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Working Papers in Linguistics No. 48

Papers in Phonology

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A Note from the Editors

The collection of papers in this volume represents a sampling of research by graduate students and faculty of the Department of Linguistics at the Ohio State University. This volume is devoted to works in Phonology, including works on the distinctive features of vowels (Mary Bradshaw, Mike Cahill, and Frederick Parkinson), prosodic structure (Rebecca Herman), phonological variation (Hyeon-Seok Kang), tone (Nasiombe Mutonyi and R. Ruth Roberts-Kohno), and reduplication (David Odden and Robert Poletto).

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Ohio State University Working Papers in Linguistics No. 48

Papers in Phonology

Table of Contents

OSU Working Papers in Linguistics, 1-11

One-Step Raising in Gbanu*

Mary M. Bradshaw

§0. Introduction

This paper presents data from the Gbanu language which illustrates one-step raising of vowels. This vowel raising poses serious challenges to feature models in which vowel height is represented with the features [high], [low] and [ATR]. On the other hand, feature models in which vowel height is represented by a uniform feature arrayed on different tiers handle the same data in an elegant fashion.

In many vowel feature geometry models (Odden 1991, Sagey 1986), vowel height distinctions can be made only with the features [high] and [low]. Furthermore, [ATR] can be used as a kind of alternate height feature when a vowel system has more than 3 heights. The models using these features account adequately for most height harmony phenomena. For example, Odden (1991) accounts for height harmony in Kimatuumbi which is illustrated in (1)[1]. Notice that the causative suffix alternates according to the height of the root vowel. When the root vowel is a high vowel [*u, i*], the causative suffix contains the high vowel [*i*], as in *ut-iy-a* 'to make pull'. When the root vowel is [*ʊ, ɪ*], the causative vowel is [*ɪ*], as in *yʊyʊʊt-ɪy-a* 'to make whisper'. When the root vowel is a mid vowel [*ɛ, ɔ*], the causative vowel is [*ɛ*], as in *gɔɔnj-ɛy-a* 'to make sleep'.

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* Thanks go to D. Odden for helpful comments and discussion.

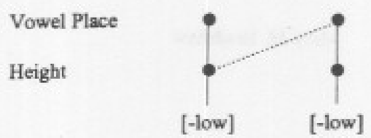
[1] The languages in this paper are tone languages but tones are left unmarked as they are irrelevant to the vowel phenomena discussed here.

(1) Kimatuumbi Height Harmony of the Causative Suffix /iy/ (Odden 1991)

ut-a	'to pull'	ut-iy-a	'to make pull'
yib-a	'to steal'	yib-iy-a	'to make steal'
yʊyʊʊt-a	'to whisper'	yʊyʊʊt-ɪy-a	'to make whisper'
bɪk-a	'to put'	bɪk-ɪy-a	'to make put'
gɔɔnj-a	'to sleep'	gɔɔnj-ɛy-a	'to make sleep'
chɛɛng-a	'to build'	chɛɛng-ɛy-a	'to make build'
kaat-a	'to cut'	kaat-iy-a	'to make cut'

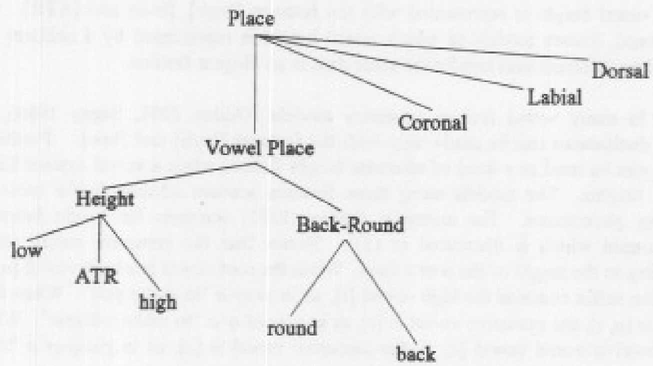
Odden (1991) accounts for these data, as in (2), where the Height node spreads when it is specified as [-low]. It is necessary to specify the trigger and target as [-low] since the low vowel [*a*] fails to spread and is opaque to spreading.

(2) Kimatuumbi Height Harmony



Odden's model for vowel features is given in (3). Note that by the height harmony process given in (2), what is spreading are the [high], [low] and [ATR] features. (Terminal features under the Vowel Place node are binary, although not so marked in (3).)

(3)



While this model handles height harmony like that of Kimatuumbi quite nicely, it is seriously challenged by a height process which involves one-step raising.

§1. One-Step Raising in Gbanu

In Gbanu, a Gbaya language of the Niger-Congo family spoken in the Central African Republic (group 1, Ubangi branch of Adamawa-Ubangi subfamily), the phenomenon of one-step raising characterizes the Perfective form of the verb (Monino, c1993). Gbanu has 7 vowels and 4 degrees of vowel height. In a model like that of Odden 1991, these vowels would be specified as in (4) where height distinctions are made in terms of [high], [low] and [ATR].

(4) Feature Specifications in the Odden 1991 Model

	i	u	e	o	ɛ	ɔ	a
high	+	+	-	-	-	-	-
low	-	-	-	-	-	-	+
ATR	+	+	+	+	-	-	-
back	-	+	-	+	-	+	+
round	-	+	-	+	-	+	-

The Perfective in Gbanu is indicated by a change in the root vowel, which surfaces as one step higher in the Imperfective. The Imperfective and Perfective forms of Gbanu verbs are shown in (5). When a root has a high vowel /*i, u*/, that vowel surfaces unchanged in the Perfective, as in ***gunu*** 'has buried' from /*gun*/. When a root has a mid vowel /*e, o, ɛ, ɔ*/, that vowel is raised one-step. The high-mid vowels /*e,o*/ become [*i, u*], as in ***hile*** 'has cried' from /*hel*/ and ***tumbo*** 'has sent' from /*tomb*/. The low-mid vowels /*ɛ, ɔ*/ become [*e, o*], as in ***zekɛ*** 'has sifted' from /*zɛk*/ and ***ɲoŋɔ*** 'has eaten' from /*ɲɔŋ*/. When a root has a low vowel /*a*/, that vowel, like the high vowels, surfaces unchanged in the Perfective, as in ***hana*** 'has fried' from /*han*/. The disyllabic verbs show that the phenomenon occurs across a consonant, and not just when vowels are adjacent.

(5) Gbanu Perfective and Imperfective Verbs[2] (Monino c1993)

	Imperfective		Perfective		Imperfective		Perfective	
/i/	ɓi	'gather'	ɓii	'has gathered'	li̲fi̲	'make net'	li̲fi̲	'has made net'
	pi̲	'throw'	pi̲i̲	'has thrown'	ʔili	'push'	ʔili	'has pushed'
	gi	'cook'	gii	'has cooked'				
/u/	ku̲	'cross'	ku̲u̲	'has crossed'	dunu	'is full'	dunu	'was full'
	ɓu	'make a circle'	ɓuu	'has made a circle'	gunu	'bury'	gunu	'has buried'
	lu	'make...	luu	'has made boule'				
/e/	fe	'die'	fie	'has died'	zele	'hear'	zile	'has heard'
	ʔe	'put'	ʔie	'has put'	hele	'cry'	hile	'has cried'
/o/	lo	'fall'	luo	'has fallen'	tombo	'send'	tumbo	'has sent'
	kpo	'knot'	kpuo	'has knotted'	dolo	'forge'	dulo	'has forged'

[2] Underlining indicates nasalization.

/ɛ/	dɛ	'do'	dee	'has done'	hɛlɛ	'tie'	helɛ	'has tied'
	pɛ	'seed'	peɛ	'has seeded'	zɛkɛ	'sift'	zekɛ	'has sifted'
/ɔ/	dɔ	'burn'	doɔ	'has burnt'	gɔmɔ	'chop'	gomɔ	'has chopped'
	kɔ̰	'want'	ko̰ɔ̰	'has wanted'	ɲɔŋɔ	'eat'	ɲoŋɔ	'has eaten'
/a/	ba	'take'	baa	'has taken'	hana	'fry'	hana	'has fried'

As illustrated in (6), the vowel raises only when the underlying root vowel is high-mid or low-mid. The Imperfective forms, like the Perfective forms, are derived from an underlying CV or CVC root. The CV forms surface as CV in the Imperfective (but CVV in the Perfective). The CVC forms surface as CVCV in both Perfective and Imperfective. Consonant-final underlying representations are assumed in spite of the surface CVCV forms because all disyllabic verbs in Monino's Gbanu data have identical vowels in both syllables. Furthermore, all verbs in Gbanu are vowel-final. Given a constraint against coda consonants[3], the surface forms are accounted for with a repair strategy by which a vowel is inserted in the Imperfective and the melody of the root vowel spreads to fill it. No such vowel insertion is necessary in the Perfective because a floating mora is suffixed as part of Perfective formation and it is filled in by the same vowel spreading operative in the repair strategy.

