Distribution of Mid Vowels and Relating Vowel Harmony in Zulu

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Abstract

This paper focuses on the distribution of mid vowels in Zulu and how the language system treats them. In this language, mid-low vowels such as [ɛ] and [ɔ] are raised to mid-high position as [e] and [o], when directly followed by a syllable with a high vowel. This paper attempts to analyze how raising happens focusing on [ATR] feature, and looks at cases which have not been studied in depth, such as whether the harmony iteratively occurs in the cases where a syllable with another mid vowel exists before the target mid vowel, or how a glide sound affects the harmony pattern. The analysis is given in terms of both Rule-based Theory and Optimality Theory. This paper has found that the vowel harmony regarding the mid vowels is non-iterative, and also found that a glide sound cannot be a trigger for the harmony.

1. Introduction

This paper focuses on the distribution of mid vowels in Zulu and how the language system treats them. In this language, mid-low vowels such as [ɛ] and [ɔ] are raised to mid-high position as [e] and [o], when directly followed by a syllable with a high vowel. This paper attempts to analyze how raising happens, and looks at cases which have not been studied in depth, such as whether the harmony occurs in the cases where a syllable with another mid vowel exists before the target mid vowel, or how a glide sound affects the harmony pattern.

Example 1

1e-i	ikesi	[ikesi]	case	mid-high
3e-e	ibele	[iɓɛlɛ]	breast	mid-mid
9e-u	phenduka	[pʰenduɻa]	to turn	mid-high
21e-e-i	phelelisa	[pʰɛlelisa]	make complete	mid-mid-high
26o-y	umoya	[umɔja]	wind	mid-glide

Above are the key data in this paper. Examples 1, 3, 9 exemplify the vowel harmony between one mid vowel and one high vowel, example 21 demonstrates the vowel harmony among three vowels in the case where two mid vowels are followed by a high vowel, and example 26 illustrates how the glide works in terms of the vowel harmony. This study is based on the hypothesis that two mid vowels may be raised and form a single high vowel in the vowel harmony, and this phenomenon is triggered by a glide.

2. Literature Review

Zulu has 5 vowels, in which [i] and [u] are high vowels, [ɛ] and [ɔ] are mid vowels, and [a] is a low vowel. However, it has also been said that the two mid vowels are raised in a specific environment, where [ɛ] becomes [e], [ɔ] becomes [o], both being their allophones respectively. Poulos and Bosch (1997) explain this phenomenon:

"The two mid-vowels have slightly raised variants in certain environments. Thus a raised variant of [e] and [o] occurs when the vowel in the next syllable is a high vowel in words such as the following:

ngithengi, ababoni" (Poulos & Bosch 1997: 51). For example, 'o' in 'ababoni' is pronounced as [o], not as [ɔ], since this 'o' is followed by a high vowel [i] in the next syllable. Poulos and Bosch (1997) describe this phenomenon as a *vowel harmony*, specifically, the assimilation of the height of the vowel.

The analysis done by Poulos and Bosch (1997) is quite reasonable since the trigger of this phenomenon is [i] and [u], and the phenomenon only occurs before these vowels, both of which are [+high]. However,–Polgárdi (2006) provides further analysis using a feature called [ATR]. [ATR] stands for 'Advanced Tongue Root', and is a feature of tongue root movement. Calabrese (2000: 59) notes that many West African languages utilize this [ATR] feature to contrast sounds in vowel harmony. Though vowels with the feature [+ATR] are mainly high vowels, [+ATR] and [high] do not refer to the same set of sounds.

Data 1

	Word	IPA	Meaning
a.	pheka	[phɛka]	cook(Verb)
b.	umpheki	[umpheki]	cook(Noun)
c.	bona	[bɔna]	see
d.	bonisa	[bonisa]	show

(Polgárdi 2006: 65)

ATR i u

ɛ ɔ

a (Polgárdi 2006: 65)

The data 1 above is what Polgárdi (2006: 65) uses to explain the phenomenon. Here, 'e' and 'o' are pronounced as [e] and [o] only when followed by a syllable with [+ATR] vowel [i] or [u], for example [e] in the example *a. pheka*. Based on the data, Polgárdi (2006: 65) formulates the following rule.

