1976, these forms avoid the labial-labial sequence by deleting the [lab] vowel. However, Dlamini (1979) observes that both labialization and deletion are accepted in these forms (see (6)).

(6)

		On/ in/ at the N...
si-fo	e-si-f^{w}-eni/e-si-f-eni	'illness'
um-fomfo	e-m-fomf^{w}-eni/ e-m-fomf-eni	'wild fruit'
li-fu	e-li-f^{w}-ini/e-li-f-ini	'cloud'
im-vu	e-m -v^{w}-ini/ e-m -v-ini	'sheep'

4.2.2 Diminutive

The diminutive is formed by suffixing the diminutive morpheme /-ana/ to nouns, adjectives, and relatives. As in locative forms, only labials in stem-final position are palatalized; the medial ones are left intact. I consider only diminutives from nouns in this study. Diminutive formation in adjectives and relatives follows the same pattern.

[19] For labialization of the vowel, see section 4.3.2.1 where I discuss secondary articulation.

4.2.2.1 Data survey

As was the case in passives and locatives, final labials palatalize in diminutives.

(7)

		Small/ a little N...
si-bamu	si-baɲ-ana	'gun'
um-lomo	u-m-loɲ-ana	'mouth'
li-tsambo	li-tsaɲʤ-ana	'bone'
umkʰumbi	u-m-kʰuɲʤ-ana	'ship'
in-ɮeɓe	in-ɮetʃ'-ana	'ear'
iŋ-guluɓe	iŋ-gulutʃ-ana	'pig'
li-gama	li-gaɲ-ana	'word/name'
um-timba	um-tiɲʤ-ana	'body'
si-tfupʰa	si-tfuʃ-ana	'thumb'

Like in the passive and locative, velar consonants are not affected by palatalization.

(8)

		Small/ a little N...
iŋ-kukʰu	iŋ-kukʰʷ-ana	'chicken'
li-k'uk'u	li-k'uk'ʷ-ana	'cake'
si-ɓuɠo	si-ɓuɠʷ-ana	'mirror'
lu-gogo	lu-gogʷ-ana	'skin'
li-ɦeɠe	li-ɦeɠ-ana	'gate'
si-pʰiɠa	si-pʰiɠ-ana	'collar'
iŋ-kokʰa	iŋ-kokʰ-ana	'padlock'

Unlike the passive and locative, alveolar consonants are also affected by palatalization in the diminutive.

(9)

		Small/ a little N...
um-kʰono	um-kʰoɲʷ-ana	'arm'
um-godzi	um-goʤ-ana	'hole/pit'
si-kʰatsʰi	si-kʰaʃ-ana	'time'
ʧ'-ani	ʧ-aɲ-ana	'grass'
in-ǀwadzi	in-ǀwaʤ-ana	'letter/book'
im-pandze	im-paɲʤ-ana	'root'
si-lʷane	silʷaɲ-ana	'animal'
um-fana	um-faɲ-ana	'boy'
li-ǀandza	li-ǀaɲʤ-ana	'egg'
um-tsʰimba	um-tsʰiɲʤ-ana	' bridal party'

The segmental alternations which occur under coronal palatalization are summarized in (10).

(10) Segmental alternations in coronal palatalization

Input	Output
tsʰ	ʃ
t'	tʃ'
dz	dʒ
n	ɲ

For now I discuss the prefixal changes in the locative, and leave the suffixal changes for later in the analysis. In (9), I group the prefixes into three types according to their behaviour in locative formation.

(11)

	Class	Noun	Locative	On/ in/ at the N...
(a)	7	si-kʰulu	e-si-kʰulʷ-ini	'chief'
	15	ɓu-ɬalu	e-ɓu-ɬalʷ-ini	'beads'
(b)	5	li-dada	e-dad-eni	'duck'
	5	li-tʃ'e	e-tʃ'-eni	'stone/rock'
(c)	3	umu-tsʰi	e-m-tsʰ–ini	'medicine'
	6	ema-tʃ'e	e-ma-tʃ'-eni	'stones/rocks'

The consonant-initial prefixes are divided into two, according to their behaviour in locative formation. Those in (11a.) prefix the locative prefix /e-/ to the whole noun (prefix plus stem), while those in (11b), which are all class 5 nouns, and begin with consonants as well, delete the noun prefix (consonant plus vowel) and replace it with the locative morpheme /e-/. Moving on to the vowel-initial prefixes VC (V), in (11c); in this class of nouns there is deletion of only the initial vowel of the prefix. This vowel is replaced with the locative morpheme vowel /e/. Prefixing the /e-/ directly to the VC (V) prefix would result in a sequence of vowels, a structure which is not allowed in siSwati[20]. In (12), I give a summary of the prefixal changes that are observed in locatives.

[20] Deletion is one of the ways in which the language resolves hiatus. (See other strategies to resolve hiatus in Chapter 2, section 2.13).

(12)

Locative Prefix		Noun Prefix				Locative Prefix		Noun Prefix	
e	-	CV	-	stem	→	e	-	CV	- stem
e	-	li	-	stem	→	e	-	∅	- stem
e	-	VCV	-	stem	→	e	-	C(V)	- stem

This completes the discussion on the prefixes. In the next section, I provide a formal analysis of the aspects of palatalization in the locative and diminutive. I begin with the consonantal changes that are involved in palatalization.[21]

4.3 OT analysis of nominal palatalization

4.3.1 Consonantal changes

In this section, I give an account of the fact that labials are the major target of palatalization in siSwati, and that coronals are palatalized in some morphological contexts but not in others. I also account for why dorsals never palatalize in this language.

4.3.1.1 Stem-final labials

Labial palatalization facts in the locative and diminutive are the same as those observed in the passive, apart from the lexical properties of the affixes involved. As already mentioned and argued for in the earlier chapters, palatalization of labials in the locative and diminutive, as in the passive, results from a V-Place /Cor [-ant]/. The locative and diminutive morphemes have, in addition, segmental features. The locative has both a prefixal morpheme /e-/ and a suffixal morpheme /-ini/, while the diminutive has a suffixal morpheme /-ana/.

[21] I have mentioned that nouns end in vowels in siSwati. By stem-final consonant, in both locative and diminutive I therefore refer to the consonant on the final syllable.

Analysis of palatalization in both locatives and diminutives follows a similar pattern to that presented for the passive in Chapter 3. Again, for reasons of space, [-ant] wil be omitted from the tableaux. Recall that ranking of the constraint MAX-MORPH above MAX C-PL-LAB forced palatalization of labials in the passive, and MAX-MORPH was subdivided into MAX-PASS, MAX-LOC, and MAX-DIM. Furthermore, the high-ranking of *LABLING prevented the [cor] from appearing as a secondary articulation to the labial consonant. I propose that the same ranking will account for palatalization in all three suffixes.[22] Moreover, the ranking for siSwati, outside palatalization, is MAX C-PL-LAB above *LAB. This ranking ensures that underlying labials surface as labials. (13) formalizes the analysis of stem-final labials in nouns. I will use MAX-LOC and MAX-DIM, instead of MAX-MORPH, although the crucial arguments do not appear until 4.3.1.3.

(13) Locative: iŋ-guɓo 'blanket' → eŋ-gutʃ'-eni

/e-iŋ-guɓo[cor]-ini/	*LABLING	MAX LOC	MAX C-PL LAB	*LAB
a. e-ŋ-guɓʸ-eni	*!			*
b. e-ŋ-guɓ-eni		*!		*
☞ c. e-ŋ-gutʃ'-eni			*	

In other languages, like in the Setswana diminutive, the consonant's labial feature, in addition to being palatalized, may re-associate and be realized as a secondary articulation (an analysis of Setswana palatalization is discused in Chapter 5, section 5.1.3.2). I propose that this results from the ranking of the constraint, *RE-ASSOCIATE (14), below MAX C-PL LAB in such languages, while the opposite ranking holds for siSwati (see (15)).

(14) *RE-ASSOCIATE (*RE-ASSOC): A feature associated with a C-Place node should not be re-associated with a V-Place node.

[22] The vowel changes that are specific to the locative and diminutive are discussed in section 4.3.2.

(15) Diminutive: iŋ-guɓo 'blanket' → iŋ-gutʃ'-ana * iŋ-gutʃʷ-ana

/iŋ-guɓo[cor]-ana/	*RE-ASSOC	*LABLING	MAX DIM	MAX C-PL LAB
a. iŋ-gutʃʷ-ana	*!			*
b. iŋ-guɓʸ-ana		*!		
c. iŋ-guɓ-ana			*!	
☞ d. iŋ-gutʃ'-ana				*

Candidate (15a) is ruled out by *RE-ASSOC. The rest of the candidates have the same violations as the candidates already discussed in (13).

4.3.1.2 Stem-initial labials

Like in the passive, stem-initial labials do not palatalize in nominals. Examples of data with stem-initial labials for the locative and diminutive are repeated in (16).

(16)[23]

	Locative	Diminutive	
im-pʰi	e-m-pʰini	i-m-pʰana *eɲʃ-ini	'war'
t'i-ɓi	e-t'i-ɓ i-ni	t'i-ɓ-ana * t'itʃ'-ana	'refuse (n)'

Note that, because of the prefix, the labial does not begin the first syllable in the noun (as it does in the passive) but the second one. Occupying this position may lead one to expect that the labial would receive the [cor] feature. This suggests that, not only verb-root-initial segments are impervious to palatalization, but also those in noun stem-initial position. In the passive, it was mentioned that stem-initial labials do not palatalize because of the top-ranked IDENT-PL,[σ1. This constraint refers to the initial syllable of the root/stem. This difference was not easily conceivable in verbs since the root may be used without affixes and still be meaningful (imperative forms). In that case, the beginning of a word and root may coincide. However, for nouns the left edge of a word never coincides with the left edge of the stem.

Ranking IDENT-PL,[σ1 above MAX-MORPH therefore accounts for non-palatalization of stem-initial and root-initial labials in all three suffixes; in fact, the change of any

[23] Recall that the /im-/, and /t'i-/ in the noun forms are prefixes marking noun classes and therefore not considered part of the noun stem.

initial segment, regardless of place of articulation. (17) shows the effect of IDENT-PL,[σ] in locative forms.

(17) Locative: im-pʰi 'war' → e-m-pʰ-i-ni

/e-im-pʰi+[cor]-ini/	IDENT-PL,[σ]	MAX LOC
a. e-ɲ-ʃ-ini	*!	
☞ b. e-m-pʰ-ini		*

4.3.1.3 Stem-medial labials

Palatalization in labials has two possible positions: (i) local palatalization, which appears immediately preceding the triggering suffix and (ii) non-local palatalization, which may appear in some position of a stem which is not directly adjacent to the triggering suffix. In locative and diminutive forms, palatalization may appear only on the stem-final labial, hence adjacent to the suffix. If the stem-final segment is not a labial, there is no palatalization (see (18)).

(18) Locative: li-kʰaɓetʰe 'cupboard' → e-kʰaɓetʰ-e-ni

/e-li-kʰaɓetʰe-[cor]-ini/	ALIGN-R	MAX LOC
a.e-kʰatʃ'etʰ-eni	*!	
☞ b.e-kʰaɓetʰ-eni		*

In contrast, palatalization in the passive may occur non-adjacent to the suffix, if the final root segment is not a labial. Consider Tableau (19), which repeats an evaluation of a candidate with a root-medial labial in the passive.

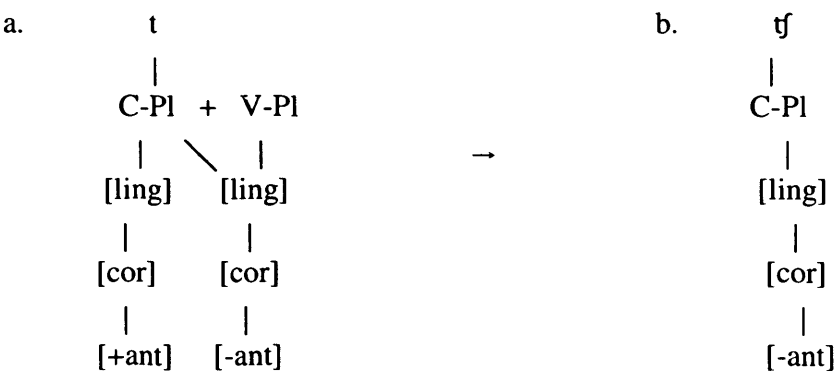
(19) Passive: seɓent'a 'Work!' → setʃ'entʷ-a

/seɓent'[cor][lab]-a/	MAX-PASS	ALIGN-R
a. seɓent'ʷ-a	*!	
☞ b. setʃ'ent'ʷ-a		*

The ranking of MAX-PASS above ALIGN-R ensures that the [cor] feature is realized even on root-medial labials in the passive. However, in locatives and diminutives, ALIGN-R dominates the constraints that require these morphemes to be realized, hence they surface only on the right edge of the word. The crucial ranking that

alveolars are C-place Cor, and dominate [+ant]. A change of an alveolar to a palatal results in the [-ant] Cor feature displacing the [+ant] Cor alveolar (see (23)).

(23) t → ʧ



This is not different from the change of a C-Place Lab to a [-ant] C-Place Cor, hence also a violation of the MAX constraint, MAX C-PL-COR in this case. I have argued that ranking MAX-MORPH above MAXC-PL-LAB accounts for why labials palatalize in all three suffixes. Also, the ranking of MAX C-PL DOR above MAX-MORPH accounts for non-palatalization in dorsals. However, ranking MAXC-PL-COR above MAX-MORPH cannot account for why alveolars palatalize in diminutives but not in passive and in locative forms. To account for the asymmetry, I argue that this is a consequence of interaction between morphological constraints and phonological constraints, and that MAX-MORPH is really a collocation of three constraints; MAX-DIM, MAX-LOC, and MAX-PASS. I propose that coronal palatalization in diminutives is one of the cases where the output is conditioned by ranking the morphological constraint for diminutive higher than competing phonological constraints whereas MAX-PASS and MAX-LOC are ranked below the phonological constraint (see (24)).

(24) MAX-DIM >> MAX C-PL-COR >> MAX-PASS, MAX-LOC

The ranking of MAX-DIM above MAXC-PL-COR forces the [cor] feature to be realized in diminutives (25), while ranking MAXC-PL-COR above both MAX-PASS and MAX-LOC forces the [cor] feature to be sacrificed. This results in a violation of MAX-MORPH in order to satisfy a higher-ranked MAXC-PL-COR (26).

(25) Coronal palatalization in the diminutive

Diminutive	/si-k^{h}atsi-[cor]-ana/	MAX-DIM	MAX C-PL-COR
	a. si-k^{h}ats-ana	*!	
	☞ b. si-k^{h}aʃ-ana		*

A representation of the relevant features affected in (25) is shown in (26).

(26) **Input**

C-Place$_a$ + V-Place$_b$

Cor$_a$ Cor$_b$
[+ant]$_a$ [-ant]$_b$

Candidates

(loser) (winner)

a. C-Place b. C-Place

Cor$_a$	Cor$_b$
[+ant]$_a$	[-ant]$_b$

In (26a), the root features, subscripted (a), are unchanged, but the diminutive morpheme is not realized, in violation of MAX-DIM. In (26b), the Cor that originated under the C-Place node, subscripted (a), has been deleted, in violation of MAX C-PL-COR, and has been replaced by the Cor that originated under the V-Place node, subscripted (b).

(27) Failure of coronal palatalization in the locative and passive

Locative	/e-si-k^{h}atsi-[cor]ini/	MAX C-PL-COR	MAX-LOC	MAX-PASS
	a. e-sik^{h}aʃini	*!		
	☞ b. e-sik^{h}atsini		*	
Passive	/sit'-[cor][lab]a/			
	a. sitʃ^{w}a	*!		
	☞ b. sit'^{w}a			*

4.3.2 Vowel quality

Recall that a verb root ends in a consonant while a noun stem ends in a vowel and that; in addition, the diminutive and locative suffixal morphemes also begin with a vowel. Thus, suffixing any of the morphemes to a noun stem creates hiatus between the root/stem and the suffix, a structure that is not allowed in the language. In Chapter 2, I discussed different strategies that are used to avoid a sequence of vowels in the language in general. In this section, I consider only those strategies that are observed in the locative and diminutive. Labialization, backness, and height are each treated differently.

4.3.2.1 Labialization

One of the strategies to resolve hiatus is labialization of the preceding consonant, if the final vowel of the noun is labial. Examples of data with labialization are repeated in (28).

(28)	Noun	Locative	Diminutive	
	si-ɓugo	e-si-ɓugʷ-eni	si-ɓugʷ-ana	'mirror'
	li-bugu	e-bugʷ-ini	li-bugʷ-ana	'book'

I propose that retention of the labial feature be attributed to the constraint MAX V-PL LAB (29).

(29) MAX V-PL LAB: No deletion of a V-Place labial.

Like secondary articulated segments, vowels are dominated by a V-Place node. Since *LINGLAB prohibits labial secondary articulation, MAX V-PL LAB must dominate this constraint. (30) formalizes the analysis of a noun with labialization.

(30) Diminutive: siɓugo 'mirror' → siɓugʷana

/si-ɓugo[cor]-ana/	MAX V-PL LAB	*LINGLAB
a. si-ɓug-ana	*!	
b.☞si-ɓugʷ-ana		*

4.3.2.2 Backness

Like in labial vowels, in some languages loss of front vowels may cause a secondary articulation. This, though, is not the case in siSwati. A sequence of vowels that involves a front vowel is resolved by either vowel coalescence or vowel deletion, which I will discuss shortly. The absence of palatal secondary articulation in the language is attributed to the constraint *LINGLING, already discussed. In (31) I illustrate with an example from the diminutive.

(31) Diminutive: li-viki 'week' → li-vik-ana

/li-viki[cor]-ana/	*LINGLING	MAX-LOC
a. li-vikʲ-ana	*!	
b. ☞ li-vik-ana		*

4.3.2.3 Height

We have seen that the stem's vowel labial feature is preserved as a secondary articulation, but its backness is not. The next vowel property to be considered is height. In the locative, height is preserved through vowel coalescence (see (32)).

(32)

			On/ in/ at the N...
(a)	/e-lu-tsʰi-ini/	e-lu-tsʰ-ini	'stick'
	/e-si-kʰulu-ini/	e-sikʰulʷ-ini	'chief'
(b)	/e-um-fana-ini/	e-m-fan-eni	boy'
	/e-li-ɦeʤe-ini/	e-ɦeʤ-eni	gate'
	/e-tin-so-ini/	e-tin-sʷ-eni	kidneys'

The decision as to which front vowel to choose is conditioned by the height of the stem vowel; if it is a high vowel /i/ or /u/, the vowel in the locative form will be the high vowel /i/, as shown in (32a). If the input vowel is a [-high] vowel /a/, /e/ or /o/, the vowel becomes a [-high] vowel /e/ (32b). I propose that this results from the constraint MAX [-high] in (33), which ensures that the [-high] feature is retained in the output. Coalescence results in a violation of the constraint UNIFORMITY (34).

(33) MAX [-high]: A [-high] in the input has a correspondent [-high] in the output.

(34) UNIFORMITY: Given two strings S_1 and S_2, related to one another as input-output, no element of S_2 has multiple correspondents in S_1.

The two allomorphs /-eni/ and /-ini/ preserve the [-back] feature from the suffix. [-back] is part of the morpheme and MAX LOC ensures its realization. To force coalescence, MAX [-high] and MAX LOC are ranked above UNIFORMITY, and above MAX [+high] (35).

(35) MAX [+high]: A [+high] in the input has a correspondent [+high] in the output.

(36) formalizes the analysis.

(36) Locative: iŋgubo 'blanket/dress' → e-ŋgutʃeni

/e-iŋgubo-[cor]-ini/	MAX LOC	MAX [-high]	UNIFORMITY	MAX [+high]
a. e-ŋgutʃ-oni	*!			*
b.e-ŋgutʃ-ini		*!		
☞ c. e-ŋgutʃ-eni			*	*

The reason that labialiation cannot be realized on the suffix vowel is that it would give us a fronted labial vowel, but this is not what we get in the grammar of siSwati; instead, we get a mid, front vowel which also has features from both input vowels. Notice that such a candidate will not be different from the optimal candidate concerning satisfaction and violation of the above constraints and will actually do worse on MAX V-PL LAB. This is illustrated in (37), where I first use the same constraints that I used in (36) to confirm that with the constraints that we have used so far this candidate poses a challenge to the winner.

(37)

/e-iŋgubo-[cor]-ini/	MAX LOC	MAX [-high]	UNIFORMITY	MAX V-PL LAB
☹a. e-ŋgutʃ-öni			*	
b. e-ŋgutʃ-eni			*	*!

The problem with the vowel in (37a) is that in siSwati round vowels are back. The ill-formedness of this candidate is therefore attributed to a constraint which forbids the co-occurrence of [labial] with [-back], *[-back, +labial] (38).

(38): *[-back, +labial]: If [labial] then [+back].

In (39), I repeat the analysis with the constraint *[-back, +labial] added to the tableau.

(39)

/e-iŋgu6o-[cor]-ini/	*[-back,+labial]	MAX-[-high]	UNIFORMITY	MAX V-PL LAB
a. e-ŋgutʃ-öni	*!		*	
☞ b. e-ŋgutʃ-eni			*	*

4.3.2.3 Vowel Deletion

In diminutive forms, hiatus is resolved through vowel deletion. The decision on which vowel to be retained depends on several factors. Casali (1997) has demonstrated that the predominant pattern cross-linguistically is to have V_1 in a V_1 V_2 sequence deleted. The same applies in the case of the diminutive. In addition, I suggest that the reason for the suffix vowel to be retained results from the high-ranking of MAX-DIM, which happens to be a [–high] vowel; hence, MAX [-high] will also be satisfied in such forms. The same ranking as for the locative accounts for the diminutive forms.

(40) Diminutive

/si-gubu[cor]-ana/	MAX-DIM	MAX [-high]	UNIFORMITY
a. si-gudʒ-una	*!	*	
b.si-gudʒ-ona	*!	*	*
☞ c.si-gudʒ-ana			

What is noticeable in these forms is that after palatalization of the labial, the following vowel is not labialized as was the case with alveolar palatalization. Moreover, in Setswana, discussed in Chapter 5, there is both palatalization of the labial and preservation of the V-Place labial in the form of secondary articulation. I return to this issue in Chapter 5.

4.4 Summary

This chapter has demonstrated that palatalization in the locative and diminutive, just like in the passive, is induced by the same feature, a floating [cor]. I have in addition demonstrated that palatalization of alveolars in the diminutive, and not in the passive and locative follows from the ranking of MAX-DIM above MAX C-PL-COR while MAX LOC and MAX-PASS are ranked below MAX C-PL-COR. In the next chapter I discuss palatalization in selected Southern Bantu languages to advance the idea of a [cor] feature inducing palatalization. Furthermore, and crucially, that as per factorial typology predictions, palatalization in these languages results from a reranking of the same constraints already developed for siSwati.

CHAPTER 5

A TYPOLOGY OF PALATALIZATION IN SOUTHERN BANTU LANGUAGES

This section locates siSwati palatalization within its broader Southern Bantu context. It identifies ways in which it is similar to and ways in which it differs from selected other Southern Bantu languages. Factorial typology postulates that languages differ in the ranking of their constraints. The aim of this chapter is to demonstrate that palatalization in the other Southern Bantu languages is parallel to that of siSwati; the trigger is the same, a floating /Cor [-ant]/ ([cor]) feature. Accordingly, an analysis of these languages is derived from a re-ranking of the constraints already developed for siSwati. For the typology I have selected four languages; namely, Setswana, Tshivenda, Xitsonga, and Sesotho. The choice was based on the wide variety these languages display in their realization of the [cor] feature.

5.1 Setswana

I first present the phonemic inventory of Setswana. Then, I discuss the behaviour of the passive, followed by that of the diminutive. In both processes I demonstrate how an OT analysis can account for their behaviour through a re-ranking of the constraints already developed for the siSwati grammar.

5.1.1 Segmental inventory

Table 5-1 presents the consonant inventory of Setswana, while the vowel system is presented in (1). The source of the segmental inventory is: the Department of African Languages and Literature: University of Botswana 1999: 10.

CHAPTER 5

A TYPOLOGY OF PALATALIZATION IN SOUTHERN BANTU LANGUAGES

This section locates siSwati palatalization within its broader Southern Bantu context. It identifies ways in which it is similar to and ways in which it differs from selected other Southern Bantu languages. Factorial typology postulates that languages differ in the ranking of their constraints. The aim of this chapter is to demonstrate that palatalization in the other Southern Bantu languages is parallel to that of siSwati; the trigger is the same, a floating /Cor [-ant]/ ([cor]) feature. Accordingly, an analysis of these languages is derived from a re-ranking of the constraints already developed for siSwati. For the typology I have selected four languages; namely, Setswana, Tshivenda, Xitsonga, and Sesotho. The choice was based on the wide variety these languages display in their realization of the [cor] feature.

5.1 Setswana

I first present the phonemic inventory of Setswana. Then, I discuss the behaviour of the passive, followed by that of the diminutive. In both processes I demonstrate how an OT analysis can account for their behaviour through a re-ranking of the constraints already developed for the siSwati grammar.

5.1.1 Segmental inventory

Table 5-1 presents the consonant inventory of Setswana, while the vowel system is presented in (1). The source of the segmental inventory is: the Department of African Languages and Literature: University of Botswana 1999: 10.

	Bilabial	Labio Dental	Alveolar	Pre-Palatal	Palatal	Velar	Glottal
Stops Aspirated	p^h		t^h			k^h	q^h
Voiced	b						
Ejective[24]	p'		t'			k'	
Affricate			ʦ' $ʦ^h$	ʧ' $ʧ^h$ ʤ			
Fricative		f	s r	ʃ		x	h
Lateral			ɬ $ɬ^h$ l				
Nasal	m		n		ɲ	ŋ	
Approximant					y	w	

Table 5-1 The phonemic inventory of Setswana consonants

Vowels

(1)

i		u
ɪ		ʊ
e		o
ɛ		ɔ
	a	

5.1.2 Palatalization in Setswana

Palatalization in Setswana occurs in the formation of the passive, diminutive, and causative. In all three processes, the stem-final labial palatalizes. In diminutive formation, alveolar and velar consonants may palatalize as well. The nasals [m, n, ɲ] become the velar nasal [ŋ] in passive formation, but [m, ŋ] do palatalize in

[24] There has been a suggestion that the so called ejectives in Setswana are just plain voiceless stops (Monaka 2001).

diminutive formation.[25] The locative is formed by suffixing /-iŋ/ to the noun, with no segmental changes. It may also be formed by prefixation. I do not discuss the locative in this thesis, since the aim is to compare those processes which exhibit palatalization. The aim of this section is to demonstrate how a re-ranking of the constraints independently motivated to analyze siSwati may be used to derive the Setswana grammar.

5.1.3 The passive

5.1.3.1 Data survey

The main source of the data is Cole, (1955: p.192-195)[26]

In the passive, a verb root of one or more syllables that ends in either an alveolar or velar consonant has two alternative forms with either /-w/ or /-iw/.

(2)	bon-a	bon^{w}-a	bon-iw-a	'be seen'
	rat-a	rat^{w}-a	rat-iw-a	'be loved'
	rok-a	rok^{w}-a	rok-iw-a	'be sewn'
	ax-a	ax^{w}-a	ax-iw-a	'be built'

A root-final labial surfaces with either palatalization of the labial consonant and the suffix /-w/, or with no palatalization and the suffix /-iw/.

(3)	bop-a	botʃ^{w}-a	bop-iw-a	'be moulded'
	xap-a	xatʃ^{w}-a	xap-iw-a	'be plundered'
	tɬ^{h}ab-a	tɬ^{h}adʒ^{w}-a	tɬ^{h}ab-iw-a	'be stabbed'
	bof-a	boʃ^{w}-a	bof-iw-a	'be bound'
	lef-a	leʃ^{w}-a	lef-iw-a	'be paid'
	tɬop^{h}-a	tɬotʃ^{hw}-a	tɬop^{h}-iw-a	'be selected'

A root-final labial nasal is either replaced by a velar nasal or /-iw/ is suffixed to the root.

---

[25] The change of nasals to the velar nasal will not be considered in this analysis.

[26] Cole uses Setswana orthography in his examples, but has a section where he gives a phonetic description of both the vowels and consonants that he uses. The data has also been modified and supplemented with the help of my informants, Segomotso Keakopa, and Peter Sebina, both Setswana native speakers from Botswana who were studying at UCL at the time.

(4)	lʊm-a	lʊŋʷ-a	lʊm-iw-a	'be bitten'
	xam-a	xaŋʷ-a	xam-iw-a	'be milked'
	rɛm-a	rɛŋʷ-a	rem-iw-a	'be chopped'

Root-final /ʦ'/ suffixes /-w/ or uses /-iw/ and becomes [d] in passive formation.

(5)	ɲaʦ'-a	ɲaʦ'ʷ-a	ɲad-iw-a	'be despised'
	biʦ'-a	biʦ'ʷ-a	bid-iw-a	'be called'
	bʊʦ'-a	bʊʦ'ʷ-a	bʊd-iw-a	'be asked, questioned'

Monosyllabic stems suffix /-iw/ to the verb root.

			Be V...(-en)
(6)	f-a	f-iw-a	'give'
	ʤ-a	ʤ-ɪw-a	'eat'
	n-a	n-ɪw-a	'rain'
	y-a	iw-a	'go to, go'
	ʃʷ-a	ʃʷ-iw-a	'die'
	ɲ-a	ɲ-ɪw-a	'excrete'
	qʰʷ-a	qʰʷ-iw-a	'spit out'

Unlike in siSwati, root-medial labials do not palatalize in Setswana. Note that the following set of data is not from Cole but was elicited from my informants.

				Be V...(-en)
(7)	ʦ'amay-a	ʦ'amayʷ-a	ʦ'amay-iw-a	'go'
	lemʊx-a	lemʊxʷ-a	lemʊx-iw-a	'recognize'
	rap'el-a	rap'elʷ-a	rap'el-iw-a	'pray'
	xop'ʊl-a	xop'ʊlʷ-a	xop'ul-iw-a	'think'

The segmental alternations which occur under labial palatalization in siSwati and Setswana are compared below.

(8) Segmental alternations in labial palatalization

	siSwati	**Setswana**
Input	Output	
/pʼ/	ʧʼ	ʧʼ
/b/	ʤ	ʤ
/p^h/	ʃ	ʧʰ
/ɓ/	ʧʼ	–[27]
/f/	f	ʃ
/m/	ɲ	ŋ

(9) shows the relationship between Setswana and siSwati passive.

(9)	SiSwati		Setswana	
a. Non-labial finally				
/sit'-a/	sitʼʷ-a	/rat-a/	ratʷ-a	
'help'	*sitʃʼʷ-a	'love'	*ratʃʷ-a	
	*sitʼ-iw-a		rat-iw-a	[different]
b. Monosyllabic root				
/ɮ-a/	*ɮʷ-a	/xa/	*xʷ-a	
'eat'	*ʧʷ-a	'draw water'	*ʧʷ-a	
	ɮ-iw-a		x-iw-a	
c. Final labial				
/ɬaɓ-a/	*ɬaɓʷ-a	/tɬʰab-a/	*tɬʰabʷ-a	
'stab'	ɬatʃʼʷ-a	'stab'	tɬʰadʒʷ-a	
	*ɬab-iw-a		tɬʰab-iw-a	[different]
d. Medial labial				
/seɓent-a/	*seɓentʷ-a	/ʦʼamay-a/	ʦʼamayʷ-a	[different]
'work'	setʃʼentʷ-a	'go'	*ʦʼaɲayʷ-a	[different]
	*seɓent-iw-a		ʦʼamay-iw-a	[different]
e. Initial labial				
/ɓon-a/	ɓonʷ-a	/bon-a/	bonʷ-a	
'see'	*ʧʼonʷ-a	'see'	*ʤonʷ-a	
	*ɓon-iw-a		bon-iw-a	[different]

[27] Setswana does not have a bilabial implosive hence the gap.

The facts of the Setswana passive are similar to those encountered in siSwati. The root-final labial surfaces with either, palatalization of the labial or suffixation of /-iw/, with no palatalization. The other segments surface with no palatalization but either suffixation of /-w/ or /-iw/. In monosyllabic roots, the [cor] always appears as [i].

(10) Summary of similarities and differences between Setswana and siSwati

- /-iw/ is always acceptable in Setswana even on longer roots, but in siSwati it is only used to satisfy minimality (Setswana: tɬʰab-iw-a vs siSwati: *ɬaɓ-iw-a).
- Labials only palatalize when root-final in Setswana (Setswana: *tsʼaɲayʷ-a vs siSwati: setʃʼentʷ-a).

5.1.3.2 Analysis

Given these similarities and differences between the two languages, the analysis is as follows: I argue that siSwati and Setswana have the same underlying morpheme: a floating V-Place [cor] and [lab] features. The [cor] feature either palatalizes the root-final labial or surfaces as /i/, depending on the dialect.[28] The labial feature appears as secondary articulation on the longer roots and as /w/ in monosyllabic ones. Justification of /i/ being the [cor] feature has been discussed earlier under passivisation of subminimal roots in siSwati.

5.1.3.2.1 Non-labial root-finally

Recall that in siSwati /-iw/ is not accepted on longer roots. This resulted in the [cor] feature not being realized on non-labial consonants: ranking DEP-μ above MAX PASS accounted for this generalisation. Since Setswana accepts forms with either suffix, DEP-μ, which prevents epenthesis in siSwati, should be equally ranked with MAX PASS in Setswana. *LINGLING and MAX C-PL DOR remain undominated in Setswana as well (see (11)).

[28] According to my informants, the palatalized form is mainly used in the western part of Botswana, Namibia, and in some parts of South Africa, whereas the unpalatalized form is commonly used in the eastern part of the country and around the Gaborone area. According to Cole p. 193, though, the tendency to use /-wa/ is most evident in the eastern dialects.

(11) Setswana: rok'-a 'sew' → rok'^{w}-a/rok'-iw-a 'sew'

/rok'[cor][lab]-a/	*LINGLING	MAX C-PL DOR	MAX PASS	DEP-μ
a. rok^{y}-a	*!			
b. rotʃ^{w}-a		*!		
c.☞rok'^{w}-a			*	
d. ☞rok'-iw-a				*

To force epenthesis on siSwati subminimal roots, Dep-μ is ranked below MIN. The behavior of C-roots in Setswana also follows from the constraint hierarchy already established. The crucial ranking is between MIN (which did not have any effect on longer roots) and Dep-μ. As in siSwati, ranking MIN above Dep-μ forces augmentation of a subminimal root in Setswana (12).

(12) Setswana: x-a → x-iw-a 'draw water'

/x[cor][lab]-a/	MIN	MAX PASS	DEP-μ	DEP- F
a.x^{w}-a	*!	*		
b. x-aw-a		*! [cor]	*	*
c. x-uw-a		*! [cor]	*	
d.☞x-iw-a			*	

The above discussion has illustrated how the difference in the two grammars results from a ranking relationship between DEP-μ and MAX PASS. In siSwati, DEP-μ is ranked above MAX PASS, while in Setswana the two constraints are equally ranked (see (13) for a ranking of the relevant constraints).

(13) SiSwati: MIN >> DEP-μ >> MAX PASS

Setswana: MIN >> DEP-μ, MAX PASS

5.1.3.2.2 Root-final labial

To account for root-final labials in siSwati; where, only one output form is accepted, MAX C-PL LAB is dominated by DEP-μ. This ranking prevents the suffixation of /-iw/ to the longer roots. In Setswana, both palatalization of the root labial and

suffixation of /-iw/ are accepted. This means the constraint against the deletion of labials, MAX C-PL LAB, should be on a par with the constraint that prohibits insertion of a mora, Dep-μ. (14) evaluates candidates from a root with a labial in the final position in Setswana.