(6)	high	/Ci/ → [Cii]	/Ci C/ → [CiCi]
		/Cu/ → [Cuu]	/CuC/ → [CuCu]
	high-mid	/Ce/ → [Cie]	/CeC/ → [CiCe]
		/Co/ → [Cuo]	/CoC/ → [CuCo]
	low-mid	/Cɛ/ → [Ceɛ]	/CɛC/ → [CeCɛ]
		/Cɔ/ → [Coɔ]	/CɔC/ → [CoCɔ]
	low	/Ca/ → [Caa]	/CaC/ → [CaCa]

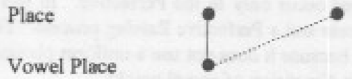
The patterns given in (6) represent only the underlying form and the output of the phonology. But the derivation of the surface forms resulting from one-step raising in Gbanu actually involves several steps. First, an empty mora is suffixed to the root (CeC → CeCμ). Evidence for this comes from CV verbs which take the form CVV in the Perfective, such as *ba* 'take' which becomes *baa* 'has taken'. Clearly, a mora has been added. Moreover, the quality of the second vowel depends on the quality of the first vowel. They are identical for high or low vowels and differ only by one degree of height for mid vowels. Thus, in all vowels within a single verb, the Place features are identical. This indicates that there is spreading of the root vowel (CeCμ → CeCe). Finally, the root vowel must be raised one-step (CeCe → CiCe). Any account must deal with these processes (mora insertion, spreading, raising). Furthermore, any account must deal with the apparent failure of the high and low vowels to raise.

[3] Coda constraints are the norm in the Gbaya group of languages.

§2. Vowel Feature Geometry of Odden 1991

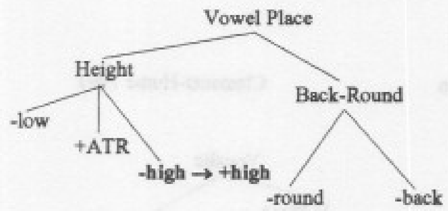
How would a model like Odden 1991 handle this phenomenon? In (7), the vowel spreading process is represented within Odden's model. Vowel spreading is triggered by the insertion of the Perfective suffix, an empty mora. Note that spreading must occur at the level of the Vowel Place node because it occurs across consonants and involves all the vowel features. The features [round] and [back] are used as place features.

(7) Vowel Place Spread



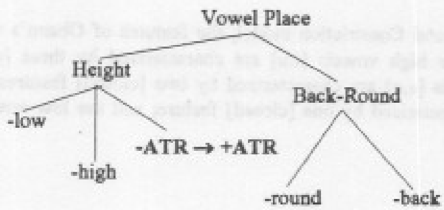
Subsequently, vowel raising affects the root vowel. Vowel raising in this model can be conceived of as morphologically sensitive processes that affect only Perfective forms. In (8), the operation that turns a root vowel /*e*/ into [*i*] in the Perfective is shown to be the result of some process which effects a feature change in the value of [high]. This is not necessarily a feature changing rule. It could equally well be an insertion rule that involves an automatic delinking of the original high specification.

(8) Vowel Raising fe → fie 'has died'



Compare this to (9), where the change from /*ɛ*/ to [*e*] in the root vowel involves a change in the feature [ATR], whether by feature change or feature insertion.

(9) Vowel Raising dɛ → deɛ 'has done'



The process illustrated in (8) must target only high mid vowels, and the process illustrated in (9) must target only low mid vowels.

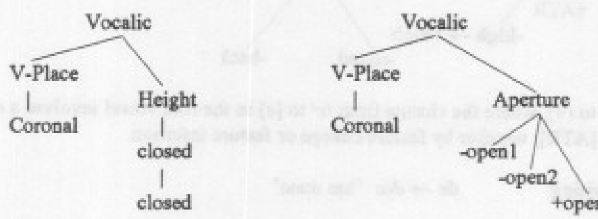
There are some problems with this approach. What happens to the root vowel in the Perfective, namely raising one-step in height, cannot be captured in a unified manner. It must be considered a change in the feature [high] for some vowels and a change in the feature [ATR] in others. Thus, two separate processes are required: one for high mid vowels and another for low mid vowels. Moreover, the generalization that the root vowel raises one-step in height is not captured. What we have is merely a feature change which changes different features for different target vowels. Furthermore, we have to stipulate that the processes involved occur only in the Perfective. In this approach, we would have a Perfective ATR process and a Perfective Raising process. Thus, the vowel feature model in Odden 1991 fails because it does not use a uniform phonological feature to account for the uniform phonetic dimension of vowel height.

§3. Other Vowel Feature Geometry Models

Other vowel feature models, such as the Incremental Constriction model of Parkinson (1995) and the model of Clements and Hume (1995), represent vowel height in terms of a uniform feature arrayed on different tiers. These models, given in (10), show the geometry from the Vocalic Node (the part relevant for vowel features) for the vowel [*e*]. I will assume the Incremental Constriction model, but both models appear capable of handling the Gbanu data.

(10) Representations of [*e*]

Incremental Constriction (Parkinson 1995) | Clements-Hume 1995



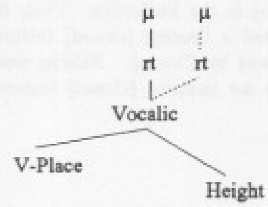
In Parkinson's Incremental Constriction model, the features of Gbanu's vowels are specified as in (11). The high vowels [*i,u*] are characterized by three [closed] features. The high-mid vowels [*e,o*] are characterized by two [closed] features. The low-mid vowels [*ɛ,ɔ*] are characterized by one [closed] feature; and the low vowel [*a*] would have no [closed] feature.

(11) Features of Vowels in Incremental Constriction Model

	i	u	e	o	ɛ	ɔ	a
closed	•	•	•	•	•	•	
	•	•	•	•			
	•	•					
Labial		•		•		•	
Coronal	•		•		•		

In order to derive the attested surface forms, a process of vowel assimilation, in (12), spreads the Vocalic node of the root vowel to the empty mora of the Perfective morpheme. Intervening consonants will not block this spreading. This will result in an intermediate form with two root nodes that shares the vowel features found under the Vocalic node. The root node of the affix is interpolated when the Vocalic node spreads. This structure differs from that of a long vowel in which one root node is shared by two moras.

(12) Vocalic Spreading (in this case to the Perfective morpheme)



Spreading results in the multiple linking of all the vowel features of the root and suffix vowels. Yet raising affects only half of the multiply linked structure. That is, it affects only the root vowel. This can be dealt with by a process of cloning, as in (13). Cloning consists of a separation of one multiply linked structure into two featurally identical singly linked structures (see Cohn 1990:56-57 and Hume 1992:118-119). It typically affects vowels which do not share the same root node. Cloning allows a process to affect the root vowel without affecting the suffix vowel. Thus, spreading causes the features in the root and suffix vowels to have the same feature specifications, and Cloning allows subsequent rules to affect one of these vowels without affecting the other one.

(13) Cloning

The vowel raising phenomenon that is the focus of this paper is accounted for by a floating [closed] feature that attaches to the root vowel. This [closed] feature is part of the Perfective morpheme. The process, given in (14), is simply a mapping process. It docks the floating feature to the leftmost [closed] feature by left to right mapping. Because of the mapping process, the feature [closed] is mapped to the leftmost linked [closed] feature, migrating across the feature specifications for the suffix vowel. Thus, the Perfective morpheme is a suffix consisting of a mora and a floating [closed] feature.

(14) Root Vowel Raising/Closed Insertion

```
closed
  :
closed
```

Note that this process automatically excludes low vowels which have no [closed] features. This corresponds to a weak crosslinguistic generalization that when a vowel has height features, it generally has place features as well. Since [*a*] is a Placeless vowel in Gbanu, and an underlyingly Heightless vowel, it cannot acquire height features.

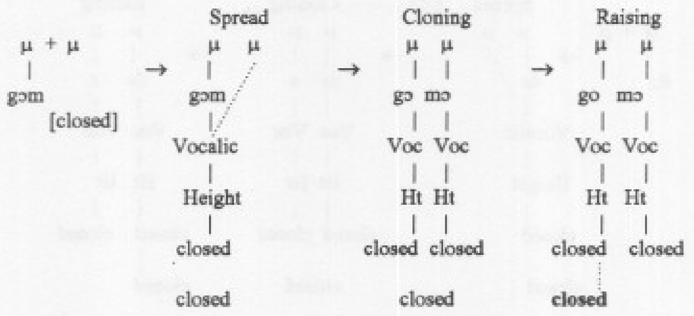
In (15) and (16), derivations involving high mid and low mid root vowels are compared. Notice that unlike with the Odden 1991 feature model, these analyses are identical. In (16), */tomb/* becomes [*tumbo*] in the Perfective. First, the Perfective morpheme, consisting of a floating mora and a floating [closed] feature, is affixed. Then, Vocalic Spreading takes place, followed by Cloning. Raising results from the mapping of the floating [closed] feature to the terminal [closed] feature of the root vowel.