Rule 1: V[-ATR] → [+ATR]/_[+ATR]

V

One thing to note is that /a/ is "opaque to harmony" (Polgárdi 2006: 65). Therefore, /a/ is not raised even when followed by a syllable with a [+ATR] vowel.

This phenomenon of vowel harmony in Zulu, in which mid-vowel /ɛ/ and /ɔ/ are raised before a high vowel, is found in other Bantu languages, such as SeSotho and Ejagham. For example, in SeSotho, /ɔ/ in [bɔn-a] 'see' is raised when a suffix /i/ is added and the word is pronounced as [bon-i] 'have seen' (Heine and Nurse 2000: 138).

Data 2 Fjagham vowel harmony

[ɛ-fan]	we counted	[ɔ-fan]	you counted
[e-fin]	we closed	[o-fin]	you closed

Also, in Fjagham, a Bantu language, this phenomenon occurs. As the data 2 shows above, vowel harmony occurs, and /ɛ/ and /ɔ/ are raised before high vowels (Linebaugh 2008: 173).

3. Data

Below are example words in Zulu containing target vowel combinations. The examples comprise, in order from left to right, Reference Number, Target Combination of Sounds, Orthography, Pronunciation in IPA, Meaning in English, and Context in Terms of Places of Articulation. The examples are elicited by ZUL001, who is a native speaker of Zulu.

Data 3

	Target	Word	IPA	Meaning	Context
1	e-i	ikesi	[ikesi]	case	mid-high
2	e-i	ummeli	[ummeli]	a lawyer	mid-high
3	e-e	ibele	[iɓɛlɛ]	breast	mid-mid
4	e-e	umgede	[umgɛdɛ]	a cave	mid-mid
5	e-a	cela	[ǀɛla]	request!	mid-low
6	e-a	eba	[ɛba]	steal	mid-low
7	e-o	uhleko	[uɬɛkɔ]	laughter	mid-mid
8	e-o	isikelo	[isikɛlɔ]	scissors	mid-mid
9	e-u	phenduka	[pʰenduǩa]	to turn	mid-high
10	e-u	ulwembu	[ulwembu]	spider web	mid-high
11	o-i	umloli	[umloli]	a cutter	mid-high
12	o-i	umongi	[umoŋgi]	a nurse	mid-high
13	o-e	goje	[gɔʒɛ]	gorge	mid-mid
14	o-e	ibhodwe	[iɓ̪ɔdʷɛ]	pot	mid-mid
15	o-a	cosha	[ǀɔʒa]	pick up!	mid-low
16	o-a	gona	[gɔna]	hug	mid-low
17	o-o	ingxoxo	[iŋǁɔǁɔ]	a conversation	mid-mid
18	o-o	inkodlo	[iŋkɔⁿdɮɔ]	poem	mid-mid
19	o-u	igovu	[igovu]	German dog	mid-high
20	o-u	indlovu	[iⁿdɮovu]	elephant	mid-high

