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AN OBSERVATION OF VOWEL CONTRACTION IN XHOSA[1]

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1. Introduction

In this paper, I will examine the phonetic nature of vowel contraction in the Bantu language, Xhosa, and the implication of this phonological process for generative phonology. I will present arguments in an attempt to constrain phonological theory. Specifically, I will argue against the use of transformational rules to account for vowel contraction as a unitary process.

In the literature concerning Xhosa (e.g. Jordan [1966]; McLaren [1936]; and Riordan et al. [1969]) a phonological process called vowel contraction or vowel coalescence is described. Since Xhosa does not tolerate two contiguous vowels in one syllable (i.e. syllables tend to conform to C_o^3V patterns rather than C_o^3VV patterns), two juxtaposed vowels, the first of which is neither [+high] nor [+back], appear to coalesce or contract to form one unique third vowel.

Implicit in the notion of vowel contraction is that two phonological processes are taking place. While one of the vowels is modified in at least one of its distinctive features (i.e. vowel height), the other of the two vowels is deleted, e.g. ai > e or au > o. What is significant about the notion of vowel contraction is that Chomsky and Halle [1968: 360] have proposed the need to use so-called transformational rules to account for an example of vowel contraction from Kasem, a Niger-Congo language. Transformational rules typically have two segments to the left of the arrow, e.g. AB $\rightarrow$ CD or AB $\rightarrow$ C, rather than the standard type of rule with one segment to the left of the arrow, e.g. A $\rightarrow$ B/__C, which they did not attempt to use in describing Kasem vowel contraction. I will show that the use of transformational rules to formalize vowel contraction for the data presented by Chomsky and

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Halle [1968:358-64] is superfluous in that the standard type of rule can adequately describe the data. The alternative analysis which I will propose for the Kasem data will show that transformational rules are a less explicit notational variant of standard type rules. The standard type rules will be more explicit in non-arbitrarily showing which vowel is modified and which is deleted. In addition, the standard type of rule will claim that the notion of vowel contraction is actually composed of two independent processes.

I will then show that not only may the notion of vowel contraction in Xhosa be viewed as being composed of two distinct processes, but also must be recognized as two distinct processes independent of the notion of vowel contraction as a unitary process in order to make another generalization in Xhosa. In this case, transformational rules cannot be a notational variant of standard rules. By recognizing vowel contraction as two processes, i.e. vowel lowering and vowel deletion, and by having another phonological rule apply between these two processes, not only does the nature of vowel contraction become more explicit, but we also maintain a more constrained phonological theory by eliminating transformational rules as a possible formal device in describing vowel contraction.

2. Transformational Rules

Before examining Xhosa phonology, let us first review the formal mechanism (i.e. transformational rules) used to describe vowel contraction, in light of the data from which it was first proposed.

Only when the given formal mechanisms within a framework cannot descriptively account for a certain phenomenon is an amendment made to that framework. In general, when an extension is to be made to the grammar, the burden of proof lies with the proponents of that extension to demonstrate that a body of data cannot be handled given the existing formal mechanisms. In the Kasem problem presented by Chomsky and Halle [1968:358-64](henceforth CH), it might be assumed that the standard rules with one segment to the left of the arrow (henceforth O[ne] S[egment] rules) were inadequate to handle the data, i.e. given OS rules, we could not account for simple vowel alternations. In order to adequately describe some of the phonology concerning vowels, CH propose a transformational rule (henceforth T[wo] S[egment] rules), to account for vowel contraction.

Let us quickly review the Kasem data and the relevant phonological rules. Assuming, as CH do, that the vowel system appearing in the transcription consists of two high vowels i and u and three low vowels æ, a and ɔ [1968:358], and further, that æ is [-back], a and ɔ are [+back], u and ɔ are [+round], and æ and a are [-round], let us observe the following data:

(1)

Singular	Plural	Gloss
bakada	bakadi	boy
fana	fani	knife

The final a is the singular morpheme and the final i is the plural morpheme. Now consider the following:

(2)

Singular	Plural	Gloss
kambia	kambi	cooking pot
pia	pi	yam
buga	bwi	river
diga	di	room
laŋa	læ	song
pia	pæ	sheep
nanǰua	nanǰwæ	fly
yua	ywæ	hair
kɔga	kwæ	back

Assuming that (with the exception of 'sheep', 'fly', 'hair', and 'back', for which CH posit /pia/, /nanǰau/, /yau/, and /kaug/ respectively as underlying forms (cf. 361-2)) the underlying forms of the noun stems are found in the columns marked 'Singular' minus the final a , CH propose the following set of ordered rules[2], to account for the last three nouns in the second set of singulars, and all of the nouns in the

[2]There is one additional rule of nasalization which applies before velar elision. This rule, however, does not affect the present discussion.

second set of plurals.

