Vowel Processes in Nguni: Resolving the Problem of Unacceptable VV Sequences

Galen Sibanda
University of California, Berkeley and Stanford University

1. Introduction

Nguni languages (Ndebele, SiSwati, Xhosa and Zulu) have five phonemic vowels given in (1)a. The other two mid vowels (both [-ATR]) in (1)b. are non-phonemic but phonetic and will not be the focus of discussion in this paper.

(1) Nguni vowels

a.	Phonemic vowels	b. Non-phonemic vowels
	i e a o u	**ɛ ɔ**

Ignoring penultimate lengthening and some long vowels in Xhosa noun prefixes and other forms derived from the noun prefixes (which involve compensatory lengthening in addition to processes discussed here) a Vowel + Vowel (VV) sequence occurring within a single phonological word is unacceptable in Nguni. The ill-formed sequence has to be repaired through at least one of the three main vowel processes: coalescence, gliding (consonantalization) and deletion. The aim of this paper is to expose these processes showing under what circumstances they occur and discussing the constraints involved in different grammatical situations. In other words the paper examines the strategies used by the Nguni languages in resolving the problem of unacceptable VV sequences.

The data showing the different ways in which the problem of unacceptable VV sequences is resolved is presented in section 2. It is drawn mainly from Ndebele but most of the words, roots, stems and affixes used are also available in the other three languages although there might be a slight shift in meaning but which should not be of concern here as the focus is mainly on the phonology. The data also covers all parts of the grammar although, due to the limitations of a paper of this nature, only a limited but representative set of examples are used. (See also Sibanda 2004 where only the data relevant to the verb is presented). Other Nguni examples not taken from Ndebele are also included where there are notable phonological variations although for the most part Ndebele examples will suffice, as the phenomenon under consideration in this paper is generally the same in all the four languages. However, for further reading about the phenomenon in SiSwati, Xhosa and Zulu the reader is referred to, for example, Ziervogel (1952), Einhorn & Siyengo (1990), Doke (1997) and Mbeje (2005). Section 3 is an analysis of the data within the framework of Optimality Theory (OT) as proposed by Prince and Smolensky (1993) and further advanced by McCarthy(1994), McCarthy & Prince (1994), McCarthy & Prince (1995) and many others, and Section 4 is the conclusion.

2. Different solutions to *VV

2.1. Coalescence

The first vowel process to be considered here is coalescence. In this paper cases of coalescence are those where two identical vowels come together to form a single monomoraic one with the same features and those involving two different vowels whose product is a single monomoraic one with non-conflicting features from the two vowels that combine. Some examples involving probably the most

ed. Masangu Matondo et al., 38-55. Somerville, MA: Cascadilla Proceedings Project.

common forms of coalescence in Nguni languages are provided in (2) where in (2)a. an adjective concord is formed by prefixing an adjective formative **a-** to a noun class prefix and in (2)b. the associative formative **la-** is prefixed to a noun.

(2) a. Adjective formative **a + Noun Class Prefix**

a+ama	→	ama-	'Class 6 adjective concord'	amanzi **ama**hle	'good (clean) water'
a+isi	→	esi-	'Class 7 adjective concord'	isihlalo **esi**khulu	'the big chair'
a+ulu	→	olu	'Class 11 adjective concord'	uluthi **olu**de	'the long stick'

b. Associative formative **la + noun (na + noun** in the 3 other languages**)**

la+abantu	→	labantu	'and/with the people'
la+inja	→	lenja	'and/with the dog'
la+umuntu	→	lomuntu	'and/with the person'

As seen in (2) coalescence can occur when the vowel **a** is followed by **a**, **i** or **u** resulting in the changes in (3). Note that even if a consonant precedes **a** as in (2)b. the same changes occur.

(3) Coalescence when the first vowel is **a**

a. a + a → a   b. a + i → e   c. a + u → o

The features [+low] and [-high] of the resultant **a** in (3)a. are the crucial ones taken from the two identical vowels that combine, [-round] and [+back] being supplied by default. In (3)b. [+low] from **a** and [+high] from **i** conflict. The non-conflicting features which survive are [-high] from **a** and [-low, -round] from **i** which are in fact features of mid-vowel **e**. The facts in (3)c. are the same as in (3)b. except that, unlike **i**, **u** has the feature [+round] rather than [-round] and hence the product of **a** and **u** is rounded mid-vowel **o**. In both (3)b. and (3)c., as in (3)a, the 'backness' feature is supplied by default since [+round] is also always [+back] in Nguni. (See also Khumalo 1987 and Sibanda 2004:123).

Perhaps more restricted is coalescence of the form illustrated in (4) which involves other combinations of identical vowels besides **a+a**.

(4) a. Noun Class Prefix + Noun Stem

ili-ihlo → ilihlo 'eye'   [plural: ama-ihlo → amehlo]

b. Compound Verb in the Immediate Past Tense (-b- = 'be' or 'become')

ube ehamba → ubehamba 'he was walking/going'

In (4)a the second **i** of the noun class prefix combines with an identical initial vowel of the noun stem. Since the vowels are identical with obviously no conflicting features it can be assumed that they coalesce to form monomoraic **i** in a way similar to what happens in the case of **a+a**. The gliding and deletion of high vowels discussed in Sections 2.2 and 2.3 may provide another perspective which will, however not be assumed for cases such as (4)a since coalescence seems a more straightforward analysis. When **e** combines with another **e** in compound words involving the verb root **-b-** 'be or become' as in (4)b. the two vowels also coalesce to a single monomoraic one. The vowel changes assumed in (4) are summarized in (5)a. and (5)b..

(5) Combination of identical vowels (excluding a+a)

a. i+i → i   c. o+o → o ?
b. e+e → e   d. u+u → u ?

No examples of **o+o** or **u+u** were found but one can only guess that an **o+o** combination if it can be found in any of the Nguni languages produces monomoraic **o** and that of **u+u** monomoraic **u** following what we have already seen with combinations of two identical vowels. Although there are no attested forms, at least for now, (5)c and (5)d. are included, but with question marks, to ensure that no possible combination is left out in the discussion.

The vowel changes due to coalescence discussed in this sub-section can be presented formally as in (6). (See also Sibanda 2004).

(6) a. Coalescence of identical vowels b. Coalescence of **a** and a high vowel

$$\begin{array}{ccccc} V & V & & V \\ | & | & \rightarrow & | \\ [\alpha F] & [\alpha F] & & [\alpha F] \end{array} \qquad\qquad \begin{array}{ccccc} V & V & & V \\ | & | & \rightarrow & | \\ [+low] & [+high] & & [-high, -low] \end{array}$$

(6)a. shows that when two vowels with identical features come together the result is a single monomoraic one with the same features. (6)b. illustrates that when a [+low] vowel is immediately followed by a [+high] one they coalesce to a monomoraic [-high, -low] one.

2.2. Gliding/Consonantalization

Next to be considered are combinations of two vowels where the first in the sequence is [+high]. Cases where a [+high] vowel subject marker is prefixed to a vowel initial verb as in (7) are good examples. In (7)a **i-** is a class 9 subject marker and in (7)b. **u-** is a class 1 subject marker.

(7) Subject Marker + Vowel Initial Verb Stem

a.	i-enza	→	yenza	'it is doing …'	b.	u-enza	→	wenza	's/he is doing …'
	i-akha	→	yakha	'it is building …'		u-akha	→	wakha	's/he is building …'
	i-ona	→	yona	'it is spoiling …'		u-ona	→	wona	's/he is spoiling …'

As can be seen, the [+high] vowel glides so that **i** becomes semi-vowel **y** and **u** semi-vowel **w**. This process whereby a vowel becomes a semi-vowel is often referred to as consonantalization. (See for example Doke 1997). The changes in (7) are summarized in (8).