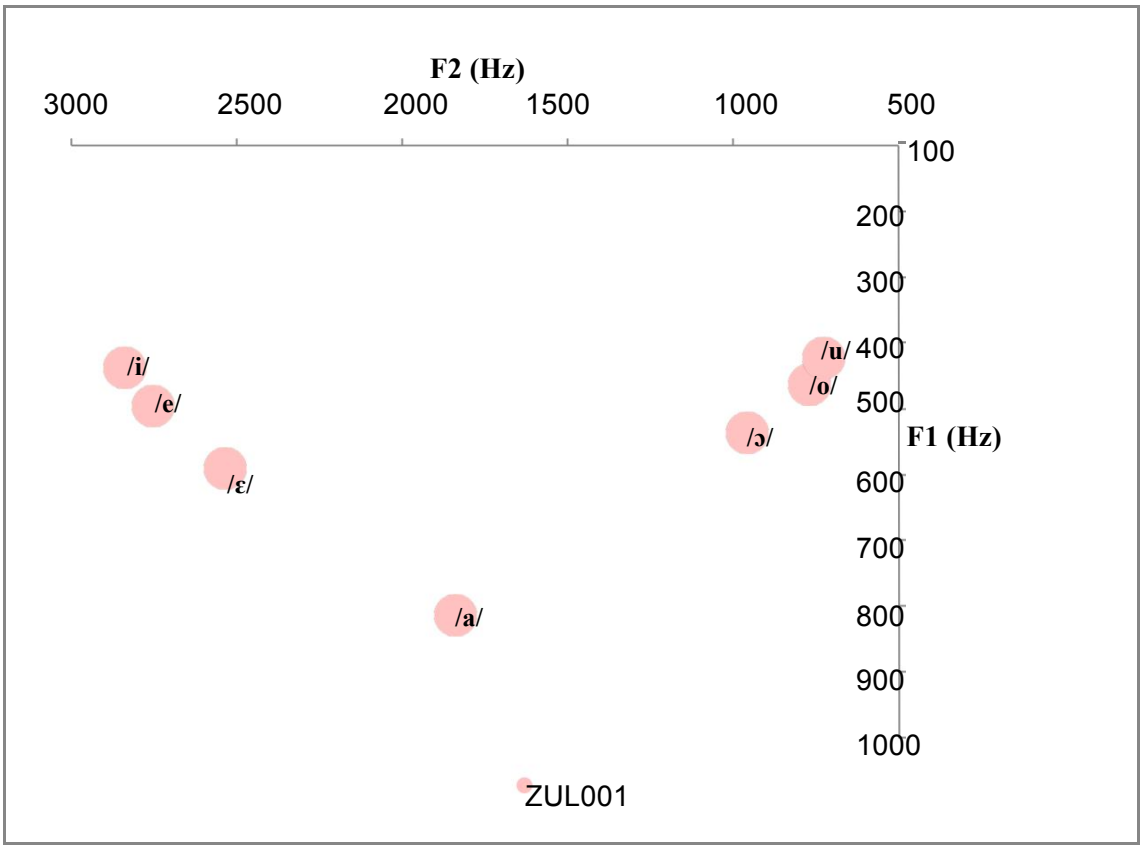
Example 1 to example 20 in data 3 show every possible combination between each of two mid vowels and all of five vowels. As for mid vowels followed by a high vowel, the same result as that of the literature is obtained: all of the mid vowels before the syllable with the high vowel are raised, and the other mid vowels are not. For example, in example 1, ikesi [ikesi], 'e' is pronounced as [e], in contrast to 'e' from cela [ǀɛla] in example 5 where it is pronounced as [ɛ]. The underlying forms of the mid vowels are /ɛ/ and /ɔ/, as seen in examples such as 14 and 17, where 'e' and 'o' are pronounced as [ɛ] and [ɔ] in the word-final position.

Figure 1

	ZUL001	
Vowel	F1 (Hz)	F2 (Hz)
i	437.267058	2837.249536
e	496.2518206	2750.777278
a	813.6907632	1838.07795
o	464.3856941	768.3939608
u	423.548513	723.95385
ɛ	590.8192136	2532.473651
ɔ	536.7488234	956.2085945

Figure 1 shows the acoustics of each vowel in Zulu, based on their F1 and F2.

Plot 1



In Figure 1, the sound /i/ and /e/ appear in example 1, 'ikesi', /ɛ/ in example 3, 'ibele', /a/ in example 6, 'eba', /ɔ/ in example 7, 'uhleko', and /o/ and /u/ in example 19, 'igovu'. As this plot shows, the high-mid vowels /e/ and /o/ are pronounced at the higher positions than those of the low-mid vowels /ɛ/ and /ɔ/.

Table 1 shows the different combination of features that are [±high], [±low], [±ATR] and [±back], according to each vowel. Note that the mid vowels are referred to as [-high, -low].

Table 1

Vowel	High	Low	ATR	Back
i	+	-	+	-
e	-	-	+	-
ɛ	-	-	-	-
u	+	-	+	+
o	-	-	+	+
ɔ	-	-	-	+
a	-	+	-	-

Example 21 to 25 show cases where a syllable containing a mid-vowel follows a mid-vowel, given the [+ATR] feature. In this research, five targets of combination are arranged such as e-e-i, e-e-u, o-o-i, e-o-u, o-e-i, based on the hypothesis that high vowels can affect even mid-vowels even from a distance.