(3) a. Velar Elision:

$$\begin{bmatrix}+\text{cns}\\-\text{ant}\\-\text{cor}\end{bmatrix} \rightarrow \emptyset / \_\_ \begin{bmatrix}+\text{voc}\\-\text{cns}\\-\text{back}\end{bmatrix}$$

(velars → ∅/__i)

b. Metathesis:[3]

S.D. $\begin{bmatrix}+\text{voc}\\-\text{cns}\end{bmatrix}_1 , [-\text{cns}]_2 , \begin{bmatrix}+\text{voc}\\-\text{cns}\end{bmatrix}_3$

S.C. 1 2 3 → 2 1 3, except when 2=3= a

(iai → aii; aui → uai)

c. Truncation:

$$\begin{bmatrix}-\text{cns}\\ \alpha\text{high}\\ \beta\text{back}\end{bmatrix} \rightarrow \emptyset / \_\_ \begin{bmatrix}+\text{voc}\\-\text{cns}\\ \alpha\text{high}\\ \beta\text{back}\end{bmatrix}$$

(aa → a; ii → i)

d. Vowel Contraction:

S.D. $\begin{bmatrix}+\text{voc}\\-\text{cns}\\-\text{high}\\+\text{back}\\-\text{rnd}\end{bmatrix}_1 , \begin{bmatrix}-\text{cns}\\+\text{high}\\ \alpha\text{back}\end{bmatrix}_2$

S.C. $1\ 2 \rightarrow \begin{bmatrix}1\\ \alpha\text{back}\\ \alpha\text{rnd}\end{bmatrix}, \begin{bmatrix}2\\ \emptyset\end{bmatrix}$

(ai → æ; au → ɔ)

e. Glide Rule:[4]

$$\begin{bmatrix}-\text{cns}\\+\text{high}\end{bmatrix} \rightarrow [-\text{voc}] / \_\_ \begin{bmatrix}+\text{voc}\\-\text{cns}\end{bmatrix}$$

(u → w/__V)

Typical derivations are given in (4) below:

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[3] Although metathesis has the format of a transformational rule, i.e. with more than one segment to the left of the arrow, it is not my present purpose to argue against the use of TS rules for metathesis. This paper is concerned only with vowel contraction.

[4] CH note that the glide rule does not apply before the singular suffix /a/. Thus we have forms such as pia 'yams'.

(4)

Rule	/pi+i/	/bug+i/	/pia+i/	/yau+i/	/kaug+i/
(3a)	---	bu+i	---	---	---
(3b)	---	---	pai+i	yua+i	---
(3c)	p+i	---	pa+i	---	---
(3d)	---	---	pæ	yuæ	kɔg+a
(3e)	---	bwi	---	ywæ	---
	[pi]	[bwi]	[pæ]	[ywæ]	[kɔga]

Notice that vowel contraction, in Kasem, appears to involve two simultaneous processes: the creation of a new vowel composed of features from each of the original two vowels and the reduction of two segments to one. It would therefore be appealing to devise some formal mechanism allowing the claim to be made that the two processes are in fact one process since the two always appear to be associated. This is precisely what CH have done.

Rule 3 states that a sequence of two vowels, the first of which is [+low], is contracted into a third unique vowel. This third vowel keeps the lowness of the first vowel and the backness and roundness of the second vowel, i.e. ai > æ and au > ɔ. In this type of rule there is an inherent arbitrariness as to which vowel is deleted. The rule could just as easily have been written as:

(5) S.D. $\underset{1}{\begin{bmatrix}+\text{voc}\\-\text{cns}\\-\text{high}\\+\text{back}\\-\text{rnd}\end{bmatrix}}, \underset{2}{\begin{bmatrix}-\text{cns}\\+\text{high}\end{bmatrix}}$

S.C. $1 \;\; 2 \rightarrow \begin{bmatrix}1\\\emptyset\end{bmatrix}, \begin{bmatrix}2\\-\text{high}\end{bmatrix}$

Given the two possibilities to formally describe vowel contraction, the theory then could claim that which of the two vowels is deleted and which undergoes feature modification is irrelevant. One could decide on a formal convention saying that it would always be the first vowel to be deleted and always be the second vowel which would undergo vowel modification; but this decision itself would be arbitrary. Whether or not one chooses a formal convention to delete the first vowel, an unjustified empriical claim is made, namely that it is the first vowel and not the second which would be deleted and that it is the second vowel and not the first which is modified. The formal apparatus, however, appears to be correct in claiming that the vowel change in feature and vowel deletion are both part of the same process.