(15) tomb → tumbo 'has sent'

```
                    Spread            Cloning          Raising
 μ + μ            μ       μ          μ    μ           μ    μ
 |           →    |     /      →     |    |     →     |    |
tomb             tomb /             tombo             tu mbo
  [closed]        | /                |    |           |    |
                 Vocalic            Voc  Voc          Voc  Voc
                  |                  |    |           |    |
                 Height             Ht   Ht           Ht   Ht
                  |                  |    |           |    |
                 closed          closed closed     closed closed
                                                      :
                 closed             closed          closed
```

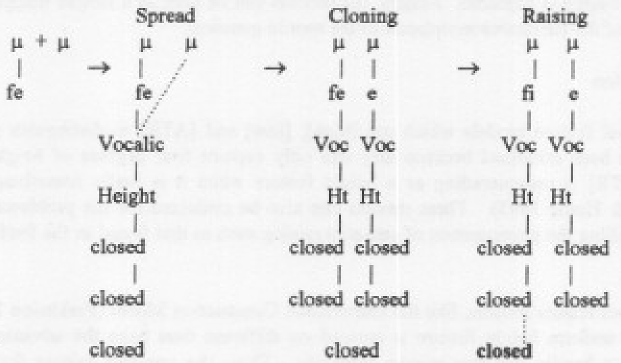
The same procedure results in */gɔm/* becoming [*gomɔ*] in the Perfective, as shown in (16). The fact that the target vowel is low mid rather than high mid does not require any new process, or any modification of the procedure whatsoever.

(16) gɔm → gomɔ 'has chopped'



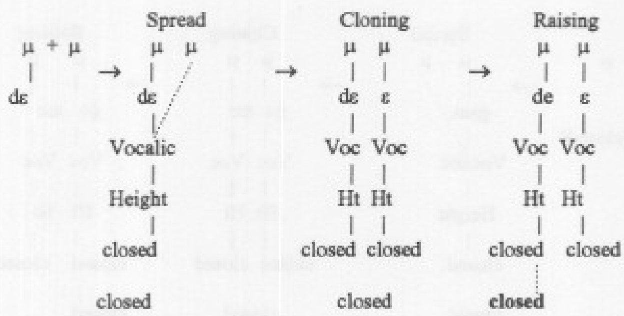
The same process applies for a verb in which no consonant intervenes between the root vowel and the suffix vowel, as shown in (17) and (18). The derivation is the same as those in (15) and (16) for verbs with intervening consonants. In (17) the derivation is shown for a CV verb with an underlying high-mid Coronal vowel.

(17) fe → fie 'has died'



In (18), the derivation is shown for a CV verb with an underlying low-mid Coronal vowel.

(18) dɛ → deɛ 'has done'



A feature model such as the Incremental Constriction model, which appeals to privative stacked vowel height features, has a number of advantages when used for an analysis of one-step raising. In this model, the phenomenon can be handled in a unified manner. All mid vowels undergo the same raising. Low vowels are excluded by the form of the mapping process. High vowels can either be excluded by structure preservation, or the raising can be applied vacuously. Basically, no higher vowels are available in the language either phonologically or phonetically. The generalization that root vowels are raising one degree is captured. Finally, the process can be seen as a simple mapping of an element of the Perfective morpheme to the root in question.

§4. Conclusion

Vowel feature models which use [high], [low] and [ATR] to distinguish vowel height have been criticized because they can only capture four degrees of height and because [ATR] is masquerading as a height feature when it is really something else (Clements & Hume 1995). These models can also be criticized for the problems they have in handling the phenomenon of one-step raising such as that found in the Perfective in Gbanu.

Vowel feature models, like the Incremental Constriction Model (Parkinson 1995), in which a uniform height feature is arrayed on different tiers have the advantage of being able to handle one-step raising elegantly. Thus, the one-step raising found in Gbanu provides additional support for this kind of model.

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ATR HARMONY IN KƆNNI*

Mike Cahill

0. Introduction

Kɔnni, a Gur language of northern Ghana, has a typical nine-vowel system with root-controlled ATR harmony. Its chief interest comes from the extremely flexible characteristics of /a/, which can alternate with [e] and [o]. Unlike its behavior in many other languages, /a/ is not a neutral vowel in Kɔnni. In this paper I examine the vowel harmony system of Kɔnni and in particular, propose a way of accounting for the malleable behavior of /a/ in terms of a feature geometric framework.

The paper is organized as follows. First, in Section 1, I lay out the basic facts of Kɔnni ATR-based vowel harmony within words. In Section 2, I examine an approach incorporating privative features into a feature geometry system. Section 3 contains some concluding remarks. An Appendix of ATR harmony data across words is included.

1. ATR Harmony in Kɔnni

The nine vowel phonemes of Kɔnni divide into two harmony sets based on the Advanced Tongue Root feature:

---

* Kɔnni is in the Central Oti-Volta subgroup of the Gur language family (Naden 1989). Previous works dealing primarily with Kɔnni phonology are Naden (1987) and Cahill (1992a,b,c, 1994). The data for this study were gathered while living in the Koma village of Yikpabongo during various periods from 1986 to 1992. Special thanks must go to Abdulai Sikpaare, who patiently repeated many of these forms over and over, to Mr. Ben Saibu, who has clarified many aspects of the Kɔnni language for me, and to David Odden, who has suggested many changes for the better in this paper. Any faults which remain are mine.

(1)

+ATR		-ATR	
i	u	ɪ	ʊ
e	o	ɛ	ɔ
		a	

With very few exceptions, all vowels in a single-root word come from only one of the two harmony sets[1]:

(2)

+ATR words		-ATR words	
súúli	'to be full'	jʊ́ʊ́rɪ	'to climb'
bitiéŋ	'beard'	tɔ́bɪ̀	'to pierce'
tókórósi	'windows'	kʊ́rʊ́bâ	'cooking pot'

Words from the [-ATR] set comprise about 80% of verbs and nouns.

1.1 Harmony Within Words

The vowel harmony of Kɔnni extends from the root to all affixes of nouns and verbs, as below (noun suffixes for plurals and articles vary with noun class):

(3) Nouns:

+ATR		-ATR	
dii-ri	'the forehead'	kʊ̀ʊ̀-rɪ	'the hoe'
siè-kú	'the path'	ǹǹ-kʊ́	'the rain'
dùùm-bú	'the horse'	nyáá-bʊ	'the water'
dèmbi-ké	'the man'	gbàà-ká	'the dog'
dùn-é	'knees'	tàn-á	'stones'
dùn-é-hé	'the knees'	tàn-á-há	'the stones'
tókóró-si-si	'the windows'	nánjʊ́-sɪ́-sɪ	'the flies'
kùn-ti-ti	'the funerals'	sʊ́n-tɪ́-tɪ́	'the brooms'
tígím-mé	'at house'	mʊ́gʊ́m-mà	'at river'

(4) Verbs:

+ATR		-ATR	
kùri-yé	'has pounded'	pàsɪ̀-yá	'has peeled'
sùgùr-é	'is washing'	pɔ̀gɪ̀l-á	'is holding'
tù-ó	'is digging'	kʊ-á	'is killing'
dígi-wó	'cooked'	gá-!wá	'went'
chii-mé	'carry!'	dum-má	'bite!'
nèn-dii	'will eat'	nàn-gá	'will go'

[1] The word [gaanluŋ] 'cat' is actually the only example I know of at this point. See further discussion in Sec. 3.

Note that instead of the expected e/ɛ and o/ɔ alternations, which one would expect if there were underlying mid vowels in suffixes, there are several cases of e/a and o/a alternations (dùné / tán-á 'knees/houses', tù-*ó* / *kʊ̀-á* 'is killing/is digging'). I will return to these later.

Since adjectives never occur in isolation, I consider them bound morphemes and part of the nominal. However, adjectives have their own value of ATR, which can differ from the root noun:

(5) jùò-háá'lɪ́-ŋ[2] 'new room' (lit. 'room-new')
néмꜜbí-kʊ́lɪ́-ŋ 'big bird' (lit. 'bird-big')

The above have [+ATR] vowels in the noun preceding the adjective, and [-ATR] vowels in the adjective. However, when the adjective has [+ATR] vowels, this value spreads to the noun:

(6) gbè-níiŋ 'female dog' (cf. gbàáŋ 'dog')
né-níiŋ 'female cow' (cf. nááꜜgɪ́ŋ 'cow')
né-bíŋ 'small cow' (cf. náá-kpɪ́'ɪ́ŋ 'big cow')
jè-vùkíŋ 'snake' (lit. 'thing wriggling'; cf. jàáŋ 'thing')
kùò-bíŋ 'small hoe' (cf. kʊ̀áŋ 'hoe')
múgú-bîŋ 'small river' (cf. mʊ́gʊ́ŋ 'river')
bùntù-bíŋ 'small toad' (cf. bʊ̀ntʊ̀ʊ́ŋ 'toad')

However, some nouns seem to be immune to this ATR spread:

(7) ná-bîŋ 'small leg' (cf. náŋ 'leg')
gʊ̀ráá'bíŋ 'small lizard' cf. (gʊ̀rá'á ŋ 'lizard')

These latter cases are exceptional ones. Beyond the fact that they all have [a] in the last syllable (which is the second most frequent vowel in words anyway, after [ɪ]), there is no apparent pattern to explain their exceptionality, and they will be treated as lexical exceptions here.