Data 4

21	e-e-i	phelelisa	[pʰɛlelisa]	make complete	mid-mid-high
22	e-e-u	izikelemu	[izikɛlemu]	worms	mid-mid-high
23	o-o-i	fokosi	[fɔkosi]	little bush	mid-mid-high
24	e-o-u	elovu	[ɛlovu]	a place's name	mid-mid-high
25	o-e-i	emoyeni	[ɛmɔjeni]	in the air	mid-mid-high

As discussed in the literature review section, Polgárdi (2006: 65) argues that a mid vowel receives [+ATR] feature when followed by a syllable with a [+ATR] vowel. Therefore, there is a possibility that a [+ATR] vowel gives the [+ATR] feature to a mid vowel, and the mid [+ATR] vowel gives a [+ATR] feature to another following mid vowel. This possibility seems to be understudied despite the extensive research on vowel harmony of a single mid-vowel and a single high-vowel. Therefore, those examples 21 to 25 may provide an idea on whether the harmony is iterative or not.

In the elicited five words, phelelisa [pʰɛlelisa], izikelemu [izikɛlemu], fokosi [fɔkosi], elovu [ɛlovu] and emoyeni [ɛmɔjeni], although the mid-vowels preceding the syllable containing a high vowel are raised (pronounced [e] or [o]), mid-vowels preceding the raised mid-vowels do not undergo any change.

4.1. *Analysis by Rule-Based Theo* According to the Rule-Based Theory, based on what can be observed, the rule for harmony in Zulu – two mid vowels /ɛ/ and /ɔ/ are raised to [e] and [o] – can be illustrated as Rule 2, below. Here, the features of [ɛ] and [ɔ] are defined as [-high, -low, -ATR], those of [e] and [o] as [-high, -low, +ATR].

Rule 2: V[-ATR]→[+ATR]/_[+ATR]

(Note that this rule is not applied to /a/ and that the rule does not apply iteratively, as it has been found that this harmony is local)

4.2. *Analysis by Optimality Theory* The data is will be looked at in the framework of Optimality Theory (OT) (Prince and Paul Smolensky 1993, 2004), which was a novel approach in looking at grammar not from rules used in the Rule-Based Theory but from constraints which dictate how the grammar works. Kaplan (2008) analyzes non-iterative harmony of the [ATR] feature in Lango, a Nilotic language, with OT.

As there are similarities between this harmony and the harmony in Zulu, Kaplan's analysis can be of great use for the analysis on Zulu. To summarize Kaplan's (2008) work, in Lango, the [±ATR] feature spreads progressively from roots to suffixes, and the [+ATR] feature of suffixes is also able to spread regressively to roots. This harmony is non-iterative. Kaplan (2008: 4) argues that in the OT framework, it is impossible for the AGREE constraint to process non-iterative spreading. Instead of AGREE, he uses the LICENSE-[ATR] constraint which licenses a [±ATR] feature on roots and [+ATR]SPREAD or [-ATR]SPREAD to block an unpreferable spreading of the [±ATR] feature.

Likewise in Zulu as shown below, the AGREE([+ATR]) constraint cannot be used to explain the harmony. The AGREE[+ATR] constraint rules out the seemingly preferred output [izikɛlemu], and ends up choosing an unpreferable candidate as its output. Therefore, as Kaplan (2008) did in his analysis of Lango, the use of LICENSE constraint has to be considered.

Tableau 1

	/izikɛlɛmu/	AGREE[(+ATR)]	IDENT([±ATR)]
	a.izikɛlɛmu	*!	
(→)	b.izikɛlemu	*!	*
☞	c.izikelemu		**

However, as the harmony in Zulu is not completely identical to that of Lango, a different formation of the LICENSE constraint is needed. Unlike Lango, the harmony in Zulu does not require suffixes. Compared to the harmony in Lango, in which the [ATR] feature spreads only between morphemes, this [+ATR] assimilation in Zulu concerns phonological harmony. Therefore, the constraint should be more generalized. Moreover, the [+ATR] feature spreads only regressively. Hence, the formation of the constraint should be as below.

LICENSE-[+ATR]LEFT : [+ATR] feature must be linked to the syllable immediately to its left .

Once this LICENSE-[+ATR]LEFT constraint is introduced, the non-iterative harmony can be successfully processed as below in Tableau 2. The candidate (d) is ruled out by SPREAD([+ATR]) that prohibits the [-ATR] feature from spreading. The LICENSE constraint rules out the faithful candidate (a) and the IDENT constraint rules out the candidate (c) with iterative assimilation. Therefore, this non-iterative harmony may be a result of the grammar keeping balance between assimilation and faithfulness.