(14) Setswana: rob-a → rodʒʷ-a/rob-iw-a 'break'

/rob [cor][lab]-a/	*LABLAB	*LABLING	MAX PASS	DEP-μ	MAX C-PL LAB
a.robʷ-a	*!		*		
b. robʸ-a		*!	*		
c.☞ rob-iw-a				*	
d.☞ rodʒʷ-a					*

5.1.3.2.3 Root-medial labial

The second difference between the two languages is that Setswana does not palatalize root-medial labials; the suffix always appears on the right edge of the root. This difference results from the relative ranking of ALIGN-R with the rest of the constraints. When ALIGN-R is dominated by MAX PASS, the [cor] feature moves to the medial position. This is what we observed in siSwati. On the other hand, when ALIGN-R dominates MAX PASS, the [cor] is restricted to the right edge of the root. This prevents palatalization of the root-medial labial in Setswana.

(15) Setswana: ʦ'amay-a → ʦ'amay-iw-a/ʦ'amayʷ-a 'walk'

/ʦ'amay[cor][lab]-a/	ALIGN-R	MAX PASS	DEP-μ	MAX C-PL LAB
a.ʦ'aɲayʷ-a	*!			*
b.☞ ʦ'amay-iw-a			*	
c. ☞ʦ'amayʷ-a		*		

We have seen that in both languages there is a clear role of ALIGN-R and MAX PASS. SiSwati would rather misalign the [cor] feature than leave it unrealized. Setswana, on the other hand, makes sure that the feature appears on the right edge of the root. If it does not, then it will not be realized.

Root-initial labials do not palatalize in Setswana and the rest of the languages that I discuss. This is accounted for by the high-ranking of IDENT-Pl,[$_{\sigma 1}$. The position of this constraint above MAX PASS accounted for the siSwati forms. The same ranking will account for the Setswana forms (see (16)).

(16) Setswana: bon-a → bon^{w}-a/bon-iw-a 'see'

/bon[cor][lab]-a/	IDENT-Pl,[$_{\sigma 1}$	*LABLING	MAX PASS	DEP-μ	MAX C-PL LAB
a. ʧon^{w}-a	*!				*
b. b^{y}on-a	*!	*			
c. ☞ bon^{w}-a			* [cor]		
d. ☞ bon-iw-a				*	

The overall ranking of the passive is provided in (17).

(17) Ranking:

SiSwati: *LINGLING, *LABLING, *LABLAB, IDENT-Pl,[$_{\sigma 1}$, MAX C-PL DOR, MIN >> DEP-μ >> MAX PASS >> MAX C-PL LAB >> ALIGN-R.

Setswana: *LINGLING, *LABLING, *LABLAB, IDENT-Pl,[$_{\sigma 1}$, MAX C-PL DOR, MIN, ALIGN-R >> DEP-μ, MAX PASS, MAX C-PL LAB

5.1.4 Diminutive

Unlike verbs, nouns end in vowels. These delete in the diminutive, but if the vowel is labial it causes labialization of the preceding consonant in both siSwati and Setswana. In Setswana, but not siSwati, a labial root consonant may also leave its labialization behind. The following examples present data from Herbert (1977).

5.1.4.1 Data survey

When alveolars end in non-labial vowels there is no labialization (but palatalization of alveolars).

(18)	nare	natʃ-ana	'a small buffalo'
	podi	pots-ane	'a small goat'
	leɓati	lebatʃ-ana	'a small door'
	tʃʰʷene	tʃʰʷeɲ-ana	'a small baboon'
	ŋʷana	ŋʷaɲ-ana	'a small child'

However, when velars end in non-labial vowels there is neither labialization nor palatalization.[29]

(19)	nɔxa	nɔx-ana	'a small snake'
	tʃʰaka	tʃʰak-ana	'a small spear'

When alveolars (20) and velars (21) end with labial vowels, there is no palatalization but labialization of the final vowel.

(20)	tʰoto	tʰotʷana	'a small pile of smth.'
	sutu	sutʷana	'a small suit of clothing'
(21)	kʊkʊ	kʊkʷ-ana	'a small fowl'
	ŋku	kʷ-ana	'a small sheep'
	nako	nakʷ-ana	'not enough time'

The segmental alternations which occur under alveolar palatalization in the two languages are summarised below.

(22)	SiSwati	Setswana
/t/	tʃ'	tʃ'
/l/	ɬ	ʃ
/d/	dʒ	ʦ'
/r/[30]	-	tʃ'
/n/	ɲ	ɲ

In Setswana, unlike siSwati, when a final labial is followed by either a labial or a non-labial vowel, there is both palatalization (caused by the suffix) and labialization (caused by the underlying labialization of the root consonant). (The data is from Stahlke (1976: 51).

[29] Note that the data in (19, 20, and 21) are not from Herbert but were elicited from my informants.
[30] SiSwati does not have the phoneme /r/ in its inventory; hence, the gap in the alternations.

(23)	kolobe	kolodʒʷ-ana	'piglet' [cf. siSwati inɮeɓe 'ear'→ inɮetʃana]
	kobo	kodʒʷ-ana	'small cloak'
	tsʰipi	tsʰitʃʷ-ana	'small piece of iron'
	lerapo	leratʃʷ-ana	'small bone'
	tsepʰe	tsetʃʰʷ-ana	'springbok kid'
	maropʰi	marotʃʰʷ-ana	'small blisters'
	pʰofu	pʰotʃʰʷ-ana	'young eland'
	lexapu	lexatʃʷ-ana	'small watermelon'
	selɛpe	selɛtʃʷ-ana	'small axe'
	lexofi	lexoʃʷ-ana	'palm of hand'

In (24), I show the relationship between siSwati and Setswana diminutive forms.

(24)	SiSwati		Setswana	
a. Non-labial vowel				
/li-ɦeɡe/ 'gate'	*li-ɦeɡʷ-ana	/kxosi/ 'chief'	*kxosʷ-ana	
	li-ɦeɡ-ana		kxos-ana	
b. Labial vowel				
/si-ɓuɡo/ 'mirror'	si-ɓuɡʷ-ana	/kʊkʊ/ 'fowl'	kʊkʷ-ana	
	*si-ɓuɡ-ana		*kʊk-ana	
c. Labial consonant				
/in-ɮeɓe/ 'ear'	*inɮetʃ'ʷ-ana	/ʦ'epʰe/ 'springbok'	ʦ'etʃʰʷ-ana	[different]
	inɮetʃ'-ana		*ʦ'etʃʰ-ana	[different]
	*inɮeɓ-ana		*ʦ'epʰ-ana	
d. Alveolar consonant				
/li-dada/ 'duck'	lidadʒ-ana	/lebat'i/ 'door'	lebatʃ'-ana	
	*lidadʒʷ-ana		*lebatʃʷ-ana	
	*lidad-ana		*lebat'-ana	

(25) Summary of similarities and differences between siSwati and Setswana

- In both languages, labial vowels cause labialization.
- Labial consonants cause labialization in Setswana, not in siSwati.

5.1.4.2 Analysis

5.1.4.2.1 Labial consonant root-finally

Labial palatalization causes the replacement of the root labial feature in both languages but, in addition, it re-associates from a C-Place node to a V-Place node in Setswana. Recall that ranking the constraint *RE-ASSOCIATE (repeated in (26)) above MAX C-PL LAB in siSwati ensures that there is no re-association of features.

(26) *RE-ASSOCIATE (*RE-ASSOC): A feature associated with a C-Place node should not be re-associated with a V-Place node.

In Setswana, *RE-ASSOC should be demoted and crucially ranked below MAX C-PL LAB to allow the labial feature to appear as a secondary articulation. *LABLING remains undominated.

(27) Setswana: tsebe → tsetʃʼʷ-ana 'ear'

/tsebe[cor]-ana/	*LABLING	MAX DIM	MAX C-PL LAB	*RE-ASSOC
a. tsebʸ-ana	*!			
b. tseb-ana		*! [cor]		
c. tsetʃʼ-ana			*!	
d.☞ tsetʃʼʷ-ana				*

5.1.4.2.2 Labial vowel root- finally

Unlike consonants, labial vowels do surface as a secondary articulation in both languages (with any consonant). (e.g. siSwati: /si-ɓuʤo/ 'mirror' → si-ɓuʤʷ-ana / *si-ɓuʤ-ana; Setswana: /kuku/ 'fowl' → kukʷ-ana / * kuk-ana). Vowels are dominated by a V-Place node, the same as secondary features. There is therefore no violation of *RE-ASSOC in these forms. Since the MAX C-PL LAB constraint regulates only deletion of labial consonants (C-Place Labial), MAX V-PL LAB prevents the labial vowel from being deleted. In siSwati, Max-V-Place Lab is ranked above *LINGLAB and MAX C-PL LAB to allow the labial vowel to surface as a secondary articulation. For ease of comparison, I repeat in (28) an analysis of a stem-final labial vowel in siSwati.

(28) SiSwati: si-ɓugo 'mirror' → si-ɓugʷ-ana

/si-ɓugo[cor]-ana/	*RE-ASSOC	MAX V-PL LAB	*LINGLAB	MAX C-PL LAB
a.si-ɓugʷ-ana		*!		
☞ b.si-ɓugʷ-ana			*	

However, in Setswana MAX C-PL LAB and MAX V-PL LAB should be equally ranked and should both dominate *LINGLAB. Both the root labial vowel and consonant always surface as a secondary articulation in the output.

(29) Setswana: nako 'time' → nakʷ-ana

/nako[cor]-ana/	MAX V-PL LAB	MAX C-PL LAB	*RE-ASSOC	*LINGLAB
a. nak-ana	*!			
b.☞nakʷ-ana				*

As in siSwati, the labial feature from a round vowel appears as a secondary articulation in the output in Setswana. If it does not, as in (29a), the candidate incurs a fatal violation of MAX V-PL LAB. In both languages, MAX V-PL LAB should be satisfied.

Nonetheless, when a round vowel is preceded by a labial consonant, there is no secondary articulation but palatalization of the labial consonant in siSwati. This was accounted for by the same ranking we saw in (28). (30) repeats an analysis of a noun with a labial followed by a round vowel in siSwati.

(30) SiSwati: li-tsʰambo 'bone' → li-tsʰaɲʤ-ana

/litsʰambo[cor]-ana/	*RE-ASSOC	MAX V-PL LAB	*LINGLAB	MAX C-PL LAB
a.li-tsʰaɲʤʷ-ana	*!		*	*
b. ☞li-tsʰaɲʤ-ana		*		*

In the above tableau, candidate (30a), the Setswana equivalent, is ruled out by *RE-ASSOC. We have seen that the [lab] feature that surfaces as a secondary articulation in Setswana is the one from the C-Place node and not the V-Place node. This is because labial consonants with dorsal and coronal vowels also appear with a labial

secondary articulation, e.g. /ʦ'ebe → ʦ'eʧ'ʷ-ana/. We can therefore conclude that the secondary labial that appears in these forms is from the root consonant not the vowel. Again, the Setswana grammar already developed can account for these forms: in particular the ranking of MAX C-PL LAB above *RE-ASSOC and *LINGLAB.

(31) Setswana: le-rapo 'bone' → le-raʧʷ-ana

/le-rapo[cor]-ana/	MAX V-PL LAB	MAX C-PL LAB	*RE-ASSOC	*LINGLAB
a. le-raʧ-ana		*!		
☞ b. le-raʧʷ-ana				

(32) provides the final ranking for the relevant constraints

(32) SiSwati: *RE-ASSOC, MAXDORS, MIN >> DEP-μ >> MAX PASS >> MAX V-PL LAB >> MAX C-PL LAB, *LINGLAB >> ALIGN-R.
Setswana: ALIGN-R, MAXDORS, MIN >> DEP-μ, MAX PASS, MAX C-PL LAB, MAX V-PL LAB >> *RE-ASSOC >> *LINGLAB.

5.2 Palatalization in Tshivenda

In the next section I discuss palatalization in Tshivenda. The segmental inventory is presented first, followed by a discussion of the passive.

5.2.1 Segmental inventory

Table 5-2 presents the consonant inventory while the vowel system is shown in (33). The abbreviations in Table 5-2 are as follows: B-lab = bilabial, D-lab = Denti-labial, Alv = alveolar, P-pal = prepalatal, Pal = palatal, Vel = velar.

	B-lab	D-lab	Den	Alv	P-Pal	Pal	Vel	Glottal
Stops Aspirated	pʰ		t	tʰ			kʰ	
Voiced	b		d̪	d			g	
Ejective	p'		t̪'	t'			k'	
Affricate			pfʰ pf' bv	ʦ' ʦʰ ʣ	ʧ' ʧʰ ʤ			
Fricative	ɸ β	f v		s z r	ʃ ʒ		x ɣ	ɦ
Lateral			l̪	l				
Nasal	m		n̪	n		ɲ	ŋ	
Approximant	w					y	(w)	

Table 5- 2 The consonant inventory for Tshivenda (source: Poulos (1990))

Vowels

(33) i u

ɛ ɔ

a

5.2.2 The passive

Like in Setswana, the passive in Tshivenda may be formed by suffixing either /-iw/ or /-w/ to the verb root. The following data are from Poulos (1990: 174 - 175).

Roots ending in non-labial segments suffix /-iw/ or /-w/.

(34)	βon-a	βonʷ-a	βon-iw-a	'be seen'
	vul-a	vulʷ-a	vul-iw-a	'be opened'
	ɸaṯ-a	ɸaṯʷ-a	ɸaṯ-iw-a	'be built'
	fun-a	funʷ-a	fun-iw-a	'be loved'
	rend-a	rendʷ-a	rend-iw-a	'be praised'
	vakaʃ-a	vakaʃʷ-a	vakaʃ-iw-a	'be visited'

Like in siSwati, C-roots suffix only /-iw/ to the verb root.

(35)			
	ɸ-a	ɸ-iw-a	'be given'
	r^w-a	r^w-iw-a	'be hit'
	n^w-a	n^wiwa	'be drunk'
	pf-a	pf-iw-a	'be heard'
	k-a	k-iw-a	'be picked'

However, root-final labial consonants surface with either palatalization (e.g. /p'/ > [p^y], or velarization of the labial consonant (e.g. /p'/ > [p^y] or a labialized velar (e.g. /p'/ > [k^w] (depending on dialect). /-iw/ is suffixed with no consonantal change. Since the study is concerned with palatalization, I consider only those forms which palatalize the labial consonant.

(36)				
	tap'-a	tap^y-a	tap'-iw-a	'be flicked'
	k^hop^h-a	k^hop^{hy}-a	k^hop^h-iw-a	'be broken off'
	dob-a	dob^y-a	dob-iw-a	'be picked up'
	ramb-a	$ramb^y$-a	ramb-iw-a	'be invited'
	lum-a	lum^y-a	lum-iw-a	'be bitten'
	lifh-a	$lifh^y$-a	lifh-iw-a	'be payed'

The following generalizations can be made from the Tshivenda data: root-final labials suffix either /-iw/ or/-w/, a pattern that has been observed in Setswana, but not in siSwati. Monosyllabic stems always suffix /-iw/. This pattern is observed in siSwati as well. However, Tshivenda differs from siSwati and Setswana in the realization of the [cor] on root-final labials; the morpheme appears as a secondary articulation to the labial, instead of replacing the labial consonant.

In (37) I present examples to show the relationship between siSwati and Tshivenda passive forms.

(37)	SiSwati	Tshivenda	
a. Final labial			
/ɬaɓ-a/ 'stab'	ɬatʃ'^{w}-a	/t'ap'-a/ 'flick' *t'atʃ^w-a	[different]
	*ɬaɓ^y-a	t'ap'^{y}-a	[different]
	*ɬaɓ-iw-a	t'ap'-iw-a	[different]
b. Non-labial finally			

/sit-a/ 'help'	sitʷ-a	/fun-a/ 'love'	funʷ-a	
	*sitʃʷ-a		*fuɲʷa	
	*sit-iw-a		fun-iw-a	[different]

c. Monosyllabic root

/ɮ-a/ 'draw water'	*ɮʷ-a	/k-a/ 'pick'	*kʷ-a	
	ɮ-iw-a		k-iw-a	

(38) Summary of the relationship between siSwati and Tshivenda

- Different from siSwati, Tshivenda suffixes the /-iw/ even on longer roots.
- The [cor] feature is realized as a secondary articulation in Tshivenda whereas in siSwati, it displaces the labial consonant and is primary articulated.

5.2.2.1 Analysis

One of the differences between siSwati and Tshivenda is that Tshivenda accepts both /-iw/ and /-w/ on longer roots. This has already been observed in Setswana and has been accounted for by demoting DEP-μ, such that it was ranked on a par with MAXPASS. The same ranking will be used to account for the Tshivenda forms (see (39)). *LINGLING remains high-ranked in Tshivenda as well.

(39) Tshivenda:rend-a → rendʷ-a/ rend-iw-a 'be praised'

/rend[cor][lab]-a/	*LINGLING	MAX C-PL COR	MAX PASS	DEP-μ
a. rendʸ-a	*!			
b. reɲdʒʷ-a		*!		
c. ☞ rend ʷ-a			*[cor]	
d. ☞ rend -iw-a				*

Although the [cor] feature is realized as a secondary articulation in Tshivenda, I assume that it also has the same underlying passive morpheme as siSwati. The crucial assumption made is that the actual phonetic realization depends on language-specific differences in the interpretation of phonological structure (Keating 1991, Kochetov 1998). We mentioned that in Setswana, and optionally Sesotho the V-Place [cor] replaces the C-Place labial through the process of promotion (Clements

1986). This results in a /p/ becoming a [tʃ]. However, in Tshivenda and Xitsonga, which will be discussed shortly, the V-Place [cor] is not promoted, nor is the [lab] delinked from its C-Place articulation. The result is a labial with a secondary articulation.

I return to the Tshivenda passive, to note that the same constraints used in evaluating the siSwati passive will be used to account for palatalization in Tshivenda. Realizing the [cor] as a secondary articulation violates the constraint *LABLING. This constraint is undominated in siSwati. However, it should be low-ranked in Tshivenda. Moreover, a form which violates *LABLING also incurs a violation of MAX PASS, since; the labial part of the morpheme is not realized. This motivates an equal ranking of the two constraints. Furthermore, Tshivenda optionally accepts /-iw/, even on longer roots, therefore Dep-μ should also be at the same position with *LABLING and MAX PASS. All three constraints should be crucially dominated by MAX C-PL LAB, since there is no change in the place specification of the labial. (40) formalizes the analysis.

(40) Tshivenda: t'ap'-a 'flick' → t'apʸa/ t'ap'-iw-a

/t'ap'[cor][lab]-a/	MAX C-PL LAB	MAX PASS	DEP-μ	*LABLING
a.t'atʃʷ-a	*!			
b.☞t'apʸ-a		*[lab]		*
c.☞t'ap-iw-a			*	

The candidates in (40) have all realized the [cor] part of the morpheme, but in different ways. The candidate in (40a) has realized all the features of the morpheme, and the same way as siSwati does. However, replacing the labial segment with a coronal, results in a violation of MAX C-PL LAB since Tshivenda prefers to keep the labial segment intact. (40b), on the other hand, preserves the labial and only realizes the [cor] feature; MAX PASS is violated, however, the violation is minimal since the constraint is ranked below MAX C-PL LAB. In (40c), both features are realized, different from siSwati, but similar to the way Setswana passivizes its forms; both features appear as independent segments. A violation of DEP-μ is incurred. Since DEP-μ and MAX PASS are equally ranked and both below MAX C-PL LAB, (40 (b and c) are optionally accepted in Tshivenda.

Root-initial labials do not palatalize in Tshivenda as well. Ranking IDENT-Pl,[$_{\sigma}$] above MAX PASS, like in siSwati, accounts for this phenomenon.

(41) Tshivenda: βon-a → βon^{w}-a/ βon-iw-a 'be seen'

/βon[cor][lab]-a/	IDENT-Pl,[$_{\sigma}$]	MAX C-PL LAB	MAX PASS	DEP-μ	*LABLING
a. ʧon^{w}-a	*!	*			
b. β^{y}on^{w}-a	*!				*
c.☞ βon^{w}-a			*[cor]		
d.☞ βon-iw-a				*	

Ranking of the relevant constraints for the languages discussed so far is presented in (42).

(42) SiSwati: *LABLING >> DEP-μ >> MAX C-PL LAB

Setswana: *LABLING >> DEP-μ, MAX C-PL LAB

Tshivenda: MAX C-PL LAB >> DEP-μ, *LABLING

5.2.3 Diminutive and Locative

Tshivenda generally uses prefixes to form the diminutive. The locative is formed by the suffixation of /-ni/ with no segmental changes. This is different from the way in which siSwati forms its diminutive and locative. Crucially there is no palatalization in these forms. Therefore, a formal analysis of these two processes will not be considered in this thesis.

5. 3 Xitsonga

Palatalization in Xitsonga is found in the passive, diminutive, and locative. This language presents a different typology in that the passive is formed by suffixation of /-iw/, in all roots, irrespective of the size. There is neither change of place specification of the labial nor palatal secondary articulation to the labial. In the discussion that follows, again we see how this phenomenon can be accounted for by constraint re-ranking. Before I present the analyses, I first present the consonant and vowel inventories of the language, followed by the data.

5.3.1 Segmental inventory

Table 5-3 presents the phonetic inventory of Xitsonga consonants according to Baumbach (1987). The vowel inventory, from the same author, is presented in (43).

The abbreviations in Table 5-3 are as follows: B-lab = bilabial, D-Lab = Denti-labial, Alv = alveolar, Retr = retroflex, Lab-Alv = Labio-alveolar, P-pal = prepalatal, Pal = palatal, Vel = velar, Glot = glottal.

	B-lab	D-lab	Alv	Retr	Lab-Alv	P-pal	Pal	Vel	Glot
Stops Ejective Aspirated Voiced	p' pʰ b mb		t' tʰ d nd	nɖ			ɲdʒ	k' kʰ g ŋg	
Nasal	m mɦ		n nɦ			ɲ		ŋ ŋɦ	
Rolled Lateral			r l						
Fricative Lateral		f v	s z ɬ ɮ		ʂ ʐ	ʃ ʒ			h ɦ
Affricate Ejective Aspirated Voiced Lateral Ejective Aspirated	pf' bv		ʦ' ʦʰ ʣ ʦɬ ʦɬʰ		ʧ, pʂ ʧʰ bʐ	ʧ' ʤ		 kɬ kɬ	
Approximant	(w)					j		w	

Table 5-3 Xitsonga consonant inventory

( ) represents an alternative position in which a particular sound is found.

Xitsonga has a six-vowel system. According to Baumbach, the central vowel (schwa) is always nasalized.

(43) i u

ɛ ə̃ ɔ

a

5.3.3 The passive

To recapitulate, we have mentioned that siSwati forms the passive by either suffixing /-w/ or /-iw/ to the verb root. The /-iw/ is suffixed only to subminimal roots. In addition, root-final labials palatalize. This is the case for Setswana and Tshivenda as well. Nonetheless, these two languages also, optionally, suffix /-iw/ on longer roots. The way Xitsonga forms its passive is different from what we have observed so far. In this language, /-iw/ is suffixed to any size of root. Furthermore, there is no palatalization of labials as was observed in the other languages. Consider the data from Baumbach (1987: 207) in (44).[31]

(44)	rah-a	rah-iw-a	'kick'
	b-a	b-iw-a	'hit'
	luk-a	luk-iw-a	'plait'
	rhandz-a	rhandz-iw-a	'love'
	lum-a	lum-iw-a	'bit'

5.3.3.1 Analysis

Since the Xitsonga passive morpheme /-iw/, has also been attested in the other Southern Bantu languages, although optionally and/or on subminimal roots, it is plausible to assume that this language has the same underlying form as the other languages; the [cor] appearing as the vowel [i] all the time and the [lab] as a segment [w]. If we do, then the Xitsonga forms can be accounted for by the same constraints developed for siSwati, nonetheless, with a different ranking. In siSwati, the non-realization of the [cor] feature on non-labial segments, which could be realized either by inserting the vowel /i/ (optionally observed in Setswana and Tshivenda), or as a secondary articulation to the segment (not attested in any of the Southern Bantu languages), was accounted for by ranking DEP-μ and *LINGLING above MAX PASS. Xitsonga realizes the morpheme by inserting the vowel /i/, which suggests that DEP-μ should be low-ranked, and crucially, below MAX PASS. Like siSwati, it does not realize the [cor] as a secondary articulation. This leaves *LINGLING high-ranked. Also, dorsals retain their place of articulation, which suggests that MAX C-PL DOR should remain undominated as well. This though does not give us a ranking between

[31] All the Xitsonga data was verified by an informant, Magezi Sithole, a 24-year old native speaker from Malamlela, in the Northern Province of South Africa.

the undominated constraints and MAX PASS. I will therefore leave them on a par in the following tableau.

(45) Xitsonga: Non-labial root-finally

/luk [cor][lab]-a/	*LINGLING	MAX C-PL DOR	MAX PASS	DEP-μ
a. luk^{y}-a	*!		*[lab]	
b. lutʃ^{w}-a		*!		
c. luk^{w}-a			*! [cor]	
☞ d. luk-iw-a				*

Since all the forms suffix /-iw/ in Xitsonga, including monosyllabic roots, the low-ranking of DEP-μ also accounts for the subminimal roots. MIN remains high-ranked.

(46) Xitsonga: Monosyllabic root

/b[cor][lab]-a/	MIN	MAX PASS	DEP-μ	DEP-F
a. b^{w}-a	*!	*[cor]		
b. b-aw-a		*![cor]	*	*
c. b-uw-a		*![cor]	*	
d. ☞ b-iw-a			*	

Candidate (46a) would also be ruled out by the high-ranking *LABLAB (not included in the tableau). Candidates (46 (b and c)) do not realize the [cor] part of the morpheme; hence, a violation of MAX PASS. Candidate (46d), in addition, inserts a feature.

In (47), I evaluate a root-final labial in Xitsonga, where I demonstrate that DEP-μ should also be ranked below the constraints that prevent palatalization of the labial, whether surfacing as a primary articulation or as a secondary articulation, since none of these forms is attested in the language.

(47) Xitsonga: lum-a → lumiwa *luɲʷa[32] 'bite'

/lum[cor][lab]-a/	*LABLAB	MAX C-PL LAB	*LABLING	DEP-μ
a. lumʷ-a	*!			
b. luɲʷ-a		*!		
c. lumʸ-a			*!	
☞ d. lum-iw-a				*

*LABLAB rules out candidate (47a) while candidates (47 (b and c)) are ruled out by MAX C-PL LAB and *LABLING, respectively. The optimal candidate incurs a minimal violation of DEP-μ. Again, the tableau in (47) does not show a conflict between the constraints MAX C-PL LAB and *LABLING; hence, it does not establish a ranking between them. However, the discussion of the diminutive, which follows shortly, will show us that *LABLING should be ranked below MAX C-PL LAB in this language. This ranking does not affect the results in (47).

If, on the other hand, we assume that the input for the Xitsonga passive is nothing else but /-iw/, the same result would be achieved. Moreover, selecting /-iw/ as the input avoids a violation of DEP-μ which was incurred by the optimal candidate from the previous tableau. Although, Richness of the Base asserts that there should be no language-particular restriction on the input and that languages differ only in the ranking of the constraints (McCarthy 2002), we can still select the input for the Xitsonga passive by Lexicon Optimisation (Kager 1999, McCarthy 2002). Proponents of Lexicon Optimization propose that in the absence of empirical evidence for one input form over another, as is the case with the Xitsonga passive, we should select an input that is closest to the output (Kager 1999:33). Therefore in the absence of /-w/ and no palatalization or palatalized labials in the Xitsonga passive, I assume that a Xitsonga learner may only postulate /-iw/ as the passive morpheme. Tableau (48) analyses the same root as in (47) but with /-iw/ as the underlying morpheme.

[32] Xitsonga does have the form /luɲʷa in its lexicon but with a specialised meaning: "to have birth pangs" (Baumbach 1987).

(48) Xitsonga: /lum-iw-a/ → lum-iw-a 'bite'

/lum-iw-a/	*LABLAB	MAX C-PL LAB	*LABLING	DEP-μ
a. lum^{w}-a	*!			
a. luɲ^{w}-a		*!		
b. lum^{ɣ}-a			*!	
☞ c. lum-iw-a				

The above analysis has shown that the Xitsonga passive can be accounted for by the same constraints as those developed for siSwati. The difference between the two grammars is that Xitsonga ranks all the constraints above DEP-μ (see (49)).

(49) Ranking:

SiSwati: *LINGLING, *LABLING >> DEP-μ >>MAX PASS >> MAX C-PL LAB

Xitsonga: *LINGLING, MAX C-PL LAB, *LABLING, MAX PASS >> DEP-μ

5.3.4 The diminutive

The discussion of the diminutive that follows illustrates that although, in the passive, the [cor] feature appears as the vowel /i/, in the diminutive it does appear as a secondary articulation to the labial consonant. Xitsonga forms the diminutive by suffixing /-ana/ to the noun. Unlike in the passive, final labials, in addition, appear with a palatal secondary articulation. The prefix of the noun is replaced by either /ʃi/ or /s^{w}i/[33].

5.3.4.1 Data survey

In diminutive forms root-final labial consonants are palatalized as seen in (50).

(50)	ri-mbambu	ʃi-mbamb^{ɣ}-ana	'rib'
	ri-ndzoβo	ʃi-ndzob^{ɣ}-ana	'fish hook'
	tsaβu	s^{w}i-tsab^{ɣ}-ana	'vegetable'

[33] Xitsonga uses both prefixes and suffixes in the formation of the diminutive. The diminutive prefix is either superimposed on the noun prefix or it may replace the noun prefix, depending on the size and shape of the noun stem. Either /ʃi-/ or /s^{w}i/ is used as the diminutive prefix. A formal analysis of the behaviour of the prefixes will not be discussed in this study. Since, my main concern is the behaviour of the suffixal part of the morpheme.

ndzombho	ʃi-ndzombhʸ-ana	'bee sting'
rhaβi	ʃi-rhabʸ-ana	'branch'
ntsʷamba	sʷi-ntsʷambʸ-ana	'milk standing...'

The segment /p/, although a labial, is not realized with a palatal secondary articulation.

(51)	ʃi-papa	ʃi-pap-ana	'snuff pouch'
	ʃi-tɬupu	ʃi-tɬup-ana	'piece of cloth'
	kunupu	ʃi-kunup-ana	'button'

Different from siSwati, alveolars do not palatalize in Xitsonga.

(52)	muti	ʃi-mut-ana	'village'
	mbuti	ʃi-mbut-ana	'goat'
	dzedze	ʃi-dzedz-ana	'flea'
	ɦofisi	ʃi-ɦofis-ana	'office'
	nkonola	ʃi-nkonol-ana	'tree'

Velars do not palatalize as well (see (53)).

(53)	yiŋgʷe	ʃi-yiŋgʷ-ana	'leopard'
	ɦokʷe	ʃi-ɦokʷ-ana	'parrot'

Nonetheless, in those nouns ending with a labial vowel there is labialization but no palatalization.

(54)	ʃi-tulu	ʃi-tulʷ-ana	'chair'
	ʃi-tolo	ʃi-tolʷ-ana	'store'
	ʃi-tiɲo	ʃi-tiɲʷ-ana	'tooth'
	ʃi-buruku	ʃi-burukʷ-ana	'trousers'

In (55), I show the relationship between siSwati and Xitsonga diminutive formation.

(55) SiSwati Xitsonga

a. Non-labial vowel

/li-saɠa/	*li-saɠʷ-ana	/ɦofisi/	*ʃi-ɦofisʷ-ana
'sack'	li-saɠ-ana	'office'	ʃi-ɦofis-ana

b. Labial vowel

/si-ɓuʃo/	si-ɓuʃʷ-ana	/ʃitolo/	ʃi-tolʷ-ana
'mirror'	*si-ɓuʃ-ana	'store'	*ʃi-tol-ana

c. Labial consonant

/in-ɧeɓe/	*in-ɧetʃ'ʷ-ana	/rhaβi/	*ʃi-rhatʃʷ-ana	
'ear'	*in-ɧeɓʸ-ana	'branch'	ʃi-rhabʸ-ana	[different]
	in-ɧetʃ'-ana		*ʃi-rhatʃ-ana	[different]

d. Alveolar consonant

/li-dada/	*li-dadʒʷ-ana	/dzedze/	*ʃi-dzedʒʷ-ana	
'duck'	li-dadʒ-ana	'flea'	*ʃi-dzedʒ-ana	[different]
	*li-dad-ana		ʃi-dzedz-ana	[different]

(56) Summary of similarities and differences between siSwati and Xitsonga

- In both languages labial vowels cause labialization.
- A final labial segment becomes a palatal in siSwati whereas in Xitsonga it gets palatalized.
- Alveolar consonants become palatals in siSwati, but not in Xitsonga.

5.3.4.2 Analysis

Xitsonga has the same underlying diminutive morpheme as siSwati; a V-Place [cor] and a segmental morpheme /-ana/. The two languages differ only in the phonetic realization of the V-Place [cor]. While siSwati realizes the feature as primary articulation, it surfaces as a secondary articulation to the labial consonant in Xitsonga. We mentioned earlier that siSwati prevents secondary articulation by ranking the constraint *LABLING above MAX C-PL LAB. Given that Xitsonga does allow secondary articulation in the diminutive, *LABLING should be ranked below MAX C-PL LAB and MAX-DIM. Like in siSwati, *RE-ASSOC is undominated in Xitsonga.

(57) formalizes an analysis of a Xitsonga root-final labial.

(57) Xitsonga: rhaβi → ʃi-rhabʸ-ana 'branch'

/rhaβi[cor]-ana/	*RE-ASSOC	MAX-DIM	MAX C-PL LAB	*LABLING
a. ʃi-rhatʃʷ-ana	*!		*	
b.ʃi-rhaβ-ana		*![cor]		
c.ʃi-rhatʃ-ana			*!	
☞d. ʃi-rhabʸ-ana				*

The non-optimal candidate in (57c) (the siSwati equivalent) violates MAX C-PL LAB, ensuring the ranking: MAX C-PL LAB >> *LABLING. There is no ranking between MAX-DIM and MAX C-PL LAB, because realizing the diminutive morpheme necessitates the labial to be left intact in Xitsonga.

The other difference between siSwati and Xitsonga is that in Xitsonga alveolar consonants do not change their input segments while in siSwati they do, and become palatals. Palatalization of these segments in siSwati has been accounted for by ranking MAX-DIM above MAX C-PL-COR. In Xitsonga the opposite ranking should hold (see (58)).

(58) Xitsonga: muti → ʃi-mut-ana 'village'

/muti[cor]-ana/	MAX C-PL-COR	MAX-DIM
a.ʃi-mutʃ-ana	*!	
☞ b.ʃi-mut-ana		*

The ranking in (59) accounts for the diminutive in the two languages.

(59) SiSwati: *LABLING >> MAX-DIM >> MAX C-PL-COR >> MAX C-PL LAB
Xitsonga: MAX C-PL-COR >> MAX-DIM, MAX C-PL LAB >> *LABLING

5.3.5 The locative

In Xitsonga the locative is formed by prefixing /e-/ to the noun stem as well as suffixing either /-eni/ or /-ini/. Syllable-final labials receive a palatal secondary articulation, just like in the diminutive.

5.3.5.1 Data survey

Final labials surface with a palatal secondary articulation on the labial consonant.

(60)	ri-mbambu	e-ri-mbambʸ-ini	'rib'
	ri-ndʒoβo	e-ri-ndzobʸ-eni	'fish hook'
	ndʒombho	e-ndʒombhʸ-eni	'bee sting'
	tsaβu	e-tsabʸ-ini	'vegetable'
	rhaβi	e-rhabʸ-ini	'branch'
	haβi	e-habʸ-ini	'castrated animal,

Non-labials finally do not change their place of articulation, only suffix either /-eni/ or /-ini.