(8) Gliding of [+high] vowel

a.	i + e	→	ye	i + a	→	ya	i + o	→	yo
b.	u + e	→	we	u + a	→	wa	u + o	→	wo

It is important to note that re-ordering the vowels has a different effect. For instance, compare i + a → ya and u + a → wa to (2)b. and (2)c. above where a + i → e and a + u → o. Clearly, a [+high] vowel glides only when it is the first in the sequence but when it is the second coalescence may occur. Before presenting a rule that takes care of the changes summarized in (8) we need to see other vowel processes in the next subsection.

2.3. Glide formation and glide deletion

We have not yet checked to see if gliding of a high vowel occurs even if there is a preceding consonant. Before we do that, consider examples in (9) where there is at least a consonant followed by a high vowel. In (9)a-b. the high vowel of interest is **i** and in (9)c-d. it is **u**. While in (9)a. and (9)c. the high vowel and the preceding consonant belong to the same morpheme in (9)b. and (9)d. the high vowel and the preceding consonant belong to different morphemes. (9)e-h. provide the same facts as (9)a-d. but specifically with bilabial consonants which will be discussed below.

(9) Ci and Cu are acceptable whether or not the C and the i or u belong to the same morpheme

a.	um-khiz-o	→	umkhizo	'drizzle (noun)'
b.	ka-ngi-bon-i	→	kangiboni	'I do not see'
c.	dub-a	→	duba	'be troublesome'
d.	genq-ul-a	→	genqula	'turn upside down'

e. mil-a → mila 'germinate'
f. themb-is-a → thembisa 'promise'
g. buz-a → buza 'ask'
h. bhabh-ul-a/bhabhu-l-a → bhabhula 'carry on the back'

As can be seen, Ci and Cu are acceptable whether or not the C and the **i** or **u** belong to the same morpheme. There is no doubt from these examples that a high vowel can be immediately preceded by a consonant in Nguni, including a bilabial one.

The facts are, however, different when there are two vowels as in the examples we saw in (7) but this time with a preceding consonant. As seen in (10)a. where **si-** is class 7 subject marker, gliding occurs as in (7) but the glide **y** is then dropped. The same changes take place in nouns such as the classes 8 ones given in (10)b. where the prefix and stem come together. The glide would lead to the pronunciation of the preceding consonant with a palatal off-glide (i.e. Cy→C^y) which is unacceptable in Nguni. Deleting the glide **y** is a preferred solution in avoiding unacceptable VV or C^y. It must be emphasized here that what is deleted is the glide not the vowel before it glides as examples in (9) have shown us that Ci is acceptable and those in (7) have revealed that in VV sequences the first V glides if it is a high vowel.

(10) Gliding when there is a preceding consonant

a.	si-enza	→	syenza	→	senza	'it is doing'
	si-akha	→	syakha	→	sakha	'it is building'
	si-ona	→	syona	→	sona	'it is spoiling'
b.	izi-enzo	→	izyenzo	→	isenzo	'deeds'
	izi-andla	→	izyandla	→	isandla	'hands'
	izi-ono	→	izyono	→	izono	'sins'
c.	lu-enza	→	lwenza			'it is doing'
	lu-akha	→	lwakha			'it is building'
	lu-ona	→	lwona	(→	lona)	'it is spoiling'
d.	uku-akha	→	ukwakha			' to build/building'
	uku-eba	→	ukweba			'to steal/stealing'
	uku-ona	→	ukwona	(→	ukona)	'to spoil/spoiling'
e.	e-muntu-ini	→	emuntwini	'on the person'		
	e-sisu-ini	→	esiswini	'in the stomach'		
f.	Xhosa locatives:		ku-iviki	→	kwiviki	'on the week'

(cf. Ndebele & other Nguni Languages: ku-iviki→ kuviki)
ku-iphepha→kwiphepha 'on the paper'
(cf. Ndebele & other Nguni Languages: ku-iphepha→ kuphepha)

g. Zulu: ku-i-computer → kwi-computer
(cf. Ndebele: ku-i-computer → ku-computer)

In (10)c. where the subject marker used is class 11 **lu-**, glide **w** is permitted. In nouns such as those in class 15 provided in (10)d. glide **w** is also acceptable just as it is also permitted in locatives derived from nouns by prefixing **e-** to vocative forms and suffixing **-ini** as in (10)e.. When **u** glides to **w** an immediately preceding consonant is then pronounced with a labial off-glide (ie. Cw → C^w). (See also Tucker 1929). In other words the preceding consonant is labialized. Where the vowel after **u** is **o** the convention in Nguni languages is to write only **o** as in the bracketed examples. It seems phonologically **u+o** results in **wo** but for speakers of Nguni languages there is no contrast between C^wo and Co and hence orthographically the shorter form Co is preferred. Note that in Xhosa locative **ku-** plus **i** becomes **kwi-** although for historical reasons the **u** from **ku-** does not undergo the expected **u→w** change in the other Nguni languages where the initial vowel of the noun is dropped instead. This we see in (10)f. However, Zulu behaves like Xhosa but only in cases where foreign (especially English) words are used without any morphophonological changes except the use of a Zulu prefix as in (10)g.

Although C^w is acceptable in Nguni it is not without restriction. Labialized bilabials are unacceptable. If the bilabial is morpheme initial or is the first C of a morpheme **w** is dropped just like **y** as illustrated with verbs with a class 14 subject marker in (11)a. and nouns with class 1 and 3 prefixes in (11)b.

(11) No Labialized bilabials

a.	bu-enza	→	bwenza	→	benza	‘it is doing’	
	bu-akha	→	bwakha	→	bakha	‘it is building’	
	bu-ona	→	bwona	→	bona	‘it is spoiling’	
b.	umu-akhi	→	umwakhi	→	umakhi	‘builder’	
	umu-enzi	→	umwenzi	→	umenzi	‘doer’	
	umu-ona	→	umwona	→	umona	‘envy; jealousy’	
c.	umumbu+ana	→	umumbwana	→	umunjana	‘little/small maize’	
	impuphu+ana	→	impupwana	→	imputshana	‘small amount of corn flour’	
d	iqhubu+ana	→	iqhubwana	→	iqhutshana/ iqhubana		‘small swelling/bulge’
	ingqamu+ana	→	ingqamwana	→	ingqanyana/ ingqamana		‘small knife’
e.	e-qhubu-ini	→	eqhubwini	→	eqhutshini	‘on the swelling’	
	e-mumbu-ini	→	emumbwini	→	emunjini	‘in the maize’	
f.	e-ngqamu-ini	→	engqamwini	→	engqamini	‘on the knife’	
	e-mvubu-ini	→	emvubwini	→	emvubini	‘on the hippopotamus’	
	e-nwabu-ini	→	enwabwini	→	enwabini	‘on the chameleon’	

However, if the bilabial is non-initial it is palatalized (more specifically changed to a pre-palatal) in addition to the deletion of the derived glide **w** as shown in (11)c and in the locative forms in (11)e.. Note that an underived glide is not deleted after palatalization. Passive -**w**-, for instance, is always kept after platalization as shown in (12)a. A word such as **tshwabhana** ‘crease’ whose palatalized initial consonant **tshw-** is underlyingly labialized also does not loose the labialization as illustrated in (12)b.

(12) Underived glide is not deleted

a.	khuph-w-a	→	khutshwa	‘be removed’
b.	tshwabhan-a	→	tshwabhana	‘crease’

Palatalization in Nguni and other Southern Bantu languages is a dissimilatory process which arises due to the unacceptability of labialized (bi)labials. (For more details on palatalization, see for example, O’Bryan 1974, Louw 1975/76, Stahlke 1976, Ohala 1978, Beckman 1993, Doke 1997 and Sibanda 2004). In some cases there is optional non-palatalization in addition to palatalization as in the dimuinutive forms in (11)d. What is important to note is that so far there is no case where palatalization fails to take place completely and that **bilabial** plus **w** is never accepted. The only exceptions to palatalization are locative forms in (11)f. but even then **bilabial** plus **w** is not accepted. Unfortunately there is no **ibi-** prefix or a corresponding **bi-** subject marker for testing to see what happens word-initial when an **i** preceded by a bilabial consonant glides. Although there is **imi-** (class 4) it is never followed by a vowel initial stem and its corresponding subject marker is **i**-, not **mi**-. However, word finally **i** does occur after a bilabial as shown in (13) where the diminutive suffix **-ana** is also included.