One alternative to this dilemma is to formulate a rule like the following:

(6) a. S.D.
$$\underset{1}{\begin{bmatrix} +\text{voc} \\ -\text{cns} \\ -\text{high} \\ +\text{back} \\ -\text{rnd} \end{bmatrix}}, \underset{2}{\begin{bmatrix} -\text{cns} \\ +\text{high} \\ \alpha\text{back} \\ \alpha\text{rnd} \end{bmatrix}}$$

S.C.
$$1 \quad 2 \rightarrow \begin{bmatrix} 1 \\ \emptyset \end{bmatrix} \begin{bmatrix} 2 \\ \emptyset \end{bmatrix} \begin{bmatrix} 3 \\ +\text{voc} \\ -\text{cns} \\ -\text{high} \\ \alpha\text{back} \\ \alpha\text{rnd} \end{bmatrix}$$

or b. S.C.
$$1 \quad 2 \rightarrow \begin{bmatrix} 1 \\ \emptyset \end{bmatrix} \begin{bmatrix} +\text{voc} \\ -\text{cns} \\ -\text{high} \\ \alpha\text{back} \\ \alpha\text{rnd} \end{bmatrix} \begin{bmatrix} 2 \\ \emptyset \end{bmatrix}$$

or c. S.C.
$$1 \quad 2 \rightarrow \begin{bmatrix} +\text{voc} \\ -\text{cns} \\ -\text{high} \\ \alpha\text{back} \\ \alpha\text{rnd} \end{bmatrix} \begin{bmatrix} 1 \\ \emptyset \end{bmatrix} \begin{bmatrix} 2 \\ \emptyset \end{bmatrix}$$

Such an alternative makes the same claim that the original TS rule makes, i.e. that there is a change of vowel features and that deletion is involved. What makes this alternative appealing is that it does not make a claim as to which vowel is modified and which is deleted. It makes the additional claim that the vowels contract to form a new third vowel which is composed of features of the original two vowels, yet it makes no claim that one vowel is more dominant in the sense that one vowel takes the pertinent features from the other while the less dominant vowel is deleted.

Recall that the truncation rule (3c) reduces vowel sequences of aa > a and ii > i. It does not appear that we have evidence to favor the deletion of one of the identical vowels over the other. CH could have written the truncation rule as a TS rule such as (7) or (8).

(7) S.D. $$\underset{1}{\begin{bmatrix} +\text{voc} \\ -\text{cns} \\ \alpha\text{high} \\ \beta\text{back} \end{bmatrix}} , \underset{2}{\begin{bmatrix} +\text{voc} \\ -\text{cns} \\ \alpha\text{high} \\ \beta\text{back} \end{bmatrix}}$$

S.C. $$1\ 2 \rightarrow \begin{bmatrix} 1 \\ \alpha\text{high} \\ \beta\text{back} \end{bmatrix} , \begin{bmatrix} 2 \\ \emptyset \end{bmatrix}$$

or

(8) S.D. $$\underset{1}{\begin{bmatrix} +\text{voc} \\ -\text{cns} \\ \alpha\text{high} \\ \beta\text{back} \end{bmatrix}} , \underset{2}{\begin{bmatrix} +\text{voc} \\ -\text{cns} \\ \alpha\text{high} \\ \beta\text{back} \end{bmatrix}}$$

S.C. $$1\ 2 \rightarrow \begin{bmatrix} 1 \\ \emptyset \end{bmatrix} , \begin{bmatrix} 2 \\ \alpha\text{high} \\ \beta\text{back} \end{bmatrix}$$

Actually, the truncation rule (3c) written as an OS rule could also just as easily have deleted the second, rather than the first identical vowel. Rule (9), as follows, is equivalent to rule (3c).

(9) $$\begin{bmatrix} +\text{voc} \\ -\text{cns} \\ \alpha\text{high} \\ \beta\text{back} \end{bmatrix} \rightarrow \emptyset / \begin{bmatrix} +\text{voc} \\ -\text{cns} \\ \alpha\text{high} \\ \beta\text{back} \end{bmatrix} \_\_\_$$

The truncation rule could have been written as rules (3c, 7, 8, or 9). In other words, since we do not know if it is the first or the second vowel which is being deleted, we can describe truncation as one of two possible OS rules, i.e. rule (3c) or (9), or as one of two possible TS rules, i.e. rule (7) or (8). Since vowel contraction contains a truncation rule, it follows that vowel contraction should be expressible as one of two possible (pairs of) OS rules (i.e. vowel height modification, and trucation or deletion) or as one of two possible TS rules.

Since we have already observed the two possible TS rules, i.e. rules (3d) and (5), let us look at the two possible pairs of OS rules which describe vowel contraction in Kasem.