(61)	ʃi-ɦeŋge	e-ʃi-ɦeŋg-eni	'pineapple'
	mɦaka	e-mɦak-eni	'case'
	murhi	e-murh-ini	'tree'
	ʃi-tolo	e-ʃitolʷ-eni	'store'
	ʃi-tulu	e-ʃitulʷ-ini	'chair'
	nɮela	e-nɮel-eni	'road'
	ɦaɦu	e-ɦaɦʷ-ini	'lung'
	gaɲdʒe	e-gaɲdʒ-eni	'crab'

Relationship between siSwati and Xitsonga locative forms is shown in (62).

(62)		SiSwati		Xitsonga	
a.	[-high] vowel				
	/li-saɠa/	*e-saɠ-ini	/gaɲdʒe/	*e-gaɲdʒ-ini	
	'sack'	e-saɠ-eni	'crab'	e-gaɲdʒ-eni	
b.	[+high] vowel				
	/lu-tsʰi/	*e-lutsʰ-eni	/ʃitulu/	*e-ʃitulʷ-eni	
	'stick'	e-lu-tsʰ-ini	'chair'	e-ʃi-tulʷ-ini	
c.	Labial vowel]				
	/si-ɓuɠo/	e-si-ɓuɠʷ-eni	/ʃitolo/	e-ʃi-tolʷ-eni	
	'mirror'	*e-si-ɓuɠ-eni	'store'	*e-ʃi-tol-eni	
d.	Labial consonant				
	/iŋ-guɓo	/e-ŋ-gutʃ'-eni	/ŋ-kʰuβo/	*e-kʰutʃ-eni	[different]
	'blanket'	*e-ŋ-guɓʸ-eni	'party'	e-kʰubʸ-eni	[different]
		*e-ŋ-guɓ-eni		*e-kʰub-eni	

(63) Summary of similarities and differences between siSwati and Xitsonga

- In both languages labial vowels cause labialization.
- A final labial segment becomes a palatal in siSwati whereas in Xitsonga it gets palatalized.

5.3.5.2 Analysis

I propose that, as previously suggested, a floating V-Place [cor] feature triggers palatalization in the locative, and in addition there is a segmental morpheme /e...ini/. Recall that realization of the [cor] feature as a secondary articulation has also been observed in the diminutive and that it has been accounted for by ranking MAX C-PL LAB high, to preserve the labial segment, and *LABLING low, to allow the secondary articulation. The locative is derived by a similar ranking with MAX LOC in place of MAX DIM.

(64) Xitsonga: ŋ-kʰuɓo → e-kʰubʸ-e-ni 'party'

/e-ŋkʰuɓo[cor]-ni/	MAX-LOC	MAX C-PL LAB	*LABLING
a. e-kʰub-e-ni	*![cor]		
b. e-kʰutʃe-ni		*!	
☞ c. e-kʰubʸ-e-ni			*

Candidate (64b) demonstrates that the other possible way of not deleting the root labial is not to realize the [cor]. Anyhow this violates MAX-LOC.

(65) Final ranking:

SiSwati: *LABLING >> MAX-DIM >> MAX C-PL-COR >> LAB DEP-μ >> MAX PASS, MAX LOC.

Xitsonga: MAX-DIM, MAX-LOC, MAX C-PL LAB >> MAX PASS, *LABLING >> DEP-μ

5.4. Sesotho

This final section discusses palatalization in Sesotho as observed in the passive and diminutive. Sesotho is different in that palatalization in the passive results in

'complex segments'. However, I have argued, in Chapter 2, that these segments are phonologically not different from the alternate forms. This implies that palatalization in Sesotho and siSwati is the same. The only other difference observed is in root-medial labials. In Sesotho, the morpheme is always realized at the right edge even at the expense of violating MAX PASS. First, consider the phonemic inventory of Sesotho.

5.4.1 Segmental inventory

The source of both the consonant and vowel inventories is Doke & Mofokeng (1967).

The abbreviations in Table 5-4 are as follows: B-lab = bilabial, D-Lab = Denti-labial, Alv = alveolar, Lab-Alv = Labio-alveolar, P-pal = prepalatal, Pal = palatal, Vel = velar, Glot = glottal, C-sounds = compound sounds.

	B-lab	**D-lab**	**Alv**	**P-pal**	**Vel**	**Glot**	**C- sounds**[34]
Stops Aspirated	p^h		t^h		k^h		pʃ' $pʃ^h$ bʒ
Voiced	b		d				
Ejective	p'		t'		k'		
Affricate			ʦ' $ʦ^h$	ʧ' $ʧ^h$ ʤ	kx^h		
Fricative		f [v]	s r	ʃ (ʒ)	[x]	h	fʃ
Lateral			ɬ' $ɬ^h$ ɬ l				
Nasal	m		n	ɲ	ŋ		
Approximant	(w)			y	w		

Table 5-4 Sesotho consonant inventory

[ ] represents a sound found in foreign acquisition.

( ) represents an alternate position of a particular sound.

[34]The compound sounds are generally found in passive forms. However, there are a few words in the language which have these sounds underlying e.g. [pʧ^{w}ang] 'of meeting unexpectedly'.

Sesotho has a seven vowel system represented phonemically in (66). Phonetically, the language has nine vowels, with the additional vowels derived from raising of the mid vowels /ɛ, ɔ/ to [e, o] when preceding high vowels.

(66)

i		u
ɪ		ʊ
ɛ		ɔ
	a	

5.4.2 Passive

Like in siSwati, the passive in Sesotho is formed by suffixing /-iw/ to monosyllabic roots and /w/ to roots of more than one syllable. Labialized monosyllabic roots suffix -uw/, instead of /-iw/. In addition, verbs ending in labial consonants undergo palatalization before suffixing /-w/. The nasals /m/ and /ɲ/ undergo velarization, instead of palatalization or remaining unchanged, respectively, before suffixing /-w/.

5.4.2.1 Data survey

The following data is from Doke & Mofokeng (1967).

Non-labial final segments suffix /-w/ to the verb root.

(67)

rat-a	rat^{w}-a	'love'
bitʂ'-a	bitʂ^{w}-a	'call'
bɔn-a	bɔn^{w}-a	'see'

In addition to suffixation of /-w/ roots ending in a labial consonant palatalize the labial segment.

(68)

fɛp'-a	fɛtʃ^{w}-a	fɛptʃ^{w}-a	'feed'
hap'-a	hatʃ^{w}-a	haptʃ^{w}-a	'seize'
ɬonɪp^{h}-a	ɬonɪtʃ^{hw}-a	ɬonɪp^{h}ʃ^{w}-a	'honour'
rɔb-a	rɔdʒ^{w}-a	rɔbdʒ^{w}-a	'break'
bɔf-a	bɔʃ^{w}-a	bɔfʃ^{w}-a	'bind'

Palatalization does not occur when the labial is no longer root-final as was the case in siSwati.

(69)	bʊp'-a	bʊp'il^{w}-e	*bʊpʃil^{w}e/*bʊtʃil^{w}e	'mould'
	ʦ'amay-a	ʦ'amay^{w}-a	*ʦ'aɲay^{w}-a	'go'

Monosyllabic roots suffix /-iw/ to the verb root.

(70)	ʧ^{h}-a	ʧ^{h}-iw-a	'burn'
	ʤ-a	ʤ-iw-a	'eat'
	s-a	s-iw-a	'clear'

Labialized monosyllabic roots suffix /-uw/, instead of /-iw/ to the verb root.[35]

(71)	ɬ^{w}-a	ɬ-uw-a	'climb'
	n^{w}-a	n-uw-a	'drink'
	ʃ^{w}-a	ʃ-uwa	'die'

Roots ending in labial vowels, suffix /-uw/ as well.

(72)	bu-a	bu-uw-a	'speak'
	ru-a	ru-uw-a	'possess'

The relationship between siSwati and Sesotho passive forms is presented in (73).

(73)	SiSwati		Sesotho	
a. Final labial				
/ɓop^{h}-a/	ɓoʃ^{w}-a	/roba/	rodʒ^{w}-a	
'tie'	*ɓopʃ^{w}-a	'break'	robdʒ^{w}-a	[different]
	*ɓop^{h}-iw-a		*rob-iw-a	
b. Medial labial				
/seɓent-a/	*seɓent^{w}-a	/ʦ'amay-a/	ʦ'amay^{w}-a	[different]
'work'	seʧ'ent^{w}-a	'go'	*ʦ'aɲay^{w}-a	[different]
	*seɓent-iw-a		* ʦ'amay-iw-a	

[35] I do not present a formal analysis of the forms that suffix /-uw/ instead of /-iw/ nor the velarization of ɲasals, in this thesis.

c. Non-labial finally

/sit'-a/	sitʷ-a	/rat-a/	ratʷ-a
'help'	*sitʃʷ-a	'love'	*ratʃʷ-a
	*sit-iw-a		*rat-iw-a
	*sitʃʷ-a		*ratʃʷ-a

d. Initial labial

/ɓon-a/	ɓonʷ-a	/bɔn-a/	bɔnʷ-a
'see'	*ʤonʷ-a	'see'	*ʤonʷ-a
	*ɓon-iw-a		*bɔn-iw-a

e. Monosyllabic root

/ɮ-a/	ɮ-iw-a	/ʤ-a/	ʤɪ-w-a
'eat'	*ɮʷ-a	'eat'	*ʤʷ-a

(74) Summary of similarities and differences between siSwati and Sesotho

- Like in siSwati, /-iw/ is limited to C-roots.
- Different from siSwati, but like Setswana, root-medial labials do not palatalize in Sesotho.
- Different from all the other languages, Sesotho retains the labial and palatalize it, providing a labio-palatal segment.

5.4.2.2 Analysis

Similar to siSwati, augmentation of C-roots in Sesotho will be accounted for by ranking MIN above DEP-μ. Also, to prevent epenthesis on longer forms, MAX-PASS will be ranked below DEP-μ. The following tableaux formalize the analyses of a monosyllabic root (75) and a bisyllabic root (76).

(75) Augmentation in a monosyllabic root: MIN >> DEP-μ

/ʤ [cor][lab]-a/	MIN	DEP-μ	MAX-PASS	DEP-F
a. ʤʷ-a	*!		*	
b. ʤ-aw-a		*	*![cor]	*
c. ʤ-uw-a		*	*![cor]	
☞ d. ʤɪ-w-a		*		

(76) Lack of augmentation in a disyllabic root: DEP-μ >> MAX-PASS

/rat [cor][lab]-a/	*LINGLING	MAX C-PL-COR	DEP-μ	MAX-PASS
a. rat$^{\gamma}$-a	*!			*[lab]
b. ratʃ^{w}-a		*!		
a. rat-iw-a			*!	
☞ b. rat^{w}-a				*[cor]

Non-palatalization of the alveolar, in (76), is accounted for by ranking the constraint MAX PASS below *LINGLING and MAX C-PL-COR. MAX C-PL DOR is ranked high in all the languages to prevent root-final velars from being palatalized. The only difference between siSwati and Sesotho is that ALIGN-R should be ranked above MAX PASS in Sesotho, to stop the [cor] from moving into the root. (77) formalizes this analysis.

(77) Sesotho: Non-palatalization of root-medial labial: ALIGN-R >> MAX-PASS

/bopel[cor][lab]a/	ALIGN-R	MAX C-PL-COR	DEP-μ	MAX PASS
a.botʃel^{w}a	*![cor]			
b. botʃ^{w}el-a	**![cor][lab]			
c. bope λ^{w}-a		*!		
d. bopel-iw-a			*!	
☞e. bopel^{w}a				*[cor]

(78) Ranking:
MAX PASS >> ALIGN-R >>MAX C-PL LAB

MAX PASS >>MAX C-PL LAB

5.4.3 Diminutive

The diminutive is formed by suffixing /-ana/ to the noun stem. In addition to the suffix, root-final labials palatalize.

5.4.3.1 Data survey

Root-final labials palatalize, in addition to the suffixation of /-w/.[36]

(79)	sɪ-rʊbɪ	sɪ-rʊʤ-ana	'pen, shed'
	bʊ-hɔbɛ	bʊ-hɔʤ-ana	'bread'
	tʰaba	tʰaʤ-ana	'mountain'

Different from siSwati, when a labial is followed by a round vowel, there is labialization of the preceding consonant.

(80)	lɪ tɬ'ʊbʊ	lɪ tɬ'ʊʤʷ-ana	'young shoot'
	sɪ-fɪfɔ	sɪfɪʃʷ-ana	'storm'
	pʰʊfʊ	pʰʊʃʷ-ana	'meal'

Root-final alveolars also palatalize in Sesotho. Again, labialization occurs if the noun ends in a round vowel.

(81)	sɪ-fatɛ	sɪ-faʧ-ana	'tree'
	k'ɔt'ɔ	k'ɔʧʷ-ana	'knob kerrie'
	mɪtʰɪ	mɪʧʰ-ana	'grain bag'
	lɪ-ŋɔlɛ	lɪ-ŋɔʤ-ana	'knee'
	mʊ-ʃɪmanɪ	mʊ-ʃɪmaɲ-ana	'boy'
	namanɪ	namaɲ-ana	'calf'

Nonetheless, if the noun ends in an alveolar fricative or velar consonant, there is no palatalization, only the suffixation of /-ana/.

(82)	mʊ-disa	mʊ-dis-ana	'herd boy'
	lɪ-tʰisa	lɪ-tʰis-ana	'uninitiated girl'
	buka	bukana	'book'

(83) presents the relationship between siSwati and Sesotho diminutive forms.

[36] Nouns that end in /p/, change the labial to an alveolar affricate, instead of a palatal, for example, sɪlɛpɛ > sɪlɛʦʷ-ana 'axe'. Thus Doke & Mofokeng refer to this process as alveolarization. I do not provide an analysis of these forms in this thesis.

(83)

		SiSwati		Sesotho
a.	Non-labial vowel			
	/li-saɠa/	*li-saɠʷ-ana	/ mʊdisa/	*mʊ-disʷ-ana
	'sack'	li-saɠ-ana	'herdboy'	mʊ-dis-ana
b.	Labial vowel			
	/si-ɓuɠo/	si-ɓuɠʷ-ana	/ pʰʊfʊ/	pʰʊʃʷ-ana
	'mirror'	*si-ɓuɠana	'meal'	* pʰʊʃ-ana
c.	Labial consonant			
	/in-ʦʰaɓa/	in-ʦʰaʧ'-ana	/tʰaba/	tʰaʤ-ana
	'mountain'	*in-ʦʰaʧ'ʷ-ana	'mountain'	*tʰaʤʷ-ana
		*in-ʦʰaɓʸ-ana		*tʰabʸ-ana
d.	Labial C + labial V			
	/iŋ-guɓo/	iŋ-guʧ'-ana	/lɪ tɬ'ʊbʊ/	*lɪtɬ'ʊʤ-ana [different]
	'blanket'	* iŋ-guʧʷ-ana	'young shoot'	lɪ tɬ'ʊʤʷ-ana [different]
		*iŋ-guɓʸ-ana		*lɪ tɬ'ʊɓʸ-ana
e.	Alveolar consonant			
	/umu-ʦʰi/	umu-ʃ-ana	/ mɪ-tʰɪ/	mɪ-ʧʰ-ana
	'medicine'	*umu-ʦʰ-ana	'grain bag'	*mɪ-tʰ-ana

5.4.3.2 Analysis

Sesotho behaves like siSwati in that both labials and alveolars palatalize in diminutive forms. Recall that, in siSwati, labial palatalization was accounted for by the ranking MAX-DIM >> MAX C-PL LAB while ranking MAX-DIM above MAX C-PL-COR accounted for palatalization of alveolars. The same ranking therefore holds for Sesotho.

(84) Labial palatalization in the diminutive

/tʰaba[cor]-ana/	*RE-ASSOC	*LABLING	MAX DIM	MAX C-PL LAB
a. tʰaʤʷ-ana	*!			*
b. tʰabʸ-ana		*!		
c tʰab-ana			*![cor]	
☞ d tʰaʤ-ana				*

(85) Coronal palatalization in the diminutive

/sɪ-fatɛ-[cor]-ana/	MAX-DIM	MAX C-PL-COR
a. sɪ-fat-ana	*!	
☞ b. sɪ-fatʃana		*

Likewise, ranking MAX-PASS below MAX C-PL-COR will prevent alveolars from being palatalized in the passive (86), and ranking MAX C-PL LAB below MAX-PASS will ensure palatalization of the labials (87).

(86) Failure of coronal palatalization in the passive

/rat-[cor][lab]-a/	MAX C-PL-COR	MAX-PASS	MAX C-PL LAB
a. ratʃʷa	*!		
☞ b. ratʷa		*	

(87) Labial palatalization in the pasive

/rob-[cor][lab]-a/	MAX C-PL-COR	MAX-PASS	MAX C-PL LAB
a. robʷa		*! [cor]	
☞ b. rodʒʷa			*

The asymmetry between the passive and the diminutive in as far as palatalization of alveolars in diminutives and lack of it, in the passive, is presented in the following ranking, showing only the relevant constraints.

(88) MAX-DIM >> MAX C-PL-COR >> MAX-PASS >> MAX C-PL LAB.

Recall that, in diminutives, when stem-final alveolars are followed by round vowels, there is both labialization of the vowel and palatalization. This we observed in both siSwati and Sesotho. In Sesotho, but not in siSwati, the same process is observed even when the noun ends in a labial consonant. The grammar that I have developed for siSwati, cannot account for this irregularity. However, I can only speculate. I mentioned that if there is a sequence of labial consonants in the passive, at times there is palatalization of both consonants, (depending on speaker preference); hence,

/pʰapʰam-is-a/ → [pʰaʃaɲ-isʷ-a] 'be awoken'. Seemingly, the [cor] feature docks on the rightmost labial and spreads the feature to the adjacent one. I suggest that in a C-place V-Place sequence, as is the case in nouns, the same procedure is followed. However, the feature can only dock onto a consonant. On the question of why the Lab feature is retained on alveolars, I assume that this results from the different feature specifications of the vowel and consonant. The [cor] docks onto the alveolar's C-place and the vowel's Lab feature is left intact.

5.5 Summary

This chapter has investigated the typology of palatalization in Southern Bantu languages. It has been demonstrated that the different characteristics of palatalization can be accounted for with different rankings of a set of constraints that are independently motivated in the analysis of siSwati. A re-ranking of these constraints produced different ways of realizing the [cor] feature; hence; the different typologies. We observed that the [cor] could be realized either as [i] or dock onto a consonant and appear as primary articulation, as was the case in siSwati. Inserting the vowel [i] resulted in augmentation of subminimal roots in siSwati. The ranking MIN >> DEP-μ accounted for these forms. Since this was observed in the other languages as well, the same ranking was retained. To prevent epenthesis on longer roots DEP-μ was ranked above MAX PASS. This was the case for Tshivenda and Sesotho. In Setswana, where, optionally [i] was suffixed even on longer roots, the constraint, DEP-μ, had to be ranked on a par with MAX PASS. Palatalization of root-medial labials was captured by ranking MAX PASS above ALIGN-R in siSwati. All the other languages had the opposite ranking.

The labialization of labial consonants in the Setswana diminutive, was analyzed as a re-association of the consonant's labial feature from a C-Place node to a V-Place node; hence; a violation of the constraint *RE-ASSOCIATE. This constraint was ranked above MAX C-PL LAB in siSwati, while in Setswana, the opposite ranking was established.

The main difference between siSwati and Tshivenda lies in the realization of the [cor] feature on root-final labials. This was accounted for by re-ranking the

constraints: DEP-μ, MAX C-PL LAB, and *LABLING. Recall that when *LABLING is high-ranked, the [cor] is prevented from appearing as secondary articulation. This is the case in siSwati and Setswana. Yet when it is dominated by MAX-C-PL LAB and DEP-μ, the feature is realized as secondary articulation, and this was observed in Tshivenda.

We also observed that the way Xitsonga forms the passive was different from what was observed in the other languages. In this language, /-iw/ is suffixed to any size of root. Furthermore, there is no palatalization of labials. According to proponents of Lexicon Optimization, in the absence of empirical evidence for one input form over another, as is the case with the Xitsonga passive, we should select an input that is closest to the output (Kager 1999:33). Therefore in the absence of /-w/ and no palatalization or palatalized labials in the Xitsonga passive, I, alternatively, assumed that a Xitsonga learner would only postulate /-iw/ as the passive morpheme. With that understanding, the Xitsonga passive was accounted for by ranking the constraints that result in palatalization of the consonant, above DEP-μ. However, because Xitsonga does allow secondary articulation on labials in the diminutive, *LABLING had to be ranked below MAX C-PL LAB and MAX-DIM. Ranking MAX C-PL-COR above MAX-DIM prevented alveolars from being palatalized in this language.

Sesotho is very similar to siSwati, taking into account the proposal and argument that there is no phonological difference between the labio-palatal 'complex segment' and the simple palatal segment. The only difference between these two languages is that root-medial labials are not palatalized in Sesotho. This promoted the constraint ALIGN-R, crucially, above MAX PASS, to stop the [cor] from moving into the root to realize the morpheme.

CHAPTER 6

NON-LOCAL PROCESSES

The discussion in Chapter 4 demonstrated that it was important to align the [cor] feature with the right edge of the prosodic word in diminutive and locative forms. In Chapter 3, we saw a similar pattern with the passive forms. However, in these forms, proper alignment was not always observed: if there was no palatalizable segment at the right edge of the prosodic word, the feature moved into the root to be realized. The long distance or non-local effects, are not only prevalent in the passive, for other processes may also behave in a similar manner. This chapter investigates non-locality as seen in the processes of vowel harmony and tone. In vowel harmony a vowel may exert its influence on another vowel, skipping the slot filled by a consonant. Tone also generally moves from its underlying source to be realized syllables away to the right of the word. First, I discuss vowel harmony, Section 6.1, then, tonal phonology follows in Section 6.2.

6.1 Vowel harmony

Vowel harmony is a phonological state in which the vowels in a given domain share or harmonise for a particular feature (Kenstowicz 1995). It is assimilatory in nature with the assimilated feature, in most cases, spreading to other vowels in different syllables (Ohala 1994; Harris 1997, 2003; Flemming 2001; Hyman 2001, 2002; Przezdziecki 2000).

Mid vowel assimilation in Southern Bantu languages operates within the word whereby the mid vowels /ɛ/ and /ɔ/ are raised to [e] and [o] respectively, when preceding high vowels. These can be observed in siSwati as claimed by Ziervogel & Mabuza, and others, as well as in isiZulu and Sesotho. I provide examples from each language next.

SiSwati: SiSwati has a phonemic 5-vowel system.

(1)

i	u
ɛ	ɔ
a	

According to Ziervogel and Mabuza (1985) and others, the process of assimilation in siSwati occurs morpheme-internally, as illustrated in (2).

(2)

ɬɛɡ-a	'laugh'	si-levu	'chin'
pʰɛɡ-a	'cook'	li-kʰeʃi	'lift n.'
si-lɔndza	'wound'	in-ɮovu	'elephant'
um-lɔtsʰa	'ash'	makoti	'daughter in law'

It also occurs in derived forms.

(3)

pʰɛɡ-a	'cook'	pʰeɡ-is-a	'cause/help to cook'
tsʰɛŋ-a	'buy'	tsʰeŋ-is-a	'sell'
dvɔns-a	'pull'	dvons-is-a	'cause/help to pull'
vɔt'-a	'vote'	vot'-is-a	'cause to vote'

In addition, assimilation may occur when a mid vowel precedes a syllabic nasal [m].

IsiZulu: IsiZulu, like siSwati has a phonemic 5-vowel system.

(4)

i	u
ɛ	ɔ
a	

The environment for assimilation is the same as that for siSwati, morpheme-internally (5) and in derived forms (6).

(5)

ŋgɛn-a	'enter'	isi-levu	'chin'
pʰɛk-a	'cook'	i-kʰeʃi	'lift n.'
isi-lɔnda	'wound'	in-ɮovu	'elephant'
um-lɔtʰa	'ash'	u-makot'i	'daughter in law'

(6)				
	pʰɛk-a	'cook'	pʰek-is-a	'cause/help to cook'
	tʰɛŋg-a	'buy'	tʰeŋg-is-a	'sell'
	dɔns-a	'pull'	dons-is-a	'cause/help to pull'
	vɔt'-a	'vote'	vot'-is-a	'cause to vote'

In addition, a mid vowel is raised when preceding the syllabic nasal [m] (Doke 1967, Harris 1987).

Sesotho: Sesotho, on the other hand, has a phonemic 7-vowel system.

(7)

i	u
ɪ	ʊ
ɛ	ɔ
a	

Assimilation in Sesotho is triggered by any high vowel where the vowels /ɛ/ and /ɔ/ become [e] and [o], in the same environments as in isiZulu and siSwati; morpheme-internally (8) as well as in derived forms (9). Data is from Harris (1987).

(8)				
	lɪ-qheku	'old person'	mu-hwɛ	'father-in-law'
	tepʊ	'spider's web'	sɪ-ɛta	'shoe'
	mʊ-lomʊ	'mouth'	mʊ-nyakɔ	'door'
	notshi	'bee'	lɪ-hlɔkwa	'grass stalk'

(9)		*agent*	
	bɔn-a	sɪbon-i	'see'
	phɛh-a	mʊ-pheh-i	'cook'

In addition, vowel raising in Sesotho may occur even when the trigger is absent. For example in those words whose causative suffix lacks an overt /i/.

(10)	*Infinitive*	*Causative*		
	tlɔla	tlotsa	'smear oneself'	*tlodisa
	laɛla	laetsa	'order'	*laedisa

SiSwati has equivalent forms. However, so far as I am aware, no-one has claimed that there is vowel raising in this type of causative form. For this reason I will indicate them as ill-formed in the following data.

(11)	*Infinitive*	*Causative*		
	vɛla	vɛta	'appear'	*vetisa
	k^{hw}ɛla	k^{hw}ɛta	'climb'	*k^{hw}elisa

Although siSwati is often said to show vowel harmony, as in (2 and 3), previous analyses on the behaviour of siSwati mid vowels /e, o/ before /i, u/ and before /a, e, o/ show conflicting results. According to Ziervogel and Mabuza (1985), Canonici (1989), Taljaard and Snyman (1993) and Taljaard, Khumalo and Dlamini (1991), siSwati mid vowels are raised to close mid [e, o] when preceding the high vowels /i, u/ (e.g. /lik^{h}eʃi/ 'lift n.', /inʞovu/ 'elephant') but remain open mid [ɛ, ɔ] before [-high] vowels (e.g. /litsemba/ 'hope n.', /ibola/ 'football'), suggesting that siSwati has a vowel height assimilation and/or ATR assimilation. However, Kockaert (1997), in his acoustic analysis of the same vowels in the same environments, disputes this description. He concludes that there is no significant difference in the F1, F2, and F3 frequency values of these vowels. Before I investigate the behaviour of the mid vowels in siSwati, I discuss the process of assimilation.

The rest of the section will proceed as follows: Section 6.1.2 discusses the difference between harmony and co-articulation with examples from some of the attested patterns of harmony and co-articulation in different languages. Section 6.1.3 examines some of the facts that led to the suggestion that the two processes are related and, in particular, that one results from the other. Section 6.1.4 presents the experimental study that I conducted on siSwati mid-vowels. Section 6.1.5 considers the results of the experiment which provides support for the conclusion that assimilation in siSwati is only phonetic and results from co-articulation. Section 6.1.6 discusses these results. Section 6.1.7 compares the behaviour of siSwati mid vowels with the behaviour of the same vowels in isiZulu, Sesotho, and the vowel harmony systems observed in some of the Central Bantu languages. Section 6.1.8 considers the different feature representations that are suggested for the property that is assimilated in mid-vowel harmony in some of the Southern Bantu languages.

Finally, Section 6.1.9 demonstrates how an interaction of faithfulness and markedness constraints in OT can account for the differences that are observed between harmony and no harmony. In addition, I also give an account for what I propose to be an intermediate stage in the development of vowel harmony.

6.1.1 Assimilation

The process of assimilation may either be phonetic; co-articulation or phonological. I refer to the latter as phonological assimilation, this is where vowel harmony fits in. Nonetheless, these two processes overlap with each other; hence it is not easy to determine whether a process is co-articulation or vowel harmony. Nevertheless whether and how co-articulation is different from phonological assimilation is a matter of controversy. In the next section I discuss theoretical background information relating to the two processes.

I mentioned that vowel harmony consist of the requirement that all vowels in a given domain agree with respect to a certain property. In contrast, co-articulation refers to the fact that a phonological segment is not realized identically in all environments, but often varies to become more like an adjacent or nearby segment (Kühnert & Nolan 1999, Boyce et al 1990). SPE describes co-articulation as resulting from physical properties of the speech mechanism. Hence the notion that it is a universal characteristic of human speech (Hardcastle and Hewlett (1999)). However, cross-language studies indicate that co-articulation varies across languages. Such patterns have been attributed in part to a language's consonant and vowel inventories (Beddor et al 2002). A general pattern is that languages with larger vowel systems show less coarticulatory effects than those with smaller systems. For example, weaker coarticulatory effects have been shown for English with a larger vowel inventory compared to the smaller 5-vowel system of Shona and Swahili (Manuel & Krakow 1984) and Japanese (Magen 1984). Weaker effects also hold for Sesotho, with a 7-vowel system, compared to Shona and Ndebele with a 5-vowel system (Manuel 1990).

Co-articulation may be local while harmony is generally long distance. During speech production properties of a preceding segment may be carried over to the following segment (carryover co-articulation) or it may be the case that production of the following segment starts before completion of the previous one as

is the case in anticipatory co-articulation. With that background I discuss some of the differences between the two processes that have been discussed in the literature.

6.1.2 Difference between co-articulation and harmony

In (12) I list some of the differences that have been observed between co-articulation and harmony.

(12)

Harmony	**Co-articulation**
May be long distance	Fairly local
Neutralising	Not neutralising
Categorical	Gradient
Obligatory	Optional
Affects whole vowel	Affects only portion close to trigger

In English a back vowel may be fronted when the vowel occurs between coronal segments; in the word *toot* [tut], for example, the back vowel is fronted when compared to the vowel in the word *coop* [kup]. Coronals induce fronting because of their generally high F2. This, in turn, leads to a raising of the F2 for the adjacent back vowel which is the acoustic correlate of fronting. In that way the difference between the adjacent C and V or V and C is minimised (Flemming 2001). This is just a phonetic change and involves adjacent segments. In contrast, in most cases of vowel harmony all the vowels in a particular domain, if uninterrupted, may be affected. An example is the Turkish back/rounding harmony, where all the high vowels in a word will have the same value for backness and rounding if uninterrupted by a non high vowel (Manuel 1990; Boyce 1990). A similar example comes from Sesotho (Harris 1987). Harris observes that in this language a sequence of mid vowels, if not interrupted by any other type of vowel, harmonise (see (13).

(13)

fɛpɛha	'be fed'	fepehɪ 'neg.'
kɔkɔta	'knock'	kokotɪ 'neg.'.

Similar to English, in Cantonese back vowels are fronted when occurring between coronals: tut → tyt 'to take off' (Flemming 2001). However, in Cantonese the effect

of the change is different: in contrast to the gradient assimilation observed in English, the change is categorical. Note that this change does not result in harmony, but to a phonological change as is the case with harmony. The vowels /u/ and /y/ are collapsed into a single category. The contrast between the two vowels is therefore neutralised. However, no contrasts are neutralised in English. The realization of the contrast is simply shifted somewhat (Flemming 2001).

Another example that illustrates the difference between gradient and categorical assimilation is from English and Ecuadorian Quechua. In these two languages segments preceded by nasals become voiced. In Ecuadorian Quechua postnasal voicing neutralises contrasts while in English it does not. If we compare the words *bent* and *bet*, in English, the /t/ in *bent* is slightly voiced. However, assimilation of the feature [voice] is not categorical since the speakers can still distinguish the word *bend* from *bent*. In Ecuadorian Quechua, on the other hand, it is ungrammatical for a voiceless stop to follow a nasal at suffix boundaries and voiced stops are substituted for voiceless; sača-**p**i 'jungle loc.' but atam-**b**i 'frog loc.' (Hayes 2004:293). Unlike English, the postnasal effect is categorical in the sense that the voicing contrast is neutralised at this position. Again, this distinguishes assimilation from co-articulation, not necessarily an example of harmony.

Categorical assimilation is typically obligatory, while in co-articulation alternations do not occur all the time with all the speakers. The occurrence of co-articulation is subject to the speed and style of speech. It is more common in casual fast speech than in formal slow speech (Jun, 2004: 267).

The other difference between vowel harmony and co-articulation, which is crucial for this discussion, is that vowel harmony categorically affects the whole vowel while co-articulation gradiently affects the vowel, with its effects being most strongly in evidence close to the trigger (see section 4 for a detail discussion and examples).

The above discussion suggests that harmony should be represented in terms of phonological rules or constraints which are part of the grammar and therefore language specific. Co-articulation on the other hand, is governed by universal articulatory processes; hence it is attested in many if not all languages (Fowler 1983).

6.1.3 Similarities observed between vowel harmony and co-articulation

Although the above discussion suggests that these processes are different, it has been observed that they may be similar. Nevertheless, whether and how co-articulation is different from vowel harmony is still a matter of controversy.

Hyman (2001) observes that vowel harmony tends to be root-controlled.[37] Affix vowels become more like the root vowels. This may result in directionality being fully or mostly predictable within a single language. For example, in Pende we find left-to-right assimilation (see (14)).

(14) Pende (Hyman 2002 : 242)

-lomb-	→	gulombela	'demander pour'
-tung-	→	gutungila	'batir pour'

Nonetheless, the issue of directionality in harmony varies from one language to the other, as in other languages it may be right to left; see examples from Kinande in (15).[38]

(15) Kinande (Archangeli D. and Pulleyblank D. (1994): 200))

[+ATR]	[ɛrili:ba]	'to cover'
	[ɛrihu:ka]	'to cook'
[-ATR]	[ɛrɪlɪ:ma]	'to cultivate'
	[ɛrɪhʊ:ma]	'to beat'

As noted earlier, co-articulation may either be anticipatory or due to carryover. The examples in (14) and (15) demonstrate that the same may be observed in vowel harmony.

I mentioned earlier that one of the differences between harmony and co-articulation was that of adjacency, co-articulation being local while harmony was generally characterized by non-adjacency. If we consider the many examples of

[37] This is a common occurrence in Bantu languages.

[38] See van der Hulst and van der Weijer (1995) for a more detailed discussion of the different types of vowel harmony.

vowel-to-vowel co-articulation discussed in the literature, where the assimilated vowel is separated by a consonant, we notice that even the domain of co-articulation may be larger than two adjacent segments and may therefore be more complex than inter-target transition.

6.1.3.1 From co-articulation to harmony

Some proposals have been suggested to the effect that vowel harmony starts as co-articulation. These will be briefly discussed in this subsection.

There has been a tendency to merge vowel harmony and co-articulation conceptually so that vowel harmony is seen as a synchronic reflex of a historical process. The idea of vowel harmony systems developing from co-articulation has been suggested by many other scholars, including Blevins (2004); Beddor et al (2001); Przezdziecki (2001); Ohala (1994) etc. Ohala (1994) observes that what starts as a minimal co-articulation effect is often sharpened or focussed into a perceptually more salient effect, often leading to phonetic or phonemic change. Phonology, in a sense, begins where phonetics leaves off. Further support for Ohala's claim comes from Beddor et al (2002). They claim that the height harmony of the type found in Bantu had its origins in vowel-to-vowel co-articulation, even though the phonological process may no longer be directly reflected in current coarticulatory patterns. If vowel harmony emerges from phonetic effects, then we should find that the phonological patterns resemble phonetic ones (Przezdziecki 2001).