Tableau 2

	/izikɛlɛmu/	SPREAD([+ATR])	LICENSE([+ATR])LEFT	IDENT([±ATR)]
	a.izikɛlɛmu		*!	
→	b.izikɛlemu			*
	c.izikelemu			**!
	d.izikɛlɛmʊ	*!	*	

In this section, the analysis of harmony in Zulu was carried out in the framework of Rule-Based Theory and the framework of Optimality Theory. The former gives a simple explanation that the rule does not apply iteratively, and as for the latter, an introduction of LICENSE constraint is needed to produce the non-iterative harmony.

5. Discussion

So far, the data and the analysis have shown how the mid vowels in Zulu act in the language system. In the following sections, the connection between observations in this paper and the findings in previous

literature will be discussed. Both of the explanations by Poulos and Bosch (1997), and Polgárdi (2006) seem to be reasonable. However, the rule 1 given by Polgárdi (2006) may not be entirely accurate, because in the case where a syllable containing a mid-vowel precedes the mid-vowel given the [+ATR] feature, the mid-vowel in the syllable is not given the [+ATR] feature. In the rule 1 by Polgárdi, the former mid vowel has to be given the [+ATR] feature by the latter mid [+ATR] vowel. For example, 'phelelisa' has to be pronounced as [pʰelelisa], but in actuality, it is not.

Therefore, it must be noted that this ATR harmony is non-iterative assimilation. It is referred to in the literature review that a suffix of a high vowel can be a trigger for the vowel harmony in SeSotho. As SeSotho and Zulu have a similar language system, what can be expected is that a high vowel suffix could be a trigger in Zulu as well, as Zulu has -i suffix as the negative verbal suffix. Therefore, it is possible that this phenomenon morpho-phonologically happens as long as the target and the trigger are adjacent, and not limited within a root.

Moreover, below is an example to confirm whether a glide sound can be a trigger for the harmony.

26	o-y	umoya	[umɔja]	wind	mid-glide

Example 26 is a case where the mid vowel is not followed by a syllable with high vowel, but followed by a glide directly. In some languages such as Turkish, "it is often assumed that the glide [j] has the same underlying representation as the vowel [i]" (Levi 2001:387). In addition to this, in some language such as Japanese, a high vowel is a trigger for a palatalization. In some language such as English, a glide sound triggers palatalization as well. Therefore, from a cross-linguistic view, it is reasonable to posit that glide sounds also trigger vowel harmony in Zulu. However, this seems not to be the case, since in example 26 umoya [umɔja], /ɔ/ remains as [ɔ]. Therefore, glide sound cannot be a trigger for the vowel harmony in Zulu.

There are some ways to explain this property of glides. The first hypothesis is that the vowel harmony does not happen because the glide [j] has the feature [-ATR]. [+ATR] is a feature for vowel, and if both features [+high] and [+ATR] are needed to trigger the harmony, this hypothesis can explain why the low-mid vowel is not raised. However, since [j] and [i] are produced in a similar manner, if [j] has [-ATR] unlike [i], it would be difficult to explain the articulatory similarity between [j] and [i].

The second hypothesis, which is much simpler, is that in Zulu, a glide sound is regarded as consonant, regardless of the manner of articulation. In general, Zulu prefers CV structure in its syllables. In order to avoid breaking the CV structure, alternations such as glide formation happens. The glide formation occurs in a specific situation where VVV structure is made in the underlying form (for example, /u+a+a/ becomes [wa]). Here, the use of the glide sound is one way to maintain the CV structure, and the glide is treated as a consonant. Therefore, this may be a reason as to why glides do not trigger the harmony, despite possessing similarities to the high vowel.

6. Conclusion

In this paper, the distribution of mid vowels in Zulu, and how the language system in Zulu treats them are considered. It has been observed that the vowel harmony regarding the mid vowels is non-iterative, and explanations have been given in terms of both Rule-based Theory and Optimality Theory. This paper has also found that a glide sound cannot be a trigger for the harmony. In this paper, the harmony is found only inside of roots. However, there is a possibility that the harmony occurs across morpheme boundaries. Thus, further investigation is needed in order to account for whether vowel harmony occurs solely inside of roots, or not.

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