(13) CiV sequences where C is a bilabial

a.	amatshumi+ana	→	amatshumyana	→	amatshumana (*amatshunyana)	‘a few tens’
	amabibi+ana	→	amabibyana	→	amabibana (amabitshana?)	‘a few heaps of rubbish’
b	umthubi+ana	→	umthubyana	→	umthubana/umthutshana	‘small york’
	indimi+ana	→	indimyana	→	indimana/indinyana	‘a few languages’
c.	inqumbi+ana	→	inqumbyana	→	inqunjana	‘small pile’
	insimbi+ana	→	insimbyana	→	insinjana	‘small piece of metal’

There is clearly no consistence here as there can be no palatalization completely as in (13)a., optional palatalization as in (13)b. or obligatory palatalization as in (13)c. In addition, when palatalization occurs optionally in Ndebele the palatalized form usually denotes an even smaller thing compared to what the unpalatalized form refers. For instance, **umthubana** ‘small yolk’ would normally be bigger than **umthutshana** ‘very small yolk’. Note also that obligatory palatalization occurs mainly when the consonant involved is the pre-nasalized stop **mb** whose labial place feature is already double linked.

The confusion in (13) is probably due to the fact that the dissimilatory process triggered by **w** is now being extended to cases where the glide is **y** as well. Palatalization seems to be treated as part of the morpheme marking the diminutive and yet the diminutive morpheme is actually **-ana**. We would otherwise not expect any palatalization here but only the dropping of **y**. It can perhaps be assumed that Nguni languages are moving towards uniform exponency of the diminutive suffix (which should now be **-ana** accompanied by palatalization) and that the leveling process is not yet complete. Given the inconsistence just discussed, there will be no focus on examples such as those in (13) in the next section. However, these examples are important here as they provide further evidence that **i** glides when the sequence is CiV. As already noted, only a glide triggers palatalization and, normally, it is **w** although in this case **y** seems to be the trigger.[1]

The more consistent phonological changes discussed in (10) and (11) which we will be concerned with can be summarized as in (14) where for clarity, a bilabial C is written as B and a palatal one as P.

(14) Gliding when the sequence is CiV or CuV

a.	C + i + a	→	Cya	→	Ca		
	C + i + o	→	Cyo	→	Co		
	C + i + e	→	Cye	→	Ce		
	[C + i +u	→	Cyu	→	Cu]?		(no examples)
b.	C + u + a	→	Cwa				
	C + u + o	→	Cwo				
	C + u + e	→	Cwe				
	C + u + i	→	Cwi				
c.	B + u + a	→	Bwa	→	Ba		(subset of b.)
	B + u + o	→	Bwo	→	Bo		
	B + u + e	→	Bwe	→	Be		
	B + u + i	→	Bwi	→	Bi		
d.	(C)(V)CVB + u + a	→	(C)(V)CVBwa	→	(C)(V)CVPa		(subset of b.)
	(C)(V)CVB + u + o	→	(C)(V)CVBwo	→	(C)(V)CVPo		
	(C)(V)CVB + u + e	→	(C)(V)CVBwe	→	(C)(V)CVPe		
	(C)(V)CVB + u + i	→	(C)(V)CVBwi	→	(C)(V)CVPi or Bi		

The examples in (14)a. show glide formation followed by glide deletion when the glide involved is **y**. However, no examples of Ciu were found although the prediction is that **i** would glide to **y** and the glide be eventually deleted as in other cases where **i** is followed by another vowel. (14)b. shows that CuV becoming CwV can be accepted as a perfect solution in avoiding some ill-formed VV sequences. (14)c. illustrates glide formation followed by glide deletion when the glide **w** is preceded by a bilabial consonant. (14)d. is the same as (14)c. except that some bilabials become palatals in the environment already discussed. Also, note that (14)c. and (14)d. are in fact sub-sets of (14)b as they are special cases of the surface realization of CuV. (For a formal palatalization rule that also takes into account non-local palatalization not discussed here, see Sibanda 2004: 208-210).

So far we have only seen the gliding of high vowels but this process is not restricted to just them. Gliding may also occur when the vowel is **o** as locative examples in (15) illustrate. In these examples the locative suffix **-eni** is used rather than the **-ini** we have already seen because **-ini** is only used when the noun ends with a high vowel **i** or **u**. The suffix **-eni** is used elsewhere.

[1] Note that even if the diminutive suffix is taken to be -yana (from Proto Bantu /-jana/ ‘child’) the palatal glide **y** must immediately follow the final consonant of the stem to trigger palatalization. In other words the final vowel of the stem must be dropped before -yana is suffixed.

(15) Gliding in the locative when the first vowel is **o**

a.	ixoxo	'frog'	e-xoxo-eni	→	exoxweni			'on the frog'
	izitho	'body parts'	e-zitho-eni	→	ezithweni			'in/on body parts'
b.	umbhobho	'gun'	e-mbhobho-eni	→	embhobhweni	→	embhojeni	'on/in the gun'
	umlomo	'mouth'	e-mlomo-eni	→	emlomweni	→	emlonyeni	'in the mouth'
c.	inkomo	'cow'	e-nkomo-eni	→	enkomweni	→	enkomeni	'on the cow'
	isimo	'shape/form'	e-simo-eni	→	esimweni	→	esimeni	'on the shape'

As seen in (15)a., when a noun is turned into a locative its final **o** glides and becomes **w**, resulting in the labialization of the preceding consonant. If the preceding consonant is a bilabial as in (15)b. palatalization may take place and the derived **w** eventually dropped. In some exceptional cases such as those in (15)c. palatalazation does not occur even if the consonant before **w** is a bilabial. The **w** is dropped, however.

One would expect to see some parallels in terms of gliding between mid vowels **o** and **e** just as we saw with high vowels **u** and **i**. However it is not very obvious that **e** glides. Consider the examples in (16) where (16)a. provides locative examples and (16)b. diminutive ones.

(16) Does **e** glide?

a.	indebe	'lip'	e-ndebe-eni	→	endebeni	'on the lip'
	ibele	'breast'	e-bele-eni	→	ebeleni	'on the breast'
b.	indebe	'lip'	in-debe-ana	→	indebana/indetshana	'small lip'
	ibele	'breast'	i-bele-ana	→	ibelana/ibedlana	'small breast'

In (16)a. there is no way of telling whether the process is coalescence or gliding followed by the deletion of **y**. In other words it is not clear whether the process is Cee → Ce or Cee→ Cye→Ce. As already alluded to, no argument on this will be pursued since the assumption here is that **ee** becomes monomoraic **e** (ee→e) through coalescence as there are no feature conflicts when the two identical vowels come together. The variation in (16)b. can perhaps be attributed to the confusion as to whether the process is deletion (Cea → Ca) or gliding followed by deletion (Cea→ Cya→Ce). One could argue that we get palatalization when there is gliding and no palatalization when there is no gliding. In the case of palatalization **y** would somehow have to change to **w** or something closer to trigger the process. (See Ohala1978 for a related discussion). However, the gliding of **e** might also occur as an intermediate stage without any accompanying palatalization just as we saw with **i**. An example would be Cea→ Cya→Ca without any palatalization similar to Cia→ Cya→Ca. Examples in (16)b. would then simply provide evidence that **e** glides but is somewhat treated as **o** which triggers palatalization when it glides. If this is the correct analysis, as assumed here, then the mid vowels **e** and **o** behave like high vowels **i** and **u** as far as gliding is concerned. Note that palatalization may here again be used as a diminutive morpheme (for example, **indlebana** 'small ear' but **indletshana** very small ear').

Other less obvious cases of gliding are those presented in (17). Here one is tempted to conclude that the mid vowel **e** is deleted before a high vowel **i** or **u** since there are no compromise vowels between mid and high.