Przezdziecki, in his analysis of three Yoruba dialects, Akure Yoruba (Akure), Moba Yoruba (Moba), and Standard Yoruba (SY), observed that in all three dialects [+ATR] mid vowels become [–ATR] when preceding [–ATR] vowels. In addition, in one of the dialects, Akure, high vowels showed [–ATR] harmony as well. In Moba and SY, although the high vowels did not show any ATR harmony, the vowels did show a difference in their F1 values from the underlying vowels, albeit in a way that is not statistically significant. Przezdziecki attributed this difference to coarticulatory effects. Akure vowel harmony and co-articulation in the other two dialects showed similar characteristics. Both processes were anticipatory in nature and the segments affected were observed to be in the same domain. Because of these similarities Przezdziecki concluded that the high vowel harmony in Akure started as a

coarticulatory process, which the other two dialects still show, and over time the once phonetic process became phonologized as vowel harmony.

Another example which contributes to the idea that vowel harmony is a synchronic reflex of co-articulation comes from Harrison (2001). Harrison studied the behaviour of the rounding harmony systems of the Siberian Turkic languages Tofa and Tuha and observed that the application of harmony in the two languages varied from speaker to speaker. In Tofa, for example, some speakers did not exhibit any harmony while others were inconsistent, applying either gradient or categorical assimilation. In Tuha, on the other hand, harmony was applied consistently only when the trigger and target were both high. However, when the trigger and target differed in height, harmony was applied only optionally. The result was that both oCu and öCü as well as oCi and öCi sequences were possible; depending on how each speaker perceived the vowels (Kaun 2004).

The development of harmony is not different from any other sound change. It has been observed that one important source of sound change is misperception. Segmental change may result from misperception of the speaker's intended pronunciation (Hyman 1973, Ohala 1989, 1990, 1994, Blevins 2004). The phonetic signal is misheard by the listener due to perceptual similarities of the actual utterance with the perceived utterance (Blevins 2004:32). A misapprehended pronunciation if uncorrected can spread to other speakers and thus give rise to sound change (Ohala 1989, 1990).

An example of a sound change in progress was reported by Gauchat (1905) cited in Romaine (1989). Gauchat observed the change of the palatal fricative [λ] to the palatal glide [j] from three generations of Charmey speakers. Use of the segments differed according to age as illustrated in Table 6-1.

Generation	I	II	III
Age	90-60 years	60-30years	Under 30 years
Segment	[λ]	[λ ~ j]	[j]

Table 6-1 Data from 3 generations of Charmey speakers (Gauchat 1905:205) cited in Romaine (1989).

This was confirmed by Hermann who later in 1929 conducted a follow-up investigation and came to the conclusion that the new variant [j] had been established in the community (Romaine 1989).

To summarise this section: we observed, that in the two Yoruba dialects Moba and SY the process of assimilation in the high vowels was still gradient while in Akure it was already categorical. In the Turkic dialects, on the other hand, there were inconsistencies within the same dialect and within the same speaker in terms of enforcing either categorical or gradient assimilation. Seemingly, the speakers of the Turkic dialects had moved a step ahead of the Yoruba dialects Moba and SY in that, in addition to co-articulation, vowel harmony was exhibited by the speakers. The Turkic dialects may therefore represent vowel harmony in transition and the ultimate result may be regular harmony (Kaun 2004). The application of assimilation in the high vowels by the Moba and SY speakers may suggest an initial stage of harmony which later develops into true harmony, as was the possibility with the Akure speakers.

6.1.4 Experiment

The study was designed to investigate whether siSwati has categorical vowel height harmony, as claimed by Ziervogel & Mabuza, and others, or not, as claimed by Kockaert. In this study I use two main criteria to distinguish between harmony and co-articulation. (i) The position where formant values change during the production of the vowel: if the change affects the whole vowel I consider that to be evidence of vowel harmony, whereas if it affects only part of the vowel, in particular the part closest to the trigger, I conclude that it results from co-articulation. (ii) I use the significance of difference in the mean values of F1 and to a lesser extent F2. The expectation is that if there is co-articulation, it would affect backness as well height.

6.1.4.1 Speakers

The speakers were four native speakers of siSwati (2 females and 2 males). All four speakers were born and raised in Swaziland and three of the four were University of London students at the time of recording. Their length of stay in Britain ranged from

four to six months. The fourth speaker was recorded in Swaziland. The speakers' ages ranged from 28 to 36 years.

6.1.4.2 Sample

For the experiment, consonants following the mid vowels were selected from all the different places of articulation to ensure that the patterns found were not specific to particular consonants. The total number of vowel tokens was 77 x 4 speakers x 2 repetitions[39], all embedded in 69 siSwati words produced within the carrier phrase /Ngitsi...kahle/ 'I say...well'. The word-list appears in appendix B. See Table 6-2 for the distribution of the tokens.

Environment	Before [-high] vowel		Before [+high] vowel	
Vowel	E1	O1	E2	O2
Number of tokens	25	22	17	13

Table 6-2 The total number of tokens for each vowel at different environments.

The abbreviation E is to be interpreted as /e/ and O is to be interpreted as /o/, both unspecified for [ATR]. E1 and O1 represent the vowels /e/ and /o/ before a [-high] vowel, and E2 and O2 represent the vowels /e/ and /o/ before [+high] vowels.

(16) E1 bhema O1 bona
E2 bhemisa O2 bonisa

6.1.4.3 Procedure

The productions of the speakers were recorded in a quiet room using a Sony CM-959 DT microphone and a TCD D10 Sony DAT player at a sampling rate of 48 KHz. Before actual recording, speakers practised reading the same carrier phrase with words not included in the target list. Next, they read the carrier phrase, this time with

the target words. They were instructed to read at a normal reading rate, with a pause between each sentence. Each speaker read two repetitions of the total number of sentences. The recorded material was then transferred to a computer and down sampled to 11.25 kHz in preparation for acoustic analysis.

6.1.4.4 Acoustic analysis

Using the Speech Filing System (SFS) (Huckvale)[40] speech analysis software, formant measurements were taken for the target vowels in all 77 tokens x 4 speakers x 2 per speaker. However, not all the readings were taken from all the 77 tokens produced by each speaker since in some of the recordings a few tokens did not show clear formants and those were discarded. The duration of each vowel was measured from the waveform in conjunction with a wideband spectrogram. F1 and F2 frequency values were measured. Since the previous studies were more concerned with whether siSwati had height harmony or not, F1 was more crucial in this experiment. F2 was also included as a general indicator of how much backness was coarticulated since the expectation is that F1 and F2 are assimilated in tandem. The mean value was automatically calculated. From the mean values I then produced graphs to show the distribution of the vowels, in particular to see whether the environment had an effect on the distribution or not.

The graph produced from speaker D-S's recordings is shown in Figure 6-1. The vowels produced before the [-high] vowels are shown here as E1 represented by a shaded square and O1 represented by a shaded triangle on the graph. Those produced before [+high] vowels are shown as E2, represented by an unshaded square and O2 represented by an unshaded triangle on the graph.

[39] Although there were 69 words, the total number of tokens added up to 77 since some of the words had more than one token, for example, /bhobosa/ has two tokens of /o/, while /sebentela/ has three tokens of /e/.

[40] SFS available at http://www.phon.ucl.uk/resource/sfs/.

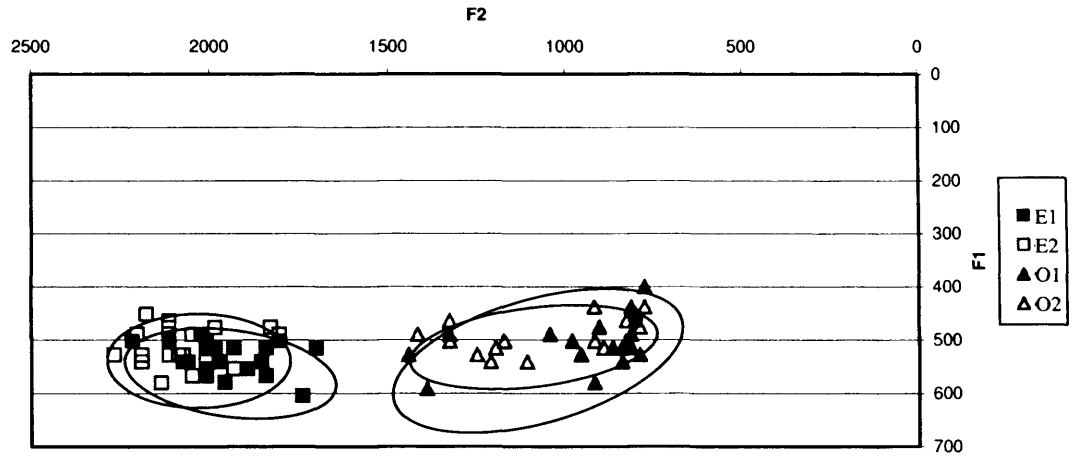


Figure 6-1 Mean value for vowels /E/ and /O/ when produced before [-high] and [+high] vowels: Speaker D-S.

An examination of the graph in Figure 6-1 does not show a clear division between the two sets of vowels especially on the F1 axis reflecting height. There is an overlap of the vowels especially the front vowels. A similar graph representing speaker VE-M's recordings is shown in Figure 6-2. This graph is similar to Figure 6-1 in that the vowels still overlap. Nonetheless, VE-M's graph does show a difference in the F1 axis. F1 was generally lower for [O2] than for [O1], consistent with [O2] being raised before a following [i]. This indicates that there may have been a difference in terms of height and towards the predicted direction. Graphs from the other two speakers, not shown, showed similar patterns.

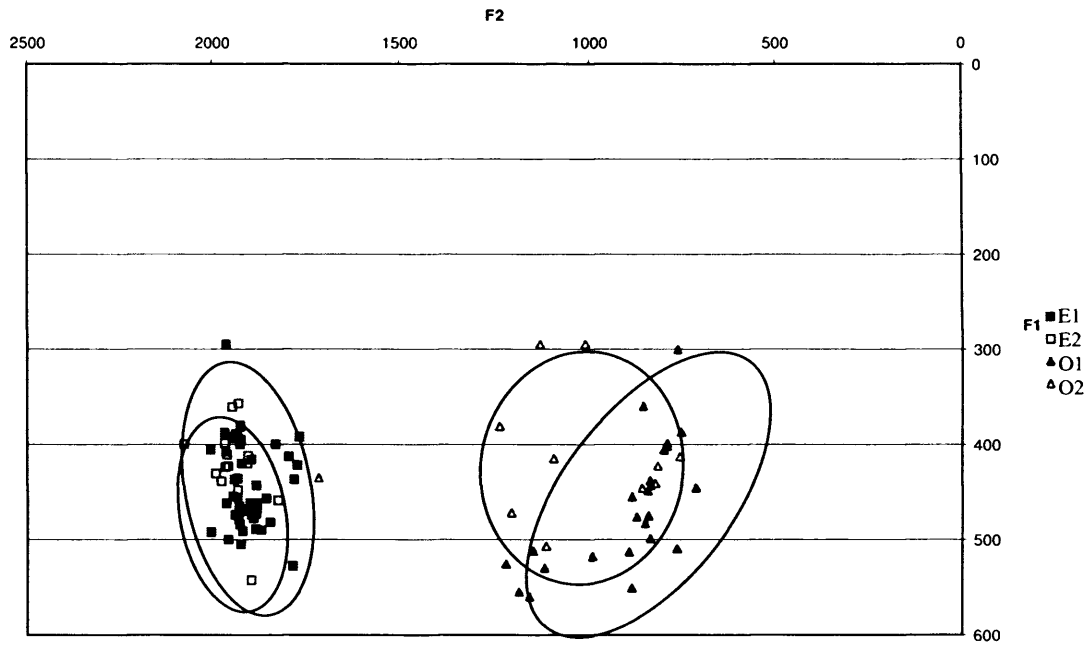


Figure 6- 2 Mean value for vowels /E/ and /O/ when produced before [-high] and [+high] vowels: Speaker VE-M.

Many studies have shown that, among other things, the degree of transconsonantal co-articulation depends on the type of consonant following the vowel in question (Modarresi et al 2004, Beddor et al 2002, and Recasens 2002). It has been said that linguals, for example, may interfere with co-articulation since their production requires the use of the tongue body in conflict with the vowels (Recasens 1987, Magen 1997). To check whether the pattern demonstrated in the above graphs was influenced by the intervening consonant, I grouped the tokens on the basis of place of articulation of the consonant that preceded the high vowel. However, since the experiment was initially not designed to consider these differences, the tokens were not evenly distributed. The same procedure was followed as for obtaining the initial graphs. In Figure 6-3, I present a graph with a coronal between the mid vowel and the high vowel.

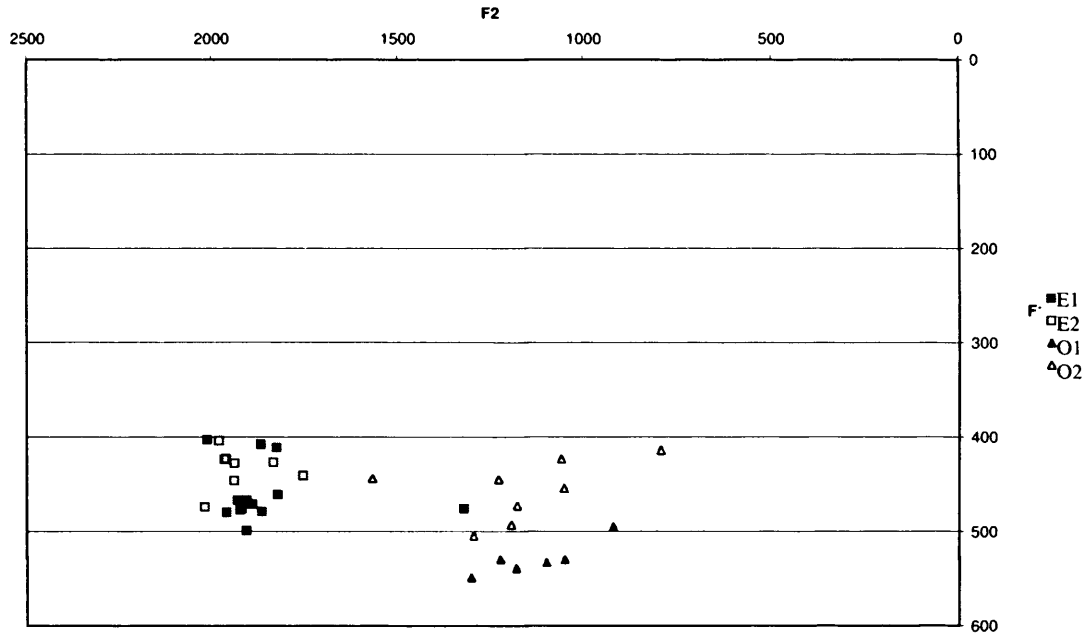


Figure 6-3 Mean value for vowels /E/ and /O/ when followed by a coronal consonant, produced before [-high] and [+high] vowels: Speaker VE-M.

Although, there is still some overlap, this graph shows a slightly clearer pattern compared to Figure 6-1, with /O/ showing a division between the shaded and unshaded triangles on the F1 axis.

Recall that in vowel harmony all the vowels in a particular domain are affected. To find out whether assimilation in siSwati was unbounded or not I also measured the F1 values from a sequence of mid vowels in a word. The vowels measured were from the words /sebentela/ 'work for', and /sebentelisa/ 'cause to work for'. The mean formant values, for the speaker NM-D, for the first, second, and third vowel in /sebentela/ 'work for' had a high F1 which was at about the same height for all three vowels; 536, 528, and 538 Hz respectively, which is what I expected since the following vowel was [-high]. Those in the word /sebentelisa/ showed a decrease in the F1 value from the furthest vowel to the one closest to the trigger: 531, 515, and 466 Hz respectively (see Figure 6-4).

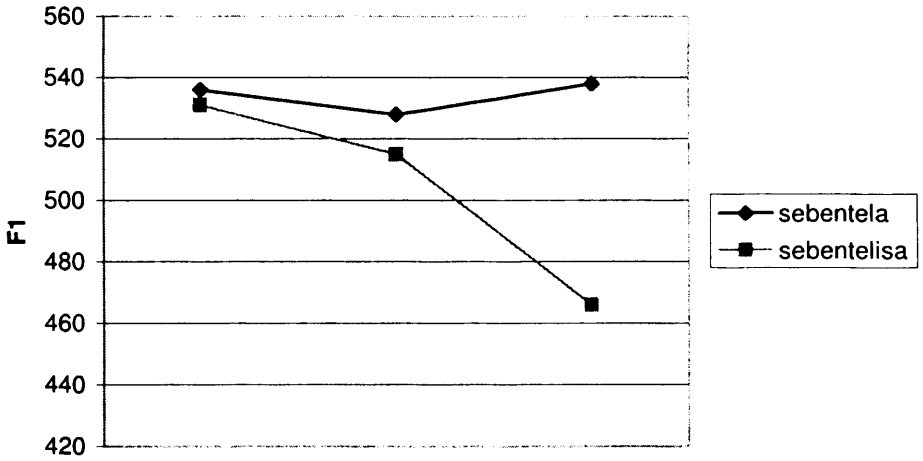


Figure 6-4 Mean F1 values for the different /e/s in the words /sebentela/ and /sebentelisa/: Speaker N-MD.

Figure 6-4 suggests that in siSwati assimilation affects only the vowel that is closest to the high vowel, in line with its lower F1. The second /e/ also shows some assimilation to the high vowel although not as much as observed in the final /e/, which has the lowest F1 value.

It has been observed that in Sesotho causative forms without an overt /i/ may also raise the mid vowels. Examples are repeated in (17).

(17) Sesotho

Infinitive	*Causative*		
tlɔla	tlotsa	'smear oneself'	*tlodisa
laɛla	laetsa	'order'	*laedisa

To find out whether the causative in siSwati had a similar effect, I took measurements for similar words. Their values were compared to those of their non-causative counterparts. In (18), I provide the mean F1 values for these words as produced by speaker VE-M.

(18)	*Infinitive*	F1	*Causative*	F1	
	vela	493	veta	491	'appear'
	khwela	507	khweta	509	'climb'

Both sets of vowels in (18) do not appear to suggest any difference in their F1 values. From these results I concluded that there was no raising of the mid vowels in the siSwati forms.

6.1.4.5 Significance level

To find out if the differences depicted by the graphs are statistically significant, I calculated the significance level of the results using a 2-tailed independent T-Test. This test is often used to evaluate whether the mean value of the test variable for one group differs significantly from the mean value of the test variable for the second group (Green et al 2001). The choice of this type of test over the one-way ANOVA, for example, was based on the unequal number of the population variances I was dealing with. The number of tokens before [+high] vowels was smaller than that before [-high] vowels. This makes 2-tailed T-Test more appropriate than the ANOVA procedure, which requires the population variances to be equal (Green et al 2001). The lower the chosen significance level, the more the data must diverge from the null hypothesis to be significant. For this particular task I used the significance level of 0.05, the commonly accepted confidence level for measuring linguistic data (Butler 1985:116). The results are shown in Table 6-3.

P-value by Speaker	F1 /E/	F1 /O/	F2 /E/	F2 /O/
D-S	0.03*	0.12	0.04*	0.03*
Z-M	0.05*	0.71	0.18	0.47
VE-M	0.02*	0.02*	0.01*	0.06
N-MD	0.01*	0.001*	0.19	0.04*

Table 6-3 P-values for each speaker for both F1 and F2 values for the mid vowels, calculated from the whole data. * $p < 0.05$, significant.

Table 6-3 shows a significant F1 difference between the /E/s for all the speakers. Only two of the speakers show a significant difference for the /O/s but all in right

direction. F2 was significant in only two of the speakers for both the /E/s and /O/s. Even when not significant, it was towards the predicted direction.

I now turn to the change in formant values during the course of the vowel. One of the characteristics of phonological vowel harmony is that the entire vowel is affected, whereas in co-articulation only the part of the vowel closest to the trigger may be affected. In that case we need multiple measuring points to determine the position of change. According to Xu and Liu's (in press) segmental theory, the second vowel in a CVCV string begins 50ms before the end of the preceding vowel. This is the point when the oral cavity starts to change toward a shape that is appropriate for the following segment. This idea is in line with most studies which suggest that the effects of co-articulation are seen at around the middle of the vowel. Hence measurements to ascertain the effects of the following vowel are taken at the middle and the end of the vowel (Manuel, 1990). In addition to the measuring points discussed earlier, I took measurements at 50ms intervals, the zero point being aligned with the offset of the vowel which was also the onset of the following consonant.

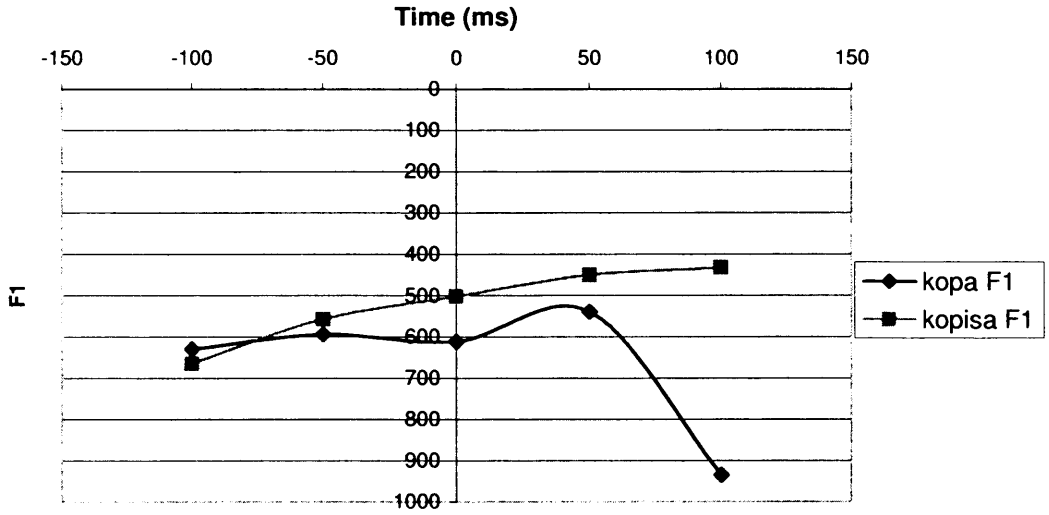


Figure 6- 5 F1 values for /o/ before [-high] and [+high] vowels at 50ms intervals: Speaker NM-D.

An examination of the graph in Figure 6-5 suggests that the F1 values for /o/ are lowered at around -50ms, in the direction of those of the following vowel /i/. The difference in the formant values of the two vowels is about 50Hz at -50ms and is

100Hz at 0ms, the vowel offset. The formant values for /o/, when preceding the low vowel /a/ do not show any change from beginning of the vowel up to 0ms, the vowel offset. It remains at an almost steady state of 600Hz. Importantly, at -100ms the two plots converge, showing that the vowels are not different through their full duration.

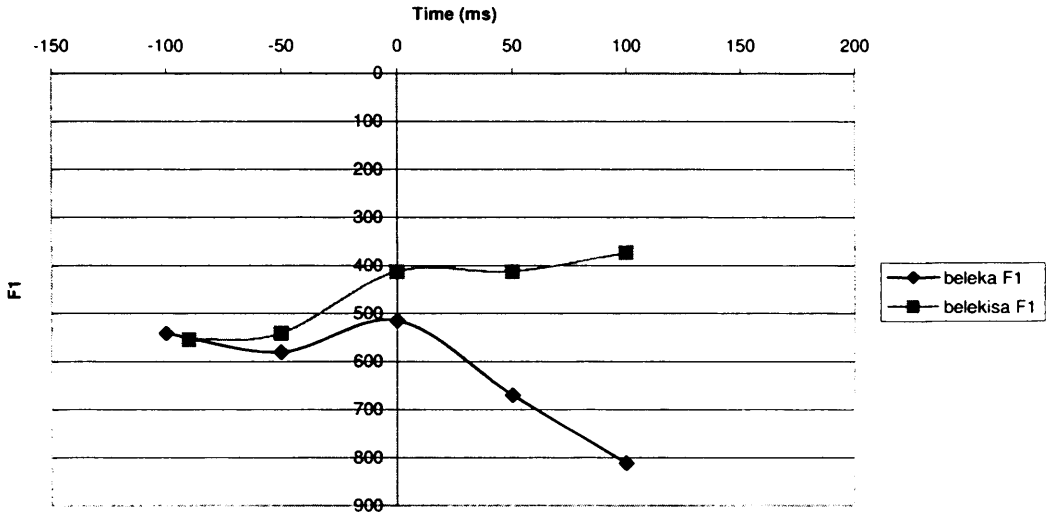


Figure 6-6 F1 values for the nearest /e/ before [-high] and [+high] vowels at 50ms intervals: Speaker NM-D

Figure 6-6 shows F1 values from the same speaker, N-MD, when producing the second /e/ in the words /beleka/ 'give birth' and /belekisa/ 'help one to give birth'. The graph demonstrates a similar pattern to Figure 6-5. The difference between the values of the two vowels is slightly more than 50Hz at -50ms and about 120Hz at 0ms. This means an even lower F1 when the /e/ occurs before a [+high] vowel and a higher F1 for the same vowel when occurring before a [-high] vowel. Again, at -100ms the two plots converge.

The expectation is that F1 and F2 are assimilated at the same time. In Figure 6-7, I present a plot for the F2 values of the same words as in Figure 6-6, produced by speaker D-S, to find out if the vowel /i/ does lead to the expected fronting of the preceding mid vowel.

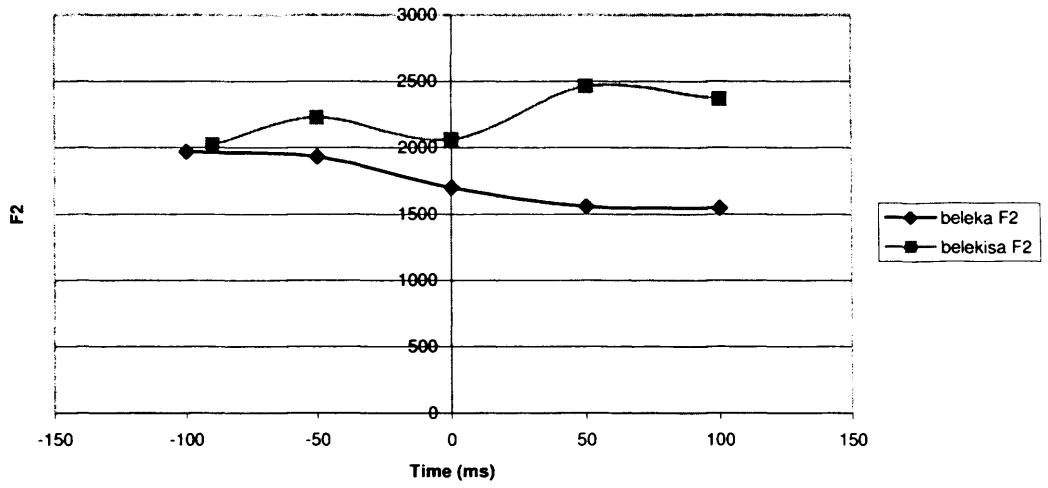


Figure 6-7 F2 values for the second /e/ before [-high] and [+high] vowels at 50ms intervals: Speaker D-S.

The F2 values seem to suggest systematic anticipatory effects. The second /e/ before the [+high] vowel /i/ has a higher F2 than the one before the [-high] vowel /a/. This suggests fronting of the vowel in addition to raising before /i/. One other thing to notice from Figure 6-7 is that seemingly, co-articulation starts before the expected -50ms. In fact it starts immediately after the beginning of the vowel.

6.1.5 Results

What do these results tell us about siSwati? Is there both co-articulation and vowel harmony in the language? The high vowel /i/, for example has a low F1 and a high F2 while a low vowel like /a/, has the opposite pattern, a high F1 and a low F2. Since the main concern of this study was to investigate the height difference in the mid vowels, I expect the effect of the following high vowel to show as a lower F1; that is, if the language has phonological vowel assimilation.

F1 Values

An examination of the graphs in Figures 6-1 and 6-2 show an almost similar pattern. When we compare the shaded and unshaded squares on these graphs we notice that there is an overlap in the distribution of the /E/s. Speaker D-S in Figure 6-1 shows the same overlap on the shaded and unshaded triangles. However, the productions by

speaker VE-M Figure 6-2 and Figure 6-3 (consonant specific environment) show a slightly clearer pattern. The unshaded triangles show a lower F1 compared to the shaded triangles. The p-values in Table 6-1 show that the difference between the /E/s was significant for all the speakers. The overlap of the /O/s for D-S is confirmed by the p-value which shows a significance level of 0.12, greater than the commonly accepted level of 0.05. This means generally the speaker produces the two vowels at about the same height. VE-M is one of the two speakers who showed a statistically significant difference in the /O/s. The p-value was 0.02, an indication that overall he does distinguish the heights of the two vowels. As for speaker N-MD there is very strong evidence that she produces the vowels at different heights. The T-Test shows a p-value of 0.001.

Turning to the differences observed at the different stages during the production of the vowels, we find that on the whole the graphs show a similar pattern. There is a clear difference between each set of vowels at around -50ms, a confirmation of co-articulation. The vowels before [+high] vowels have a lower F1 compared to those before [-high] vowels. This pattern is evident in most of the speakers, as depicted in the graph for speaker N-MD in Figure 6-4 and 6-5 for the vowels /E/ and /O/ respectively.

F2 Values

The previous studies were more concerned with whether siSwati had height harmony or not, therefore, F1 was more crucial in this experiment. However, F2 was also included as a general indicator of how much backness was coarticulated since the expectation is that F1 and F2 are assimilated in tandem.

Generally, raising of the F2 in the two sets of vowels varied from speaker to speaker such that only two of the speakers showed a significant difference between the vowels. Although the F2 values for the /E/s showed some overlap, it was different from those we have seen in the F1 values. This is in line with the T-Test summarised in Table 6-1, which showed a p-value of 0.04 and 0.01 for D-S and VE-M respectively. For the /O/s, D-S had a p-value of 0.03 while VE-M had a p-value of 0.06. On the measurements at different intervals of the vowel, Figure 6-6 showed a difference in the F2 values for speaker D-S. One other thing to note on this graph is that the vowels separate even before the -50ms (more on this graph shortly).

Nonetheless, not all the graphs demonstrated a straightforward case of co-articulation. There were some discrepancies, not only from speaker to speaker but within the same speaker. The graph in Figure 6-8 illustrates such a discrepancy in the production of the mid vowels in the words /bopha/ and /bophisa/ 'tie' when produced by the speaker N-MD. Note that the same speaker's production of the mid vowels in /kopa/ vs /kopisa/ 'copy' showed an instance of co-articulation in Figure 6-5.

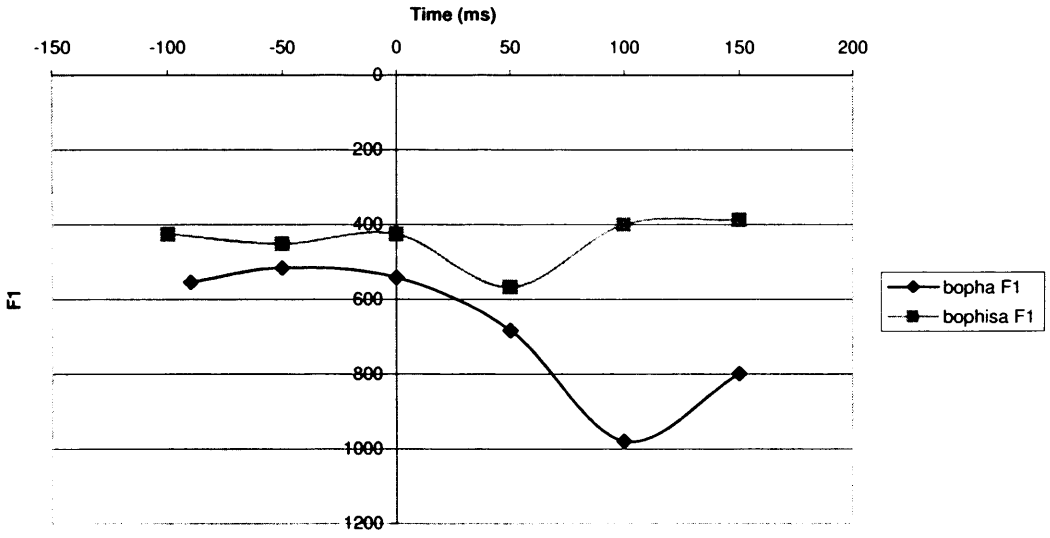


Figure 6-8 F1 values for /o/ before [-high] and [+high] vowels at 50ms intervals: Speaker NM-D.

The above graph, showing a steady state difference of about 100Hz, is not different from what would be expected in a language with canonical vowel harmony. Compare Figure 6-8 with the height harmony distinction in Kera, illustrated in Figure 6-9.

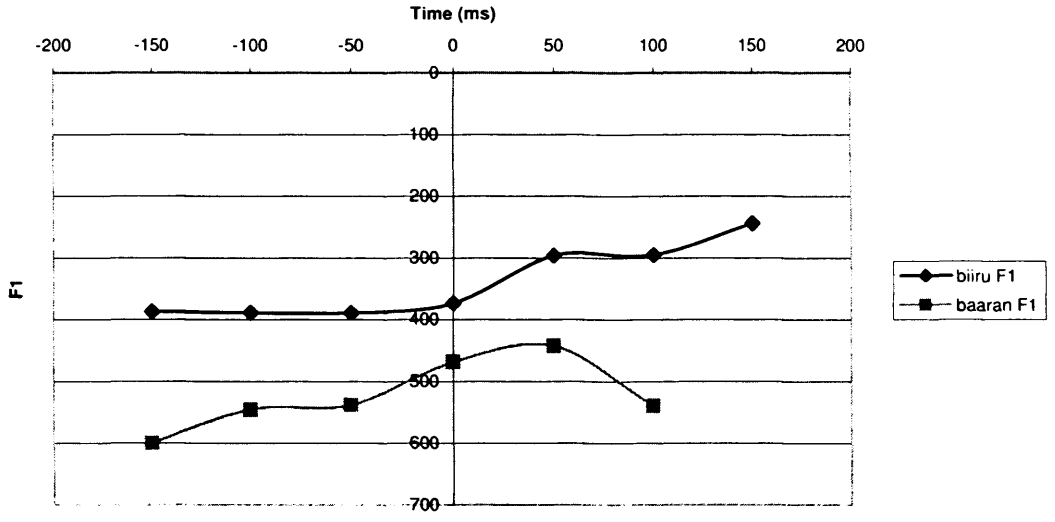


Figure 6-9 F1 values, at 50ms intervals, for an underlying /aa/ produced as a barred [i], (represented as [i] on the graph), before the suffix /-u/ and as /aa/ before a suffix with a [-high] vowel /-an/. (Data from Pearce, to appear).

6.1.6 Discussion

The results of the experiment confirm that the phonological environment does influence the quality of siSwati mid vowels; both /E/ and /O/ are raised as well as fronted before the high vowel /i/. However, this difference cannot be considered as evidence for vowel harmony, as claimed by Ziervogel & Mabuza and others. First, and crucially, the maximal difference in the formant values was reached only at around 50ms in most of the vowels, suggesting only a phonetic change. If the change had been that of harmony, the whole vowel would have been affected. Secondly, the quality difference was not significant for all the speakers. Therefore, I conclude that, instead of the vowel height harmony claimed in the previous studies, the nature of the difference in the mid vowels is evidence of co-articulation. Moreover, there are other reasons which favour the idea of co-articulation over vowel harmony in siSwati.

I mentioned that in canonical vowel harmony systems all the vowels in a particular domain are affected. However, in siSwati, as suggested by the graph in Figure 6-4, there is a gradient effect whereby the influence on a vowel's quality is greater the closer it is to the trigger. The direction and gradual decrease of the F1 value in vowels occurring at different distances from the trigger is characteristic of co-articulation. In vowel harmony, F1 would be lowered either consistently across

all vowels in a sequence (in the case of unbounded assimilation) or only in the neared vowel (in the case of bounded assimilation).