Similarly, each component of a compound noun can contribute its own value of ATR to the word:

[2] /ŋ/ is the singular indefinite suffix, and is found on over 95% of nouns in citation form. It occurs as the final morpheme on a noun. For simplicity's sake, I will not indicate this morpheme boundary in the remainder of this paper.

(8) daa-gbuge 'stumps' ('wood-short')
nĩĩm-bó-ˈliŋ 'lightning' ('rain-fire')
nàà-chígíŋ 'lion' ('cow-running'?)
núú-ˈtálí 'palm of hand' ('hand-??')
bitié-gbáríŋ 'chin' ('jaw-lower.part')

In contrast to adjectives, there is no spreading of ATR from one component of a compound noun to another.

1.2 Summary

As seen above, affixes take their specification of ATR from the root to which they are affixed, whether noun, verb, or adjective. I assume, then, that in Kɔnni only nouns, verbs, and adjectives are lexically specified for ATR, with each being specified for only one value of ATR. There are two separate processes of ATR spreading. Besides the rightward spreading from nouns and verbs to suffixes, leftward spreading of [+ATR] occurs in most noun-adjective complexes. There is no spreading in compound nouns.

2. Analysis in a Feature Geometric Framework

A plausible way of representing Kɔnni vowels is in a feature geometric framework, as in Clements and Hume (1995). In this model, vocalic features are split into two groups, under a V-place node and an aperture node, as below (placement of [ATR] is discussed below):

(9)

```
                    Vocalic
                  /         \
           V-Place           aperture
         /    |    \             |
[labial] [coronal] [dorsal]  [closed]
```

2.1 The Representation of Underlying Vowels

Unlike previous work on Kɔnni vowels which utilized a traditional binary feature system (Cahill 1992b,c, 1994), the privative vocalic features above will be assumed here.

2.1.1 [closed]

The [closed] under the aperture node is taken from Parkinson (1996), rather than the [open] feature used in Clements and Hume (1995). There may be multiple occurrences of [closed] to differentiate different degrees of vowel height. Thus in a three-height vowel system, /i/ has two features of [closed], /e/ has one feature of [closed], and /a/ has no [closed].

2.1.2 [labial]/[dorsal]

In Clements and Hume's (1995) framework, a back round vowel such as /u/ or /o/ has properties of both [labial], since the vowels have lip-rounding, and [dorsal], since the articulator is the tongue dorsum. The question I will consider now is whether both of these are active. If not, which one is the active one? This is closely related to the classic [back]/[round] feature question: which one should be specified? In Kɔnni, as in many languages, the traditional features [back] and [round] are intimately related. All [+round] vowels are also [+back], and with the exception of /a/, all [+back] vowels are also [+round].[3] In the feature geometry model I am using here, I treat [dorsal] as the active feature, and formulate a crucial rule in terms of [dorsal] rather than [labial] (see 20), but formulate no process that refers to [labial].

Evidence for choosing [dorsal] comes from the behavior of /w/. The phoneme /w/ is identical to /u,ʊ/ in features except for being in a non-syllabic position rather than a syllabic one. As with /u,ʊ/, /w/ could conceivably have [dorsal], [labial], or both as its place of articulation feature(s). In the nasal assimilation process, a nasal consonant assimilates in place of articulation to a following consonant:

(10) Nasal assimilation across words in Kɔnni[4]

ŋ wo jaaŋ	'I lack anything.'
m baarɪ wɪɪŋ	'I discuss a matter'
ŋm gbalɪgɪya	'I am tired'

Before /w/, the nasal becomes [ŋ], the [dorsal] nasal, leading us to use the [dorsal] feature as its place of articulation. Also relevant is the fact that nasals may assimilate as [m] before labial consonants (/p,b/) and [ŋm] before labiovelar consonants (/kp,gb/). If /w/ were specified as [labial], it would group with /b/, with [m] preceding it. If /w/ were specified as both [labial] and [dorsal], it would group with /gb/, with [ŋm] preceding it. Of the possibilities for specifying features for /w/, only [dorsal] fits. Extending the properties of /w/ to the back round vowels, I will use [dorsal] here to refer to them.

2.1.3 [ATR]

Languages which make a distinction in tongue root position may have either [ATR] or [RTR] specified, but it seems much more common to have [ATR] as the marked value (e.g. Archangeli & Pulleyblank 1989, Pulleyblank 1986). Also, in Nawuri, a Guang language of Ghana, Casali (1988) points out that it is only the positive value of [ATR] that optionally spreads both left and right across word boundaries:

(11) Nawuri:
/ɪpʊ ## leŋbiri/ → [ipulembiri] 'black soup'
(some phonetic detail suppressed for clarity)

In Akan as well, it is the positive value of ATR which spreads to the left, usually for one syllable, across words (Dolphyne 1988:23-24):

---

[3] In the framework of Cahill 1992c, I maintained that [round] is the feature which is needed underlyingly, since there is a lexical rule referring to [+round], but not to [back]. If this could be directly translated into the present theoretical framework, it would mean that [labial] would be needed in an underlying representation of /u,o/. However, we shall see that [dorsal] rather than [labial] is needed here.

[4] The full account of nasal assimilation in Kɔnni is somewhat more complex. Before labial-velar stops [gb,kp], a nasal assimilates as [ŋm] across word boundaries, as shown above, but within words, the nasal assimilates as [ŋ], as in [sɪŋkpaaŋ] 'peanut.' For further details, see Cahill 1995a.

(12) [əko fie] 'he goes home' (cf. ɔkɔ 'he goes')

In common with these languages, I claim [ATR] is the marked value in Kɔnni rather than [RTR] and will be specified in underlying representation[5]. There are lexical items that are [-ATR] in isolation but are [+ATR] when adjacent to a [+ATR] morpheme, but there are no morphemes which are [+ATR] in isolation and [-ATR] when adjacent to a [-ATR] morpheme. In Kɔnni, it is the positive value of [ATR] that spreads across words and within words (data below are repeated from (6) and (29):

(13) gbèniiŋ 'female dog' (cf. gbààŋ 'dog')
ge ye 'go see' (cf. ga 'go')

Since [ATR] is a feature of the morpheme, it will not be a feature of an individual vowel, but rather of a lexical morpheme: noun, verb, or adjective. In a phonetically [ATR] word, the [ATR] autosegment will associate to all vowels in the word. There is no evidence of left-to-right or right-to-left association, nor could there be, if the [ATR] associates to every vowel in the word. Affixes are unspecified for [ATR], and if the root has an [ATR] autosegment associated to it, the [ATR] will spread into the affix. The domain of automatic spreading of [ATR], then, is the word in Kɔnni. Additional spreading of [ATR] across words is by rules to that effect.

There has been some question as to whether [ATR] is the best term for the relevant feature. For example, Clements (1991) and subsequent work (Clements and Hume 1995) have proposed that [ATR] can be subsumed under the feature [pharyngeal], unifying other phenomena besides "ATR" harmony. For expository purposes, however, I will use the more traditional [ATR] in this paper.

2.1.4 [coronal]

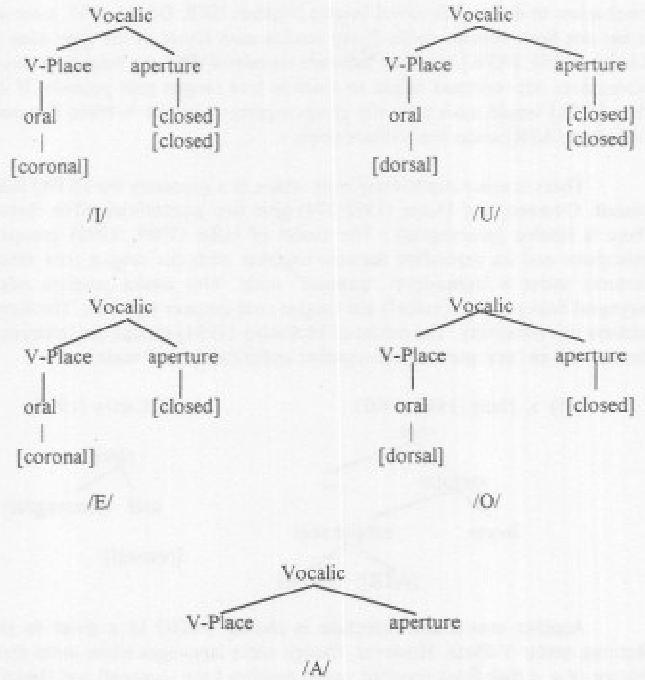
The feature [coronal] will be used for front vowels, as justified extensively in Hume (1994).

2.1.5 The Geometry of Kɔnni Vowels

Abstracting [ATR] away from the specifications of individual vowels in Kɔnni, since [ATR] functions as a property of the morpheme, we are left with five vowels. Specification of these five vowels, then, would be:

[5] Possibly relevant to markedness is the relative frequencies of [+ATR] vs. [-ATR] in Kɔnni. We note again that approximately 80% of Kɔnni nouns and verbs belong to the [-ATR] set, intuitively consistent with [-ATR] as the redundant value and [+ATR] as the marked one.