(10) a. $$\begin{bmatrix}+\text{voc}\\-\text{cns}\\-\text{high}\\+\text{back}\\-\text{rnd}\end{bmatrix} \rightarrow \begin{bmatrix}\alpha\text{back}\\\alpha\text{rnd}\end{bmatrix} / \_\_ \begin{bmatrix}-\text{cns}\\+\text{high}\\\alpha\text{back}\end{bmatrix}$$

(ai → æi; au → ɔu)

b. $$\begin{bmatrix}+\text{voc}\\-\text{cns}\end{bmatrix} \rightarrow \emptyset / \text{V}\_\_$$

(æi → æ; ɔu → ɔ)

(11) a. $$\begin{bmatrix}+\text{voc}\\-\text{cns}\\+\text{high}\end{bmatrix} \rightarrow [-\text{high}] / \begin{bmatrix}+\text{voc}\\-\text{cns}\\-\text{high}\\+\text{back}\\-\text{rnd}\end{bmatrix} \_\_$$

(ai → aæ; au → aɔ)

b. $$\begin{bmatrix}+\text{voc}\\-\text{cns}\end{bmatrix} \rightarrow \emptyset / \_\_\text{V}$$

(aæ → æ; aɔ → ɔ)

Rule (10a) changes the backness and roundness of the first of two vowels in a sequence to the backness and roundness of the second vowel if the first vowel is a and the second vowel is i or u. Rule (10b) then deletes the i or u vowel.

Rule (11a) makes i or u [-high] if it follows a, i.e. there is a partial height assimilation of i or u to the height of a. Rule (11b) then deletes a.

The original vowel contraction, rule (3d), then, is descriptively equivalent to rules (5, 10 and 11). In other words rules (3d, 5, 10 and 11) are notational variants of each other. Likewise rules (3c, 7, 8 and 9) are notational variants of each other. Given the original five rules (3a-e) used to describe some of Kasem phonology, we then have sixteen different possible grammars, e.g. rules (3a, 3b, 3c, 3d, 3e); rules (3a, 3b, 7, 3d, 3e); rules (3a, 3b, 3c, 5, 3e); rules (3a, 3b, 7, 5, 3e); etc. Out of these sixteen possible grammars, can we choose one to be simpler than the rest in the sense of expressing generalizations which the other cannot?

Suppose we choose a grammar consisting of rules (3a, 3b, 9, 10 and 3e), truncation (9) must precede vowel contraction (10) as follows:

(9)
$$\begin{bmatrix} -\text{cns} \\ \alpha\text{high} \\ \beta\text{back} \end{bmatrix} \rightarrow \emptyset \ / \begin{bmatrix} +\text{voc} \\ -\text{cns} \\ \alpha\text{high} \\ \beta\text{back} \end{bmatrix} \underline{\quad}$$

(aa → a; ii → i)

(10) a.
$$\begin{bmatrix} +\text{voc} \\ -\text{cns} \\ -\text{high} \\ +\text{back} \\ -\text{rnd} \end{bmatrix} \rightarrow \begin{bmatrix} \alpha\text{back} \\ \alpha\text{rnd} \end{bmatrix} / \underline{\quad} \begin{bmatrix} -\text{cns} \\ +\text{high} \\ \alpha\text{back} \end{bmatrix}$$

(ai → æi; au → ɔu)

b.
$$\begin{bmatrix} +\text{voc} \\ -\text{cns} \end{bmatrix} \rightarrow \emptyset \ / \ \text{V}\underline{\quad}$$

(æi → æ ɔu → ɔ)

Notice that rules (9) and (10b) are very similar in that they are both truncation rules. It would be notationally convenient if we could collapse these two rules. This would be possible if rule (10a) were not ordered between them. We could then make the claim that there is really only one vowel truncation rule.

At the end of the discussion concerning the Kasem data (p. 364), CH inadvertently reordered truncation and vowel contraction when they listed the final order of rules (cf. p. 364 and example 93 on p. 361), i.e. the final order of rules is: 1 - velar elision, 2 - metathesis, 3 - vowel contraction, 4 - truncation, and 5 - glide rule. This inadvertent reordering raises a question. If the vowel contraction rule contains a truncation rule, e.g. rule (10b), is it not redundant to state another truncation rule (9) immediately after vowel contraction, assuming such an ordering is possible?

In other words, our grammar would have the following order: rules (3a, 3b, 10, 9, 3e). Rule (9), a truncation rule, would follow rule (10b) another truncation rule. The redundancy exists because we now have two truncation rules, one ordered immediately after the other. We have probably missed a generalization concerning vowel deletion in Kasem.