It has been suggested that the main difference between co-articulation and harmony is that in the former assimilation is phonetic while in the latter it is phonological. Sesotho is an example of a language where the process of assimilation has been phonologized. The formation of the causative in this language shows us to what extent the process has been phonologized: the mid vowels are raised even when the assimilatory trigger is absent. In siSwati the infinitive and causative forms do not show any difference in their F1 values.

Kockaert's (1997) conclusion that there is no significant difference in the quality of the vowels in the two environments is based on formant readings at the steady state of each vowel: this is where the formant trajectory is minimally affected by adjacent segments. If the language had vowel harmony, then the difference between each set of vowels would have been expected to be statistically significant. It has already been observed from the results of my experiment that the F1 and F2 values of the vowels in question *did* show a difference if the measurements are taken less than 50 ms before the end of the vowel, suggesting that the height and backness of the latter portion of the assimilating vowels is determined to some extent by the following vowel, in particular the high front vowel. Although significant, the difference cannot be attributed to vowel harmony since the difference is not observed throughout the duration of the vowel, as is the case with Kera vowel harmony for example.

Nevertheless, some siSwati speakers *did* show a change in vowel height throughout the duration of the targeted vowel (see Figure 6-8), which may be suggestive of fully phonological harmony. The difference between these speakers and those with gradient assimilation indicates the existence of different dialects. It is usual to suppose that dialect differences of this sort are symptomatic of sound change in progress. The next section discusses how these differences fit into the wider historical picture of vowel assimilation in Southern Bantu.

6.1.7 Comparative analysis

One of the differences observed between vowel harmony and co-articulation is that the former is categorical and potentially neutralising, while the latter is not. In isiZulu, although a vowel harmony language, there is no neutralisation of contrasts. In this way it is not different from siSwati. At least in this respect there is no difference between the two processes in the two languages. The harmony in Sesotho is different from that of isiZulu in that a contrast is neutralised in Sesotho while in isiZulu the two sets of vowels are not contrastive. So the process of assimilation in isiZulu seems to be in between that of siSwati and Sesotho. Table 6-4 summarizes the relationship among these languages.

	Harmony	Neutralization
SiSwati		
IsiZulu	x	
Sesotho	x	x

Table 6-4 A summary of the harmony facts about siSwati, isiZulu, and Sesotho

As mentioned, there are reasons to support the idea that vowel harmony develops, historically from co-articulation and that the change from one to the other is not abrupt but gradual. Let us assume that the three Southern Bantu languages just discussed represent different stages along this route. That is, co-articulation amongst some siSwati speakers represents the early stages of vowel harmony. In other speakers the change has already moved a step forward from the initial stage: is at more or less at the same stage as the dialects of Siberian Turkic discussed earlier. All the same, siSwati still represents an earlier stage comparatively. In generations to come it may develop to the next stage and become more like isiZulu, with all speakers producing vowel harmony. As the language develops it may include neutralisation of contrasts and the opacity observed in Sesotho, which, I propose, represents the next stage. Finally, it may develop to be like the fully categorical height harmony systems which are observed in some of the Central Bantu languages.

6.1.8 Feature representation

In my analysis of the difference between a language with vowel harmony and one without, I follow Ohala and others in their argument that sound change results from a listener misunderstanding the speaker's intentions. If the misunderstanding goes uncorrected then a new sound may be introduced. Although their arguments are not specific to harmony, it has been claimed that harmony systems develop in the same way (Blevins 2004). This goes against the assumption that, when speakers coarticulate, they do it intentionally to preserve a certain percentage of the perceptual cues for a particular property that ends up being assimilated, as Jun (2004) suggests in his analysis of place assimilation in Korean. Speakers do not change sound for purposes of ease of articulation either. If that was the case the change would not have been limited to the domain of the word (Ohala 1993:166)[41]. Flemming treats both co-articulation and harmony as phonological processes and accounts for both by means of phonological constraints. In contrast, for the same reasons mentioned above, I do not treat co-articulation as a phonological process.

In all the languages the quality of the following vowel determines the feature of the preceding mid vowel. Based on the evidence of only siSwati and isiZulu, one may propose that [ATR] is the feature that is assimilated from the following high vowels. Although the property assimilated is the same in isiZulu and siSwati, there are grounds for saying that the process has been phonologized in isiZulu and remains phonetic in siSwati. However, if we include Sesotho we may opt for the feature [low], following Harris (1987, 2003), and van der Hulst and van der Weijer (1995). It has been observed that, while high vowels tend crosslinguistically to involve an advanced tongue root, it is nevertheless possible for a given language to contrast different tongue root values for high vowels (Archangeli and Pullyblank (1994)).

This leads us to the next point. Sesotho is one of the languages which has been suggested to have both [-ATR] and [+ATR] high vowels (Harris 1987, 2003 and others). For this reason we cannot claim that the feature assimilated is [ATR] since the [-ATR] vowels [ɪ, ʊ] also induce raising of /ɛ, ɔ/ to [e, o]. In his analysis of both Sesotho and isiZulu, Harris (1987) suggests the feature [low] to distinguish the vowels. He argues that the vowels [i, u, ɪ, ʊ, e, o] have the feature [-low] while [ɛ, ɔ,

[41] Although speech may exhibit as much across-word co-articulation as within-word, nevertheless across-word co-articulation leads to sound change far less often than within-word (Ohala, 1993).

a] are [+low]. In that case the trigger, which is any of the high vowels, and the resultant vowels [e, o], have the same feature [-low]. In his analysis, assimilation results from spreading of the feature [-low] from the high vowels to the [+low] vowels [ɛ, ɔ] to yield a [-low] vowel [e, o]. The vowels are further distinguished by their values of [+back] and [+round]. The feature [+ATR] is retained only to distinguish [i, u] from [ɪ, ʊ]. In addition, non-high vowels [e, ɛ, o, ɔ] are unspecified for [low] before spreading. Harris's vowel feature system is summarised in (19).

(19) A summary of the vowel feature system according to Harris (1987)

	i	ɪ	e	ɛ	a	ɔ	o	ʊ	u
high	+	+	-	-	-	-	-	+	+
low	-	-	-	+	+	+	-	-	-
round	-	-	-	-	-	+	+	+	+
back	-	-	-	-	+	+	+	+	+
ATR	+	-						-	+

In contrast, Clements (1991) rejects the use of the standard features [high], [low] and [ATR] to describe vowel height assimilation in Bantu languages and instead, suggests the use of the feature [open]. His argument against using the feature [high] is that in some languages the vowels do not acquire the feature [high] even after raising. Clements further observes that [ATR] defines the location of a vocal tract constriction and can therefore not pattern with articulator-free features such as [high] and [low]. However, his argument does not hold as confirmed by Archangeli and Pullyblank (1994) who suggest that there *is* a correlation between tongue root advancement and tongue body height, since the tongue body and the tongue root are physically connected. Moreover, both tongue body raising and tongue root advancement cause lowering of F1. According to Archangeli and Pullyblank, raising the tongue body tends to correlate with tongue root advancement; hence the assumption that there is an unmarked correlation between [+high] and [+ATR]. They also note that interdependency between tongue root and tongue body movements constitutes a tendency not an absolute correlation.

Returning to the use of the feature [low], although it could account for the Sesotho data, Clements (1991) argues that it is less satisfactory than the feature [open]. His arguments are twofold. First, the treatment of [ɛ, ɔ] as [+low] has neither phonological nor phonetic motivation; [a] does not always pattern with [ɛ, ɔ] cross-linguistically. Second, there is a considerable difference in first formant frequency between [a] and [ɛ, ɔ]. He instead uses a hierarchical model of vowel height where the feature [open] is used to assign vowels into an abstract phonological 'space' which he divides into registers. (20) illustrates Clements' vowel feature system.

(20) The vowel feature system according to Clements (1990)

	i	u	ɪ	ʊ	e	o	ɛ	ɔ	a
$open_1$	-	-	-	-	-	-	-	-	+
$open_2$	-	-	-	-	-	-	+	+	+
$open_3$	-	-	-	-	+	+	+	+	+
$open_4$	-	-	+	+	+	+	+	+	+

Clements argues that vowel raising in Sesotho does not occur only before high vowels but also before the vowels /e, o/. As a result, the vowels /ɛ, ɔ/ become [e, o] after [i, u, ɪ, ʊ, e, o]. Hence the process may be analysed as spreading of the feature $[\text{-open}]_2$ to all $[\text{-open}]_1$ vowels. To support his idea that /e, o/ are also triggers of assimilation, he gives an example from how *kobehelɪ* (neg.) 'curve towards' is derived from *kɔb-ɛh-ɛla*. He claims that the raised mid vowels in the negative form are an outcome of an iterative process; first, the negative suffix [ɪ] raises the first /ɛ/ to [e] which in turn raises the next vowel. The process is repeated until all the vowels have been raised. However, Clements does not give an example where the vowel /e/ triggers harmony in the absence of a high vowel in the same word.

Like Clements, Hyman (2002) accounts for vowel raising by using the feature Open instead of the vowel height features [high] and [low]. Unlike Clements, his vowels have in addition the features ATR, Front, and Round. Furthermore, all his features are privative. This results in the general feature system AFRO, an acronym

from the different features that he uses. Hyman's analysis of the nine vowels is shown in (21).

(21) Hyman's (2002) vowel feature system

	i	u	ɪ	ʊ	e	o	ɛ	ɔ	a
ATR	*	*			*	*			
Front	*		*		*		*		
Round		*		*		*		*	
Open					*	*	*	*	*

Hyman analyses assimilation in Punu, which works the same way as in isiZulu, as a leftward spreading of ATR from /i, u/ into /ɛ, ɔ/ to derive [e, o] respectively. There is no mention of the other features. Apparently, Hyman's additional features do not play any role in distinguishing the vowels [i, e, u, o] and [ɛ, ɔ]. Furthermore, his analysis does not include any examples from a language like Sesotho, where the [-ATR] vowels [ɪ, ʊ] also induce raising. He argues, though, that the vowels which have been traditionally analysed as [ɪ, ʊ] in Kalɔŋ for example, should not be described as such. This he supports by their inconsistent behaviour. He observes that in this language the vowels may merge with different vowels depending on the type of syllable. In open syllables they merge with [i, u] but with [ɛ, ɔ] in closed syllables. He refers to these vowels as 'abstract vowels'.

6.1.8.1 A summary of the analyses.

According to Harris, assimilation in isiZulu and Sesotho, results from the spread of [-low] to [+low]. His analysis works well for both languages only if [low] is redefined, that is, to include the vowels [ɛ, ɔ]. However, there is no cross-linguistic evidence for grouping [ɛ, ɔ, a] as [+low]. Another problem with this analysis is that in languages with [æ], none of the features would distinguish [ɛ] and [æ].

Clements accounts for assimilation in isiZulu and Sesotho as spreading of the feature [-open$_2$] to [-open$_1$]. His analysis works if the triggers of assimilation also

include /e/ and /o/. However, this is a problem since it is not yet shown that the vowels /e, o/ trigger assimilation in these languages.

Hyman observes that in Punu, a language whose harmony process is similar to that of isiZulu, assimilation involves the spread of the feature [ATR]. In his discussion, he does not include languages like Sesotho, where assimilation is triggered by both [-ATR] and [+ATR] high vowels. The problem with Hyman's analysis is that his feature Open does not have any role to play in the analysis of vowel raising, since we cannot spread the absence of a privative feature.

From the above summary we can conclude that none of the analyses can perfectly account for assimilation in Sesotho. The problem results from the fact that, in this language, both [-ATR] and [+ATR] vowels induce raising of the mid vowels. Ladefoged & Maddieson (1990) suggest that a tongue root feature cannot be appropriate for distinguishing the vowels [i, u] and [ɪ, ʊ] in English. This may also be the case in Sesotho. Moreover, there has been some debate as to whether ATR is the best term for the relevant feature (Lindau 1978, Clements & Hume 1995, Ladefoged & Maddieson 1996). Lindau's observation on Akan vowels is that in the production of these vowels the tongue root is independent of the mechanism for controlling tongue height. She observes that the tongue root mechanism is usually combined with vertical displacement of the larynx, and sometimes with movements of the back pharyngeal wall. She proposes the use of the feature Expanded, referring to pharyngeal expansion. Ladefoged & Maddieson's observation is similar to Lindau's in that, in the same language, Akan, there is in addition to the tongue root gesture a lowering of the larynx. Clements & Hume and Ladefoged & Maddieson agree on the use of the feature [pharyngeal]. Their proposal is that ATR be subsumed under the feature Pharyngeal, to unify other phenomena besides ATR. The fact that variation in the size of the pharynx and variation of the highest point of the tongue have very similar acoustic effects explains why this type of vowel harmony was described in terms of vowel height differences (Lindau 1978: 552). I am not in position to provide experimental evidence for or against the use of the feature ATR in the two languages that I compare. As previously suggested in the literature, I will analyze isiZulu as involving allophonic ATR harmony, triggered by the ATR feature on the high vowels and targeting mid vowels. I am thus using roughly Hyman's system but with binary [+/-ATR].

6.1.9 O T analysis

Recall that isiZulu has a phonemic 5-vowel system (22a) which becomes a 7-vowel system after raising (22b).

(22)

a.	i		u	b.	i		u
	ɛ		ɔ		e		o
		a			ɛ		ɔ
						a	

Assimilation in isiZulu is generally induced on a mid vowel by a following high vowel and is therefore anticipatory in nature. When a [-ATR] vowel /ɛ, ɔ/ is followed by a [+ATR] vowel /i, u/ it raises to a [+ATR] [e, o] otherwise it remains [-ATR] (23). On the other hand, siSwati mid vowels are always [-ATR], irrespective of environment (24).

(23)	bɛma	'smoke'	bemisa
	bɔna	'see'	bonisa

In siSwati there is no phonological change irrespective of environment.

(24)	bɛma	'smoke'	bɛmisa
	bɔna	'see'	bɔnisa

The OT analysis that follows is based on the assumption that isiZulu has vowel harmony while siSwati does not. The analysis shows that an interaction of constraints can account for the differences between vowel harmony and no harmony. It also considers and accounts for the possible intermediate stage which was revealed by the production of both co-articulation and harmony by some of the siSwati speakers.

In the following analysis, I follow Beckman's analysis of Shona height harmony in that assimilation in isiZulu results from an interaction between faithfulness and markedness constraints involving the feature that is assimilated. In this case the feature involved is [ATR]. To ensure that the underlying [ATR] features

are retained in the output, the faithfulness constraint IDENT [ATR] (25) should be part of the grammar in both languages, although it will turn out to be low-ranked.

(25) IDENT [ATR]: Correspondent segments in output and input have identical values for [ATR].

In addition, in both siSwati and isiZulu high vowels and low vowels retain their [ATR] specification. This is because; assimilation i) is always anticipatory, ii) is induced by only high vowels and, iii) targets only mid vowels. To ensure that both high and low vowels maintain their [ATR] specifications in the output, we need to add to the grammar two markedness constraints that are specific to height, *[+high, -ATR] (26) and *[+low, +ATR] (27).

(26) *[+high, –ATR]: vowels should not be simultaneously specified for [+high] and [-ATR] in the output.
(27) *[+low, +ATR]: vowels should not be simultaneously specified for [+low] and [+ATR] in the output.

These constraints are undominated and therefore ranked above IDENT [ATR]. This ranking will ensure that both low and high vowels always surface with the correct feature specification. (30) evaluates candidates from an input /mila/ 'sprout', which could be from either language, with an underlying [+ATR] high vowel and a [-ATR] low vowel.

(28) SiSwati and isiZulu

/m i l a/ [+ATR] [-ATR]	*[+high, –ATR]	*[+low, +ATR]	IDENT [ATR]
a. m i l a [-ATR]	*!		*
b. m i l a [+ATR]		*!	*
c. ☞ m i l a [+ATR] [-ATR]			

Candidate (28a) illustrates that, although assimilation is expected to be anticipatory, it is never induced by the vowel /a/ and does not target high vowels. Since, in this candidate, the low vowel spreads its [-ATR] feature to the high vowel, the result is an ill-formed [-ATR] high vowel. This candidate ends up with a fatal violation of *[+high, –ATR]. Candidate (28b) does the reverse, the high vowel spreading its [+ATR] to the low vowel, violating the requirement that assimilation should be anticipatory and should only target mid vowels. This candidate incurs a violation of *[+low, +ATR]. In the optimal candidate none of the vowels spread its [ATR] feature; hence, both vowels retain their underlying feature specifications. Both candidates (28a) and (28b), in addition, have one violation of IDENT [ATR] each. Spreading of either feature, results in an unfaithful version of the input vowel targeted by assimilation.

Now let us consider the consequences of the OT assumptions of the Richness of the Base which postulate that there are no language-particular restrictions on inputs (McCarthy 2002). This assumption suggests that the constraints that we have suggested for the siSwati and isiZulu grammars should be able to achieve the same results even if we posit a different input; a [-ATR] high vowel and a [+ATR] low vowel. The same candidate [mila] is selected when the input would contain a different [ATR] feature specification for the vowels. This is shown in tableau (29).

(29) SiSwati and isiZulu

/m ɪ l a/ [-ATR] [+ATR]	*[+high, –ATR]	*[+low, +ATR]	IDENT [ATR]
a. m i l a [-ATR]	*!		*
b. m i l a [+ATR]		*!	*
c. ☞ m i l a [+ATR] [-ATR]			**

Although we have now chosen a different input, the same constraints and ranking yield the same surface structure; candidate (29c) is still the winner. Although, Richness of the Base asserts that there should be no language-particular restriction

on the input, proponents of Lexicon Optimisation (Kager 1999, McCarthy 2002), propose that in the absence of empirical evidence for one input form over another we should select an input that is closest to the output, which is /mila/ in this case.

Up to this point, the two languages behave the same way and have the same grammar. However, the siSwati grammar is different from isiZulu in that mid vowels retain their feature specification in siSwati, but not in isiZulu. To account for this asymmetry, the constraint *[-high, +ATR] (30) should be high-ranked in siSwati.

(30) *[-high, +ATR]: vowels should not be simultaneously specified for [-high] and [+ATR] in the output.

This constraint ensures that mid vowels retain their [-ATR] feature, irrespective of environment. Since harmony in isiZulu is between mid vowels and the following high vowel, in (31) I consider candidates with possible harmony between these two vowels in siSwati. I also show that the ranking of the constraints result in no harmony in this language.

(31) SiSwati: no harmony

/b ɛ m i s a/ [-ATR] [+ATR]	*[+high, -ATR]	*[+low, +ATR]	*[-high, +ATR]	IDENT [ATR]
a. b e m i sa [+ATR]			*!	*
b. ☞ bɛ m isa [-ATR] [+ATR]				

Candidate (31a) illustrates that harmony would result from the spread of an [+ATR] feature from a high vowel to a mid vowel. Since siSwati does not have harmony, this leads to a violation of the high-ranked constraint, *[-high, +ATR]. In (31b) there is no spreading of any feature; both vowels retain their underlying feature specifications. Because of the ranking of the constraints candidate (31b) is chosen as the optimal candidate over (31a), the harmony candidate. For the purposes of Richness of the Base, which I discussed earlier, I illustrate that the same constraints and ranking can account for why there is still no harmony in siSwati even if the input was different.

(32) SiSwati: no harmony

/b e m i s a/ | | [+ATR] [+ATR]	*[+high, –ATR]	*[+low, +ATR]	*[-high, +ATR]	IDENT [ATR]
a. b e m i s a \ | [+ATR]			*!	
b. ☞ b ɛ m i s a | | [-ATR] [+ATR]				*

Since the mid vowels never become [+ATR] in siSwati, the constraints developed thus far should also account for the straightforward cases, where harmony is not expected. This is illustrated in (33) and (34) where I demonstrate that whatever input, the mid vowel surfaces as [-ATR].

(33) SiSwati

/ɓɔna/	*[+high, –ATR]	*[+low, +ATR]	*[-high, +ATR]	IDENT [ATR]
a. ɓona			*!	*
b. ☞ ɓɔna				

Candidate (33a) is less harmonic since it surfaces with a [+ATR] mid vowel which the language does not allow.

(34) SiSwati

/ɓona/	*[+high, –ATR]	*[+low,+ATR]	*[-high, +ATR]	IDENT [ATR]
a. ɓona			*!	
b. ☞ ɓɔna				*

Taken together (33) and (34) show that the same constraints in the same hierarchy are responsible for the correct surface forms. Like in tableaux (28) and (29), the difference lies in the violation of IDENT [ATR], and confirms that IDENT [ATR] must be below all three markedness constraints in siSwati.

To summarise the results of siSwati, we have seen that the constraints *[+high, -ATR], *[+low, +ATR], and *[-high, +ATR] are ranked high in the grammar. We have also seen that ranking *[-high, +ATR] above IDENT [ATR] stops harmony in this language.

IsiZulu

Returning to isiZulu, we have observed that in this language mid vowels harmonise with high vowels in terms of the [ATR] feature giving us alternations like *ɓɔna ~ ɓonisa*. This may suggest that *[-high, +ATR] should be ranked below IDENT [ATR]. However, taking into account Richness of the Base, this ranking cannot account for different input forms. It would mean simple /o/ in /ɓona/, for example, would surface unchanged (see (37)). ☹ marks the candidate incorrectly chosen under a particular ranking.

(35) IsiZulu

/ɓona/	*[+high, -ATR]	*[+low, +ATR]	IDENT [ATR]	*[-high, +ATR]
a. ☹ ɓona				*
b. ɓɔna			*!	

The ranking wrongly chooses candidate (35a) as the winner.

Notice that in isiZulu the only time the mid vowels surface as [+ATR] is when [+ATR] spreads from a following vowel, and the [-ATR] from the mid vowel disappears. So the output has only one [ATR] specification instead of two. So if we penalize each [+ATR] or [-ATR] specification, we can achieve this result. This means we need to have extra constraints which we have not discussed yet; the general markedness constraints, *[+ATR] (36) and *[-ATR] (37) and leave *[-high, +ATR] above IDENT [ATR] in isiZulu as well.

(36) *[+ATR]: Vowels should not have the feature [+ATR].
(37) *[-ATR] Vowels should not have the feature [-ATR].

Ranking *[+ATR] above *[-ATR] will allow the mid vowels to surface as [-ATR] in a non-high vowel context, while ranking *[-high, +ATR] below these two constraints will ensure that there is harmony in this language (38 and 39).

(38) IsiZulu

/b e m i s a/ [+ATR] [+ATR]	*[+high, –ATR]	*[+low, +ATR]	*[+ATR]	*[-ATR]	*[-high, +ATR]	IDENT [ATR]
a. b e m i s a [+ATR] [+ATR]			**!		*	
b. b ɛ m i s a [-ATR] [+ATR]			*	*!		*
c. ☞ b e m i s a [+ATR]			*		*	

The idea is that every *[+ATR] or *[-ATR] specification violates markedness. (38a) has two violations of [+ATR], hence it is ruled out while (38b) and (38c) have one violation each and survive. Where there is a sequence of [-ATR] [+ATR] as in candidate (38b), there is a violation of both *[+ATR] and *[-ATR] hence the candidate loses. Candidate (38c) with a single doubly-linked [+ATR] violates only *[+ATR] and therefore survives.

The next tableau assumes the mid vowel is [-ATR] in the input and shows that harmony still results.

(39) IsiZulu

/b ɛ m i s a/ [-ATR] [+ATR]	*[+high, –ATR]	*[+low, +ATR]	*[+ATR]	*[-ATR]	*[-high, +ATR]	IDENT [ATR]
a. b e m i s a [+ATR] [+ATR]			**!		*	*
b. b ɛ m i s a [-ATR] [+ATR]			*	*!		
c. ☞ b e m i s a [+ATR]			*		*	*

(40) evaluates the same candidate as in (35) with the additional markedness constraints included in the tableau.

(40) IsiZulu

/ɓona/	*[+high, –ATR]	*[+low, +ATR]	*[+ATR]	*[-ATR]	*[-high, +ATR]	IDENT [ATR]
a. ɓona			*!		*	
b.☞ ɓɔna				*		*

(40a) incurs a violation of *[-ATR] and now loses over (40b).

Going back to siSwati, in order to stop harmony in this language, *[+ATR] and *[-ATR] must be low-ranked (see (41)).

(41) SiSwati

/b e m i s a/ [+ATR] [+ATR]	*[+high, –ATR]	*[+low, +ATR]	*[-high, +ATR]	IDENT [ATR]	*[+ATR]	*[-ATR]
a. b e m i s a [+ATR] [+ATR]			*!		**	
b. b e m i s a [+ATR]			*!		*	
c.☞b ɛ m i s a [-ATR] [+ATR]				*	*	*

(42) Final ranking:

SiSwati: *[+high, –ATR], *[+low, +ATR], *[-high, +ATR] >> IDENT [ATR] >> *[+ATR] >> *[-ATR].

IsiZulu: *[+high, –ATR], *[+low, +ATR] >> *[+ATR] >> *[-ATR] >> *[-high, +ATR] >> IDENT [ATR].

6.1.10 Stages in the development of harmony

In the above section I have demonstrated how a re-ranking of the same constraints can account for the grammars of siSwati and isiZulu. I have also discussed in the previous sections the possibility that vowel harmony in isiZulu may have developed from co-articulation. I mentioned then that the change from one process to the other was not abrupt but gradual, hence a possibility of an intermediate stage. In this final section I show how a re-ranking of the same constraints developed for siSwati and

isiZulu can also account for a possible intermediate stage. I have already suggested that siSwati represents the initial stage, co-articulation, while isiZulu represents the final stage, vowel harmony. I expect the intermediate stage to be characterized by optional harmony, for example, both /bemisa/ and /bɛmisa/ would be possible output forms. This means the grammar at this stage would have more or less the same ranking as that of isiZulu. However, instead of *[-ATR] dominating *[-high, +ATR], these constraints should be equally-ranked. (43) formalizes the analysis.

(43) Intermediate stage

/b e m i s a/ [+ATR] [+ATR]	*[+high, –ATR]	*[+low, +ATR]	*[+ATR]	*[-ATR]	*[-high, +ATR]	IDENT [ATR]
a. b e m i s a [+ATR] [+ATR]			**!		*	*
b. ☞ b ɛ m i s a [-ATR] [+ATR]			*	*		*
c. ☞ b e m i s a [+ATR]			*		*	*

In (44) I show the ranking of constraints in the three grammars. I have excluded the two top-ranked constraints in all the grammars.

(44) Final ranking

Co-articulation

(siSwati): {*[-high, +ATR]>>IDENT [ATR]}**1**>>{*[+ATR]>>*[-ATR]}**2**.

Intermediate: {*[+ATR] >> *[-ATR]} **2**, {*[-high, +ATR] >> IDENT [ATR]} **1**.

Harmony

(IsiZulu): {*[+ATR] >> *[-ATR]} **2** >> {*[-high, +ATR] >> IDENT [ATR]} **1**.

Development of co-articulation to vowel harmony can be captured by a re-ranking of the constraints I have labelled 1 and 2 in (44). *[+high, –ATR] and *[+low, +ATR] remain at the top in all three stages. In the initial stage the grammar has the constraints in group 1 dominating those in group 2. In the next stage we see a reverse

in the ranking; group 2 dominates group 1. However, domination is partial since the second constraint in group 2, *[-ATR] is ranked on a par with the first constraint in group 1, *[-high, +ATR]. This ranking is responsible for the production of both [+ATR] and [-ATR] mid vowels at this stage. In the final stage there is a clear division between the two sets of constraints; group 2 dominates group 1. More importantly, *[-ATR] dominates *[-high, +ATR].

6. 1.11 Summary

The results of the experiment presented in this section suggest that there is no phonological change in the siSwati mid vowels; hence, no vowel harmony, as previously suggested. The language has instead, co-articulation. In Section 6.2, I investigate the other non-local process, tone.

6.2 Tonal phonology

In this section I compare the behaviour of tone with that of palatalization in siSwati. I have claimed and argued that palatalization in siSwati results from a floating [cor] feature. This feature is right-aligned in that it is realized on the segment that is on the right edge of the stem, otherwise there is no palatalization. In the passive though, the rightmost labial may also be palatalized if there is none on the right edge of the stem. The process of tone shift and tone spread confirm that long-distance effects are not peculiar to palatalization in siSwati.

It has already been suggested and argued in the literature that, although, phonetically there is high vs. low tone, phonologically there is one tonal contrast in Bantu Languages, high vs. toneless (Downing 1990, Myers 1997, 1998, Creissels 1999, Hyman 2000, Cassimjee & Kisseberth 1998, 2001, Yip 2002). The low tone is supplied at the end of the phonology to supply any still toneless syllable with a tonal specification. This suggestion is supported by the fact that tonological patterns in Bantu languages, depend on High tones, not Low tones. For example, tone spreading, tone shift, plateauing, and tone reduction, affects High tones not Low tones (Hyman 2000). Myers observes that when two High tones are juxtaposed, something generally happens, but nothing happens when two Low-toned syllables are

juxtaposed. He further observes that the position of a High tone is restricted: it may not occur word-finally, for example, whereas Low tone can occur in any position in a word.

However, the generalization about a H vs toneless contrast in Bantu languages does not hold for all the languages. Hyman (2000) observes that there are other tonal oppositions in Bantu languages including Low vs. toneless. He provides examples from Ciluba, Ruwund and Phende. In these languages it is the marked L that is active in phonological processes. Examples from Ruwund show that Meeussen's Rule applies as in the other Bantu languages. However, in Ruwund Meeussen's Rule deletes a L after a L not a H after H /mù-kìl-a/ → [mùkil-a] 'it's a tail'. Tone spreading also involves L tone, for example in the same language /wù-a-ma-mu.fut-ol-in-a/ →[w-à -mà-mù.fut-ol-in] 'She paid him a lot for them'. Hyman views the behavour of tone in such languages as the result of tonal reversals: historical (marked) *High becomes (marked) Low.

Bradshaw (1999, 2003) argues that siSwati can be analysed as a three-tone language; high, mid, and low. She argues that the language has both High tone and Low tone underlyingly. The default tone, according to her, is actually Mid and not Low, as has been previously claimed. Bradshaw bases her argument on the fact that siSwati has depressor consonants and also that certain grammatical morphemes are Low-toned underlyingly.

Depressor consonants are the voiced consonants which lower the tone of neighbouring High tones, and may also block High spreading across them. In siSwati, depressor consonants comprise all the voiced obstruents, including the prenasalised voiced obstruents (Bradshaw 1999). Bradshaw argues that the reason why these consonants block tone is because they have their own tone underlyingly. However, according to Trail, Khumalo & Fridjohn (1987), it is inappropriate to classify depressor consonants with L tone since they have an effect on both H and L tone: they cause an H tone to rise from L and they make an L tone much lower. Their argument is based on the results of an experiment which they conducted on isiZulu depressors. In that experiment they observed that the pitch lowering effect of a depressor is so extreme that the pitch interval between a depressed tone (H or L) and L is greater than the interval between non-depressed L and H tone. This led them to conclude that a depressed tone is not an L tone. However, Trail (1990), in his

experimental study of depressor consonants on siSwati tone, acknowledges that there might be a third tone in the language, albeit with a limited distribution. Nevertheless, more experimental work is required to determine the actual number of tones in siSwati. Bradshaw's example of a grammatical Low tone comes from copula nominals which are formed by replacing the prefixal High tone with a Low tone in siSwati (e.g. sísu → sìsu 'it is the stomach').

Nonetheless, in this thesis I assume the more usual H vs. toneless; since the main objective of this section is not to discuss the general behaviour of tone in the language, but only to focus on the behaviour that is related to palatalization. A discussion on depressor consonants and the floating grammatical tone is therefore not included. Moreover, this approach is preferred because it makes it possible to capture the generalizations about the behaviour of lexical tone in the language. Tone shift and tone spread therefore refers to the movement of H tone. The underlying toneless words are referred to as Low-toned.

A Tone Bearing Unit (TBU) varies from language to language. It could either be the syllable or mora. Nguni languages have no length contrast, but only an automatic lengthening of the penultimate syllable phrase-finally. In languages lacking a weight or length distinction, it is impossible to distinguish syllable and mora as TBU. It is for this reason that I assume the syllable, as opposed to a mora, as a TBU in siSwati. Xu (1999) has argued and discussed why the whole syllable and not just the vowel should be regarded as the TBU.

As mentioned in Chapter 3, Bantu languages have agglutinative morphology, that is, different types of morphemes concatenate with the verb or nominal stem to form a word. These morphemes may either be High-toned or Low-toned. Mobility of H tone is one of the fundamental phenomena of Bantu tonology (Kisseberth & Odden 2003: 62). H tone shift and H tone spread are such instances of mobility. A tone may originate from any of the morphemes and either shift or spread to the right of where it originated from, either to the penultimate or the antepenultimate syllable. This is the general pattern in Nguni languages. In some languages, though, one may find leftward movement, but it is less common. Examples include Shi and Tonga (Phillipson. 2006). Leftward shift may be used in some languages only as a strategy to avoid H tone on the final syllable (Kisseberth & Odden 2003).

The rest of the chapter is organised as follows: Section 6.2.1 briefly discusses the morphological domains that are relevant to the analysis of tone in siSwati. Section 6.2.2 presents data and generalizations of the behaviour of lexical tone. Section 6.2.3 discusses the behaviour of Low-toned verbs, while a discussion of High-toned verbs is presented in section 6.2.4. Section 6.2.5 presents results of an acoustic study which confirms the previously suggested surface realizations of tone, since none, so far as I am aware, was based on an acoustic study.[42] Section 6.2.6, discusses the results of the study. Section 6.2.7 presents previous accounts of tone in Nguni languages, while Section 6.2.8 presents a new alignment approach where I show that ALIGN-R is responsible for the movement of tone towards the right edge of the PrWd in siSwati. Section 6.2.9 discusses evidence for the proposal that there is fusion instead of deletion in the PhWd. Finally, I summarize the section in Section 6.2.10.

6.2.1 Morphological domains

This section discusses tonal behaviour as observed on verbs. I have mentioned in Chapter 3 that in siSwati morphemes concatenate to form a verbal phrase. This fact is important in the understanding of tonal phonology in Bantu languages. Tone that is underlyingly realized on one morpheme may surface on a different morpheme. Morphological domains, also discussed in Chapter 3, may contribute to the surface realization of tone. A recap of these domains is therefore in order.

For purposes of phonological analysis, the Bantu verb phrase allows different morphological domains. According to Hyman and Ngunga (1994), Myers (1994) the verbal phrase in Bantu languages could be divided into a Macrostem and a Phonological word: the Macrostem is the part that consists of the verb root plus suffixes and in addition the object marker. The Phonological word includes the Macrostem plus morphemes before the object marker. For example, /[[ɓa-ya[si-fundz-el-a]$_{MStem}$]$_{PhWd}$ 'They read for us'. In his (1998) paper, Myers further groups the morphemes before the Macrostem under what he refers to as an Inflectional Stem (tense, aspect and modality). A combination of morphemes from the two stems

[42] Trail, Khumalo, and Fridjohn (1987), conducted an instrumental investigation of depressors and depression in Zulu, while Trail (1990) did experimental work on siSwati depression.

comprises a Phonological Word. For example in his analysis of tone in Shona, he observes that the domain of Meeussen's Rule is the PhWd while that of fusion is either the Inflectional Stem or the Macrostem. In the following analysis I show that the differences in tonal behaviour of the siSwati verb are also influenced by the morphological domain of the underlying tone.

6.2.2 Data and generalizations

In siSwati verb phrases are either High-toned or toneless. Sources of H tone are either affixes; 3rd person subject marker, infinitive /ku/ and all object markers or H tone verb roots. See (45) for a summary and examples.