(14)



The front vowels /I/ and /E/ above are [coronal] in place, while the round back vowels /U/ and /O/ are [dorsal] in place. The high vowels /I/ and /U/ have two features of [closed], while the mid vowels /E/ and /O/ have only one feature of [closed], and the low vowel /A/ has no [closed] at all. The place representation of /a/ is particularly worthy of comment. In different languages /a/ can pattern as either a central or back vowel, which would lead to either no specification or a [dorsal] specification, respectively. In Kɔnni, there is no evidence linking /a/ to other back vowels, and I argue below that /a/ is particularly vulnerable to change. A null specification fits its behavior nicely, under the assumption that unspecified segments are more vulnerable to spreading than are specified segments. It is relevant to note here that Clements and Hume (1995) also note that central vowels will have no place features.

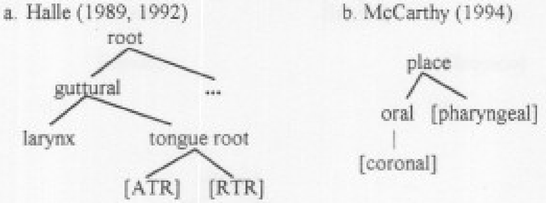
In light of the behavior of /a/ in [+ATR] environments and when adjacent to /u,w/, the V-place and aperture nodes of /a/ may actually be dispensed with, leaving a bare vocalic or possibly root node for /a/.

2.1.6 Geometry of [ATR]

If we follow Odden's (1991) argument for grouping [ATR] together with [high], [ATR] will associate to the aperture node. However, the use of [ATR] in some analyses has little to do with actual tongue-root position, but rather is used as an additional mechanism to distinguish vowel heights (Hyman 1988, Odden 1991, *inter alia*). Although it has not been possible to do X-ray studies with Kɔnni of the type done for Akan (e.g. Lindau 1975), [ATR] harmony between vowels of different heights shows that [ATR] in Kɔnni does not represent height so much as true tongue root position. If this is the case, then [ATR] would more naturally group together with the V-Place features. Therefore, I will place [ATR] under the V-Place node.

There is some controversy over where in a geometry the [ATR] feature should be placed. Clements and Hume (1995:274) give two possibilities. (The feature in question there is labeled [pharyngeal].) The model of Halle (1989, 1992) groups the laryngeal articulator and its dependent features together with the tongue root articulator and its features under a higher-level "guttural" node. This model predicts rules that spread laryngeal features (e.g. [voice]) and tongue root features as a unit. The Kɔnni data do not address this possibility. The model of McCarthy (1994) groups the [pharyngeal] (=[ATR]) feature and an "oral place" node together under the "place" node.

(15) a. Halle (1989, 1992) b. McCarthy (1994)

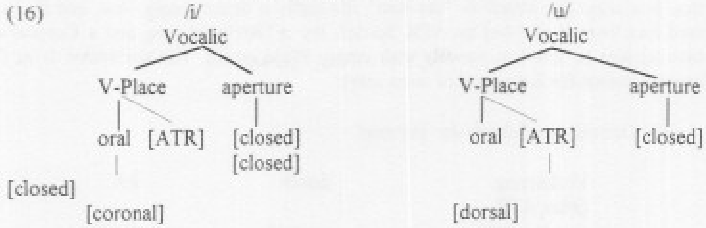


Another conceivable structure is placing [ATR] as a sister to the other place features, under V-Place. However, though some languages allow more than one V-Place feature (e.g. a high front rounded vowel requires both [coronal] and [labial]), Kɔnni does not. One reason for placing [ATR] so it is not a sister to the oral features is that [coronal] can be inserted as a default feature, as we will see later. Since it is assumed that default features are generally inserted onto nodes that are empty, [ATR] cannot be placed under the same node as the oral features such as [coronal]. Thus Kɔnni is consistent with McCarthy's placement of [pharyngeal].

Though there is no conclusive evidence in Kɔnni favoring one version over the other, a simpler analysis is possible with McCarthy's model.

More complete representations of /i/ and /u/, therefore, would be as below. Representations of /ɪ/ and /ʊ/ would be identical except lacking the [ATR] feature.

(16)



2.2 Rules and Derivations

With the above representations, we will see that two spreading rules and two default rules are needed to account for the ATR harmony data for suffixes of Kɔnni words.

2.2.1 Non-round Words

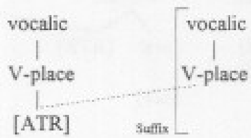
We have seen above that there is no [+ATR] counterpart for /a/, the lowest vowel. This lack of a low ATR vowel is extremely common across languages. Archangeli and Pulleyblank (1994), for example, express this as an ATR/LO Condition holding across many languages: if [+ATR], then [-low]. In terms of the [closed] feature used here, there is a constraint that a [+ATR] vowel must have at least one specification for [closed]. We can formulate this in terms of a linking rule which applies everywhere (as in Mohanan 1991):

(17) ATR/Closed rule: [ATR] → [closed]

This rule will have the effect of inserting a feature [closed] onto a vowel which is specified for [ATR] if no [closed] is already present.[6]

Next, we formulate the basic rule of ATR spreading as:

(18) ATR Spread (note: consonants may intervene between the vowels)

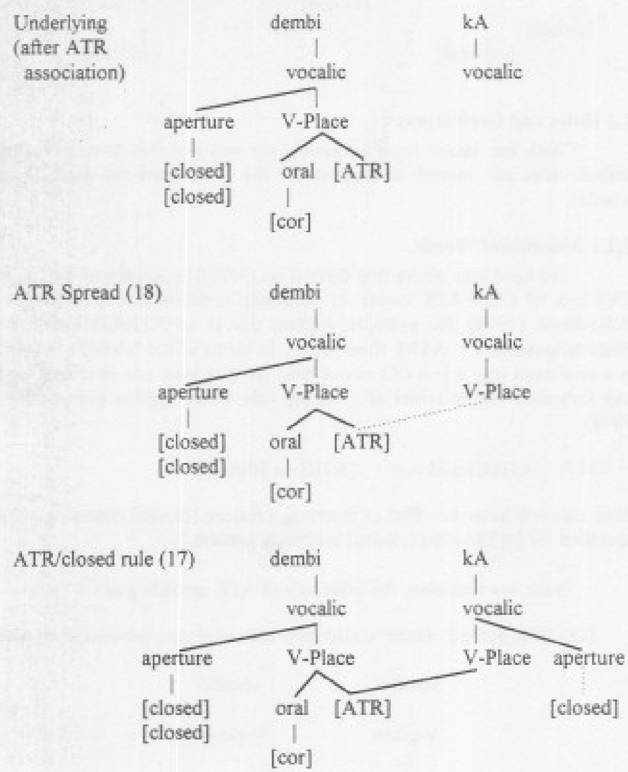


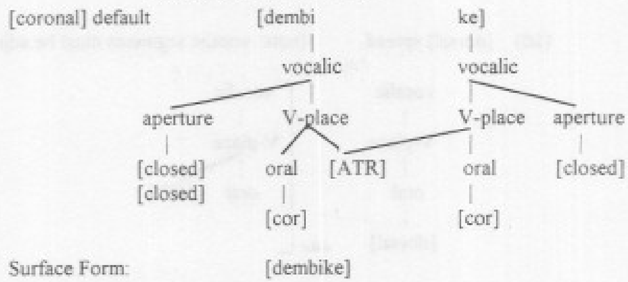
This rule spreads the [ATR] feature from roots to suffixes, which have no underlying [ATR] specification, as in *dùùm-bú* 'the horse' vs. *nyáá-bʊ́* 'the water'. Note also that the SUFFIX specification is necessary, since [ATR] does not spread rightward from a root to another root, as in *juo-haalɪŋ*, 'new house,' *juo-haalɪ-ka* 'the new house.' If the suffix contains the low vowel /a/, and the root vowels are [ATR], then the [ATR] spreads and /a/ becomes [e], as in /dembi-ka/ → [dembike] 'the man' and /dun-a/ → [dune] 'knees.'

[6] Note that if [open] were to be used, a constraint something like *[ATR, +open, +open] would be needed, which would have the effect of deleting one of the values of [+open].

Thus, in a word like *dembi-ke* 'the man', the suffix is underlyingly /-ka/, and the vowel is raised and fronted to [-ke] by ATR Spread, the ATR/closed rule, and a Coronal default which applies to non-low vowels with empty Place nodes. The derivation is as follows (features shown for last vowel of stem only):

(19) Derivation of *dembi-ke* 'the man'





The [coronal] default comes as the result of a constraint common in many languages: that non-low vowels must have a Place feature, presumably either [dorsal] or [coronal] (see Parkinson 1996 for more exemplification of this). This would apply to languages which have no three-way distinction in backness for any height, by far the majority of the world's languages. [coronal] is less marked than [dorsal], as shown both cross-linguistically and in particular by the fact that a [coronal] vowel, /I/ (abstracting away [ATR]), is the epenthetic vowel in Kɔnni.[7] The result is that when a vowel gains a [closed] feature, it also gains [coronal] if no V-Place feature is already present. So, while a low vowel cannot have a place specification in Kɔnni, a non-low vowel must have one. Once ATR spreads to a vowel, that vowel must have some height (gaining a [closed] feature), and when it gains [closed], it must have a Place specification. The process could be repeated for words like *dun-e-he* 'the knees' (see (3)) which have two suffixes. The [ATR] would first spread to the plural suffix /-a/, then to the definite article suffix /-ha/, changing both suffixal vowels to [e] by means of the rules discussed above.