(17) Vowel **e** followed by a high vowel

a.	ibe ihamba	→	ibihamba	'it was going'
	ube uhamba	→	ubuhamba	'you were going'
b.	ise-ihamba	→	isihamba	'it is now going'
	use uhamba	→	usuhamba	'you are now going'

However, as already noted the glide never surfaces when the underlying sequence is Cy. In exceptional cases we have seen where **y** is treated like **w** it triggers palatalization of a preceding bilabial but in (17)a. palatalization cannot occur even if **y** is treated like **w** because the first C of a morpheme is exempt from the process. Unlike in the case of **i**, the gliding of **e** cannot be shown when there is no preceding consonant as no examples were be found.

What is clear from the discussion in this sub-section is that besides the changes in (14) we also get the changes in (18). For these additional changes the first vowel in a sequence of two glides if it is mid vowel **o** or **e**.

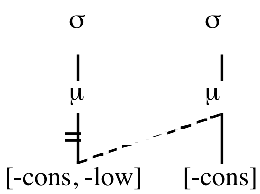
(18) Gliding when the first vowel in the sequence is a mid-vowel **o** or **e**

a.	o+e →	we	c.	e+a →	ya	e.	e+i →	yi
b.	o+a →	wa	d.	e+o →	(yo)?	f.	e+u →	yu

In (18)a. vowel **o** glides before **e** to give rise to **we** and in (18)b. where **o** precedes **a** the outcome when **o** glides is **wa**. In (18)c. **e** glides before **a** resulting in **ya**. No examples of **e** coming before **o** were found but the prediction is that the outcome would be **yo**. When **e** comes before **i** or **u** it also glides so that the result is **yi** or **yu** as in (18)e. and (18)f., respectively.

It is clear that both high and mid vowels glide in Nguni and the rule that summarizes the changes in this subsection and the preceding one is presented in (19).

(19) Glide formation



The rule shows that a [-low] vowel looses a mora (or glides) before another vowel. The second vowel in the sequence can be low, mid or high, as we have already seen, although there was no example of **i** coming before **u** and **e** preceding **o**.

2.4. Vowel deletion

Let us now turn to vowel deletion which, in this paper, simply refers to the dropping of a vowel. Changing the vowel's features or merging it with another does not count as deletion. When there is a sequence of two or more vowels deletion occurs mainly due to incompatibility of the features of the vowels involved. Here are some examples where **a** immediately precedes a mid vowel.

(20) Vowel **a** followed by a Mid Vowel

a.	a-enza	→	enza	'they are doing'
	a-ona	→	ona	'they are spoiling'
b.	be-sa-enza	→	besenza	'while they are still doing'
	be-sa-ona	→	besona	'while they are still spoiling'
c.	ba-onke	→	bonke	'all'
	ba-odwa	→	bodwa	'only them, alone'

In (20)a. each of the vowel initial stems follows the class 6 subject marker **a-** and in (20)b. the stem is preceded by the progressive prefix **sa-**. Pronoun stems in (20)c. are preceded by the class 2 subject marker **ba-.** In all cases vowel **a** is dropped and the mid vowel survives. The features of **a** and those of the mid vowels conflict and there is no compromise vowel in between as in the case of **a** versus high vowels where the compromise is a mid vowel.

The important changes we note in this sub-section are given in (21) where (21)a. and (21)b. show that **a** is dropped before a mid vowels **e** and **o**, respectively.

(21) Vowel deletion

a. a + e → e   b. a + o → o

These are the only cases where gliding does not seem to occur before deletion. The deletion rule can be presented as in (22).

(22) Vowel Deletion Rule

$$\begin{array}{c} V \\ [+low] \end{array} \rightarrow \emptyset \; / \_\_\_ \; \begin{array}{c} V \\ [-high, -low] \end{array}$$

The rule illustrates that a [+low] vowel is deleted before a mid [-high, -low] one.

2.5. Sequences with more than two vowels

It is also important to see what happens when there are more than two vowels in a row. Take, for instance, a vowel initial verb stem preceded by a subject marker and remote past tense **-a-** as in (23):

(23) Sequence of three vowels

a.	u-a-akh-a	→	w-a-akha/ u-akha	→	wakha	‘s/he built’
b.	si-a-on-a	→	sy-a-ona/ si-ona	→	syona/saona → sona	‘it spoiled’
c.	lu-a-enz-a	→	lw-a-enza/ lu-enza	→	lwenza	‘it does…’
d.	ba-a-akh-a	→	ba-akha	→	bakha	‘they did’

These examples present no new process but the processes we have seen above already: glide formation, glide deletion, coalescence and vowel deletion. In each case at least two processes are involved and the order in which they occur generally does not matter hence the variations. For instance, in (23)a. the underlying form **/u-a-akh-a/** becomes **w-a-akha** in the intermediate stage if glide formation occurs first but **u-akha** if coalescence takes place first. The surface form is of course **wakha** ‘s/he built’ no matter which of the two routes is taken at the intermediate stage. Only glide deletion needs to come after glide formation. In (23)b. there are even two intermediate stages because there is glide deletion in addition to glide formation and vowel deletion. In a case such as /**ba-a-akh-a**/ ((23)d.) coalescence occurs twice so that the sequence of three -**a-**s yields a monomoraic vowel **a**. No further comment is necessary here as the processes involved in each example are now obvious following the discussion above.

2.6. Summary

Before we leave this section a summary of all the vowel changes we have discussed appears to be in order. This is provided in the form of a table in (24)

(24) Combinations of two vowels

	i	**e**	**a**	**o**	**u**
i	i	ye	ya	yo	---
e	yi	e	ya	yo?	yu
a	e	[e]	a	[o]	o
o	---	we	wa	o ?	---
u	wi	we	wa	wo	u?

The first vowel in the sequence is in the leftmost column and the second is in the top row. The rest of the boxes show the product of combining the two vowels. While cases of gliding are obvious from the table, cases of deletion have been put in square brackets. This means that the rest of the vowels not preceded by glides are a result of coalescence. The products of **o+o** and **u+u** have question marks because no examples were found but are mere predictions. Boxes for other unattested cases have been left blank.

The processes discussed in this section which all occur in order to avoid unacceptable VV sequences can be treated together and summed up by the rule in (25). The prohibition of VV is resolved by de-linking the first V from the feature α leaving only the second V linked to β as illustrated with a general rule in (25)a. More specific changes follow in (25)b-d.

(25) Prohibition of VV

a.

$$\begin{array}{ccccc} V & & V & & V \\ | & & | & \rightarrow & | \\ \alpha & & \beta & & \alpha\,\beta \end{array}$$

b. ø → C if α = [-low]

c. If α = [+low] and β= [-high, -low] then α gets deleted.

d. Otherwise α + β coalesce:

   (i) If α = β no change in features

   (ii) If α = [+low] and β= [+high] result is [-high; -low]

(25)b. represents cases of gliding when α is [-low]. In other words it accounts for gliding when α is a mid or high vowel. Vowel deletion when α is [+low] and β is [-high, -low] is taken care of by (25)c. In cases where there is no gliding or deletion coalescence occurs in one of the two ways in (25)d. (25)d.(i) shows that coalescence when α and β are identical results in an identical vowel. However, if α is [+low] and β is [+high] the output is a [-high; -low] vowel as indicated in (25)d.(ii).

3. Optimality Theory (OT) Analysis

We now need to see what the phonological processes or changes noted in the preceding section translate to in Optimality Theory (OT) terms. Of course, OT constraints do not always have a simply one-to-one correspondence with serial derivation type of rules but the rules used in the presentation of data above were provided for clarity. There is obviously a non-violable constraint, *VV, which prohibits a sequence of two or more vowels within a phonological word and hence the processes we have seen. Two other non-violable markedness constraints defining the form of linguistic structure can be identified particularly where gliding is involved. These are $*C^{y}$ and $*B^{w}$ as we saw that in Nguni languages a consonant cannot be pronounced with a palatal off-glide and that labialized bilabials are disallowed. We also noted that when a bilabial is labialized there is palatalization if that bilabial is not morpheme initial. This means that there is also a violable markedness constraint, PAL, and a faithfulness constraint discussed in the next paragraph. As in Sibanda (2004), it is assumed here that palatalization occurs when a floating [+lingual, +high] feature bundle is linked to a bilabial C.[2] PAL forbids a labialized bilabial consonant and the floating feature bundle from remaining unlinked as illustrated in (26)a. where B^{w} stands for a labialized bilabial C.