(45)

Low-toned affixes	**High-toned affixes**
Subject marker: 1st person: ngi-, si-	*Subject marker*: All 3rd person:
2nd person: u-, ni-	e.g. class 1/2: u-/ɓa-
Progressive marker: -ya-	class 7/8: si-/t'i-
Future tense marker: to/tawu	*Object marker*: All classes
Vebal extensions: -is, -el, -an	e.g. class 1/2: mu-/ɓa-
-ek, -isis, -w	class 9/10: yi-, ti
	Infinitive: ku

H-toned verbs have the underlying H tone on the first syllable of the verb root. The input H tone targets either the penultimate or the antepenultimate syllable, depending on whether the verb is in phrase-medial or phrase-final position, respectively. In cases where all the morphemes are toneless, the verb phrase is produced without any H tone. The data that I present combines different types of morphemes either H-toned or L-toned. The data shows the following generalizations.

(46) Generalizations

- High tone moves rightwards, to the penult in phrase-medial forms and to the antepenult in phrase-final forms.
- Tone never moves leftward.

- Hence if the tone originates from the antepenult it will move to the penult even when in phrase-final position.
- However, tone never moves to the final position.
- In HLH sequences both Highs survive and there is shift of the first tone to the next syllable and spreading of the second tone to either the penult or antepenult in phrase-medial and phrase-final forms, respectively.
- Adjacent Highs result in one getting deleted: the surviving tone either shifts or spreads to the penult or antepenult.
- When the source of at least one H tone is outside the Macrostem there is tone spread instead of tone shift but only in phrase-final forms.

The overall tonal pattern of a verb phrase is not only determined by lexical association of tone to a TBU but by different factors which interact with tonal rules. The data is adapted, from Creissels (1999), with my own judgements as a native speaker of the language. The experimental study also confirmed the surface position of tone.

6.2.3 Low-toned verbs

In the following forms none of the morphemes contribute H tone to the input representation. The words therefore surface with a Low tone.

SiSwati, like other Bantu languages has penultimate lengthening phrase-finally. In all the examples that I use, a colon is used to mark a lengthened vowel. Morphemes are separated by a dash. In (47) I use the verb root with a second person plural subject marker /ni/ and a progressive marker /ya/.

(47) Phrase-finally

L	L	L		'You (pl.) are V...'	
ni	ya	wa	>	ni-ya:-w-a	'fall'
		natsʰ-a	>	ni-ya-na: tsʰ-a	'drink'

ɬaɠul-a	>	ni-ya- ɬaɠu: l-a	'weed'
ɬaɠul-is-an-a	>	ni-ya- ɬaɠul-is-a: n-a	'weed + caus.'

Since the morpheme /ya/ cannot be used in phrase-medial utterance, I use instead the L-toned future tense morpheme *tawu/to*. In all the examples that I use phrase-medially, the word following the verb phrase begins with a Low-toned syllable.

(48) Phrase-medially

L	L	L		'You (pl.) will V... together'
ni	tawu	natsʰ-a	>	ni-tawu- natsʰ-a kanye kanye 'drink'
		ɬaɠul-a	>	ni-tawu- ɬaɠul-a kanye kanye 'weed'
		ɬaɠul-is-an-a	>	ni-tawu-ɬaɠul-is-an-a kanyekanye'weed+ caus.'

6.2.4 High–toned verbs

When any of the morphemes has a High tone the output representation also surfaces with a High tone. I first give examples where the High tone is contributed by only one morpheme.

6.2.4.1 One High tone in the input

In Phrase-final forms tone shifts rightwards to the antepenultimate syllable. Words with H-toned monosyllabic and disyllabic roots behave differently, with the tone remaining in the underlying position, the initial syllable of the root. In longer stems, tone shifts from the initial syllable to the penultimate syllable. In the following examples, the source of High tone is underlined and its surface position is shown by the acute accent.

(49) Phrase-finally

L	L	H		'You (pl.) are V...'	
ni	ya	pʰ-a̲	>	ni-ya:-pʰ-á̲	'give'
		ɓo̲n-a	>	ni-ya- ɓó̲: n-a	'see'

ɓulal-a	>	ni-ya- ɓulá: l-a	'kill'
ɓulala-n-a	>	ni-ya-ɓulála:-n-a	'kill + recip.'
ɓula-l-is-an-a	>	ni-ya-ɓula-l-ís-a: n-a	'kill+recip.+ caus.'

The H tone target may shift from the antepenultimate syllable to the penult, when the same word occurs in phrase-medial position. Monosyllabic and disyllabic stems behave differently, as has already been discussed.

(50) Phrase-medially

L	L	H		'You (pl.) will V... Sipho'	
ni	tawu	p^h-a	>	ni-tawu-p^h-á Sipho	'give'
		ɓon-a	>	ni-tawu- ɓón-a Sipho	'see'
		ɓulal-a	>	ni-tawu- ɓulál-a Sipho	'kill'
		ɓulal-is-a	>	ni-tawu- ɓulal-ís-a Sipho	'kill + caus.'

In words with enough syllables the underlying position of High tone does not make a difference to the surface position. It moves to the same location as before; the antepenultimate syllable phrase-finally, and the penult phrase-medially. In monosyllabic stems, though, it shifts off the antepenult onto the penultimate syllable, suggesting that staying in-situ is prohibited. The source of High tone is from the class 1 subject marker, /ɓa/.

(51) Phrase-finally

H	L	L		'They are V...ing'	
ɓa	ya	l^w-a	>	ɓa-yá:-l^w-a	'fight'
		natʂ^h-a	>	ɓa-yá-na:tʂ^h-a	'drink'
		ɬaɠul-a	>	ɓa-ya-ɬáɠu:l-a	'weed'
		ɬaɠul-is-an-a	>	ɓa-ya-ɬaɠul-ís-a:n-a	'weed + caus.'

Tone shifts to the penult in phrase-medial situation. If it originates on the penult, it stays in-situ.

(52) Phrase-medially

H	L	L		'They will V... together'	
ɓa̲	to	lʷ-a	>	ɓa-tó-lʷ-a kanye kanye	'fight'
		natsʰ-a	>	ɓa̲-to-nátsʰ-a kanye kanye	'drink'
				'They will V... Sipho'	
		natsʰ-is-a	>	ɓa̲ -to natsʰ-ís-a Sipho	'drink + caus.'
		natsʰ-is-el-a	>	ɓa̲-to-natsʰ-is-él-aSipho	
				'drink+caus.+appl'	

H	L		'They V... together'	
ɓa̲	lʷ-a	>	ɓá̲-lʷ-a kanye kanye	'fight'
	natsʰ-a	>	ɓa̲-nátsʰ-a kanye kanye	'drink'
			'They V... Sipho'	
	natsʰ-is-a	>	ɓa̲- natsʰ-ís-a Sipho	'drink + caus.'
	natsʰ-is-el-a	>	ɓa̲- natsʰ-is-él-a Sipho	'drink + caus. + appl.'

In the next set of examples the source of the High tone is the class 9 object marker /yi/. Object markers immediately precede the verb root. Note that the tone moves off the OM onto the penult, but if it originates on the antepenult it moves to the penult, suggesting that staying in-situ is prohibited (see also (50)). However, it never moves to the final syllable, so if the verb root is monosyllabic it stays put.

(53) Phrase-finally

L	L	H	L		'You (pl.) are V... it'	
ni	ya	yi̲	lʷ-a	>	ni-ya-yí̲:-lʷ-a	'fight'
			natsʰ-a	>	ni-ya-yi̲-ná:tsʰ-a	'drink'
			ɬaɠul-a	>	ni-ya-yi̲- ɬáɠu:l-a	'weed'

ɬaɠul-is-is-a > ni-ya-yi̲-ɬaɠul-ís-i:s-a 'weed properly'

Tone is realized on the penultimate syllable in all forms, phrase-medially.

(54) Phrase-medially

L	H	L			
				'you (pl.) V... it together'	
ni	yi̲	lʷ-a	>	ni-yí-lʷ-a kanye kanye	'fight'
		natsʰ-a	>	ni-yi̲- nátsʰ-a kanye kanye	'drink'
				'You (pl.) V...Sipho'	
		ni-yi̲-natsʰ-is-a		>ni-yi̲-natsʰ-ís-a Sipho	'drink + caus.'
		ni-yi̲-natsʰ-is-el-a		>ni-yi̲-natsʰ-is-él-a Sipho	'drink+caus.+appl.'

6.2.4.2 Two adjacent High tones in the input

In the following examples both H tones are from the Macrostem (the object marker /yi/ and the verb root). The first tone gets deleted and the second one shifts according to the same principles as in the previous examples in (49), where there was only one H tone contributed by the verb root. Again, staying in situ is not allowed.

(55) Phrase-finally

L	L	H	H			
					'You (pl.) are V... it'	
ni	ya	yi̲	pʰ-a̲	>	ni-ya-[yi̲:-pʰ-á	'give'
			ɓo̲n-a	>	ni-ya-[yi̲-ɓó: n-a	'see'
			se̲ɓent-a	>	ni-ya-[yi̲-se̲ɓé: nt-a	'work'
			pʰe̲keletel-a	>	ni-ya-[yi̲-pʰe̲keléte:l-a	'accompany'

Just as in phrase-final position, one tone gets deleted, and the remaining tone shifts to the penult if the number of syllables permits.

(56) Phrase-medially

L	H	H			
				'You (pl.) V... it together'	
ni	yi	p^h-a	>	ni-[yi-p^h-á kanye kanye	'give'
		ɓon-a	>	ni-[yi-ɓón-a kanye kanye	'see'
		seɓent-a	>	ni-[yi-seɓént-a kanye kanye	'work'
		p^hekeletel-a	>	ni-[yi-p^hekeletél-a kanyekanye 'accompany'	

Generalization so far: When there are two adjacent High tones, one deletes and the other must move to the same location as before.

6.2.4.3 Two non-adjacent High tones

Once the two High tones are separated by a Low tone we see a different pattern; both tones survive. The initial tone shifts to the following syllable (except where the source of the second H is from a monosyllabic root), and then we see a High tone plateau up to the antepenult. In the following examples, a High-tone subject marker /a/ is used in conjunction with a High-tone verb root.

(57) Phrase-finally

H	L	H			
				'They are V...ing'	
a	ya	p^h-a	>	á-ya:-p^h-á	'give'
		ɓon-a	>	a-yá-ɓó:n-a	'see'
		seɓent-a	>	a-yá-séɓé:nt-a	'work'
		seɓent-el-an-a	>	a-yá-séɓént-él-a:n-a	'work for e.o.'
		p^hekeletel-an-a	>	a-yá-p^hékélétél-a:n-a	'accompany e.o'

Like in Phrase-final forms, in phrase-medial position, there is no deletion of either tone and, in addition, there is spreading to the usual penult location for phrase-medial forms.

(58) Phrase-medially

H	L	H		'They will V... Sipho'	
a̲	tawu	ɓo̲n-a	>	a̲-táwú-ɓó̲n-a Sipho	'see'
		se̲ɓent-a	>	a̲- táwú -sé̲ɓént-ís-a Sipho	'work + caus.'
		se̲ɓent-el-a	>	a̲- táwú -séɓént-él-a Sipho	'work+ appl.'

6.2.4.4 One of the High tones is outside the Macrostem

When the source of High tone combines morphemes from outside the Macrostem and from within the Macrostem one tone appears to be deleted as in the previous examples where both High tones were within the Macrostem. However, the surviving High, instead of shifting to the antepenult, spreads to that position such that the intervening syllables are also H-toned (compare (55)).

(59) Phrase-finally

H	H	L		'They V...(pst.) it)'	
a̲	yi̲	lʷ- ile	>	á-[yí̲-lʷ- i: le	'fight'
		natsʰ-ile	>	a̲-[yí̲-nátsʰ-i: le	'drink'
		natsʰ-is-is-ile	>	a̲-[yí̲-nátsʰ-ís-ís-i: le	'drink + intens.'

Unlike in the phrase-final forms, there is no spreading phrase-medially. The tonal behaviour follows the same procedure as the previous examples where there was one High tone contributed by the Macrostem (compare (56)).

(60) Phrase-medially

H	H	L		'They V...together'	
a̲	yi̲	lʷ-a	>	a̲-[yí̲-lʷ-a kanye kanye	'fight'
		natsʰ-a	>	a̲-[yi̲-nátsʰ-a kanye kanye	'drink'
		ɬaɠul-a	>	a̲-[yi̲-ɬaɠúl-a kanye kanye	'weed'

ɬaɠul-is-is-a > a̲-[yi̲-ɬaɠul-is-ís-a kanye kanye 'weed +intens.'

6.2.4.5 Three High tones in the input

In the following forms High tone is contributed by morphemes from the Phonological Word, that is, both outside and within the Macrostem. Like the forms in (59) only one tone survives, and it spreads to the antepenult, depending on the number of syllables of the verb root.

(61) Phrase-finally

H	H	H			
ɓa̲	yi̲	pʰ-a̲-ile	>	ɓa̲-[yí-pʰ-í:le	'give'
		ɓo̲n-a-ile	>	ɓa̲-[yí-ɓó̲n-í:le	'see'
		se̲ɓent-a-ile	>	ɓa̲-[yí-sé̲ɓént-i:le	'work'
		pʰe̲keletele	>	ɓa̲-[yí-pʰé̲kéléte:le	'accompany'

The number of H tones and the type of morphemes do not make a difference in phrase-medial forms; there is no spreading but shift to the penultimate syllable when the verb root has enough syllables (compare (60)).

(62) Phrase-medially

H	H	H			
a̲	yi̲	pʰ-a̲	>	a̲-[yí-pʰ-á̲ kanye kanye	'give'
		ɓo̲n-a	>	a̲-[yi̲- ɓó̲n-a kanye kanye	'see'
		se̲ɓent-a	>	a̲-[yi̲-se̲ɓént-a kanye kanye	'work'
		se̲ɓent-is-a	>	a̲-[yi̲-se̲ɓent-ís-a kanye kanye	'work+caus.'
		pʰe̲keletel-a	>	a̲-[yi̲-pʰe̲keletél-a kanye kanye 'accompany'	

The generalizations observed from the data may be summarised as follows:

(63) Generalizations

- High tone moves rightwards, to the penult in phrase-medial forms and to the antepenult in phrase-final forms.
- Tone never moves leftward;
- Hence if the tone originates from the antepenult it will move to the penult even when in phrase-final position.
- However, tone never moves to the final position.
- In HLH sequences both Highs survive and there is shift of the first tone to the next syllable and spreading of the second tone to either the penult or antepenult in phrase-medial and phrase-final forms, respectively.
- Adjacent Highs result in one getting deleted: the surviving tone either shifts or spreads to the penult or antepenult.
- When the source of at least one H tone is outside the Macrostem there is tone spread instead of tone shift but only in phrase-final forms.

6.2.5 Experiment

It has been known for a long time in Bantu language research that there may not be a one-to-one correspondence between an underlying tone and its surface tone. Surface realization of tone is determined by a number of factors. In Nguni languages, the following are some of the factors that determine surface representation of tone: a) the position of a word in an utterance, whether phrase-final or phrase-medial; b) the number of tones in a particular word; c) the sequence of tones, whether adjacent, as in HH (H) or non-adjacent as in HLH; d) if the tones are adjacent, the morphological domain of the tones, whether it is the PhWd or the Macrostem, also matters. Although minor differences occur, most of the literature (Cassimjee & Kisseberth, Creissels, Downing) agrees on the surface representation of tone in Nguni languages summarised in (19), for siSwati. Cf. Bradshaw, who argues for a three-way tone system in siSwati and therefore includes mid tones to the surface representation of words, for example, [u-ya-ɓó̱na] would have the tone melody MMHM.

Before I present a formal analysis of the behaviour of tone in siSwati, I present results of an acoustic study which I conducted for siSwati tone to mainly

confirm the previously suggested surface realization of tone. The study was designed to answer the following questions: i) Does position of the same word in an utterance determine the surface realization of tone? ii) Is there a leftward shift of tone? iii) Does adjacency of tone vs. non-adjacency make a difference in the surface realization? iv) Does the morphological domain determine surface realization of tone?

6.2.5.1 Materials

There were 23 sentences in all used in the experiment. So as not to influence the word under investigation, the word following the target word, in phrase-medial forms, was always L-toned on the initial syllable. Words with voiced obstruents, which are known to lower the fundamental frequency (F_0) of the following vowel, were avoided. The target sentences were repeated 6 times, randomised. The total number of tokens was 23 sentences x 6 repetitions. (A full list of all the sentences used in the experiment is given in Appendix C).

6.2.5.2 Subjects

Due to difficulties in finding willing siSwati speakers around London, the number of subjects was just one, the author of this thesis. Nonetheless, I considered the lack of more speakers to be a minor problem, since studies of (F_0) contours usually examine data from a few speakers, ranging from 1 to 4 (Xu, 1999: 60). Xu observes that since such an analysis is a series of case studies of the specific individual, there is no statistical need for a larger population.

6.2.5.3 Recording

Recording was done in the anechoic room of the Department of Phonetics and Linguistics at UCL using a Bruel & Kjaer sound level meter type 2231, fitted with a 4165 microphone cartridge. The output from the sound level meter was fed to the line input of a Sony 60ES DAT recorder. The digital output from the DAT recorder fed to the digital input of an M-Audio Delta 66 sound card in a PC. Adobe Audition software was used to record the speaker directly onto the hard disk at 44.1 kHz sampling rate with 16 bit quantization. The microphone was positioned 30 cm from

the speaker's mouth, at 15 degrees to the mid-sagittal line. In each session 23 sentences were read. The digitised sound was later resampled at 22.05 kHz. The recordings were monitored and controlled by an experienced technician throughout.

6.2.5.4 F_0 extraction and measurement

Using a custom-written script (Xu, 1999) for the Praat programme (www.praat.org), the waveform and spectrogram of each sentence were displayed automatically on a computer monitor. A label window was also displayed. The onset and offset of the voiced portion of target syllables were segmented and labelled using the waveform broadband spectrogram and pitch trace in Praat. The aim was to capture the F_0 contour in these words. In cases where these were not measured automatically, by Praat, correction of any vocal cycle skipping of the individual pulses was done manually (Xu, 1999: 61). Segmentation provided accurate tone-segment alignment information. Smoothing was done to reduce random variation in the F_0 contours. To facilitate averaging across repetitions, and for direct comparison among F_0 curves, the labelled segments were time-normalized (Xu, 2005: 76).

6.2.5.5 Analysis and results

The results of the experiment confirmed the generalizations suggested in the literature:

1. The generalization that phrase-final forms differ from phrase-medial forms in that tone is realized on the antepenult and penult syllable respectively, is captured in the graph shown in Figure 6-10. In all the graphs that I present, a column on the X-axis represents a syllable while the Y-axis displays F_0 in Hz.

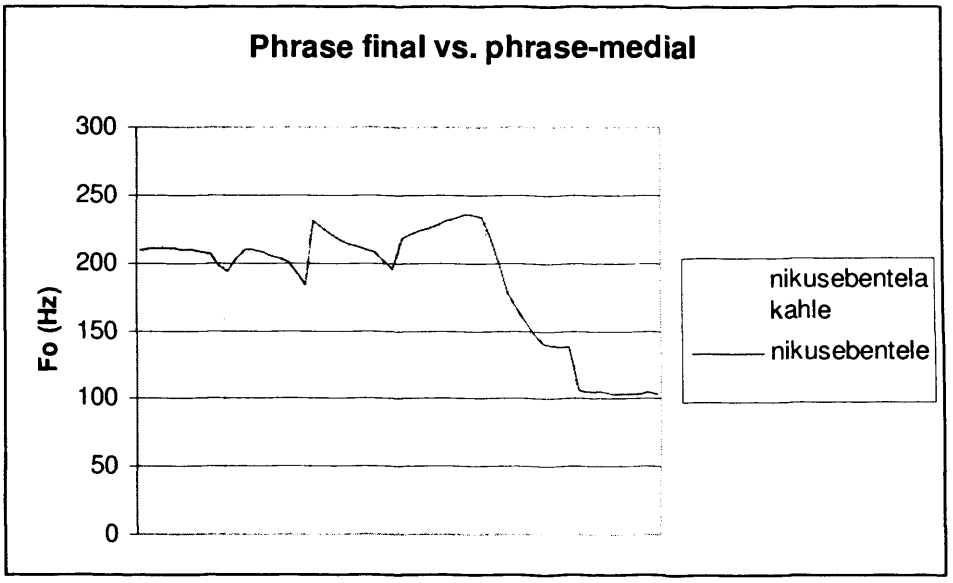


Figure 6- 10 /nikusebénte:le/: phrase-final form - tone is realized on the antepenultimate syllable. /nikusebentéla .../: phrase-medial form - tone is realized on the penultimate syllable.

To facilitate comparison, Figure 6-10 overlays the graphs of the phrase-final word /ni-ku-sebént-ele/, represented by a solid line, with that of the phrase-medial word /ni-ku-sebent-éla .../ represented by a broken line, on the graph. The two words are segmentally and tonally identical (except for the final vowel). The only difference is the position of each word in a sentence. The F_0 contours in Figure 6-10 suggest that, in both words, the first 3 syllables are relatively low in pitch. When the word is phrase-final, the pitch goes up on the antepenult, then, drops off sharply. Whereas when it is phrase-medial, the pitch does not go up till the penult, and then it drops off. What appears as a rise on the 3rd syllable is the perturbation of the fricative /s/. This graph confirms the generalization that the siSwati speaker captures the difference between phrase-final and phrase-medial position by realizing H tone on different syllables, the antepenult, phrase-finally, and the penultimate syllable, phrase-medially.

2. Non-adjacent H tones underlyingly, result in tone spreading from its source to the antepenult or penult, depending on the position of the word in an utterance, while adjacent H tones result in deletion of the first tone, and simple shift of the second tone to the same position. The graph in Figure 6-11 confirms this generalization. It shows two phrase-medial words, /atáwúbóna/ with an underlying sequence HLH (solid line) and /likuliméla/ which has a HH sequence underlyingly (broken line).

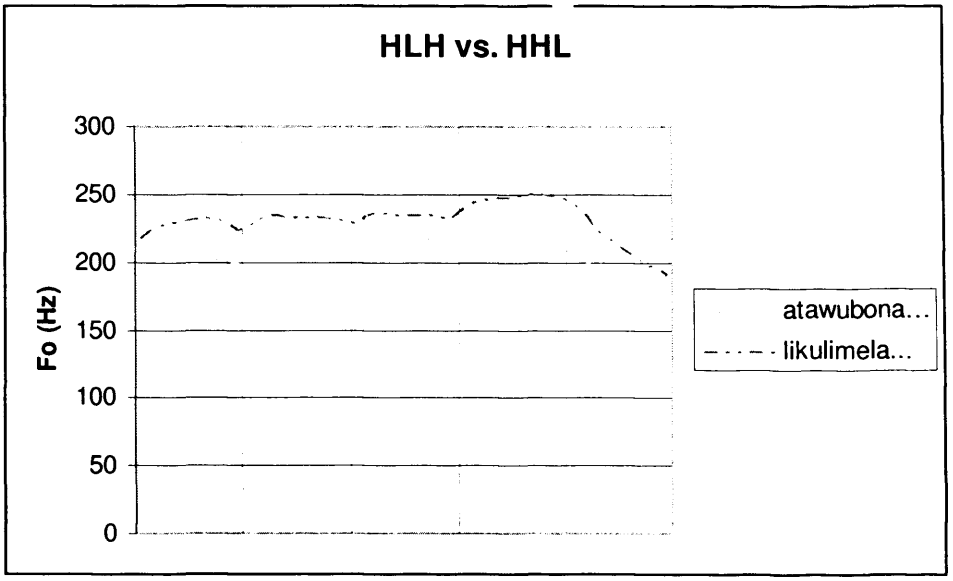


Figure 6- 11 /atáwúbóna/: underlying HLH results in tone spreading vs. /likuliméla/: underlying HH results in second tone shifting to the penult.

An examination of the F_0 contours in Figure 6-11 reveals that a HLH sequence, underlyingly, does result in spreading on the surface, while a HH sequence results in tonal shift. The pitch for the production of the word /atáwúbóna/, shown by the solid line, is low on the first syllable but rises and remains high from the second, up to the fourth syllable, where it drops off. For the word /likuliméla/, shown by the broken line, the graph shows a low pitch from the first syllable, and continues low up to the third syllable. The pitch rises only on the fourth syllable and then drops off again on the last syllable. Since both words are produced in phrase-medial position, we see the expected high pitch on the penult syllable. The amount of pitch change on the final syllable is similar as well.

3. We have observed that in an underlying HH sequence there is deletion of one tone and shift of the other (Figure 6-11). In phrase-final forms, though, it is only when both tones are contributed by the Macrostem that this generalization holds. When one of the tones is outside the Macrostem, there is tone spreading, instead of shift. Phrase-medially, there is no difference, a HH result in tone shift, irrespective of domain. The graph in Figure 6-12, demonstrates the asymmetry in the two positions.

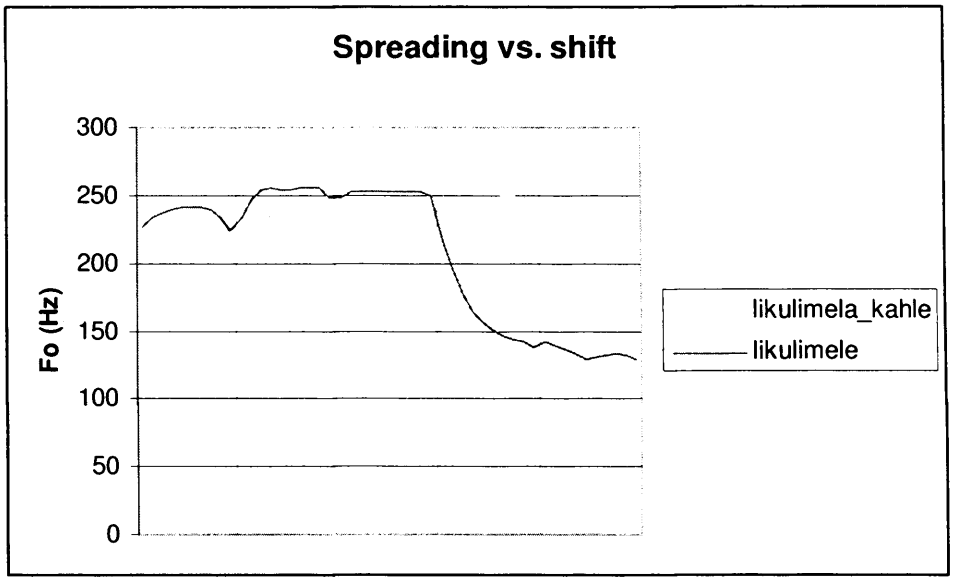


Figure 6-12 /li[kuliméla.../: phrase-medial position (shift) vs. /li[kúlímele/: phrase-final position (spreading)

In Figure 6-12, the broken line represents a pitch track for the word /li[kuliméla.../, said phrase-medially, where High tone is expected to surface only on the penultimate syllable. Phrase-finally (solid line), tone is expected to spread from the second syllable up to the antepenult. The pitch tracks suggest and confirm the difference between these forms. Phrase-medially, only one syllable has indicated a high pitch, the penult, whereas phrase-finally two syllables form a High plateau, ending on the antepenult. The descent to even lower levels on the final two syllables, in /li[kúlímele/, results from final lowering, commonly known as declination. Similar instances of final lowering have been reported for other languages, for example, Japanese (Pierrehumbert & Beckman, 1988), Mandarin (Shih, 1988), and Igbo, Akinlabi & Liberman 2001).

4. The final generalization that I discuss is the prohibition of leftward movement of tone in siSwati. Recall that tone targets the antepenult in phrase-final forms. Nonetheless, when tone originates from either the penult or final syllable, this generalization is not observed. The graph in Figure 6-13 confirms this observation.

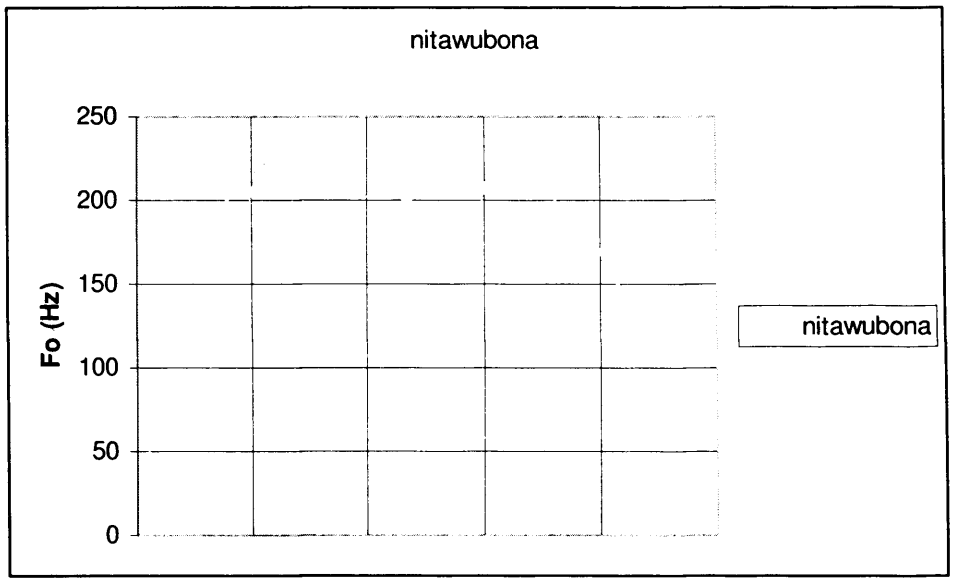


Figure 6-13 /nitawuɓo̲na/: No leftward movement of tone */nitawúɓo̲na/

The underlying tone in /nitawuɓó̲na/ originates from the penultimate syllable /ɓo/ and remains on that syllable. Although the word is produced in phrase-final position, the tone is not realized on the antepenult. The pitch tracks suggest a high tone on the fourth syllable /ɓo/. The rise on the second syllable results from the perturbation of the ejective /t/ [t'], which, like other obstruents, raises F_0.

6.2.6 Discussion

The preceding section has confirmed earlier generalizations about the behaviour of Nguni tone. These generalizations, indirectly, confirm that the overall shape of an F_0 contour results from the interaction of different factors. There are however some intriguing differences between the data collected in these recordings and the standard descriptions. A closer look at the graphs, for all the recordings, raises a question on the generalization that tone shifts rightwards from its underlying source to at least the next syllable (other than tone that originates on the penult or final syllable). I illustrate this seemingly, odd behaviour by the example in Figure 6-14.

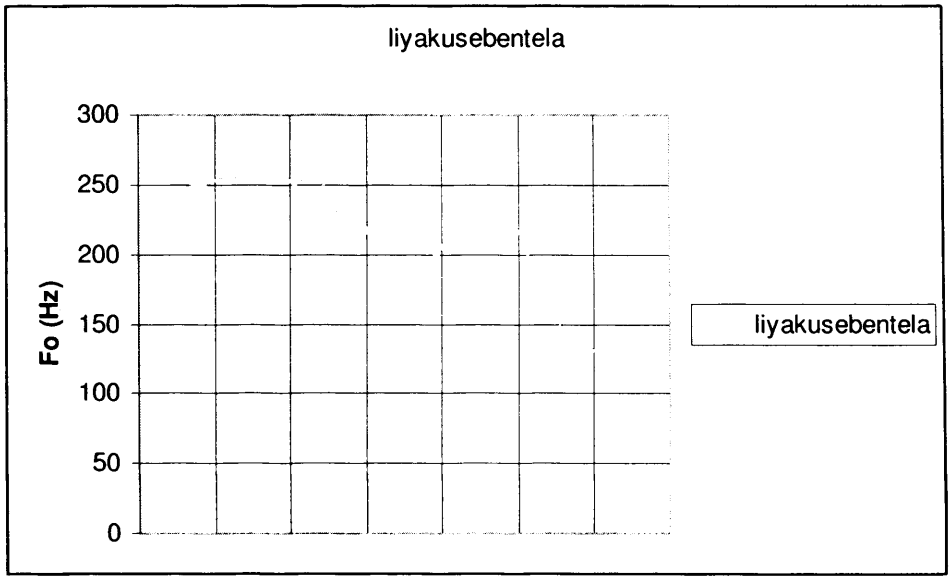


Figure 6-14 /liyákúsɛ́ɓéntela/

As revealed by the pitch tracks in Figure 6-14, the expected shift of the underlying tone from /li/ to /ya/ in the word, /liyakuseɓentela/ is not convincing. The graph suggests a rise of pitch from its neutral position, as early as beginning of the syllable which lowers on the third syllable, for reasons not relevant to the present discussion. This unexpected pattern was only observed in those graphs whose words had an /i/ - /y/ sequence. Moreover, during labelling of the segments, it was difficult to separate the boundaries between these two segments. This may in turn have led to the confusion of whether the /i/ and /yi/ form one or two syllables. If that was the case, maybe the tone does shift; however, if the two syllables are reduced to one, it may not be easy to tell which part of the syllable bears the tone. The words with segments from different places of articulation, suggested a clear shift from the initial syllable to the second. For example, in Figure 6-12, in /likulimele/, represented by a solid line, spreading started from the second syllable. Nonetheless, further experimental study is required, to look into these forms to confirm whether tone does shift from the first syllable or not, and it will be necessary to avoid the /i-y/ sequence.

6.2.7 Analysis

The behaviour of tone in siSwati has been previously analysed by Creissels (1999). Cassimjee & Kisseberth (1998) and Downing (2001) have analysed tone in Nguni languages, in particular Xhosa and Zulu, respectively. All three analyses are based

on a H tone domains approach. Creissels' approach is rule-based while Cassimjee & Kisseberth and Downing use the Optimal Domains Theory (ODT). A summary of each analysis is presented next.

6.2.7.1 Creissels' analysis

Creissels' rule-based analysis is based on the idea that surface forms are derived from their underlying representations through the application of rules which result in the retraction and expansion of H tone domains. He defines a High Domain (HD) as a maximal sequence of High-toned TBU uninterrupted by either toneless TBU or word boundaries. Local shift and Metrical shift are responsible for the expansion of H domains, while a series of rules applied on the expanded domain lead to subsequent retraction leaving a single H syllable in most cases. Local shift targets the immediate following syllable while Metrical shift targets the antepenult syllable phrase-finally and penult syllable phrase-medially. (64) illustrates how Creissels derives the surface form for [ɓa̲-ya-ɬaɠulísana] 'they help each other to weed' from /ɓa̲-ya-ɬaɠulisana/.

(64) Derivation of a single H following Creissels.

1. Constitution of H domain	[ɓa̲]-ya-ɬaɠulisana
2. Expansion of H domain-i) by Local shift	[ɓa̲-ya]-ɬaɠulisana
ii) By metrical shift to antepenult	[ɓa̲-ya-ɬaɠuli]sana
3. Retraction of H domain	ɓa̲-ya-ɬaɠu[li]sana
4. High tone spelling	ɓa̲-ya-ɬaɠulísana

Creissels also assumes a general constraint on tone shift in siSwati: the last syllable of a word cannot be annexed to an H domain generated by another syllable of the same word; hence in /uyaɓó̲na/ 'you sg. see', Local shift does not expand the H domain to /na/; /uya[ɓó̲]na/ and not */uya[ɓó̲na]/. In the underlying form /ɓa̲-ya-se̲ɓent-el-an-a/ there is an HLH sequence resulting in spreading of the tone; [ɓa̲-yá-sé̲ɓént-él-an-a]. Spreading is derived by applying the same rules, except that he stipulates that retraction applies only to the first H domain.