By reformulating, i.e. collapsing, the truncation rule (9) and the truncation rule (10b) of the vowel contraction rule (10) as follows in (12), it will be possible not only to order truncation after vowel contraction (actually vowel height assimilation), but we will use an OS rather than a TS rule to formalize vowel contraction.

(12) Truncation:

$$\begin{bmatrix}+\text{voc}\\ -\text{cns}\\ \alpha\text{back}\\ \beta\text{rnd}\end{bmatrix} \rightarrow \emptyset \;/\; \begin{bmatrix}+\text{voc}\\ \alpha\text{back}\\ \beta\text{rnd}\end{bmatrix} \_\_\_$$

(13) Vowel Assimilation:

$$\begin{bmatrix}+\text{voc}\\ -\text{cns}\\ -\text{high}\\ +\text{back}\\ -\text{rnd}\end{bmatrix} \rightarrow \begin{bmatrix}\alpha\text{back}\\ \alpha\text{rnd}\end{bmatrix} \;/\; \_\_\_ \begin{bmatrix}-\text{cns}\\ +\text{high}\\ \alpha\text{back}\end{bmatrix}$$

By reordering the reformulated rules with velar elision, metathesis, and glide formation, we have the following derivations:

(14) Rule	/pi+i/	/bug+i/	/pia+i/	/yau+i/	/kaug+a/
Velar elision (3a)	---	bu+i	---	---	---
Metathesis (3b)	---	---	pai+i	yua+i	---
Vowel assimilation(13)	---	---	pæi+i	yuæ+i	kɔug+a
Truncation (12)	pi	---	pæ	yuæ	kɔg+a
Glide formation (3e)	---	bwi	---	ywæ	---
	[pi]	[bwi]	[pæ]	[ywæ]	[kɔga]

In the derivation of pæ 'sheep', the truncation rule will have to apply iteratively right-to-left (cf. Jensen and Jensen [1973]). In other words, the truncation rule (12) claims that the vowel immediately to the left of the rightmost vowel in a sequence causes the deletion of the rightmost vowel.

We have now captured two generalizations which the other fifteen grammars did not. First we claim that there is only one truncation rule. Second, we claim that truncation, or vowel deletion, occurs in a right-to-left direction iteratively, i.e. the rightmost vowel is deleted by the vowel immediately to its left.

In view of the fact that one of the purposes of linguistic theory is to restrict the domain of possible grammars, before accepting an extension (in this case the addition of a TS rule to account for vowel contraction), it must first be demonstrated that standard OS rules are inadequate in descriptively accounting for the data. Not only can OS rules easily account for vowel contraction in Kasem, but the internal nature of these rules makes explicit which vowel is modified and which is deleted.

Assuming that TS rules are not or at least were not intended to be a notational variant of OS rules and assuming also the possibility that CH knew that OS rules could account for vowel contraction, then perhaps CH proposed TS rules to better attain a level of explanatory adequacy in accounting for vowel contraction. In other words, given the early observations on many African languages, especially of Bantu, descriptive linguists recorded what appeared to be the single coalescence process of two juxtaposed vowels, e.g. ai > e or au > o. As this notion of vowel contraction became known, CH may have felt obligated to incorporate some formalism, i.e. TS rules, to account for the linguist's intuition that when two vowels of some languages are juxtaposed, there is a single phonological process which merges or contracts the two vowels into a third vowel.

A very possible reason which may have led many observers of language to the notion of vowel contraction as a unitary process is that they observed only the obvious and transparent cases of vowel processes in language. I have demonstrated that when we investigate other phonological processes, vowel contraction should be viewed as being composed of two separate processes in order to capture other phonological generalizations and such generalizations can only be captured by OS rules.

3. Vowel Contraction in Xhosa

I will now present some examples from Xhosa which could also lead one to the notion of vowel contraction as a unitary process. However, in light of additional data, I will demonstrate that the notion of vowel contraction must be viewed as two independent phonological processes expressed as OS rules in order to obtain a clearer and deeper understanding of the nature of Xhosa phonology.

I will assume that Xhosa has an underlying system of five vowels:

(15)

	-back	+back
high	i	u
	e	o
low		a

For our purposes, I will also consider these five vowels to be phonetic vowels.

In Xhosa, as in Kasem, there is a similar phenomenon of vowel contraction, i.e. given two vowels, they coalesce and form not a lengthened or double vowel, but a short single vowel segment. In some vowel combinations, it is not clear which vowel has undergone a feature modification and which vowel has been deleted, as seen in (16):

(16) a.	a + a > a	/wa + aɓa + ntu/	[waɓantu]	for the people
		/aɓa + akhi/	[aɓakhi]	builders
b.	a + i > e	/wa + inkosi/	[wenkosi]	of the chiefs
		/na + impendulo/	[nempendulo]	with the answer
c.	a + u > o	/wa + umfazi/	[womfazi]	of the woman
		/na + um + ntu/	[nomntu]	with the person

In example (16a) there is no evidence to argue whether it is the first or the second a which is deleted. Likewise, in examples (16b) and (16c) we do not know whether it is a or the [+high] vowels which delete. In addition, we have no evidence to know if it is a that becomes [-low] and [αback] or if i and u become [-high].