For a [-ATR] form, such as *tɪɪ-ka* 'the tree,' there is no [ATR] present, and so the conditions for ATR Spread are not met. [coronal] default cannot apply, since there is no [closed] associated with the suffix vowel /a/. Therefore, the /a/ remains [a].

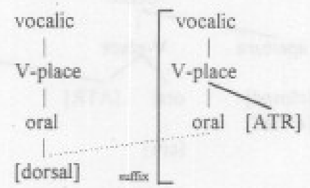
2.2.2 [dorsal] Spread

Recall that if /a/ is in a suffix following an ATR stem and preceded by either /u/ or /w/, it changes to [o], in words like *tu-o* 'is digging', *digi-wo* 'cooked.' This contrasts with the same suffixes following non-ATR stems such as *kʊ̀-á* 'is killing' and *gá-ꜜwá* 'went' (see 4). The process consists of spreading the feature [dorsal] from a vocalic segment to an empty Oral node under V-Place in a suffix:

---

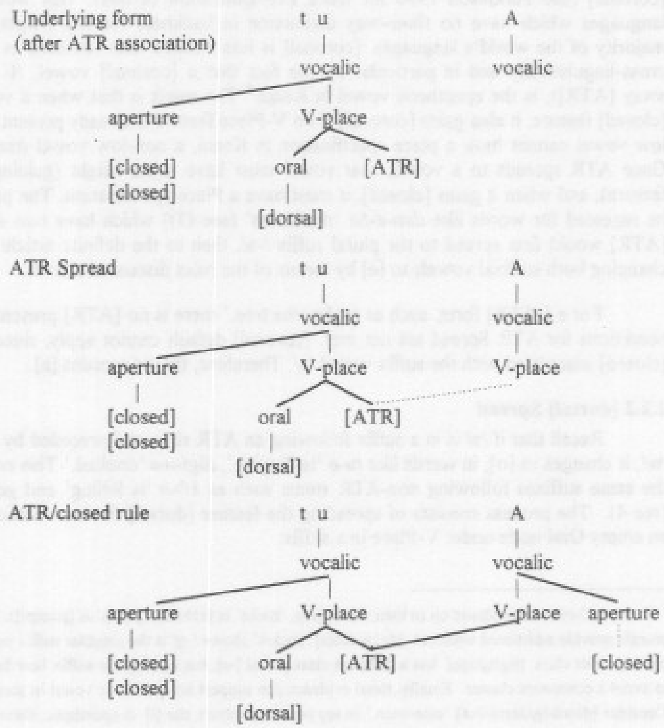
[7] The epenthetic vowel shows up in loan words (e.g. 'socks' is [sɔkɪsɪ], 'pump' is [pɔmpɪ]). Second, noun plurals provide additional evidence. [daaŋ/daatɪ] 'stick/s' shows /-ŋ/ is the singular suffix and /-tI/ the plural in this class. [tigiŋ/tige] has a different class plural [-e], but its singular suffix here has /I/ inserted to avoid a consonant cluster. Finally, tonal evidence can support an epenthetic vowel in some nouns. Consider [dèmbíŋ/dèmbìké] 'man/men.' In my present analysis, the [i] is epenthetic, there is a lexical Low tone on the root, and the final High tones in each word come from the suffix, either /-ŋ/ or /-kA/. In *dèmbíŋ*, the Low is on the root and the High docks to the second syllable. In *dèmbìké*, the High from the suffix associates there, rather than the second syllable. The second syllable is formed when epenthesis occurs, and the Low is inserted by an independently required rule of Low default (see Cahill 1995b).

(20) [dorsal] spread (note: vocalic segments must be adjacent)

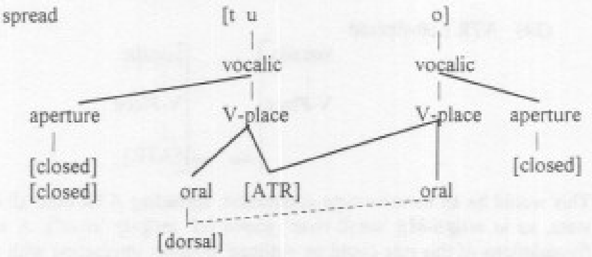


The [ATR] on the suffix above comes from spreading ATR from the stem, not from any inherent value of the suffix itself. The following shows how *tu-o* 'took' would be derived using the model above.

(21) Underlying form (after ATR association)



[dorsal] spread



Surface Form: [tuo]

Note that Coronal Default cannot apply here, since the oral place node is not empty.

In *digi-wo*, ATR must spread from the *i* in the root, and [dorsal] from the *w* in the suffix itself, again emphasizing the independence of the two spreading rules.

2.2.3 Left-Spread of ATR

The only other area to explain within words is the leftward spreading of ATR from an ATR adjective into a non-ATR noun stem, and the lack of spreading in the reverse situation (data repeated from (5-6)):

(22) a. no spreading:

jʊ̀ɔ̀-háá'lɪ́ŋ	'new room' (lit. 'room-new')
ném'bi-kʊ́lɪŋ	'big bird' (lit. 'bird-big')

b. spreading:

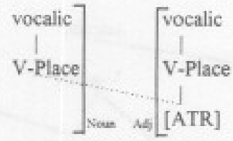
né-biŋ	'small cow' (cf. náág'íŋ 'cow', náá-kpí'íŋ 'big cow')
jè-vùkiŋ	'snake' (lit. 'thing wriggling'; cf. jàáŋ 'thing')
kùò-biŋ	'small hoe' (cf. kʊ̀áŋ 'hoe')
múgú-bîŋ	'small river' (cf. mʊ́gʊ́ŋ 'river')

ATR spreads only into noun stems, and not into the other adjective type, as shown by:

(23) tígí-yɛ́ɛ́lɪ́-'bí-sì 'small white houses'
house-white-small-PL

Above, the morphemes that are lexically specified for ATR are underlined. The suffix *-si* is ATR by the normal spreading process discussed above, but *yɛɛlɪ* is unaffected by ATR spread, though flanked by ATR morphemes. Recall also that ATR does not spread from one noun to another in compound nouns, e.g. *nɪ̀ɪ̀m-bó'líŋ* 'lightning' ('rain-fire', from (8). The rule for spreading ATR from an adjective to the root noun, then, must specify both adjective and noun, and can be formulated as:

(24) ATR Left-Spread



This would be an iterative-type application, spreading ATR onto all the vowels of a noun stem, as in *múgú-bīŋ* 'small river' above (cf. *mʊ́gʊ́ŋ* 'river'). A number of alternative formulations of this rule could be outlined, possibly interacting with morphological levels. For example, one approach would be that a general rule of left spreading applies at the level at which the adjectives are added to the stem. I have no evidence at this point that would be conclusive in choosing between various alternatives, so I leave the formulation above.

2.3 Summary

To sum up, in the feature geometric approach outlined here:

- ATR is a privative, morphemic-level feature, and spreads within a stem to all vowels.
- Any [ATR] vowel must have at least one feature of [closed] associated to it. If [closed] is not present when ATR spreads to a suffix, one will be inserted.
- A rule of ATR Spread spreads [ATR] to a suffix.
- A rule of [dorsal] Spread spreads [dorsal] from /u,w/ to /A/ in a suffix.
- [coronal] place is inserted by default if there is no [dorsal] present, when there is at least one feature of [closed] present.
- ATR spreads leftward from an adjective to all vowels of the adjacent head noun.

3. Discussion

One of the ways in which languages with vowel harmony vary is the behavior of "neutral" vowels with respect to the vowels of one or the other harmonic set in the same word. In some languages, a neutral vowel is 'transparent,' with its value of ATR not affecting any of the surrounding vowels. In other languages, e.g. Akan, a neutral vowel such as /a/ acts as an 'opaque' vowel with respect to ATR. It starts a new harmony domain, any vowels to the right of /a/ being [-ATR], but those to the left being from either set (Hulst & Smith 1986). Similarly, in Turkana, /a/ also has the same opaque behavior (Vago & Leder 1987).

In contrast to the above cases, the model I have proposed above predicts that in Kɔnni, [a] would never occur in the same monomorphemic word with a [+ATR] vowel. To see why this is so, imagine words such as [bita] and [batu]. In these words, or any like them, /a/ has no underlyingly specified features. The [ATR] spreads automatically to all vowels in the word. But when [ATR] has spread, the linking rule that supplies a [closed] value comes into play, and /a/ becomes [e] or [o]. Therefore, [a] would not be expected to occur in any word together with a [ATR] vowel. In actual fact, there is only one non-compound word in my data where [a] does occur with a [+ATR] vowel: gaanluŋ 'cat.' Compound words, with the possibility of each word contributing its own value of [ATR], have been mentioned above in Sec. 1.1. The probability is that gaanluŋ was a historically compound word, bringing both negative and positive values of [ATR], but the component morphemes have been lost in people's consciousness. For a more detailed treatment of single morphemes which must be treated as phonologically compound words in another Gur language, see Garber (1991). The lack of [a] and [+ATR] vowels occurring in single words thus affirms the analysis that /a/ is unspecified for any place or height features.