(65) Derivation of a H plateau following Creissels

1. Constitution of H domain	[ɓa̲]-ya-[se̲]ɓent-el-an-a
2. Expansion of H domain-i) by Local shift	[ɓa̲-ya]-[se̲ɓe]nt-el-an-a
ii) By metrical shift to antepenult	[ɓa̲-ya]-[se̲ɓent-e]l-an-a
3. Retraction of H domain	ɓa̲-[ya]-[se̲ɓent-e]l-an-a
4. High tone spelling	ɓa̲-yá-sé̲ɓént-él-an-a

The same procedure is followed in phrase-medial forms. Metrical shift targets the penult syllable instead of the antepenult in these forms.

6.2.7.2 Optimal Domains Theory (ODT) analyses

Both Cassimjee & Kisseberth (1998) and Downing (2001) use the ODT approach to analyse Nguni tone. ODT adopts OT in all its essential aspects. However, it adopts featural domains instead of autosegmental representation. It assumes that just as segments are organised into domains (syllables), features are also organised into domains. The motivation for tonal domains lies in the assumption that tonal domains are prosodic constituents and therefore show properties common to other prosodic constituents. The existence of both metrical and tonal domains includes the assumption that both domains respect each other's boundaries. This is crucial in Downing's analysis of Zululand Zulu.[43] In her analysis of this language, Downing accounts for rightward movement of tone by the constraint Align R (TD, word). This constraint optimises extending the tone domain to the end of the phrase in requiring that the end of the tone domain be aligned with the right edge of a phonological phrase. NONFINALITY ranked above Align R (TD) is used in this analysis to account for why tone does not move to the final syllable. This ranking results in spreading of tone to the penult. The constraint NOOVERLAP is proposed to account for why the antepenult is the rightmost target phrase-finally, instead of the penult. NOOVERLAP

[43] It is beyond the scope of this study to motivate ODT, in further detail. See Cassimjee 1998, and Cassimjee & Kisseberth (1998) for a detailed description of the theory.

requires that prosodic constituents of the same type should not overlap. Cassimjee & Kisseberth use a different constraint, AVOID PROMINENCE.

Recall that in phrase-final position, the penult syllable is lengthened and therefore stressed in Nguni languages. However, in most Bantu languages prominent syllables tend to attract, as in Chichewa, rather than repel tone. The expectation is that the penult should likewise attract H tone and yet instead it goes on the antepenult in Nguni languages. Although Cassimjee & Kisseberth do this with a constraint AVOID PROMINENCE they acknowledge that it is controversial. Downing's choice for NOOVERLAP is different; it is based on reasons of parsing. She observes that since tone and stress domains are both subtypes of prominence-defining constituents, they may not overlap. Downing, however, points out that more research is required to understand the asymmetry in the tonal behaviour of Bantu languages: why the stressed penult attracts tone in some while it repels it in others.

6.2.8 A new alignment approach

The above discussion has shown that ODT can derive the correct results of the behaviour of tone in Nguni languages; nevertheless, I use a more standard OT approach. I do not reject the ODT analysis on empirical reasons but mainly because I want to relate the behaviour of tone to that of palatalization in the passive. I argue that the long-distance effects observed in both the passive and in tone result from a general family of constraints, in particular alignment constraints. Recall that in the passive the morpheme aligns with the right edge of the stem, although the [cor] feature may move leftwards; in cases where there is no labial on the right edge of the root, for example, /seɓenta/ becomes [setʃ'ent^{w}a]. In a sequence of labials it always docks on the rightmost one; /p^{h}ap^{h}ama/ becomes [p^{h}ap^{h}aɲ^{w}a] and not *p^{h}aʃam^{w}a. The proposal is that tone follows the same principle; it aims to align with the rightmost syllable of the word.

6.2.8.1 Phrase-medial forms

I first present an analysis of tone in phrase-medial forms where rightward movement targets the penultimate syllable. The generalization that tone moves rightwards is

accounted for by an alignment constraint, ALIGN-R(T) in (66) which requires that H tone be aligned with the right edge of the word.

(66) ALIGN-R (H, PRWD)- ALIGN-R (T): Every H tone should be aligned with the right edge of a Prosodic Word.

Since the target of tone is either the penult or antepenult, phrase-medially or phrase-finally respectively, ALIGN-R(T) will be gradiently assessed to allow tone to be realized as close to the end of the word as possible. To account for the extratonality of the final syllable I use the constraint NONFINALITY (67).

(67) NONFINALITY: Do not align H tone with the right edge of the Prosodic Word

In the following tableaux the word that follows the verb phrase will not be included since it is irrelevant to the discussion. /.../ will be used in place of that word to show that the form is non-final. I use underlining to show the location of underlying H, and acute accent to show its surface placement.

6.2.8.1.1 One H tone in the input

NONFINALITY is ranked above ALIGN-R(T) to optimise movement up to the penult of the verb phrase.

(68) NONFINALITY >> ALIGN-R(T)

/ ɓa̲- natsʰ-is-an-a.../	NONFINALITY	ALIGN-R(T)
a. ɓa̲- natsʰ-is-an-á	*!	
b. ɓa̲- natsʰ-ís-an-a		**!
c. ☞ ɓa̲- natsʰ-is-án-a		*

We mentioned that tone needs to be aligned with the right edge, however, candidate (68a) illustrates that the final syllable cannot be a target. The high-ranking NONFINALITY rules the candidate out. In the optimal candidate, (68c), the tone has moved rightwards, but not to the final syllable; hence the minimal violation of

ALIGN-R(T). In (68b), there is extra violation of ALIGN-R(T), eliminating candidates where tone stops short of the penult.

Although candidate (68a) is ruled out by NONFINALITY, monosyllabic roots may realize tone on the final syllable; when it originates from this syllable, for example, /ni-tawu-pʰá̲/ 'you (pl.) will give'. On this word there is a single H tone contributed by the verb root. Since movement is only rightwards, tone fails to shift to the predicted penultimate syllable. Leftward movement is blocked by the constraint ANCHOR-L (69) which requires that the left edge of the tone in the output correspond to a left edge in the input.

(69) ANCHOR-L: Leftward movement of H tone is prohibited.

Ranking ANCHOR-L above NONFINALITY allows tone to remain on the final syllable in monosyllabic roots. (70) presents a formal analysis of /ni-tawu-phá̲/ 'you (pl) will give...' and illustrates the dominance of ANCHOR-L over NONFINALITY.

(70) ANCHOR-L >> NONFINALITY

/ni-tawu-ph-a̲.../	ANCHOR-L	NONFINALITY	ALIGN-R(T)
a. ni-tawú-ph-a̲	*!		*
b. ☞ ni-tawu-ph-á̲		*	

Although candidate (70a) realizes tone on the expected penultimate syllable, for phrase-medial forms, leftward shift violates ANCHOR-L. In candidate (70b) the tone remains in its underlying positions but survives with a minimal violation of NONFINALITY. This mini grammar also accounts for disyllabic roots as well, where the source of the H tone is the penult.

(71) NONFINALITY >> ALIGN-R(T)

/ni-tawu-ɓo̲n-a.../	ANCHOR-L	NONFINALITY	ALIGN-R(T)
a. ni-tawu- ɓo̲n-á		*!	
b. ☞ni-tawu- ɓó̲n-a			*

Candidate (71b) with a violation of ALIGN-R(T) survives because of the ranking NONFINALITY >> ALIGN-R(T), which ensures that tone does not move to the final syllable.

6.2.8.1.2 Adjacent H tones: Anti-Meeussen's rule applies

A sequence of two H tones is avoided by deletion of one of the tones, a process common in Bantu languages. It is known as Meeussen's Rule when the second of the two tones deletes. For example Shona, /ndi-chá-teng-es-a/ 'I will sell', (Myers 1997). This rule is known as Anti-Meeussen's Rule when the first tone deletes. This is what happens in siSwati. According to (Myers 1997), Rimi also deletes the first H tone in a sequence. Deletion of one of the tones is one way of obeying the OCP, in (72), which ensures that there are no adjacent tones.

(72) OCP: Adjacent H tones are prohibited

However, deletion violates the constraint *DISASSOCIATE (73).

(73) *DISASSOCIATE (*DISASSOC): No removal of association lines.

Since deleting of one of the tones is preferred to adjacent tones, in siSwati, the OCP must dominate *DISASSOC.

(74) OCP >> *DISASSOC

/ni-yi-bon-a.../	OCP	*DISASSOC
a. ni-yí-bón-a	*!	
b. ☞ ni-yi-bón-a		*

Candidate (74a) is the most faithful to the input since both tones are kept. However, this results in a violation of the OCP. Because *DISASSOC is ranked below the OCP, candidate (74b), which has deleted one of the tones is then chosen as the winner. Another candidate to consider is the one that applies Meeussen's Rule instead of

Anti-Meeussen's Rule. This candidate would be ruled out by ALIGN-R(T) because the remaining tone would be one more syllable away from the right. In (75) I include such a candidate with ALIGN-R(T) added to the tableau. Observe that this candidate though, does not give us a ranking relationship between ALIGN-R(T) and the OCP. Later, I will present cases of forms which show that a violation of the OCP is worse than aligning all the tones with the right edge.

(75)

/ni-yi̲-6o̲n-a.../	OCP	ALIGN-R(T)	*DISASSOC
a. ni-yí-6ó̲n-a	*!	***	
b. ni-yí-6o̲n-a		**!	*
c.☞ni-yi̲-6ó̲n-a		*	*

Candidates (75b, c) incur violations of the same constraints, except that candidate (75b) has more violations of ALIGN-R (T)[44].

6.2.8.1.3 Two non-adjacent H tones

In a HLH sequence we see a derived OCP violation, as in /a̲tó6ó̲na/ 'they will see'. I argue that this results from the pressure that tone should always move from its underlying source.

Observations from the data show us that tone always moves at least one syllable to the right, so long as the result respects NONFINALITY. In the analysis of Nguni languages, Downing observed that there are two different types of tonal movement; one to the adjacent syllable and the other to either the penult or antepenultimate syllable. She referred to these movements as Local shift and Metrical shift, respectively. I propose that Downing's Metrical shift results from ALIGN-R (T), as in the previous section, while Local shift is accounted for by the

[44] Although candidate (75a) is ruled out by the OCP, it could also be ruled out by ALIGN-R: Every OCP violation incurs an extra ALIGN-R (T) violation (unless one H is final). We shall see in phrase-final forms, (85) the effect of the OCP, in particular above ALIGN-R (T).

constraint which I call TONEREJECTION (76), which requires that tone must move from its underlying source.

(76) TONEREJECTION: A tone in the output must not be associated to the TBU with which it is associated in the input.

However, compared to Downing's Local shift, in TONEREJECTION, first, the tone must move off its original TBU, and secondly, and most crucially, this movement can go any distance.

The form /a̲tóɓó̲n-a/ with an underlying HLH sequence show us that a violation of the OCP is preferred to leaving the tone in its underlying source. This motivates the ranking of TONEREJECTION above the OCP. Nonetheless, the second tone on /ɓo/ does not move. This suggests the dominance of NONFINALITY over TONEREJECTION.

(77) NONFINALITY >> TONEREJECTION >> OCP

/a̲-to-ɓon-a.../	NONFINALITY	TONEREJECTION	OCP	*DISASSOC
a. a̲-tó-ɓo̲n-á	*!			**
b. á̲-to-ɓó̲n-a		**!		
c. ☞a̲-tó-ɓó̲n-a		*	*	*

Candidate (77a) respects TONEREJECTION in that both tones shift. However movement to the final syllable is prohibited in siSwati, hence the fatal violation of NONFINALITY by this candidate. Leaving both tones in their underlying positions results in two violations of the constraint TONEREJECTION, (candidate (77b)). The optimal candidate moves the first tone but not the second, hence the minimal violation of TONEREJECTION.

The grammar that we have developed so far also accounts for the longer forms, (see (78)). These show us that in an underlying HLH sequence, in addition to tone movement there is also spreading. Spreading results from the requirement that TBU's be specified for tone.[45]

[45] For a discussion on spreading and the relevant constraints, see section 6.2.9 which discusses the behaviour of tone in the PhWd.

(78) NONFINALITY >> TONEREJECTION >> OCP >> *DISASSOC

/a-to-ɓon-is-a.../ H H	TONEREJECTION	OCP	*DISASSOC
a. á-tó-ɓón-ís-a H H	**!		
b. a-tó-ɓón-ís-a H H	*!	*	*
c.☞a-tó-ɓón-ís-a H H			**

Candidate (78a) incurs two violations of TONEREJECTION since both tones remain in situ. To reduce the number of violations for this constraint, candidate (78b) like the optimal candidate in (77) moves only the first H tone. However, this also results in a violation of TONEREJECTION. In (77), moving one tone was allowed and optimal, since the stem was shorter. Moving the second tone would have led to a violation of a higher-ranked constraint, NONFINALITY. Since the stem s longer, in (78), the second H can move without a violation of NONFINALITY.

The shorter forms, where the source of the H is a monosyllabic root, can also be accounted for by the same grammar (see (79)).

(79) TONEREJECTION >> OCP

/a-to-pʰ-a.../	NONFINALITY	TONEREJECTION	OCP	*DISASSOC
a. á-to-pʰ-á	*	*!		
b.☞a-tó-pʰ-á	*		*	*

Like in bisyllabic roots, tone movement creates an OCP violation in the optimal candidate. However, ranking the OCP below TONEREJECTION renders this a minimal violation. Candidate (79a), although obeying the OCP is ruled out by the higher-ranking TONEREJECTION. (80) shows the constraint ranking so far.

(80) ANCHOR-L >> NONFINALITY >> TONEREJECTION >> OCP, ALIGN-R (T) >> *DISASSOC

6.2.8.2 Phrase-final forms

In phrase-final forms tone targets the antepenult instead of the penult. We already have a grammar that ensures rightward movement of tone. However, this grammar favours a candidate that realizes tone on the penult syllable to the one that realizes it on the antepenult. Since ALIGN-R (T) is gradiently assessed, that candidate would have one violation of ALIGN-R (T) while the correct output would have two. We therefore need a constraint that will account for the retraction of tone from the penult to the antepenult in these forms. Recall that the penultimate syllable is lengthened and stressed when words appear in phrase-final position (vowel lengthening is indicated by a colon in front of the vowel that is lengthened). To account for this generalization, Downing argues for the constraint NOOVERLAP. Downing's NOOVERLAP suggests that tone may be grouped into tonal domains, which may in turn be classified as a type of prosodic constituent. Since stress also forms a prosodic constituent, these may not overlap. Cassimjee & Kisseberth (1998), on the other hand, use the constraint AVOID PROMINENCE. The understanding is that, because of the prominence of the penultimate syllable, it should be avoided by other prominent features like H tone. Since I do not use tonal domains in my analysis I adopt Cassimjee & Kisseberth's AVOID PROMINENCE (81), which is not necessarily specific to tonal domains.

(81) AVOID PROMINENCE (AVOIDPROM): High tone may not be realized on a prominent syllable (adapted from Cassimjee & Kisseberth (1998)).

The effect of AVOID PROMINENCE is that tone is realized further away from the right. This constraint should therefore be ranked above ALIGN-R (T). (82) illustrates.

6.2.8.2.1 One H tone in the input

(82) AVOIDPROM >> ALIGN-R (T)

/ku-ya-natsʰ-is-an-a/	AVOIDPROM	ALIGN-R (T)
a. ku-ya-natsʰ-is-á:n-a	*!	*
b. ☞ ku-ya-natsʰ-ís-a:n-a		**

Ranking AVOIDPROM above ALIGN-R (T) ensures that (82b) with two violations of ALIGN-R (T) is chosen as the optimal candidate over (82a) with only one violation.

In disyllabic roots tone may originate from the prominent syllable and remain there; even though AVOIDPROM prohibits tone on this syllable. The tone neither moves to the left or right. We mentioned that leftward movement is prohibited by the undominated ANCHOR-L, which must therefore dominate AVOIDPROM. The failure to move rightwards suggests that AVOIDPROM is also dominated by NONFINALITY.

(83) NONFINALITY >> AVOIDPROM

/niyaɓon-a/	ANCHOR-L	NONFINALITY	AVOIDPROM	ALIGN-R (T)
a. niyáɓo:n-a	*!			**
b. niyaɓo:n-á		*!		
c. ☞niyaɓó:n-a			*	*

Movement to the expected antepenult violates the high-ranked ANCHOR-L; hence, (83a) is ruled out, while (83b) incurs a fatal violation of an equally high-ranking NONFINALITY.

If tone originates from the antepenult, the expectation is that it would remain on that syllable. However, because of TONEREJECTION, there is still movement to the adjacent syllable; (aya:lʷa → ayá:lʷa), creating a violation of AVOIDPROM. The form /ayá:lʷa/ suggests that TONEREJECTION should be ranked above AVOIDPROM. (84) formalizes the analysis.

(84) TONEREJECTION >> AVOIDPROM

/a̲-ya:-lʷ-a/	TONEREJECTION	AVOIDPROM	ALIGN-R (T)
a. á-ya:-lʷ-a	*!		**
b. ☞ a̲-yá:-lʷ-a		*	*

6.2.8.2.2 Two non-adjacent H tones

We have observed that in a HLH sequence for example, /a̲tóɓo̲na.../, the pressure to move creates an OCP violation, motivating a ranking of TONEREJECTION above the OCP. However, if the second tone is from a monosyllabic root with no suffixes, the initial tone remains in its underlying position; (/áya:pʰá̲/ and not */ayá:pʰá̲/), respecting AVOIDPROM at the expense of TONEREJECTION. We have also seen from /a̲yá:lʷa/ that TONEREJECTION cannot be below AVOIDPROM, and from a̲tóɓó̲n-a that TONEREJECTION is above the OCP. Seemingly, /áya:pʰá̲/ neutralises the ranking of TONEREJECTION above AVOIDPROM and renders these constraints equal and leaves the decision to the OCP. Note that equal ranking still works for (84), since ALIGN-R (T) decides things.

(85) TONEREJECTION, AVOIDPROM >> OCP

/a̲-ya-pʰ-a̲/	NONFINALITY	TONE REJECTION	AVOID PROM	OCP	ALIGN-R (T)
a. a̲-yá:-pʰ-á̲	*		*	*!	*
b.☞ á̲-ya:-pʰ-á̲	*	*			**

6.2.8.2.3 Adjacent tones: Anti-Meeussen's Rule applies

Recall that in phrase-medial forms an OCP violation is prevented by the application of Anti-Meeussen's Rule. This rule applies in phrase-final forms as well, but only when both High tones are contributed by the Macrostem. (86) illustrates the derivation of /ni-ya-[yi̲-se̲ɓént-e:la/ 'you (pl.) accompany it'. Square brackets indicate the Macrostem boundary. The same constraints and ranking will account for these forms.

(86) Macrostem: Application of Anti-Meeussen's Rule

/ni-ya-[yi̲-se̲ɓent-el]a/	OCP	*DISASSOC
a. ni-ya-[yí-sé̲ɓent-e:-la]	*!	
b.☞ ni-ya-[yi̲-se̲ɓént-e:l-a]		*

Another possible candidate is one that moves the second tone away from the first, in order to avoid an OCP violation. This candidate would be ruled out by TONEREJECTION, since it is ranked above the OCP. When one of the tones is contributed by a morpheme outside the Macrostem, indicated by square brackets, Anti-Meeussen's Rule does not apply, only phrase-finally though. Instead there is fusion and tone spread to the antepenult, for example, /ɓa̲-[yí-nátsʰ-ile]/ 'They drank it'.

6.2.9 Evidence for fusion in the PhWd

Before I present an analysis of tone in the PhWd, I first provide evidence for the claim that fusion, instead of deletion of tones applies in the PhWd. This pattern is seen when one of the tones is outside the Macrostem. Evidence for fusion comes from verb phrases used with a trisyllabic stem (a stem includes a verb root plus suffixes). First, consider the word /ni-ya-[yi̲-se̲ɓé:nta]/ where both H tones are contributed by the Macrostem in square brackets. The tone from the /yi̲/ deletes, while the second tone from the root initial syllable /se̲/ moves to the penultimate syllable: Anti-Meeussen's Rule applies. We already know that in phrase-final forms tone avoids the penultimate syllable and that AVOIDPROM prevents it from being

realized on this syllable. However, in /ni-ya-[yi̲-se̲ɓé:nta]/ tone is realized on this syllable. This, as I have already argued, results from the constraint, TONEREJECTION. This example clearly shows that the surviving tone is the one from /se̲/ not from /yi̲/, because the tone from /yi̲/ would have moved onto the antepenult, not the penult. This is evidence that siSwati uses Anti-Meeussen's Rule to remove OCP violations.

Next, consider the word /[ɓa̲-[yí-nátsʰ-í:le]$_{MS}$]$_{PhWd}$/, where like in /ni-ya-[yi̲-se̲ɓé:nta]/, there are two adjacent tones. The difference is that in this example one of the H tones is outside the Macrostem. Application of Anti-Meeussen's Rule on this form would result in a deletion of the tone on /ɓa̲/ while the tone from /yi̲/ would shift to /na/ to obey the constraint, TONEREJECTION. However, this is not the case, instead /yi̲/ is still realized with a H tone. I propose that the tone on /ɓa̲/ and /yi̲/ fuse, and because of the constraint TONEREJECTION, spreading starts from the second syllable. Fusion of input tones to form one output tone is a violation of UNIFORMITY(T) (87) which requires correspondence to be one to one.

(87) UNIFORMITY: Output tones must not have multiple correspondents in the input.

Fusion like the Anti-Meeussen's Rule is another way of obeying the OCP hence the constraint UNIFORMITY(T) should be dominated by the OCP. In addition to fusion there is spreading of tone to adjacent syllables in these forms. Spreading results from the requirement that TBU's be specified for tone. SPECIIFY (88) accounts for the spreading in the PhWd.

(88) SPECIFY: A TBU must be associated with tone

However, specifying all the TBU's with tone, that is those which did not have any underlyingly, violates a faithfulness constraint *ASSOCIATE (89) which prohibits new association lines.

(89) *ASSOCIATE (*ASSOC): No insertion of association lines

To account for spreading in the PhWd, SPECIFY should dominate UNIFORMITY and *ASSOC.

(90) PhWd: Fusion and spread: SPECIFY >> UNIFORMITY(T)

/6a̲-yi̲-natsʰ -ile/ | | H_1 H_2	SPECIFY	UNIFORMITY(T)	*ASSOC
a. 6a̲-[yi̲-nátsʰ -ile] | H_2	****!		*
b. ☞ 6a̲-[yí̲-nátsʰ -ile] |/ $H_{1,2}$	***	*	**

Candidate (90a) deletes the first tone (Anti-Meeussen's Rule) and the second shifts to the antepenult. This results in a fewer number of syllables specified for tone hence the fatal violation of SPECIFY. The optimal candidate, on the other hand, incurs less violations of this constraint since fusion is accompanied by spreading of the tone to other syllables. The winning candidate has, in addition, more violations of *ASSOC, comparatively. The candidates do not give us a ranking argument for the constraints UNIFORMITY(T) and *ASSOC.

The above ranking and constraints does account for the preference of fusion to deletion in the PhWd. However, in the Macrostem where the application of Anti-Meeussen's Rule is preferred to fusion, a candidate like the ill-formed (90a) would be the one favoured.

Recall Myers's observation of tonal behaviour in Shona. He observed that, in this language, the domain of Meeussen's Rule was the PhWd while that of fusion was the Macrostem. SiSwati has just the opposite behaviour, where Anti-Meeussen's Rule applies on the Macrostem and fusion on the PhWd. Myers assumes that phonological domains are different in morphologically-defined domains. Like McCarthy and Prince (1993), he further assumes that each domain has an independent constraint ranking. For siSwati, this would be UNIFORMITY(T) >> SPECIFY for the Macrostem, but SPECIFY >> UNIFORMITY(T) for the PhWd. In my analysis, though, I will depart from Myers, and show that the two processes result from the same grammar. The idea is that an equivalent of root-faithfulness constraints results in the lack of fusion in the Macrostem. Generally speaking, faithfulness constraints require a lexical form to remain unchanged at the surface. McCarthy and Prince (1995a) have proposed that faithfulness requirements are more strictly imposed within roots than in other types of morphemes, such as affixes. This

led to the conclusion that there are distinct faithfulness constraints for roots and affixes. To capture this linguistic tendency in OT, root-faithfulness constraints are ranked above the general versions of these constraints. In siSwati, the contrast is not so much Root-Affix as Stem/affix, assuming that Myers' MStem is a type of stem.

Following from the above argument about the general status of roots cross-linguistically, I argue that, in the Macrostem, just as in roots, there is need to preserve as much input material as possible. I further suggest that there is a positional faithfulness constraint that is specific to the Macrostem, UNIFORMITY-MACROSTEM (91), ranked above both the markedness constraint (SPECIFY) and the general faithfulness constraint, (UNIFORMITY(T)), and that this ensures that there is no fusion of tone in the Macrostem, while it is permitted in the PhWd.

(91) UNIFORMITY-MACROSTEM (UNIFORMITY-$_{MSTEM}$) : Output tones must not have multiple correspondents in the input Macrostem.

The suggested ranking will account for the lack of fusion and spreading in the Macrostem (see (92)), while allowing it in the PhWd (see (93)). The Macrostem domain is marked by square brackets.

(92) Macrostem: No fusion- UNIFORMITY-$_{MSTEM}$ >> SPECIFY

/ni-ya-[yi-seβenta]/ H$_1$ H$_2$	UNIFORMITY-MSTEM	SPECIFY	UNIFORMITY(T)	*ASSOC
a. ni-ya-[yi-séβé:nta] H$_{1,2}$	*!	****	*	**
b. ☞ni-ya-[yi-seβé:nta] H$_2$		*****		*

Candidate (92a), with fusion of the two input H tones into one, violates UNIFORMITY-$_{MSTEM}$.

The same ranking allows both fusion and tone spread in the PhWd. UNIFORMITY-$_{MSTEM}$ has no influence on these forms.

(93) PhWd: Fusion and spread- SPECIFY >> UNIFORMITY(T)

/ɓa-[yi-natsʰ-ile]/ | | H_1 H_2	UNIFORMITY-MSTEM	SPECIFY	UNIFORMITY(T)	*ASSOC
a. ɓa-[yi-nátsʰ-ile] | H_2		****!		*
b. ☞ ɓa-[yí-nátsʰ -ile] |/ $H_{1, 2}$		***	*	**

Tableaux (92) and (93) illustrate that an independent constraint ranking for the MStem and PhWd is not necessary, at least in siSwati, as long as the specific faithfulness constraints are ranked above the general faithfulness constraints. (94) shows the ranking for these constraints.

(94) UNIFORMITY-$_{MSTEM}$ >> SPECIFY >> UNIFORMITY(T)

The grammar that I have developed for siSwati, and the arguments that I put forward earlier, point towards fusion of tone in the PhWd. However, there is no phonetic evidence to support this claim. It has been suggested that a sequence of tones that result from spreading is realized with the same pitch whereas, if the tones are separate they are realized with a downstep in between the two H's (Odden 1995, Myers 1998). Kishambaa is one of the languages that distinguishes a sequence of tones from those that result from spreading. The difference is captured in the realization of tones in the example in (95). The data is from (Odden 1995).

(95) nyóká 'snake' vs. ngó!tó 'sheep'

nyóká: H

ngó!tó: H H

The experimental study that I conducted for siSwati was not designed to look into these facts; hence; the lack of phonetic evidence for fusion. Experimental work is therefore required to confirm or dispute the claim that there is fusion in the PhWd.

6.2.10 Summary

The results of the experiment presented in this section confirmed the traditional description of tone in Nguni languages. It also confirmed the suggestion that surface realization of tone is influenced by more than one factor, namely the position of a word in an utterance, whether phrase-final or phrase-medial; the number of tones in a particular word; the sequence of tones, whether adjacent, as in HH (H) or non-adjacent as in HLH; and finally, the morphological domain of underlying tone also influences the surface realization of tone. However, a closer look at the graphs, raised some questions about the generalization that tone shifts rightwards from its underlying source. This means, further experimental study is required, to either confirm or dispute the earlier generalization in connection with tone shift, and it will be necessary to avoid the /i-y/ sequence.

In the OT analysis presented, I illustrated how an interaction of different constraints could account for the behaviour of tone in siSwati. In addition, and most crucially, I demonstrated how the ALIGN-R(T) constraint, just like in the passive, in Chapter 3, ensured the movement of tone to the right edge of the word.

CHAPTER 7

CONCLUSIONS

In this Chapter 1 present a summary of the preceding chapters and present the proposals that have been made and the conclusions that have been reached. I also briefly explore areas of future research that arise from this thesis. The study has been concerned with palatalization in Southern Bantu languages. In addition, an analysis of non-local processes; tone and vowel harmony has been undertaken.

7.1 Proposals and conclusions

Within Optimality Theory, I have provided an analysis that views palatalization in siSwati as the need to realize a feature in the triggering suffix, namely a floating [cor] feature. In the discussion I have shown that the alternate passive suffixes /-w-/ and /-iw-/ in siSwati are not derived from a single underlying form, rather /-w-/ is the labial part of the suffix and /-i/ is the realization of the [cor] feature on subminimal roots. It has been shown that a feature geometry that unifies consonants and vocoids is crucial for the palatalization observed in Southern Bantu languages since the [cor] either appears as a vowel, [i], or as a palatal consonant. Hence the adoption of the feature geometry model proposed by Clements (1989), Hume (1990), and Clements & Hume (1995).

The pattern of non-local palatalization which creates a challenge for the processes of assimilation, dissimilation, and segmental fusion, has been accounted for by ranking the constraint, MAX-PASS above ALIGN-R. Another proposal which has been advanced in this thesis is that alignment constraints, in particular ALIGN-R, unify palatalization with the other processes investigated in this study: in the passive, locative, and diminutive, the morpheme is always aligned with the right edge of the word; tone shifts from its underlying source to the rightmost possible position; vowel harmony aligns vowel features with the following high vowel. A summary of the findings of the study is provided below.

In Chapter 3, I have argued that palatalization in siSwati is triggered by a floating palatal feature [cor]. To illustrate this proposal, this chapter has discussed the passive, which has, in addition, the feature [lab] as part of the morpheme. The feature geometry presented in Chapter 2 illustrated how a model that represents both consonants and vowels with the same feature was an advantage to the analysis of the passive: the [cor] feature may either appear as a consonant or as a vowel, depending on prosodic requirements. In this chapter, I have also investigated the notion of reduplication with respect to the passive. I have shown that the need for identity between the base and reduplicant leads to 'overapplication' of the passive process. This has been accounted for by high-ranking the IDENT-BR constraint. Nonetheless, subminimal forms have illustrated that the base and the reduplicant could also be un-identical. Ranking one of the Output-to-Output constraints, BASE-IDENT above the constraint that enforces identity between the base and the reduplicant, IDENT-BR, accounted for this asymmetry.

In Chapter 4, I have demonstrated that palatalization in nominals, just like in the passive, could also be accounted for by a floating [cor] feature. The asymmetry between palatalization of alveolars in diminutive forms and lack of it in the locative has been accounted for by the ranking MAX-DIM >> MAX C-PL-COR >> MAX-LOC.

In Chapter 5, I have demonstrated that the different characteristics of palatalization could be accounted for with different rankings of a set of constraints that are independently motivated in the analysis of siSwati. A re-ranking of these constraints has produced different ways of realizing the [cor] feature; hence; the different typologies. Noteworthy is the fact that re-ranking of the constraints was not substantial, as some constraints remained in the same position in the hierarchy for all the languages. This has captured the fact that although different, these languages are related. The realization of optional forms in the passive of Setswana and Tshivenda was accounted for by an equal ranking of the constraints concerned.

The process of augmentation in subminimal roots followed from the ranking MIN >> DEP-μ in all the languages. In Setswana where, optionally [i] was suffixed even on longer roots, the constraint DEP-μ, had to be ranked at par with MAX PASS. Palatalization of root-medial labials was captured by ranking MAX PASS above ALIGN-R in siSwati. All the other languages had the opposite ranking.

The labialization of labial consonants in the Setswana diminutive, was analyzed as a re-association of the consonant's labial feature from a C-Place node to a V-Place node; hence, a violation of the constraint *RE-ASSOCIATE. This constraint was ranked above MAX C-PL LAB in siSwati, while in Setswana, the opposite ranking was established.

The purpose of Chapter 6 has been to show that long-distance effects are not only observed in the passive, but in tone and vowel harmony as well. The results of the experiment presented in section 6.1 revealed that siSwati does not have vowel harmony but co-articulation. This has cleared the controversy that has surrounded the behaviour of mid vowels in this language.

Section 6.2 has been a discussion of tonal phonology. The behaviour of tone confirmed, not only the long-distance effects observed in the language, but also the effect of ALIGN-R. The results of the experiment confirmed the generalizations made about the behaviour of tone in siSwati and other Nguni languages. It was concluded from the experiment that the surface position of tone was influenced by different and unrelated factors: a) the position of a word in an utterance; whether it was phrase-final or phrase-medial, b) the number of tones in a particular word, c) the sequence of tones, whether adjacent, as in HH (H) or non-adjacent as in HLH, and d) if the tones are adjacent, the morphological domain of the tones: whether it is the PhWd or the Macrostem matters. Most importantly, the results supported Myers' observation that the behaviour of the surface tone depended on the domain of morphemes that contributed tone. For example, spreading was shown to be associated with tone that was contributed by the PhWd while shifting was common in words whose tone was contributed by the MStem. Next, I consider suggestions for future research that arise from this thesis.

7.2 Suggestions for future research

When stem-final alveolars are followed by round vowels, in diminutive forms, there is both labialization of the vowel and palatalization in both siSwati and Sesotho. However, in Sesotho, but not in siSwati, the same process has been observed even when the noun ends in a labial consonant. The grammar that has been developed for siSwati, cannot account for this irregularity. Further investigation is therefore required to explain this anomaly.

Although this thesis did not address the effect of depressor consonants on tone, more experimental work need to be done to ascertain the controversy surrounding the number of underlying tones in Nguni languages. Bradshaw (1999) argues for a three-tone system in siSwati. Her argument is based on the presence of depressor consonants in the language. However, Trail, Khumalo and Fridjohn (1987), do not consider it appropriate to classify depressor consonants with L tone since they have an effect on both H and L tone. Their argument is based on results of an experiment which they conducted on isiZulu depressors. Nonetheless, more experimental work is required to determine the actual number of tones in siSwati; which could be clarified once the status of tone contributed by depressor consonants is understood.

I proposed that tone in siSwati also depends on the phonological domain of the underlying tone. I have suggested and argued for the Anti-Meeussen's rule as the reason why there was deletion and shift of tone in the Macrostem. In the domain of the PhWd, I suggested that there was fusion and spread of tone. However there is no phonetic evidence to support this proposal. The experimental study conducted on tone was not designed to look into these facts. Experimental work is therefore required to confirm or refute my proposal.

Due to difficulties in finding willing siSwati speakers around London, the number of subjects for the tonal experiment was limited to one. For this reason I feel that the results obtained in this study could only be presented as tentative, with solid conclusions based on more subjects. Moreover, a closer look at the graphs for the recordings raised some questions on the generalization that tone shifts rightwards from its underlying source. More experimental work would confirm the standard description of tone and it would be necessary to avoid the /i-y/ sequence which seemed to create a problem during labelling of the segments.

More experimental work is also necessary to consider the effects of coarticulation on other segments. In this study, in a CV1CV2 sequence, only the characteristics of V2 (high vowel) to V1 (mid vowel) coarticulation were examined. Future studies could investigate coarticulation on different vowels as well, to assess whether coarticulation could in any way be affected by the characteristics of the segment concerned.

REFERENCES

Akinlabi, Akinbiyi. 1996. Featural alignment. *Journal of Linguistics* 32: 239-289.

Akinlabi, A. & M. Liberman. 2001. Tonal Complexes and Tonal Alignment. In Minjoo Kim and Uri Strauss (eds.), *Proceedings of the North East Linguistic Society* 31. Amherst, Mass: GLSA, pp. 20.