(26) a. * [+lingual, +high]

B^{w}

b. [+lingual, +high]

$$\begin{array}{c} [+\text{lingual}, +\text{high}] \\ | \\ B^{w} \end{array}$$

The acceptable form is the one represented by (26)b. where the bilabial and the floating [+lingual, +high] feature bundle are linked. This has the effect of palatalizing input labialized bilabials in the output. The problem, however, is that for PAL we have to refer to an intermediate stage where gliding or labialization occurs rather than simply looking at input-output correspondence. The constraint in fact holds for ‘intermediate stage – output’ correspondence, something we will have to keep in mind when evaluating candidates in tableaux. Recall also that the palatals surface with no labialization

[2] [+lingual] is a feature of coronals and velars proposed by Lass (1976).

unless the glide triggering the process is underived such as the passive suffix **-w-** or the labialization in a palatal consonant that is underlyingly palatalized. It is clear that there is also a constraint $*P^w$ that prohibits palatal consonants from being labialized (but which is ranked lower than the faithfulness constraint prohibiting the deletion of a non-derived **w**). All these markedness constraints hold throughout the grammar.

Further, there are faithfulness constraints that require output to be identical to input (i.e. output to be faithful to input). IDENT +C is the faithfulness constraint blocking the palatalization of a morpheme initial bilabial by requiring the output C to be identical to input. This is a case of positional faithfulness. (For a discussion on positional faithfulness see Beckman 1998 & 1999). The faithfulness constraint MAX /w/ is the one that prohibits the deletion of a non-derived **w**. Glide deletion and vowel deletion obviously violate MAX, a faithfulness constraint forbidding the deletion of input segments in the output. Gliding (glide formation) and coalescence are violations of IDENT, a faithfulness constraint requiring output to be identical to input. In these two cases (gliding and coalescence) input segments are retained in the output but in a different form or with modified features. Furthermore, coalescence is a violation of UNIFORMITY (UNIF), a constraint prohibiting an output segment from having multiple correspondents in the input. Since epenthesis (including glide insertion) is not a solution to the problem of unacceptable VV sequences, it means that we also have a non-violable faithfulness constraint DEP requiring output segments to be present in the input or simply prohibiting insertion of new segments in the output. Finally, we also need to recognize a non-violable faithfulness constraint, MAX-rightmost V (MAX-RV), ensuring that in a sequence of two or more vowels the rightmost always survives regardless of the morpheme to which it belongs. In fact (25) illustrates how the rightmost vowel is always protected and that in serial derivation this is automatic when rules apply.

The constraints that have been identified are presented formally in (27).

(27) Constraints

*VV	A sequence of two or more vowels is disallowed within a single phonological word.
$*B^w$	No labialized bilabials. (No **Bilabial + w** sequence).
$*C^y$	No consonant pronounced with a palatal off-glide. (A sequence of **C** plus glide **y** is disallowed).
PAL	No unpalatalized labialized bilabial. (No labialized bilabial C unlinked with floating feature bundle [+lingual, + high]).
$*P^w$	No labialized palatal. (No **Palatal + w** sequence).
MAX	Do not delete segments.
MAX /w/	Do not delete underived /w/.
MAX-RV	Do not delete the rightmost vowel in a sequence of two or more vowels.
DEP	Do not insert new segments.
IDENT	Segments in the output are identical to segments in the input. (No modification).
IDENT +C	An input morpheme initial bilabial must also be bilabial in the output.
UNIF	No coalescence (No element of S2 has multiple correspondents in S1)

These are competing constraints that determine the shape of the output word and there is need to establish how they are ranked with respect to each other. The non-violable constraints *VV, $*C^y$, $*B^w$, IDENT +C , Max /w/, MAX-RV and DEP are, of course, undominated as they are all ranked highest. PAL is violated in cases where the labialized bilabial is the initial consonant of a morpheme. In other words it can be violated in order to satisfy IDENT +C. There are also a few irregular cases such as those we saw in (11)d. where PAL can be violated but due to the limitations of this paper we will ignore those and simply treat them as exceptions. $*P^w$ must be ranked lower than MAX /w/ since it is violated when palatalized forms with an underived **w** surface labialized. However, $*P^w$ does not seem to be ranked lower or above PAL. It is clear that $*P^w$ must be ranked above MAX as the latter can be violated when palatals loose labialization. It follows that MAX is ranked lower than all the non-violable constraints. MAX can in fact be violated in order to avoid violating them. We have seen that vowel deletion occurs in order to avoid VV sequences and that glide deletion ensures that there are no C^y and B^w consonants. Although IDENT may also be violated in order to avoid violating a higher ranked constraint, *VV, it is ranked below MAX as it may be violated in order to avoid deletion. IDENT is also violated when palatalization occurs. This means that it must also be ranked below PAL. In cases where gliding and coalescence are acceptable (i.e. where IDENT is violated) violations of MAX and the undominated constraints are avoided. Since coalescence is acceptable in Nguni, it means UNIF is lowly ranked and it is assumed here that it is freely ranked with IDENT. In fact UNIF does not seem to play any crucial role that could affect the outcome in any of the tableaux considered below. The constraints in (27) can therefore be ranked as in (28) where *VV, *C^y, *B^w, IDENT +C and DEP are ranked highest and IDENT and UNIF lowest.

(28) Constraint Ranking

*VV, *C^y, *B^w, IDENT +C, MAX /w/, MAX-RV, DEP >> PAL, *P^w >> MAX >> IDENT, UNIF

Given these constraints we now need to see if indeed they generate acceptable surface forms. Consider the tableau in (29) where a few plausible candidates for the input /ba-onke/ ‘all’ are evaluated. From what we saw in the last section vowel deletion should produce the optimal candidate in this instance.

(29) Vowel Deletion is optimal

Input /ba-onke/	*VV, *C^y, *B^w , MAX /w/, DEP, IDENT +C, MAX-RV	PAL, *P^w	MAX	IDENT, UNIF
a. baonke	*! (*VV)			
☞ b. bonke			*	
c. banke	*! (MAX-RV)		*	
d. bawonke	*! (DEP)			

As can be seen, candidate (29)a. is ruled out as it violates one of the highest ranked constraints, undominated *VV, even though output is identical to input. Candidate (29)d. is also unacceptable as it violates undominated DEP by epenthesizing glide **w**. Candidate (29)c., **banke,** makes a fatal violation of MAX-RV besides violating the more general faithfulness constraint, MAX. Candidate (29)b., **bonke**, emerges as the clear winner since it only violates a lower ranked constraint, MAX. In fact the winner where there is a VV sequence will always violate at least one of the two lower ranked faithfulness constraints, MAX or IDENT, in order not to make a fatal violation of the undominated constraint *VV. As already alluded to, Max is violated through vowel and glide deletion, and IDENT through coalescence or glide formation.

The constraint MAX-RV also plays a crucial role when coalescence and glide formation are optimal. The tableau in (30) with input **/la-umuntu/** ‘and/with the person’ illustrates how candidates are evaluated when coalescence is optimal.