At a first glance, a TS rule would appear to be desirable since up to this point, vowel contraction appears to be taking place as a unitary process. At this point, we really have no justification to posit two OS rules to explain what appears to be a unitary process. We must now investigate a precise formulation of the Xhosa vowel contraction rule which utilizes a TS rule.

In order for a rule to account for the following vowel contractions: aa > a, ai > e, and au > o, the rule would have the following format:

(17) S.D. $\begin{bmatrix} +\text{voc} \\ -\text{cns} \\ \langle +\text{low} \rangle \end{bmatrix}_{1} , \begin{bmatrix} +\text{voc} \\ -\text{cns} \\ \langle -\text{low} \rangle \\ \alpha\text{back} \end{bmatrix}_{2}$

S.C. $1 \; 2 \rightarrow \begin{bmatrix} 1 \\ -\text{low} \\ \alpha\text{back} \end{bmatrix} , \begin{bmatrix} 2 \\ \emptyset \end{bmatrix}$

The use of the angled brackets has been employed to keep cases of aa from becoming o. Notice, however, that rule (17) is actually collapsed from two distinct rules--presumably to capture a generalization. Since the angled bracket notation is an abbreviation of two rules, rule (17) represents the following ordered rules:

(18) a. S.D. $\begin{bmatrix} +\text{voc} \\ -\text{cns} \\ +\text{low} \end{bmatrix}_{1} , \begin{bmatrix} +\text{voc} \\ -\text{cns} \\ -\text{low} \\ \alpha\text{back} \end{bmatrix}_{2}$

S.C. $1 \; 2 \rightarrow \begin{bmatrix} 1 \\ -\text{low} \\ \alpha\text{back} \end{bmatrix} , \begin{bmatrix} 2 \\ \emptyset \end{bmatrix}$

(to account for cases like ai → e and au → o)

b. S.D. $\begin{bmatrix} +\text{voc} \\ -\text{cns} \end{bmatrix}_{1} , \begin{bmatrix} +\text{voc} \\ -\text{cns} \\ \alpha\text{back} \end{bmatrix}_{2}$

S.C. $1 \; 2 \rightarrow \begin{bmatrix} 1 \\ \alpha\text{back} \end{bmatrix} , \begin{bmatrix} 2 \\ \emptyset \end{bmatrix}$

(to account for cases of aa → a)

Rule (17) looks somewhat suspicious in the sense that both a's are [+back] and it is actually redundant to utilize alpha notation. Rule (17) simply states that after the application of rule (18a), of any two contiguous vowels, the second one is deleted. But that is exactly what the following two OS rules claim.

(19) $V \rightarrow \begin{bmatrix} -\text{low} \\ \alpha\text{back} \end{bmatrix} / \_\_ \begin{bmatrix} +\text{voc} \\ -\text{cns} \\ +\text{high} \\ \alpha\text{back} \end{bmatrix}$

(20) $V \rightarrow \emptyset \ / \ V\_\_$

In Xhosa, are TS rules simply complex notational variants of OS rules? Perhaps TS rules are not notational variants of OS rules. We could advance this position if we reformulate rule (17) into rule (21). Since TS rules involving vowel contraction arbitrarily choose which vowel to delete, rather than to delete the second vowel as in rule (17), let us delete the first vowel as in rule (21).

(21)
$$\text{S.D.} \quad \begin{bmatrix} +\text{voc} \\ -\text{cns} \\ +\text{low} \end{bmatrix}, \begin{bmatrix} +\text{voc} \\ -\text{cns} \end{bmatrix}$$
$$\qquad\quad 1 \qquad\qquad 2$$
$$\text{S.C.} \quad 1\ 2 \rightarrow \begin{bmatrix} 1 \\ \emptyset \end{bmatrix}, \begin{bmatrix} 2 \\ -\text{high} \end{bmatrix}$$

Rule (21) is a simplified version of rule (17) in the sense of having fewer feature specifications, and the angled brackets are eliminated. It states the first vowel elides rather than the second. Rule (21) states what the two sub-rules of (17) state as well as the following two ordered OS rules:

(22)
$$\begin{bmatrix} +\text{voc} \\ -\text{cns} \end{bmatrix} \rightarrow [-\text{high}] \ / \begin{bmatrix} +\text{voc} \\ -\text{cns} \\ -\text{high} \end{bmatrix} \_\_$$