Antilla, Arto. 1997. Deriving variation from grammar. In Frans Hinskens, Roeland van Hout & W. Leo Wetzels (eds.), *Variation, change and phonological theory.* Amsterdam: Benjamins, pp. 35-68.

Archangeli, D. & D. Pulleyblank. 1994. *Grounded Phonology.* Cambridge: MIT Press.

Archangeli, D. & T. Langendoen (eds.). 1997. *Optimality Theory: An Overview.* Oxford: Blackwell.

Baumbach, E.J.M. 1987. *Analytical Tsonga Grammar.* Pretoria: University of South Africa.

Beckman, Jill. 1993. Feature organization and the strong domain hypothesis in Zulu [labial] phonology. *UMOP* 16.

Beckman, Jill. 1997. Positional faithfulness, positional neutralization, and Shona vowel harmony. *Phonology* 14: 1-46.

Beddor, P. S., J. D. Harnsberger and S. Lindemann. 2002. Language-specific patterns of vowel-to-vowel coarticulation: acoustic structures and their perceptual correlates. *Journal of Phonetics* 30. 591-627.

Benua, Laura. 1995. Identity effects in morphological truncation. In J. Beckman, L. Walsh, Dickey, and S. Urbanczyk. *Papers in Optimality Theory.* Amherst, MA: GLSA, pp. 77-136.

Bhat, D. N. S. 1974. A general study of palatalization. In J. Greenberg (ed.), *Universals of Language.* Stanford: Stanford University Press.

Bleek, W. 1862. *A comparative grammar of South African languages.* Trübner, London (republished in 1971 by Gregg International. Westmead, England).

Blevins, J. 2004. *Evolutionary Phonology: The Emergence of Sound Patterns.* Cambridge: Cambridge University Press.

Boardi, Lawrence. 1988. Palatalization in Akan. *Journal of West African Languages* 18: 3-16.

Borowsky, T. 1983. On glide insertion in Luganda. *Chicago Linguistic Society* 19: 39-51.

Boyce, S.E, R.A. Krakow, F. Bell-Berti and C.E. Gelfer. 1990. Converging sources of evidence for dissecting articulatory movements into core gestures. *Journal of Phonetics* 18: 173-188.

Bradshaw, M. 2003. Consonant-tone interaction in SiSwati. *Studies in Phonetics, Phonology and Morphology.* 9.2: 277-294.

Broselow, E. & A. Niyondagara. 1989. Feature geometry of Kirundi palatalization. *SLS* 20 1: 71-88.

Browman, C.P. & L.M. Goldstein. 1986. Towards an articulatory phonology. *Phonology yearbook* 3: 219-252.

Browman, C.P. & L.M. Goldstein. 1989. Articulatory gestures as phonological units. *Phonology* 6: 201-251.

Butler, C. 1985. *Statistics in Linguistics.* Oxford: Basil Blackwell.

Canonici, N. 1994. *The Nguni languages: A simple presentation and comparison on Zulu, Xhosa and Swati.* Durban: University of Natal.

Casali, R. F. 1997. Vowel elision in hiatus context: which vowel goes? *Language* 73.3: 493-533.

Cassimje, F. 1998. *IsiXhosa Tonology: An Optimal Domains Theory Analysis.* Munich: Lincom Europa.

Cassimje, F. and C. W. Kisseberth. 1998. Optimal domains theory and Bantu tonology: a case study from Isixhosa and Shingazidja. In L. M. Hyman & C. W. Kisseberth (eds.), *Theoretical Aspects of Bantu Tone.* Stanford: CSLI, 33-132.

Cassimje, F. and C. W. Kisseberth. 2001. *Zulu tonology and its relationship to other Nguni languages.* ms. Morris College and Tel Aviv University.

Chen, Su-I and Gloria Malambe. 1998. Palatalization in SiSwati: An Optimality Theory approach. In I. Maddieson and T. Hinnebuch (eds.), *Language History and Linguistic Description in Africa.* Trenton, NJ: Africa World Press, 137-146.

Clements, G. N. 1976a. Palatalization, linking or assimilation? *Chicago Linguistic Society* 12: 90-109.

Clements, G. N. 1985. The geometry of phonological features. *Phonology* 2: 225-52.

Clements, G. N. 1989. Place of articulation in consonants and vowels: a unified theory. In *Working Papers of the Cornell Phonetics Laboratory* 5: 77-123.

Clements, G. N. 1990. The role of the sonority cycle in core syllabification. In J. Kingston, J.C. and M.E. Beckman (eds.) *Papers in Laboratory Phonology 1: Between the Grammar and Physics of Speech.* Cambridge: Cambridge University Press.

Clements, G. N. 2000. Phonology. In B. Heine and D. Nurse (eds.), *African Languages: An Introduction.* Cambridge: Cambridge University Press.

Clements, G. N. and Elizabeth Hume. 1995. The internal organization of speech sounds. In John A. Goldsmith (ed.), *The Handbook of Phonological Theory.* Oxford: Blackwell, pp. 245-306.

Clements, G. N. 1991. Vowel height assimilation in Bantu languages. In *Working Papers of the Cornell Phonetics Laboratory* 5: 37-76.

Cole, D. T. 1955. *An introduction to Tswana grammar.* Cape Town: Longman Penguin Southern Africa.

Cooke, S. 2000. Palatalization from a Government Phonology perspective: The passive construction in Zulu. *SOAS Working Papers in Linguistics* Vol.10.

Creissels, D. 1999. Remarks on the sound correspondences between Proto-Bantu and Tswana (S31), with particular attention to problems involving*j, *y, *i and sequences *NC. In B. Hombert, and L. Hyman. (eds.), *Bantu Historical Linguistics: Theoretical and Empirical Perspectives.* Stanford: CSLI, pp. 297-334.

Creissels, D. 1999. Bimoraic syllables in a language without length contrast and without consonants in coda position: the case of siSwati (S43). In J. A. Blanchon and D. Creissels (eds.), *Issues in Bantu tonology.* Cologne: Rüdiger Köppe Verlag, pp. 153-196.

Crowhurst, Megan & Lev Michael. 2005. Iterative footing and prominence-driven stress in Nanti (Kampa). *Language* 81: 47-95.

Crowhurst, Megan. 2001. Coda conditions and Um infixation in Toba Batak. *Lingua* 111: 591-627.

Davis, Stuart. 1988. Syllable onsets as a factor in stress rules. *Phonology* 5.1: 1-19.

Department of African languages and literature, University of Botswana. 1999. *The Sound System of Setswana.* Gaborone: Lentswe La Lesedi (Pty) Ltd.

Dimmendal, Gerrit J. 2000. Morphology. In B. Heine and D. Nurse (eds.), *African languages: An introduction.* Cambridge: Cambridge University Press.

Dlamini, J.V. 1979. *Luhlelo LwesiSwati (SiSwati Grammar).* Pietermaritzburg: Shuter and Shooter (Pty) Ltd.

Doke, C. M 1954. *A Texbook of Zulu Grammar.* Cape Town: Longman.

Doke, C. M 1967. *The Southern Bantu Languages.* London: Oxford University Press.

Doke, C. M. 1943. *Outline grammar of Bantu.* Distributed [1983] as communication no.12, department of African Languages, Rhodes University, Grahamstown, Republic of South Africa.

Doke, C. M.1926. *The phonetics of the Zulu language.* Johannesburg: UWP.

Doke, C.M. & S. M. Mofokeng. 1967. *Textbook of Southern Sotho Grammar.* Cape Town: Longman Penguin: Southern Africa.

Downing, L. 1990. Local and metrical tone shift in Nguni. *Studies in African Linguistics* 21: 261-317.

Downing, L. 1994. SiSwati verbal reduplication and the theory of Generalized Alignment. In M. Gonzalez (ed.), *Proceedings of the North East Linguistic Society* 24, Amherst, MA: Graduate Student Linguistic Association, pp. 81-95.

Downing, L. 1996. *The Tonal Phonology of Jita.* LINCOM Studies in African Linguistics 05. Munich: LINCOM EUROPA.

Downing, L. 1997. Correspondence effects in siSwati reduplication. *Studies in the Linguistic Sciences* 25. 1: 17-35.

Downing, L. 1998b. On the prosodic misalignment of onsetless syllables. *Natural Language and Linguistic Theory* Vol.16: 1-52.

Downing, L. 1999. Morphological constraints on Bantu reduplication. *Linguistic Analysis* 29: 6-46.

Downing, L. 1999a. Prosodic Stem≠ Prosodic Word in Bantu. In T. Alan Hall and Ursula Kleinhenz (eds.), *Studies on the Phonological word.* Amsterdam: John Benjamins, pp. 73-98.

Downing, L. 1999b. Verbal reduplication in three Bantu languages. In R. Kager, H. van der Hulst and Zonneveld (eds.), *The Prosody Morphology Interface.* Cambridge: Cambridge University Press.

Downing, L. 2000a. Morphological and prosodic constraints on Kinande verbal reduplication. *Phonology* 17: 1-38.

Downing, L. 2001b. Ungeneralizable minimality in Ndebele. *Studies in African Linguistics* 30: 33-58.

Downing, L. 2005. On the ambiguous status of nasals in homorganic NC sequences. In M. van Oosterndorp and J. van der Weijer (eds.), *The internal organization of phonological segments.* Berlin: Moutorn De Gruyter.

Flemming, E. 2001. Scalar and categorical phenomena in a unified model of phonetics and phonology. *Phonology* 18.1: 7-44.

Fowler, C.A. 1983. Realizm and unrealizm: a reply. *Journal of Phonetics* 11: 303-322.

Gafos, D. 1998a. Eliminating long-distance consonantal spreading. *NLLT* 16: 223-278.

Gafos, D. 2002. A grammar of gestural coordination. Natural Language and Linguistic Theory 20: 269-227.

Gorecka, A. 1989. Palatalization of labials in Tswana. In John P. Hutchison and Victor Manfredi (eds.), *Current Approaches to African Linguistics* 7.

Green S.B., N.J. Salking and T.M. Akey. 2000. *Using SPSS for Windows: Analyzing and Understanding Data.* London: Prentice-Hall.

Grimes, B.F. and J.E. Grimes, (eds.). 2000. *Ethnologue.* Volume 1: languages of the world: volume 2: maps and indexes. Dallas: SIL International.

Guma, S. M. 1991. *An outline structure of Southern Sotho.* Pietermaritzburg: Shuter and Shooter (Pty) Ltd.

Guthrie, M. 1967-1971. *Comparative Bantu.* London: Gregg International Publishers, volumes 1-4.

Hardcastle, W. J. and N. Hewlett (eds.). 1999. *Coarticulation: Theory, Data and Techniques.* Cambridge: Cambridge University Press.

Harris, J. 1987. Non-structure-preserving rules in Lexical Phonology: southeastern Bantu harmony. *Lingua* 73: 79-116.

Harris, J. 2003. Grammar-internal and Grammar-external assimilation. In R. Vermeulen, and Ad Neeleman (eds.) *UCL Working Papers in Linguistics* 15: 317-326

Hayes B. 1985. Iambic and trochaic rhythm in stress rules. In BLS, 11: 429-446.

Hayes, B., Kirchner, R. and D. Steriade (eds.). 2004. *Phonetically-Based Phonology.* Cambridge: Cambridge University Press.

Hebert, R. K. 1975. Reanalysing prenasalised consonants. In *Studies in African Linguistics* 6: 105-123.

Hebert, R. K. 1977. Morphophonological palatalization in Southern Bantu: A reply to segmental fusion. *Studies in African Linguistics* Vol. 8.2: 143-171.

Hebert, R. K. 1990. Labial palatalization in Nguni and Sotho languages: Internal and external evidence. S. Afr.Tydskr. *Afrikatale* 10: 74-80.

Hebert, R. K. 1995. Prenasalised consonants and Dahl's Law: Questions of representation and subclass. In A. Traill, R. Vossen, and M. Biesele (eds.), *The complete linguist*: 217-236.

Herman, Rebecca. 1996. Prosodic structure in siSwati. *Ohio State Working Papers in Linguistics* 48: 31-55.

Hubbard, K. 1995. Prenasalised consonants and syllable timing: evidence from Runyambo and Luganda. *Phonology* 12: 235-256.

Huffman, M. K. 1986. Patterns of coarticulation in English. *UCLA Working Papers in Phonetics* 63: 26-47.

Hume, E. 1990. Front vowels, palatal consonants and the rule of umlaut in Korean. *Proccedings of the North Eastern Linguistic Society* 20.1: 230-243.

Hume, E.1992. Front vowels, coronal consonants and their interaction in nonlinear phonology. Doctoral dissertation, Cornell University.

Hyman, L. M. 1973. The role of consonant types in natural tonal assimilations. In L.M. Hyman (ed.), *Consonant Types and Tone.* University of Southern California, pp. 151- 79.

Hyman, L. M. 1993. Conceptual issues in the comparative study of the Bantu verb stem. *Topics in African linguistics.* In S.S. Mufwene and L. Moshi (eds.), Amsterdam: John Benjamins., pp. 3-34.

Hyman, L. M. 1995a. Minimality and the prosodic morphology of Cibemba imbrication. *Journal of African Languages and Linguistics* 16: 3-39.

Hyman, L. M. 1995b. Nasal harmony at a distance: the case of Yaka. *Studies in African Linguistics* 24.1: 5-30.

Hyman, L. M. 1998. Positional Prominence and the 'Prosodic trough' in Yaka. *Phonology* 15: 41-75.

Hyman, L. M. 1999. The historical interpretation of vowel harmony in Bantu. In J. M. Hombert and L. M. Hyman (eds.), *Bantu Historical Linguistics*. Stanford: CSLI Publications, pp. 235-295.

Hyman, L. M. 2000. *Privative tone in Bantu*. Paper given at a symposium on tone, ILCAA, Tokyo.

Hyman, L. M. 2001. Vowel harmony in Gunu. *Studies in African Linguistics* 30.2: 147-170.

Hyman, L. M. 2002. Is there a right-to-left bias in vowel harmony? Submitted to *Proceedings of the 9th International Phonology Meeting*.

Hyman, L. M. 2003. Sound change, misanalysis, and analogy in the Bantu causative. *Journal of African Languages and Linguistics* 24: 55-90.

Hyman, L. M. and F. X. Katamba. 1999. The syllable in Luganda phonology and morphology. In H. van der Hulst and N. A. Ritter (eds.). *The Syllable: Views and Facts*. Berlin: Mouton de Gruyter.

Hyman, L. M. and A. Ngunga. 1994. On the non-universality of tonal association 'conventions': evidence from Ciyao. *Phonology* 11: 25-68.

Inkelas, S. 1993. Deriving Cyclicity. In S. Hargus and E.M. Kaisse (eds.). *Phonetics and Phonology 4; Studies in Lexical Phonology*. Newyork: Academic Press, pp. 75-110.

Jun, J. 2004. Place Assimilation. In B. Hayes, R. Kirchner, and D. Steriade (eds.), *Phonetically-Based Phonology*. Cambridge: Cambridge University Press, pp. 58-86.

Kager, R. 1999. *Optimality Theory*. Cambridge: Cambridge University Press.

Katamba, Francis. 1985. A non-linear account of the syllable in Luganda. In D. L. Goyvaerts (ed.) *African Linguistics: Essays in memory of M. W. K. Semikenke.* Amsterdam: J. Benjamins, 267-283.

Kaun, A. 2004. The typology of rounding harmony. In B. Hayes, R. Kirchner, and D. Steriade (eds.), *Phonetically-Based Phonology*. Cambridge: Cambridge University Press.

Keating, P. A. 1988. The window model of co-articulation: articulatory evidence. *UCLA Working Papers in Phonetics* 69: 3-29.

Keating, P. A. 1991. Coronal places of articulation. In C. Paradis and F. Prunet (eds.), *The special status of coronals: internal and external evidence.* San Diego: Academic Press, pp. 29-48.

Kenstowicz, M. 1994. *Phonology in generative grammar.* Oxford: Basil Blackwell.

Kenstowicz, M. 1996. Base-identity and uniform exponence: alternatives to cyclicity. In J. Durand & B. Laks (eds.), *Current trends in phonology: models and methods.* CNRS, Paris X, and University of Salford Publications. 363-393.

Khumalo, J. S. M. 1988. Palatalization in Zulu. In A. C. Nkabinde (ed.), *Anthology of Articles on African Linguistics and Literature.*

Khumalo, J. S. M. 1987. An Autosegmental Account of Zulu Phonology. PhD thesis, University of Witwatersrand, Johannesburg, S.A.

Kisseberth, W. & D. Odden 2003. Tone. In D. Nurse and G. Philippson (eds.) *The Bantu Languages.* London. Routledge, pp. 59-70.

Kiyomi, S. and S. Davies. 1992. Verb reduplication in Swati. *African Languages and Culture* 5: 113-124.

Kochetov, A. 1998. Labial palatalization: A gestural account of phonetic implementation. In *The Canadian Linguistic Association Annual Proceedings*: 38-50.

Kockaert, H. J. 1997. Vowel harmony in siSwati: An experimental study of raised and non-raised vowels. *JALL* 18: 139-156.

Kühnert Barbara & Francis Nolan. 1999. The origin of coarticulation. In W. J. Hardcastle and N. Hewlett (eds.), *Coarticulation: Theory, Data and Techniques.* Cambridge. Cambridge University Press, pp. 7-30.

Kula, N. C. 2002. *The phonology of verbal derivation in Bemba.* ULCL: LOT (PhD dissertation).

Kula, N.C.1999. On the representation of NC clusters in Bemba. In R.van Bezooijen and R. Kager (eds.), *Linguistics in the Nertherlands.* Amsterdam: John Benjamins Publishing Co., pp. 135-148.

Kunene, E.C.L. 1991. *Palatalization in siSwati.* Ms. University of Swaziland.

Ladefoged, P. & I. Maddieson. 1996. *The sounds of the world's languages.* Oxford: Blackwell.

Lahiri, A. and V. Evers. 1991. Palatalization and coronality. In C. Paradis and F. Prunet (eds.), *The special status of coronals: internal and external evidence.* San Diego: Academic Press, pp. 79-100.

Lass, Roger. 1976. *English phonology and phonological theory: synchronic and diachronic studies.* Cambridge: Cambridge University Press.

Lin, Y.H. 1993. Degenerate affixes and templatic constraints: rime change in Chinese. *Language* 69.4: 649-82.

Lindau, M. 1978. Vowel features. *Language* 54.3: 541-563.

Lombard, Daan. 1985. *An introduction to the grammar of Northern Sotho.* Cape Town: Maskew Miller Longman.

Lombardi, Linda. 1999. Positional faithfulness and voicing assimilation in Optimality Theory. *Natural Language and Linguistic Theory* 17: 267-302.

Lombardi, Linda. 2001. Why place and voice are different: constraint specific alternations in Optimality Theory. In Linda Lombardi (ed.), *Segmental phonology in Optimality Theory: constraints and representations.* Cambridge: Cambridge University Press, pp. 13-45.

Louw, J. A. 1975. Palatalization of bilabials in the passive, diminutive, and locative in Xhosa and Tsonga. *Afrika and Ubersee* 59: 241-278.

Maddieson, I. 1984. *Patterns of Sounds.* Cambridge: Cambridge University Press.

Maddieson, I. 1992. The Structure of Segment Sequences. In J. J. Ohala et al (eds.). *Proceedings, 2nd International Conference on Spoken Language Processing,* Addendum 1-4.

Maddieson, I. 2003. Vowel spacing in four-vowel systems (Abstract). *Journal of the Acoustical Society of America* 113.

Magen, H. S. 1984. Vowel-to-vowel coarticulation in English and Japanese. *Journal of the Acoustical Society of America,* Supplement 1, 75: S41.

Magen, H. S. 1997. The extent of vowel-to-vowel coarticulation in English. *Journal of Phonetics* 25: 187-205.

Malambe, Gloria Baby. 1999. Palatalization in the formation of passives in siSwati: An autosegmental analysis. *UNISWA Research Journal* Vol.13: 53-60.

Malambe, Gloria. 2004. Palatalization in the morphology of siSwati. *Proceedings of the University of Cambridge Second Postgraduate Conference in Language Research.* Cambridge, pp. 203-210.

Manuel, S. 1990. The role of contrast in limiting vowel-to-vowel coarticulation in different languages. *Journal of the Acoustical Society of America,* 88: 1286-98.

Manuel, S. and R. A. Krakow. 1984. Universal aspects of vowel-to-vowel coarticulation. *Haskins Laboratories Status Report on Speech Research,* SR 77/78, 69-78.

Mathangwane, Joyce T. 1999. Diachrony in Ikalanga velarization. Malilime: *Malawian Journal of Linguistics* 1.

McCarthy, J. & A. Prince. 1993a. Generalized Alignment. *Yearbook of Morphology* 1993. In Geert Booij and Jaap van Marle (eds.), Dordrecht: Kluwer, pp. 79-153.

McCarthy, J. 1994. The phonetics and phonology of Semitic pharyngeals. In Patricia A. Keating (ed.). Phonological structure and phonetic form: papers in Laboratory phonology III . Cambridge. Cambridge University Press.

McCarthy, J. 1995a. Faithfulness and reduplicative identity. In J. Beckman, L. Walsh Dickey, and S. Urbanczyk (eds.), *University of Massachusetts Occasional*

Papers in Linguistics 18. Amherst, Mass: Graduate Linguistic Student Association, pp. 249-384.

McCarthy, J. 1995b. Prosodic morphology. *The Handbook of Phonological Theory.* In John A. Goldsmith (ed.), Cambridge, MA: Blackwell, pp. 318-66.

McCarthy, J. 1999. Faithfulness and identity in prosodic morphology. The prosody-morphology interface. In R. Kager, H. van der Hulst, and W. Zonneveld (eds.). Cambridge: Cambridge University Press, pp. 218-309.

McCarthy, J. 1999. Sympathy and phonological opacity. *Phonology* 16: 331-99.

McCarthy, J. 2002. *A Thematic Guide to Optimality Theory.* Cambridge. Cambridge University Press.

McCarthy, J. and A. Prince. 1986/1999. Prosodic morphology 1986. In John Goldsmith (ed.): *Essential Readings in Phonology.* Oxford: Blackwell 1999, pp. 238-288.

Mchombo, Sam A. 1993. Reflexive and reciprocal in CiChewa. In Sam A. Mchombo (ed.), *Theoretical aspects of Bantu grammar.* Stanford: CSLI, pp. 181-207.

Mchombo, Sam A. 2002. *The syntax of Chichewa.* Ms. University of Carlifornia Berkeley.

Meinhof and N. van Warmelo. 1932. *Introduction to the phonology of Bantu languages.* Berlin: Dietrich Reimer/Ernst Vohsen.

Mester, R. A. and Itôr, J. 1989. Feature predictability and underspecification: palatal prosody in Japanese mimetics. *Language* 65: 258-293.

Monaka, K.C. 2001. *Shekgalagari stop contrasts: a phonetic and phonological study.* PhD dissertation. University of London.

Myers, Scott. 1990. *Tone and the Structure of Words in Shona.* New York: Garland Press.

Myers, Scott. 1997. OCP effects in Optimality Theory. *NLLT* 15: 847-892.

Myers, Scott 1998. Aux in Bantu morphology and phonology. In L.M. Hyman and C. W. Kisseberth (eds.), *Theoretical aspects of Bantu Tone.* Stanford: CSLI, pp. 231-264.

O'Bryan, Margie. 1974. The role of analogy in non-derived formations in Zulu. *Studies in the Linguistic Sciences* 4: 144-178.

Odden, David. 1995 Tone: African Languages. In John A. Goldsmith (ed.). *Handbook of Phonological Theory.* Oxford: Blackwell, pp. 444- 475.

Odden, David, and Mary Odden. 1985. Ordered reduplication in Kihehe. *Linguistic Inquiry* 16: 497-503.

Ohala, J. J.1978. Southern Bantu vs. the world: The case of palatalization of labials. *Proceedings of the fourth annual meeting of the Berkeley Linguistics Society,* pp. 370-86.

Ohala, J.J. 1989. Sound change is drawn from a pool of synchronic variation. *Trends in Linguistics: Studies and monographs* 42: 173-198.

Ohala, J. J. 1990. The phonetics and phonology of aspects of assimilation. In J. Kingston and J.M. Beckman (eds.). *Papers in Laboratory Phonology 1.* Cambridge: Cambridge University Press, pp. 258-275.

Ohala, John J. 1993. Coarticulation and phonology. *Language and Speech* 36:155-71.

Ohala, John J. 1994. Towards a universal, phonetically-based theory of vowel harmony. *Proceedings of the third International Conference on Spoken Language Processing*: 491-494.

Ola, Olanike. 1995. Properheadedness and binarity: Prosodic words in Yoruba. In Akinbiyi Akinlabi (ed.), *Trends in African Linguistics: Theoretical Approaches to African Linguistics*. Trenton, NJ; Africa, pp. 273-293.

Park, Jae-ick. 1995. Minimality effects in Swahili. In Akinbiyi Akinlabi (ed.), *Trends in African Linguistics: Theoretical Approaches to African Linguistics.* Trenton, NJ; Africa, pp. 295-312.

Pearce, Mary (to appear) Dissertation on Kera phonology (UCL).

Peng, Long (Bruce). 1991. Swati and Kikuyu reduplication: Evidence against exhaustive copy. *Studies in African Linguistics* 22: 45-72.

Phillipson, G. 2006. *Tone 'anticipation' in Bantu.* Paper presented at the International Conference on Bantu Grammar: Description and Theory, London SOAS. 20-22 April 2006.

Pierrehumbert Janet. B. & Mary Beckman 1988. Japanese tone structure. Cambridge: MIT Press.

Poulos, G. 1990. *A linguistic analysis of Venda.* Pretoria. Via Afrika.

Poulos, G. and C. Msimang. 1998. *A linguistic analysis of Zulu.* Cape Town. Via Afrika.

Prince, A. S. and P. Smolensky. 1993. Optimality Theory: constraint interaction in generative grammar. ms. Rutgers university center for cognitive science.

Przezdziecki, Marek. 2000. Vowel-to-vowel coarticulation in Yoruba: the seeds of ATR vowel harmony. In R. Billery, and B. Lillehaugen. *WCCFL 19 Proceedings*. Somerville, MA: Cascadilla Press, pp. 385-398.

Recasens, D. 1987. An acoustic analysis of V-to-C and V-to-V coarticulatory effects in Catalan and Spanish VCV sequences. *Journal of Phonetics* 15: 299-312.

Recasens, D. 2002 Patterns of Jaw Coarticulatory Direction and Linguomandibular Coordination in CVC sequences. *ZAS papers in Linguistics* 28: 83-92.

Romaine, S. 1989. Pidgins, creoles, immigrant, and dying languages. In N. Dorian (ed.). *Investigating Obsolescence: Studies in Language Contraction and Death.* 369-383.

Rose, Sharon. 1993. Palatalization, underspecification and plane conflation in Chaha. In Eric Duncan, Donka Farkas, and Phillip Spaelti (eds.), *The proceedings of the twelfth West Coast conference on formal linguistics*, pp. 101-116.

Rosenthall, S. 1992. Prenasalised stops and feature geometry. In W. D. Dressler, H. C. Luschützky and J. R. Rennison (eds.), *Phonologica* 1988: Proceedings of the 6th international phonology meeting. Cambridge: Cambridge University Press, pp. 249-258.

Rycroft, D. K. 1981. Concise siSwati dictionary. Pretoria: J. L. Van Schaik.

Schourup, L. and Tamori, I. 1992. Palatalization in Japanese mimetics: response to Mester and Itor. *Language* 68: 139-148.

Shih, C.L. 1988. Tone and intonation in Mandarin. In *Working Papers of the Cornell Phonetics Laboratory* 3: 83-109.

Stahlke, Herbert F. W. 1976. Segmental sequences and segmental fusion. *Studies in African Linguistics* 7.1: 41-63.

Steriade, Donca. 2000. Paradigm uniformity and the phonetics-phonology boundary. In M. Broe and J. Pierrehumbert (eds.). *Papers in Laboratory Phonology* 6. Cambridge university Press.

Takeda, K. 1998. Single consonant reduplication and causative formation in Kammu. *UCI Working Papers in Linguistics* 4: 163-198.

Taljaard, P. C., J. N. Khumalo, and S. E. Bosch. 1991. *Handbook of siSwati*. Pretoria: J. L. Van Schaik Ltd.

Taljaard, P.C & J.W. Snyman. 1993. *An Introduction to Zulu phonetics*. Cape Town: Marius Libbe Publishers.

Topintzi. Nina. 2006. *Putting 'commas' at the right place: A note on crucial non-ranking in OT*. [ROA # 756].

Trail, A. 1990. Depression without depressors. *South African Journal of African Languages* 10: 166-172.

Trail, A., J. S. M. Khumalo, and P. Fridjohn. 1987. *Depressing facts about Zulu*. African Studies: 46. 2: 255-274.

Ussishkin, A. 2005. A fixed prosodic theory of nonconcatenative templatic morphology. *Natural Language and Linguistic Theory* 23: 169-218.

van der Hulst and van der Weijer 1995. Vowel harmony. In John A. Goldsmith (ed.), *Handbook of Phonological Theory*. Oxford: Blackwell, pp. 495-534.

Xu, Y. 1999. Effects of tone and focus on the formation and alignment of F0 contours. *Journal of Phonetics* 27. 55-105.

Xu, Y. 2005. Speech melody as articulatorily implemented communicative functions. *Speech Communication* 46: 220-251.

Xu, Y. and F. Liu's (in press) Tonal alignment, syllable structure and coarticulation: Toward an integrated model. To appear in *Italian Journal of Linguistics*.

Yip, Moira. 1988. The obligatory contour principle and phonological rules: a loss of identity. *Linguistic Inquiry* 19.1: 65-100.

Yip, Moira. 1992. Prosodic morphology in four Chinese dialects. *Journal of East Asian Linguistics* 1: 1-35.

Yip, Moira. 2002. *Tone*. Cambridge: Cambridge University Press.

Ziervogel, D. 1952. *A grammar of Swazi (siSwati)*. Johannesburg. Witwatersrand University Press.

Ziervogel, D. & E. J. Mabuza. 1976. *Agrammar of the Swati language*. Pretoria. J. L. van Schaik Ltd.

Zoll, C. 1995. Consonant mutation in Bantu. *Linguistic Inquiry* 26.3: 536-545.

Zoll, C. 1996. Parsing below the segment in a constraint based framework. PhD dissertation. University of California, Berkeley.

Zoll, C. 1997b. Conflicting directionality. *Phonology* 14: 263-86.

Zsiga, Elizabeth C. 2000. Features, gestures, and Igbo vowels: An approach to the phonology-phonetics interface. *Language* 73-2: 227- 273.

Zuraw, Kie. 2002. Aggressive reduplication. *Phonology* 19: 395-439.

APPENDICES

Appendix A (Chapter 2)

Sesotho complex segments vs plain segments

1. '*mould*'	bōpjŏa	31. bōtjŏa
2. '*seize*'	hapjŏa	32. hatjŏa
3. '*feed*'	fepjŏa	33. fetjŏa
4. '*wound*'	hlabjŏa	34. hlajŏa
5. '*break*'	robjŏa	35. rojŏa
6. '*malign*'	sebjŏa	36. sejŏa
7. '*dig*'	rafshŏa	37. rashŏa
8. '*bind*'	bofshŏa	38. boshŏa
9. '*pay debt*'	lēfshŏa	39. lēshŏa
10. '*annoy*'	hlōpshŏa	40. hlōchŏa
11. '*honour*'	hlonēpshŏa	41. hlonēchŏa
12. '*river*'	mōlapo	
13. '*herd*'	mōhlapē	
14. '*women*'	mēthēpa	
15. '*stone*'	lējŏe	b. majŏe
16. '*news*'	litaba	
17. '*rock pigeon*'	lēēba	b. maēba
18. '*conjugal jealousy*'	lēfufa	
19. '*blind man*'	sēfofu	
20. '*lake*'	lētša	b. matša
21. '*honour*'	hlompha	
22. '*grass*'	jŏang	
23. '*stone*'	lējŏe	

24. '*simmer* pjatla

25. '*to crunch*' hō-bjabjaretsa

26. '*of whiteness*' bjaa b. bjŏa

27. '*ostrich*' mpshe

28. '*break to pieces*' pshatla b. pshoatla

29. '*of meeting unexpectedly*' pjŏang

30. '*species of bird*' pjempjete

Appendix B (Chapter 6: Section 6.1)

A list of siSwati words used with the carrier sentence:

Ngitsi ... kahle 'I say... well'.

1. indlela	*'path'*
2. ingwe	*'leopard'*
3. Lweti	*'November'*
4. silevu	*'chin'*
5. sipoko	*'ghost'*
6. litiko	*'fireplace'*
7. bovu	*'pus'*
8. bhema	*'smoke v.'*
9. bhemisa	*'smoke (caus).'*
10. pheka	*'cook v.'*
11.umpheki	*'cook n.'*
12.hleka	*'laugh'*
13.hlekisa	*'laugh (caus.)*
14. ngena	*'get in'*
14. ngenisa	*'bring in'*
16. dvonsa	*'pull'*
17. dvonsisa	*'cause/help to pull'*
18. yona	*'sin v.'*
19. yonisa	*'sin caus.'*
20. phola	*'cool down'*
21. pholisa	*'cool down caus.'*
22. bona	*'see'*
23. bonisa	*'help one to see'*
24. kopa	*'copy'*
25. kopisa	*'help to copy'*
26. bopha	*'tie'*
27. bophisa	*'help to tie'*

28. bhobosa *'pierce'*
29. bhobosisa *'help to pierce'*
30. beleka *'give birth'*
31. belekisa *'help to give birth'*
32. baleka *'run away'*
33. balekisa *'help to run away'*
34. tsenga *'buy'*
35. tsengisa *'sell'*
36. tsela *'pour out'*
37. tselisa *'help to pour'*
38. sitsela *'disappear'*
39. lusela *'herd for'*
40. sondzela *'get closer'*
41.sondzelisa *'get closer caus.'*
42. sebentela *'work for'*
43.sebentelisa *'cause to work for'*
44. ifulegi *'flag'*
45. lihleta *'juicy bone'*
46. likheshi *'lift n.'*
47. lukhetse *'sandy soil'*
48. ummeli *'lawyer'*
49. sitelega *'strike n.'*
50. sicephu *'piece of cloth'*
51. sephulelo *'discount'*
52. indlovu *'elephant'*
53. simoko *'smoke n.'*
54. makoti *'wife'*
55. kukokola *'to limp'*
56. kukokolisa *'cause to limp'*
57. bugovu *'greed'*
58. kucota *'to peel'*
59. lijozi *'Johannesburg'*
60. phopho *'pawpaw'*
61. khwela *'climb'*

62. khweta *'climb caus.'*
64. vela *'emerge'*
65. veta *'emerge caus.'*
66. layela *'show'*
67. layeta *'show caus.'*
68. tfwesa *'help to carry'*
69. khukhumeta *'raise'*

Appendix C (Chapter 6: section 6.2)

SiSwati verbal phrases

1. liyapha	'It is giving'
2. niyapha	'You are giving'
3. niyakupha	'You are giving it'
4. kuyalwa	'It is fighting'
5. niyalwa	'You are fighting'
6. liyakusebentela	'It is working for you'
7. niyakusebentela	'You are working for it'
8. kuyasebenta	'It is working'
9. nitawubona	'You will see'
10. nitawulima	'You will cultivate'
11. nitobona	'You will see'
12. nitolima	'You will cultivate'
13. niyalimelana	'You are cultivating for e.o.'
14. liyalimelana	'It cultivates for one'
15. likupheleketele	'It has accompanied you'
16. likulimela kahle	'It cultivates well for you'
17. likulimele	'It has cultivated for you'
18. nikusebentela make	'You do the work for mother'
19. nikusebentele	'You did the work for it'
20. atawubona kahle	'They will be able to see well'
21. atawubona	'They will see'