(30) Coalescence is optimal

Input / la-umuntu/	*VV, *C^y, *B^w , MAX /w/, DEP, IDENT +C, MAX-RV	PAL, *P^w	MAX	IDENT, UNIF
a. laumuntu	*! (*VV)			
b. lumuntu			*!	
☞ c. lomuntu				*** (IDENT, UNIF)
d. lamuntu	*! (MAX-RV)		*	
e. lawumuntu	*! (DEP)			

Candidates (30)a. and (30)e. are clearly ruled out by the undominated constraints *VV and DEP, respectively. (30)d. would be a strong candidate but violates undominated MAX-RV by deleting the vowel from the stem rather than the one from the prefix. This leaves only candidates (30)b. and (30)c. which delete the prefix vowel and coalesce the two successive vowels, respectively. Lower ranked constraints MAX and IDENT have to decide the winner. Although candidate (30)c. violates IDENT twice and UNIFORMITY once it emerges as the winner since (30)b. is penalized for violating a higher ranked constraint, MAX.

In (31) where glide formation is optimal we also see that candidate (31)a. whose output is identical to input and candidate (31)e. which inserts a glide between vowels are both ill-formed as they violate the highest ranked constraints *VV and DEP, respectively. Candidate (31)c. is ruled out by MAX-RV as the vowel from the suffix is deleted rather than the one from the stem. This is in contrast to (33)b. which drops the vowel from the stem and violates none of the highest ranked constraints.

(31) Glide formation is optimal.

Input /e-xoxo-eni/	*VV, *C^y, *B^w , MAX /w/, DEP, IDENT +C, MAX-RV,	PAL, *P^w	MAX	IDENT, UNIF
a, exoxoeni	*! (*VV)			
b. exoxeni			*!	
c. exoxoni	*! (MAX-RV)		*	
☞ d. exoxweni				* (IDENT)
e. exoxoweni	*! (DEP)			

However candidate (31)b. is penalized for violating MAX which (31)d. does not. The winning candidate, (31)d., only violates lowest ranked IDENT but this is inconsequential.

So far the constraints*C^y, *B^w , PAL and *P^w have not played any role. A question we will need to answer below is whether or not we really need them in these tableaux. In some cases, as we saw in the previous section, glide deletion is optimal rather than vowel deletion. However, in OT, this may not be obvious as the focus is usually on input-output correspondence. Since gliding occurs at an intermediate stage what is obvious is the deletion of an input segment, the vowel, not the modified intermediate segment, the glide. Consider a case of consonant plus glide, Cy, surfacing as consonant illustrated in (32) where input Ci becomes C in the output.

(32) Glide Deletion is optimal.

Input / si-enza/	*VV, *C^y, *B^w , MAX /w/, DEP, IDENT +C, MAX-RV	PAL,*P^w	MAX	IDENT, UNIF
a. sienza	*! (*VV)			
☞ b. senza			*	
c. sinza	*! (MAX-RV)		*	
d. syenza	*! (*$C^{y)}$			* (IDENT)
e. siyenza	*! (DEP)			

As can be seen from the tableau, the candidates with a Cy (C^y) consonant fair badly in the evaluation but we still get the correct result by comparing output C to input Ci. Each of the candidates in (32) violate one of the highest ranked constraints except the winner, (32)b., which however, violates a lower ranked constraint, MAX by deleting a vowel from the prefix. [3] As we saw in the last section, the vowel is deleted only after it glides even though this is not reflected on the tableau. Cases of Cw (C^w) that do not involve palatalization can obviously be evaluated like those involving Cy (C^y) we have just

[3] Note that (32)e., **siyenza** is identical to a continuous present verb meaning “we are doing” but whose input is /si-ya-enza/ not simple present tense input /si-enza/ ‘we do’.

seen. The constraints $*B^w$, $*P^w$ and PAL still seem to play no role even here as we are able to get the correct result without involving them.

Let us see how candidates are evaluated when there is a palatalizable bilabial consonant, for example, **mb** (^{m}b), a pre-nasalized bilabial stop which must surface as a pre-nasalized palatal stop **nj** (^{n}j). Let us consider evaluation of candidates in (33) when the input is **/umumbu+ana/** 'little/small maize'.

(33) Is glide deletion accompanied by palatalization optimal?

Input /umumbu-ana /	*VV, $*C^y$, $*B^w$, MAX /w/, DEP, IDENT +C, MAX-RV	PAL, $*P^w$	MAX	IDENT, UNIF
a. umumbuana	*! (*VV)			
💣☞ b. umumbana			*	
c. umumbuna	*! (MAX-RV)		*	
d. umumbwana	*! ($*B^w$)			* (IDENT)
e. umumbuwana	*! (DEP)			
f. umunjwana		*! ($*P^w$)		**** (IDENT)
g. umunjana			*	**! (IDENT)
h. umunjuna	*! (MAX-RV)		*	*** (IDENT)

Candidates (33)a., (33)c., (33)e and (33)h. which all violate undominated constraints are less interesting. However, (32)d. which is also penalized for violating one of the highest ranked constraints, $*B^w$, is of interest as it is the candidate we expect to win at an intermediate stage. Candidate (32)f. with both gliding and palatalization also fairs badly as it violates $*P^w$ since a derived glide cannot co-occur with a palatal consonant. In addition, (33)f. violates lower ranked IDENT thrice. Note that this candidate should in fact not be on the tableau (together with candidates (33)g. and (33)h.) as there is no glide in the input to trigger palatalization. It is included just because it will be relevant in the discussion below. Candidate (33)g. which should in fact be the winner loses as it violates IDENT twice besides violating MAX once. This candidate can also not be expected to win as there is no glide in the input to trigger palatalization. (33)b., the candidate which eventually wins only violates MAX once. By ignoring the intermediate stage both the acceptable surface form **umunjana** and its intermediate stage form **umumbwana** lose to unpalatalized **umumbana**. We get the wrong result because glide deletion in (33) is treated the same way as vowel deletion we saw in (29).

In Optimality Theory opacity and cyclicity or simply those cases involving an intermediate stage such as CVV→CGV→CV/PV we have just seen (where G is a glide and P a palatal consonant) are often dealt with by appealing to the Sympathy Theory (McCarthy 1999, 2003), Output-Output Correspondence Theory (Benua, 1995, Benua, 1997b, Kager, 1999, Kenstowicz, 1996,) or some modified versions of these (for example, Coetzee 2002).[4] Both Sympathetic and Output-Output correspondence constraints have to do with non-Input-Output relations. Problems with both theories are well articulated in Kiparsky (2000) and need not be restated here. However, an important point to emphasize is that the Sympathy Theory treats a change A→B→C as A→C and ignores the crucial role B plays. Rather than acknowledge the role played by B, a sympathetic candidate is introduced and the problem is shifted from the data to constraints so that serial evaluation is avoided in preference to parallel evaluation. Thus, instead of the original input-output correspondence constraints the Sympathy Theory introduces Sympathy Constraints many will probably agree, are less transparent and not easy to process. As Kiparsky (2000:14) notes about the Sympathy Theory, "nothing can be concluded in such a case about the relation between A and C". Ordering theories and level theories, on the other hand, properly capture the relationship between A, B and C.

---

4 McCarthy (2006 & 2007) provides another way of dealing with opacity in OT by introducing candidate chains. There are also other proposals such as those presented in Green 2004 and Wee 2007. Although these approaches could be used, it seems, the data presented here is more straightforwardly handled in Stratal OT.

The Output-Output Correspondence Theory appears to have a similar problem as it also ignores the crucial direct role played by B and looks for something else (the base) which, in many cases, may just have an indirect role. For the same change A→B→C the Output-Output Correspondence Theory also treats it as A→C but further looks for correspondence between C and another related form, say X, identified as the BASE. This theory works best in cases where the pronunciation of big words appears to depend on the pronunciation of smaller words from which they are derived (usually in a cyclic fashion). A rough sketch of how these two theories can be conceptualized is given in (34).

(34) Correspondence for process A→B→C

a. Sympathy Theory			b. Output-Output Correspondence		
Input A	↔	Output C	Input A	↔	Output C
		↕			↕
		Sympathetic Candidate			Output X (Base)

Arrows with unbroken lines show correspondence between Output C and the other two forms in each case. Arrows with dotted line capture the fact that both the Sympathetic Candidate and Output X (Base) are not arbitrary but must somehow be related to Input A.

The Nguni data discussed above shows that B is crucial in the relationship between A and C. Input-output correspondence is between A and B and between B and C as illustrated in (35).