I close with an interesting implication of using [closed] rather than [open] to indicate vowel height. This is that /a/ rather than /i/ is the unspecified vowel. This is an interesting analysis in that it claims that the *maximally underspecified* vowel is not the *epenthetic* vowel. In terms of underspecification studies, particularly Radical Underspecification (Archangeli and Pulleyblank 1989, Pulleyblank 1986, *inter alia*), this is an unexpected result.

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APPENDIX: Harmony Across Words

Though this paper concentrates on ATR harmony within words, the data below are presented for the sake of completeness.

The subject and object pronouns agree with the verb in ATR:

(25)	+ATR		-ATR	
	ù yè-yé	'he has seen'	ʊ̀ yɪ̀-yá	'he has given'
	bè yè-yé	'they have seen'	bà yɪ̀-yá	'they have given'
	ǹ yé fù	'I saw you (sg)'	ǹ yɪ́ fʊ̀	'I gave you (sg)'
	ǹ yé nì	'I saw you (pl)'	ǹ yɪ́ nɪ̀	'I gave you (pl)'
	ǹ yé wò	'I saw him'	ǹ yɪ́ wà	'I gave him'
	ǹ yé bè	'I saw them'	ǹ yɪ́ bà	'I gave them'
	ǹ yé kè	'I saw it'	ǹ yɪ́ kà	'I gave it'

The negative particle /kA/ coming between subject and verb also agrees in ATR with the verb root:

(26)	hɔ̀wwá ké yé wô	'The woman did not see him.'
	bè ké yé wó	'They did not see him.'
	bà ká yɪ́ wá	'They did not give him.'
	bììkú ká yɪ́ wâ	'The goat did not give him.'

In noun phrases, where two words with different values of ATR are adjacent, each keeps its own ATR:

(27)	jùné chɪ́á	'foundations' ("rooms' bottoms")
	nàsá!rá júóŋ	'white man's room'
	tá!sɪ́ŋ sikpéŋ	'top of pan' ("pan's head")

Similarly, when two verbs adjoin in a serial verb construction, each has its own value of ATR (tones on verbs will vary with exact context):

(28)	ŋ̀ keŋ mɪŋa ...	'I come know...' (recognize)
	ti nèn díí kʊ̀má miŋ	'We will eat crying' (mourn)
	nàá chii	'Have carry!' (put it on your head)
	hágɪ́ túò	'Get-up take!' (go help!)
	ŋ̀ gá sùgùri gààtí	'I go wash clothes.'

There are a few cases in which ATR appears to spread from one verb to another:

(29)	ge ye ...	'go see...' (cf. *ga* 'go')
	ge keŋ ...	'go come...'

However, the conditions for spreading are not clear at present, as the case *yaa gu ziele* 'have go stand' shows. At this point, all that can be claimed with certainty is that ATR spread across verbs is very limited in scope and frequency.

An interesting question is what happens when a pronoun comes between serial verbs having opposite values of ATR. The pronoun agrees in ATR with the first verb:

(30) tɪ yaa <u>ba</u> kieŋ 'We brought them.'
1p have 3p come

be to <u>be</u> dʊa 'They laid them down.'
3p take 3p lie.down

The domain of ATR can stretch over a phrase with several particles:

(30) ← [-ATR]———→ ←[+ATR]→

dí ká yíà kà kè nyindiiké "That (you) do not give it its food."
that NEG give it it food

As seen above, particles of various sorts, like the suffixes, are also unspecified for ATR and take their value from a nearby lexical morpheme. Occasional spreading of ATR across verbs has been observed, but not across nouns.[8]

[8] There are also cases like the following, which is more properly analyzed as a case of elision and compensatory lengthening:

	dùné !ɑ́tɑ̂	→	[dùnɑ́ !ɑ́ta]	'three knees'
	kpíinè àtâ	→	[kpíinà àtâ]	'three guineafowls'

In the similar item *bìé !ɑ́tɑ̂* → [bìɑ́ !ɑ́ta] 'three goats,' an unresolved question is whether the final phonetic form includes [bia] or [bɪa].

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Prosodic Structure in SiSwati*

Rebecca Herman

1. Introduction

There are several phonological patterns in SiSwati, a member of the Nguni subfamily of the Bantu family of languages, which point to the existence of some sort of prosodic structure. This paper will describe those patterns and compare and contrast the prosodic structure of SiSwati with the types of prosodic structures which occur cross-linguistically.

One theory which has tried to describe prosodic structure cross-linguistically is metrical phonology. One of the insights of metrical phonology is that words are not just strings of sequential elements but rather that they are organized hierarchically into rhythmic units. Instead of rhythm being represented featurally, it is represented structurally as an organization of syllables, words, and phrases. This conception of structure is developed by, for example, Liberman and Prince (1977) and Selkirk (1980).

One of the ways in which this organization has been represented is in prosodic phonology, where a constituent tree hierarchy is proposed to express the metrical structure of a language (Nespor and Vogel, 1986). The hierarchy is strictly layered, with each constituent of a lower level being dominated by a constituent at the next level up, although later work indicates that strict layering may not be a necessary component of the hierarchy, and that elements undominated by constituents at the next higher level may still be prosodically licensed (Downing, 1993, Bagemihl, 1991). In this hierarchy, syllables are gathered into binary feet, feet are gathered into words, and words are gathered into phonological phrases. Such groupings apply to all syllables, regardless of morphological or syntactic structure.

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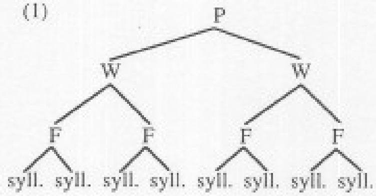
(1)



This paper will concentrate on structure at the level of the foot, that is, the structure immediately dominating syllables, since that is the level that is of interest in SiSwati. Feet have a different status in different languages. In English, for example, feet are so important that children often cannot even pronounce material outside of the foot, such as an unstressed initial syllable. Thus, English-acquiring children often say things like [nænə] for "banana," omitting the unstressed initial syllable which is not part of the foot. Gerken (1996) surveys work pointing to canonical metrical patterns in children's early speech, citing as supporting evidence facts such as the more frequent omission of weak syllables from the sequence weak-strong (like in the word "giraffe") than from the sequence strong-weak (like in the word "zebra"). Echols (1996) also discusses the "trochaic bias" of young English-acquiring children, who tend to focus on, store, and then produce strong-weak sequences. Of course, this trochaic bias is later weakened, as evidenced by the fact that adults can produce a greater range of structures than just strong-weak, although Cutler (1990) does report that the most common word type in English is a polysyllable with initial stress. The foot in English is also crucial in phonological processing, as shown by Cutler and Norris (1988). They showed that in English, strong syllables (with full vowels) are likely lexical word onsets and so listeners attempt lexical access at strong syllables.

In Indonesian, the evidence for foot structure is stress assignment, which does seem to pervade the language, just as it does in English (Cohn and McCarthy, 1994). However, contrary to the situation in English where foot-structure is only marginally affected by morphology (as in, for example, tri-syllabic laxing), foot structure in Indonesian is greatly influenced by morphology. Suffixed words act differently in stress assignment than non-suffixed words. For example, suffixed words do not have the secondary stress that is present in monomorphemic words of the same length. This can be seen in a comparison of the four-syllable suffixed form [bicará-kan] "speak about" with the four-syllable monomorphemic form [bìjaksána] "wise." This difference in stress between suffixed and unsuffixed forms corresponds, Cohn and McCarthy suggest, "to the traditional distinction between rhythmic and demarcative stress." Thus, in Indonesian foot structure is present throughout the language and interacts with the morphology.

In Japanese, on the other hand, foot-structure is not so all-pervasive as it is in English and in Indonesian. However, the foot, or at least some notion of binarity of morae or syllables, is still a useful construct in a description of Japanese. For example, truncations obey minimality restrictions, both for minimal word size (greater than a syllable) and for minimal stem size (at least bimoraic) (Itô, 1990). An example is that [saiko], a name, can be shortened to the bimoraic [sai-(chaN)], since the name is a stem which must be followed by the suffix [chaN] whereas [saikederikku], "psychedelic," a borrowing, can only be shortened to bisyllabic [saike], since it is a free-standing word.

Even in languages in which feet have not been posited before, such as in Sesotho, a Southern Bantu language which has "stress" as a prominence on the penult, early words are typically bisyllabic (Demuth, 1996, reporting on work by Connelly, 1984). However, only examples where a bisyllabic root is left after the prefix is truncated are reported. No examples of truncations of trisyllabic or longer roots are reported. Thus it is not clear whether this phenomenon is evidence for a bisyllabic template or for omission of inflectional morphology. Supporting evidence for a bisyllabic template in Sesotho comes from bisyllabic word minimality, which is a restriction in the language.