(23)
$$\begin{bmatrix} +\text{voc} \\ -\text{cns} \end{bmatrix} \rightarrow \emptyset \ / \ \_\_ \begin{bmatrix} +\text{voc} \\ -\text{cns} \end{bmatrix}$$

In answering now the question of whether TS rules are simply notational variants of OS rules, let us consider more data:

(24)	a.	a + e > e	/wa + eyele/	[weyele]	'he fell in'
			/aɓa + enzi/	[aɓenzi]	'doers'
	b.	a + o > o	/aɓa + oni/	[aɓoni]	'wrong doers'
			/ba + oǰa/	[boǰa]	'they roast'

We now have five instances of two contiguous vowels contracting into one: a + a > a, a + e > e, a + o > o, a + i > e, a + u > o. We note that only in the last two of the five cases does the second vowel undergo a feature change. In other words, in three of the five cases, it appears as though we simply have a deletion of the first of two vowels and only in the last two cases (cf. examples (16b) and (16c)) do we have genuine cases of feature modification of vowels in addition to vowel deletion.

As was mentioned earlier, in the case of rule (17), the alpha notation was needed to insure the deletion of one of the two a 's and not change the remaining a to [-low]. The contraction of a 's was only one of what appeared to be three legitimate cases of vowel contraction (examples (16a - c)).

Observe the following examples:

$$\text{(25)}\quad \begin{matrix}\text{a.}\\ \text{b. i +}\\ \text{c.}\end{matrix} \begin{Bmatrix}\text{a}\\ \text{e}\\ \text{o}\end{Bmatrix} > \begin{Bmatrix}\text{a}\\ \text{e}\\ \text{o}\end{Bmatrix}$$

/ndi + akha/	[ndakha]	'I build'
/ni + enza/	[nenza]	'you make'
/ni + oǰa/	[noǰa]	'you roast'

We now have additional cases of two contiguous vowels where the first of two vowels deletes. Rule (21) should be able to account for these cases but i is [+high] and not [+low] as the structural description requires. It appears that we can eliminate the feature [+low] from the structural description and simplify rule (21) into rule (26):

$$\text{(26)}\quad \text{S.D.}\quad \underset{1}{\begin{bmatrix}\text{+voc}\\ \text{-cns}\end{bmatrix}}\ ,\ \underset{2}{\begin{bmatrix}\text{+voc}\\ \text{-cns}\end{bmatrix}}$$

$$\text{S.C.}\quad 1\ 2 \rightarrow \begin{bmatrix}1\\ \emptyset\end{bmatrix}\ ,\ \begin{bmatrix}2\\ \text{-high}\end{bmatrix}$$

It appears now that we have captured a significant generalization in Xhosa phonology. Actually we have obscured any generalization that we might have had. That is, by eliminating the feature [+low] from the structural description, the structural change states that if the second of two contiguous vowels is [+high], it is accidental that the [+high] vowel becomes [-high]; the rule, then, claims that it is not a case of vowel lowering by influence of a which is [+low] and [-high].

Moreover, is it not strange that only two of eight cases, namely the vowels i and u, undergo any feature modification, and that in the remaining six cases, there is only vowel deletion? In other words, is it not strange that rule (26) says: "in case the second of two contiguous vowels is [+high], in addition to deleting the first vowel, make the second vowel [-high]--otherwise just delete the first vowel." More intuitively, one would expect that we have two cases of vowel lowering and eight cases of vowel deletion. If this is true, then TS rules are actually obscuring significant generalizations concerning the nature of vowel contraction, i.e. we really have cases of vowel lowering and vowel deletion.

Another inadequacy of rule (26) is that we have what appear to be counter-examples. Examine the following:[5]

(27)	a. u + i > wi	/umntu + ini/	[emntwini]	'person'	(locative)
		/isisu + ini/	[esiswini]	'stomach'	"
	b. o + i > we	/isilo + ini/	[esilweni]	'animal'	"
		/ußuso + ini/	[ußusweni]	'face'	"

The non-low ([+round, +back]) vowels become glides and do not delete. We could prevent the deletion of u and o by stating in the structural description of rule (26) that the first vowel must be [-round]. The addition of the feature [-round] only prevents u and o from being deleted. We still must formulate a rule which would convert the round back vowels into glides, i.e. a glide formation rule:

(28) $$\begin{bmatrix} +\text{voc} \\ -\text{cns} \\ +\text{rnd} \end{bmatrix} \longrightarrow \begin{bmatrix} -\text{voc} \\ +\text{high} \end{bmatrix} / \_\_\_ \begin{bmatrix} +\text{voc} \\ -\text{cns} \end{bmatrix}$$

By creating such a rule and ordering it before rule (26), we eliminate the need for adding the feature [-round] to the structural description of the first vowel. Rule (28) would bleed, or eliminate, u and o as inputs to rule (26). To attempt the converse would be to add to the complexity of rule (26) and therefore make it less general and less highly valued. Ordering (28) after (26) would force the addition of [-round] to the structural description of (26) in order to exempt examples of u and o which must undergo glide formation.