(35) What Nguni Data shows

A ↔ B ↔ C which can be restated as, Input A ↔ Output B Input B ↔ Output C
e.g. ^{m}buV ↔ ^{m}bwV ^{m}bwV ↔ ^{n}jV

Without the glide in B the relationship between A and C is not captured as **^{m}buV** in A is not the trigger of palatalization in C (**^{n}jV**) but **^{m}bwV**. Assuming that there is an input Cx whose base is Xz and whose output is Cz, the Nguni data would show the following correspondences.

(36) Nguni data when input=Cx , Base=Xz and output=Cz.

Cx↔Cy↔ Cz and Xx↔Xy↔ Xz
[e.g. umu**mbu**-ana → umu**mbw**ana → umu**nj**ana 'small maize' **and**
emu**mbu**-ini → emu**mbw**ini → emu**nj**ini 'in the maize'
where in both cases ^{m}bu (x) →^{m}bw (y)→nj (z)]

However, in (36) umu**nj**ana 'small maize' and emu**nj**ini 'in the maize' do not show the type of base-output correspondence usually referred to in Output-Output accounts. A natural base for both should be **umumbu** 'maize' which has no palatalization. There is no word **umunju** with a palatalized consonant **^{n}j** which can serve as the base. This case would therefore be problematic for an Output-Output correspondence account where correspondence between an output and its base is crucial.

A way of resolving the problem in (33) is evaluating the candidates twice as dictated by the data. While this might look like serial evaluation which is avoided in OT it seems best to do it within the Lexical Phonology frame work (as advanced by Kiparsky 1982, 1985, Mohanan 1982, Booij and Rubach 1987 and others) so that constraints are only used at the level(s) to which they apply. This way serial evaluation is appropriately constrained. In other words Kiparsky's (2000) Stratal OT approach seems the best way forward in cases of opacity. In fact what we end up with is parallel evaluation in a constrained serial fashion, the number of levels where evaluation takes place being determined by Lexical Phonology. This should be seen as enriching OT rather than weakening the theory as such an approach has more straightforward explanatory power lacking in the other two versions of OT that deal with opacity we have discussed.

Given an input such as **/umumbu+ana/** 'little/small maize', what we get at the intermediate stage should be treated as the output of the first input. This output then becomes the input for the second (final) output. The constraints $*B^w$, $*P^w$ and PAL are only relevant when the evaluation is done for the second time as bilabial plus glide is acceptable in the first output. When the evaluation is done for the first time these constraints need not even be included in the tableau as they play no role in deciding the winning candidate. The two tableaux in (37), one for evaluation at the Cyclic Lexical Phonology level and the other for evaluation at the Post-Cyclic Lexical Phonology level should help explain the point. Note that the constraints $*B^w$, $*P^w$ and PAL dealing with glide deletion and palatalization are at the Post-Cyclic Lexical Phonology level not the Post-Lexical level because glide deletion and palatalization have some lexical exceptions as we saw above unlike Post-Lexical rules which apply without exceptions. Also, constraints in the first tableau in (37) are also included in the second one as the same well-formedness conditions still hold. For clarity the same candidates as those in (33) are retained in each of the tableaux even if some of the candidates **umunjwana**, **umunjana** and **umunjana** are irrelevant in the first tableau as there is no environment for palatalization.

(37) Glide deletion with palatalization is optimal

Input 1 /umumbu-ana / (Cyclic Lexical phonology)

Input /umumbu-ana /	*VV, DEP, MAX /w/, IDENT +C, MAX RV	MAX	IDENT, UNIF
a. umumbuana	*! (*VV)		
b. umumbana		*!	
c. umumbuna	*! (MAX RV)	*	
☞ d. umumbwana			* (IDENT)
e. umumbuwana	*! (DEP)		
f. umunjwana			***! (IDENT)
g. umunjana		*!	** (IDENT)
h. umunjuna	*! (MAX RV)	*	** (IDENT)

Input 2 /umumbwana / (Post-Cyclic Lexical phonology)

Input /umumbwana/	*VV, DEP, MAX /w/, $*C^y$, $*B^w$, IDENT +C, MAX RV	PAL, $*P^w$	MAX	IDENT, UNIF
a. umumbuana	*! (*VV)	* (PAL)		* (IDENT)
b. umumbana		*! (PAL)	*	
c. umumbuna		*! (PAL)	*	* (IDENT)
d. umumbwana	*! ($*B^w$)	* (PAL)		
e. umumbuwana	*! (DEP)	* (PAL)		
f. umunjwana		*! ($*P^w$)	*	** (IDENT)
☞ g. umunjana			*	** (IDENT)
h. umunjuna			*	***! (IDENT)

When the input is **/umumbu-ana /** four candidate a., c., e. and h. are the first to be eliminated as they violate the highest ranked constraints, *VV, MAX RV, DEP and MAX RV, respectively. This leaves candidate b. d., f and g. to compete. Since b. and g. violate MAX by deleting the vowel **u** they are the next to be eliminated as the other remaining two candidates only violate lowest ranked IDENT**.** Candidate d. which violates IDENT once by changing **u** to glide **w** eventually wins as candidate f. violates the same constraint three times. Although candidate g. is one of the least plausible in the tableau as there is no glide triggering palatalization, it is crucial in the second tableau as it must be the winner.

As can be seen, when **/umumbwana/**, the winning candidate in the first tableau, becomes the input in the second tableau three candidates (a., d. and e.) are ruled out as they violate at least one undominated constraint each. This leaves five candidates to compete two of which are penalized for violating PAL and one for violating $*P^w$. Although the remaining two candidates (g. and h.) tie when evaluated for violations of MAX candidate g., **umunjana,** emerges as the sole winner as it violates the lowest ranked constraint, IDENT, twice while candidate h. violates the same constraint thrice. Note that candidate f. which could easily be the winner violates $*P^w$. by its failure to delete a derived glide after palatalization. Candidate a., c. and h. are the least plausible and would normally not even be included in the tableau as **w** never becomes **u** in Nguni although **u** can become **w**.

A question that now arises is what (37) tells us about other cases of glide deletion which do not involve palatalization such (32). It should be clear that when we treat glide deletion as vowel deletion we get the correct outcome by coincidence. Just as in mathematics one can sometimes get the correct answer using the wrong method but then get stuck when working on other similar problems. If correctly done, all cases of glide deletion should involve two stages of evaluation as in (37), $*C^y$ being at the Post-Cyclic level just like $*B^w$. Treating glide deletion as vowel deletion yields the correct result only because **y** never surfaces in cases involving **Cy** and, unlike **w** which triggers palatalization of a preceding bilabial consonant, **y** does not normally trigger any phonological processes whose effect could be seen after it has been dropped. Obviously, where **w** does not lead to palatalization of a preceding consonant we could also get the correct outcome by treating glide deletion as vowel deletion but two stage evaluation as in (37) would account for all Cy and Cw cases without exception if we exclude the few irregular forms we pointed out in the previous section.

4. Conclusion

This paper has not been an exhaustive study of Nguni vowel processes but has concentrated on those processes relevant to the discussion of unacceptable VV sequences, namely, coalescence, vowel deletion, glide formation (consonantalization) and glide deletion. There may however be other vowel process not dealt with here and which are not associated with resolving the problem of unacceptable VV sequences such as glide insertion in the imperative where every syllable must have an onset.

From the discussion above it is clear that the problem of unacceptable VV sequences can generally be resolved mainly phonologically with very little appeal to morphology. However, historical facts cannot be ignored for a few cases that look like exceptions especially where MAX RV seems to be violated such as those involving vowel subject and object markers, and some locative prefixes but not discussed here for lack of space. It has also been shown that the data can be analyzed within the OT framework but requires more than just input-output correspondence as there is an important intermediate stage which cannot be ignored particularly where vowel gliding triggering palatalization of a preceding consonant occurs. It has been demonstrated that Stratal OT, a fusion of Lexical Phonology and Optimality Theory, is best suited to handle opacity particularly the type displayed by Nguni data.