[5]The change of the word initial vowel is a replacement of the subject classifier by the locative classifier, i.e. a morphosyntactic change.

We have a problem. Clearly the glide formation rule must precede rule (26). If it follows (26), there would be no back round vowels to be converted into glides (unless, of course, we choose ad hocly to include [-round] in the structural description). But by changing the back round vowels to glides, we change the [+voc] feature of these segments to [-voc]. This change poses no problem for the examples in (27a), but in (27b) we notice that i becomes e. Rule (26) now cannot change the feature of [+high] to [-high] for the vowel i since we no longer have a [+voc] segment preceding i. Even if we would allow a glide, namely w, to meet the structural description, the rule would claim that i becomes e because of the preceding [+high] glide.

One possible solution would be to assume that there are two w glides, one [+high] and the other [-high]. The [-high] glide would cause the vowel i to become [-high]. A later rule would convert all [-high] glides to [+high] glides, i.e. absolutely neutralize (cf. Kiparsky [1968]) the phonetic contrast between the two glides. However, there is no motivation for such a solution unless one is attempting to salvage TS rules, namely rule (26).

The real solution lies in the OS rules, precisely rules (22) and (23) in conjunction with rule (28), which must follow (22) and precede (23). By using these three ordered rules, we can account for the data presented in examples (16), (24), (25) and (27).

(29) a. Rule (22)

$$\begin{bmatrix}+\text{voc}\\-\text{cns}\end{bmatrix} \rightarrow [-\text{high}] / \begin{bmatrix}+\text{voc}\\-\text{cns}\\-\text{high}\end{bmatrix} \_\_\_ \qquad \text{(Vowel Lowering)}$$

b. Rule (28)

$$\begin{bmatrix}+\text{voc}\\-\text{cns}\\+\text{rnd}\end{bmatrix} \rightarrow [-\text{voc}] / \_\_\_ \begin{bmatrix}+\text{voc}\\-\text{cns}\end{bmatrix} \qquad \text{(Glide Formation)}$$

c. Rule (23)

$$\begin{bmatrix}+\text{voc}\\-\text{cns}\end{bmatrix} \rightarrow \emptyset / \_\_\_ \begin{bmatrix}+\text{voc}\\-\text{cns}\end{bmatrix} \qquad \text{(Vowel Deletion)}$$

Rule (22) will only lower [+high] vowels if they follow [-high] vowels. It claims that there is a partial assimilation of vowel height to the height of the preceding vowel. Rule (28) will convert u and o into the glide w if it appears before a vowel, and rule (23) then deletes the first of any two contiguous vowels.

The following are typical derivations:

(30)	Rule	/wa + umfazi/	/isisu + ini/	/isilo + ini/
	(22) (VL)	wa + omfazi	---	isilo + eni
	(28) (GF)	---	isiw + ini	isilw + eni
	(23) (VD)	w + omfazi	---	---
		[womfazi]	[esiwini][6]	[esilweni][7]

By using OS rules, i.e. rules (22) and (23), our grammar forces us to make our description of vowel contraction more explicit than a grammar that employs TS rules. The grammar using OS rules is forced on internal grounds to claim which vowel is modified and which vowel is deleted. In the case of a grammar using TS rules, we were free to choose which vowel to modify and which to delete. Because of rule (28), the glide formation rule, we are forced to view the notion of vowel contraction as two independent processes. We have constrained the number of possibile grammars for Xhosa by eliminating the use of TS rules to account for vowel contraction as a unitary process.

4. Conclusion

By excluding TS rules as a possible description of vowel contraction, there are certain implications for both diachronic and synchronic grammars. First, for diachronic descriptions, the use of OS rules allows us to claim that vowel contraction took place in at least two distinct historical stages. Secondly, we could account for the possibility of there being two dialects which differ solely on the basis of reverse ordering of the two OS rules of vowel contraction.

For synchronic descriptions, TS rules are also not allowed as a possible description of vowel contraction. Even if there are no rules which intervene between the vowel modification rule and the vowel truncation or deletion rule, TS rules cannot be allowed as an acceptable formal description. Although transformational rules may exist for syntactic operations

[6] Cf. footnote 5.

[7] Cf. footnote 5.

in the mind of the native speaker, they cannot exist in the mind of the native speaker as part of the phonology to account for vowel contraction.

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