The paper will, hopefully, help in resolving some of the problems of morpheme concatenation in Nguni. It is often tempting to use morphological constraints such as MAX ROOT and MAX AFFIX when in fact the VV problem can be solved phonologically once the operation of vowel processes discussed here is understood.

References

Beckman, Jill. 1993. Feature Organization and The Strong Domain Hypothesis in Zulu [Labial] Phonology. *University of Massachusetts Occasional Papers* 16: 1-26.

___. 1998. Positional Faithfulness. Ph.D. Dissertation. University of Massachusetts, Amherst.

___. 1999. *Positional Faithfulness: An Optimality Theoretic Treatment of Phonological Asymmetries*. New York: Garland Publishers.

Benua, Laura. 1995. Identity Effects in Morphological Truncation. In Jill Beckman, Laura Walsh Dickey and Suzanne Urbanczyk (eds), *Papers in Optimality Theory* (pp 77-136). Amherst, MA: GLSA Publications.

___. 1997b. Transderivational Identity: Phonological Relations Between Words. Ph.D. Dissertation. University of Massachusetts, Amherst.

Booij, G. and J. Rubach. 1987. Postcyclic Versus Postlexical Rules in Lexical Phonology. *Linguistic Inquiry* 18: 1-44.

Casali, Roderick F. 1996. Resolving Hiatus. Ph.D. Dissertation. University of California, Los Angeles. ROA-215.

Coetzee, Andries W. 2002. OO-Correspondence as Cumulativity. *University of Massachusetts Occasional Papers* 26: 27-57.

Doke, Clement M. 1997. *Textbook of Zulu Grammar*. Sixth Edition, Fourteenth impression. Maskew Miller Longman.

Einhorn, E. and L. Siyengo 1990. *Xhosa: a concise manual*. Cape Town: Faircape Books.

Green, Antony D. 2004. Opacity in Tiberian Hebrew: Morphology, not phonology*. *ZAS Papers in Linguistics* 37: 37 – 70.

Kager, René. 1999. Surface Opacity of Metrical Structure in Optimality Theory. In Ben Hermans and Marc van Oostendorp (eds), *The Derivational Residue in Phonological Optimality Theory*, (pp 207-245). Amsterdam: John Benjamins.

Kenstowicz, Michael. 1996. Base-identity and Uniform Exponence: Alternatives to Cyclicity.. In J. Durand and B. Laks (eds), *Current Trends in Phonology: Models and Methods* (pp 363-393). Paris-X and Salford: University of Salford Publications.

Khumalo, James Steven Mzilikazi. 1987. An Autosegmental Account of Zulu Phonology. Ph.D. Dissertation. University of Witswatersrand, Johannesburg.

Kiparsky, Paul. 1982. From Cyclic Phonology to Lexical Phonology. In John A. Gold Smith. 1999. *Phonological Theory: The Essential Readings* (pp 34-62.). Malden, MA : Blackwell.

___. 1985. Some Consequences of Lexical Phonology. *Phonology Yearbook* 2: 82-138.

___. 2000. Opacity and Cyclicity. *The Linguistic Review* 17: 351-367.

___. Fenno-Swedish Quantity: Contrast in Stratal OT. To appear in Bert Vaux (ed.).

Lass, Roger. 1976. *English Phonology and Phonological Theory: Synchronic and Diachronic studies*. Cambridge: Cambridge University Press.

Louw, J. A. 1975/76. Palatalization of Bilabials in the Passive, Diminutive and Locative in Xhosa and Tsonga. *Afrika und Ubersee, Band LIX/4*: 241-278.

Malcolm, D. McK. 1966. *A New Zulu Manual,* Second Edition. Cape Town: Longman.

Mbeje, Audrey N. 2005. *Zulu Learner's Reference Grammar*. Maddison: NALRC Press.

McCarthy, John J. 1994. Remarks on Phonological Opacity in Optimality Theory. ms., Amherst: University of Massachusetts.

___. 1999. Sympathy and Phonological Opacity. *Phonology* 16: 331-399.

___. 2003. Sympathy, Cumulativity, and the Duke-of-York Gambit. In Caroline Féry and Ruben van de Vijver (Eds). *The Optimal Syllable* (pp 23-76). Cambridge: Cambridge University Press.

___. 2006. Candidates and Derivations in Optimality Theory. ROA 823.

___. 2007. *Hidden Generalizations: Phonological Opacity in Optimality Theory*. London: Equinox Publishing.

McCarthy, John J. and Allan S. Prince. 1990. Foot and Word in Prosodic Morphology: The Arabic Broken plurals. *NLLT* 8: 209-284.

___. 1993a. Generalized Alignment. *Yearbook of Morphology*: 79–153.

___. 1994. The Emergence of the Unmarked: Optimality in Prosodic Morphology. *NELS 24*, 333-379.

___. 1994 Prosodic Morphology. In John Goldsmith (ed.). *A Handbook of Phonological Theory* (pp. 318–366). Oxford: Basil Blackwell.

___. 1995. Faithfulness and Reduplicative Identity. *University of Massachusetts Occasional Papers in Linguistics* 18: 249–384.

Mohanan, Karuvannur Puthanveettil. 1982. Lexical Phonology. Ph.D. Dissertation. M.I.T., Cambridge, Massachusetts.

O'Bryan, M. 1974. The Role of Analogy in Non-Derived Formations in Zulu. *Studies in the Linguistic Science* 4, Number 1: 144-178.

Ohala John, J. 1978. Southern Bantu vs The World: The Case of Palatalization of Labials. *Berkeley Linguistics Society:* 370-386

Prince Allan and Smolensky, Paul. 1993. Optimality Theory: Constraint Interaction in Generative Grammar. ms., New Brunswick : Rutgers University and Boulder: University of Colorado.

Sibanda, Galen. 2004. Verbal Phonology and Morphology of Ndebele. Ph.D. Dissertation. University of California, Berkeley.

Stahlke, Herbert F. W. 1976. Segment Sequences and Segmental Fusion. *Studies in African Linguistics 7*: 41-63.

Tucker, A. N. 1929. *The comparative Phonetics of the Suto Chuana Group of Bantu Languages*. London: Longmans, Green and Co.

Wee, Lian Hee. 2007. A Percolative Model of Phonology. ROA 919.

Ziervogel, D. 1952. *A Grammar of Swazi*. *Johannesburg*: Witwatersrand University Press.

Selected Proceedings of the 38th Annual Conference on African Linguistics: Linguistic Theory and African Language Documentation

edited by Masangu Matondo, Fiona Mc Laughlin, and Eric Potsdam

Cascadilla Proceedings Project Somerville, MA 2009

Copyright information

ISBN 978-1-57473-429-4 library binding

Ordering information

Orders for the library binding edition are handled by Cascadilla Press.
To place an order, go to www.lingref.com or contact:

Cascadilla Press, P.O. Box 440355, Somerville, MA 02144, USA
phone: 1-617-776-2370, fax: 1-617-776-2271, e-mail: sales@cascadilla.com

Web access and citation information

This entire proceedings can also be viewed on the web at www.lingref.com. Each paper has a unique document # which can be added to citations to facilitate access. The document # should not replace the full citation.

This paper can be cited as:

Sibanda, Galen. 2009. Vowel Processes in Nguni: Resolving the Problem of Unacceptable VV Sequences. In *Selected Proceedings of the 38th Annual Conference on African Linguistics*, ed. Masangu Matondo, Fiona Mc Laughlin, and Eric Potsdam, 38-55. Somerville, MA: Cascadilla Proceedings Project.

or:

Sibanda, Galen. 2009. Vowel Processes in Nguni: Resolving the Problem of Unacceptable VV Sequences. In *Selected Proceedings of the 38th Annual Conference on African Linguistics*, ed. Masangu Matondo, Fiona Mc Laughlin, and Eric Potsdam, 38-55. Somerville, MA: Cascadilla Proceedings Project. www.lingref.com, document #2134.