Thus, even in languages without stress-based alternating rhythmic feet there is still evidence from minimality and from acquisition for some kind of "foot." Foot-structure thus differs in both functional load and in function from language to language. Foot structure can serve either as a unit organizing syllables into strong and weak (which is the motivation for Hayes' (1995) metrical grid theory), as a template arranging syllables/morae into pairs (as seen by the use of "the foot" as a template in reduplication), or as a marker of prosodic edges (as, for example, with aspiration of voiceless stops in English).

In SiSwati, the prosodic structure is such that it is not clear whether the bisyllabic prosodic constituents that are present qualify as "feet" in the rhythmic, binary, strictly layered sense of the term. Nonetheless, evidence for bisyllabic prosodic constituents does appear throughout the language in different morphological domains (which are divisions of morphemes and strings of morphemes into classes based on function and distribution). However, there is evidence for only one such unit per morphological word, and in some cases the unit seems to be acting simply as a measure of bisyllabic minimality. Various types of evidence can be adduced for the presence of prosodic structure. One type of evidence for these prosodic constituents is the presence of additional material (in addition to the usual morphology) in a shorter word that is not present in a longer word. This extra material is not morphologically part of the word in that it would not be part of the lexical entry for either the root or the affix. Additional evidence for these prosodic constituents comes from alternations involving the edges of the constituents.

The constituents can be shown to be prosodic (and not morphological) due to the behavior of onsetless initial syllables. There is evidence that onsetless initial vowels, which are syllabified with the prefix, are excluded from the prosodic structure. Initial onsetless vowels cross-linguistically behave differently than vowels in syllables with onsets, as shown, for example, by a detailed examination of onsetless vowels in Kikerewe (Odden, 1995).

It will be claimed here that the prosodic structure in SiSwati is not generalized so as to be "built" automatically on every word in the language. Rather, this type of structure will be assumed to be present only when there is direct evidence from augmentation or from alternations that attests to its presence. It is not assumed that the native speaker generalizes from the evidence and goes on to proliferate prosodic structure in other environments, but rather that the speaker/hearer tolerates ambiguity as to the presence or absence of prosodic structure, given a lack of positive evidence. As Trubetzkoy (1969, p.274) says, regarding phonological means of signaling sentence, word, or morpheme boundaries:

> They can probably be compared to traffic signals in the street. ... It is possible to get along without them: one need only be more careful and attentive. Therefore they are not found on every street corner but only on some. Similarly, linguistic delimitative elements generally do not occur in all positions concerned but are found only now and then.

Furthermore, it is not assumed that syllables must be gathered into this type of prosodic structure to be pronounceable. This is contrary to what has been suggested for foot structure by the strict layering hypothesis (articulated by Selkirk, 1984). The conception of prosody in which units such as syllables or morae may be prosodic licensors without being dominated by higher level structure such as the foot resembles the prosodic structures described for Aranda by Downing (1993) and for Bella Coola by Bagemihl (1991), who allow for a mora to be a prosodic licensor without being syllabified. So too syllables in SiSwati need not be parsed into these prosodic domains in order to be pronounced. Thus, $[\sigma\ \sigma]_W$ is as permissible as $[[\sigma\ \sigma]_F]_W$.

Since, as discussed above, the notion of "foot" means so many different things in so many different languages, instead of taking "the foot" as a primitive constituent that is a part of a universal prosodic hierarchy, the "foot" will be decomposed into two more primitive concepts, the concept of binarity and the concept of a domain. The bisyllabic prosodic domain in SiSwati can then be viewed as the product of the general notion of binarity (Itô, Kitagawa, and Mester, 1995) applied to the general notion of phonological domains (Kisseberth, 1994). The general notion of binarity as described by Itô, Kitagawa, and Mester (1995, p. 25) states that:

> In prosodic structures with no more than binary branching, every constituent lies at one edge (left or right) of some larger constituent, is prominent within some larger constituent. Constituent prominence in (maximally) binary structures can be expressed as alignment within a higher constituent. ... Every prosodic constituent is aligned with some (properly) containing prosodic constituent.

The general notion of "domains," as put forth by Kisseberth (1994, pp.133-134), is that they are: "a sequence of phonological material enclosed by a left and right bracket" which are "direct reflexes of phonological, morphological, and syntactic structure." Such domains are not restricted in size, and may be of any length. Selkirk (1986) is a precursor to Kisseberth in the use of prosodic domains, although it must be noted that she argues (contrary to the views taken here) that the theory of domains does not include feet, only higher levels such as prosodic words and prosodic phrases. She gives a representation of domains as follows:

(2) $a[...]a$ a = a syntactic or phonological category

The notion of general binarity captures a crucial pattern in language: a distinction or alternation between adjacent elements. There need to be distinctions created between adjacent elements in order for them to be both pronounceable and perceptible. One such example of an alternating pattern is syllable structure. For example, Mattingly (1981, p.418) writes that:

> The general prerequisite for parallel transmission [which "makes possible higher information rates for speech than would be possible in a truly segmental process"] would appear to be that the constrictions of one or more closer articulations must be in the process of being released or applied in the presence of constrictions for one or more less close constrictions.

Another example of the pervasiveness of binarity for production and perception is the "Obligatory Contour Principle," originally motivated by tone languages, where adjacent identical elements are disfavored (Leben, 1973). A final example comes from stress, where rhythm is created by an alternation of strong and weak syllables (Hayes, 1995). Furthermore, binarity can be imposed on any level of structure, not just on the syllable (as it is in the traditional foot). For example, Stowell (1979, p.61) describes stress in Passamaquoddy, in which "feet themselves are paired into larger binary feet, resulting in an undulating stress contour from foot to foot."

Furthermore, the general notion of a prosodic "domain" is also useful, as has been shown by its utility in a wide range of issues. Many phenomena are neatly captured by prosodic domains. One example of a phenomenon that can be expressed using domains is tone and the issue of the span of realization of a tone (Odden, 1994; Kisseberth, 1995; Hsiao, 1995; Donnelly, 1996). Another such phenomenon is nasal harmony and issues such as transparency and opacity (Homer, 1995). Yet another example involves vowel harmony and the issue of parasitic harmony (Cole and Kisseberth, 1994). One final example of the utility of domains is in accounting for vowel lengthening and issues such as the finding that vowel lengthening is greater when the voiced consonant is tautosyllabic with the preceding vowel (that is, in the same prosodic domain) than when they are heterosyllabic (Davis and Summers, 1989; Lauefer, 1992). Thus, the decomposition of "feet" into the concept of "binarity" applied to "domains" proves to be an insightful division to make, whereas taking "feet" as primitives does not allow for generalization to so many heterogeneous phenomena.

The first piece of evidence about prosodic structure in SiSwati comes from word minimality. The shortest word in SiSwati is two syllables long. Moreover, words which might otherwise be monosyllabic, because they consist of a single C root with a single vowel suffix, have an additional syllable added on which does not appear in words formed from longer roots. This is the first indication that there is some sort of prosodic structure present. The presence of the augmentative syllable in shorter forms indicates that in order to be pronounceable as a word in SiSwati, there must be at least two syllables. Instead of claiming that the presence of an augmentative syllable in what would otherwise be sub-minimal words implies that every word begins with a bisyllabic prosodic constituent, the minimality requirement will be interpreted as a type of measure which determines whether something is long enough to be a word.

The next evidence relating to prosodic structure comes from the verb stem, which may be preceded by several prefixes and which consists of the verb root together with following affixes. Hankamer (1989), who studies morphological parsing in Turkish, evaluates affix-stripping morphological parsing vs. root-driven morphological parsing (in which the parser actively seeks out the root) from both a computational and a psycholinguistic perspective. Agglutinative languages like Turkish (and SiSwati) pose problems for overly simplistic models of processing and lexical access which are based on morphologically simple languages. Hankamer, in studying parsing, makes the assumption, based on Turkish morphology, that the word is root-initial. Thus, in Turkish the choice between root-driven and affix-stripping parsing is basically a choice between left-to-right and right-to-left parsing. He concludes that considerations from both psycholinguistic and computational perspectives point to the advantages of root-driven analysis. Interpreted broadly, this means that identification of the root is a crucial step in parsing. Since in SiSwati the stem generally starts with a root (but is preceded by prefixes), knowing where the left edge of the stem is would help identify the left edge of the root, and thus provide benefits in parsing. So having prosodic structure based on the stem and making the stem prominent would be beneficial. As Cohn and McCarthy (1994) write,

> It seems quite plausible that the favored left-edge alignment [of the root with the prosodic word, for Indonesian] has an explanation in the processing domain, perhaps because the coincidence of a root edge and a conspicuous prosodic word edge favors lexical retrieval.

Although the metrical structure of English is quite different from the prosodic structure of SiSwati, nevertheless Cutler and Norris' observations about lexical access at "strong" syllables seem applicable, although "strong" must be interpreted somewhat differently since "strong" in SiSwati refers to having a consonantal edge of a certain type or to being of a certain length; it does not refer to having a certain vowel quality which appears with stressed vowels. As Cutler (1990, p.119) suggests,

> Thus, native speakers of different languages might use a number of different variants of the same basic type of segmenting device. The metrical segmentation strategy is a specific proposal about how such a device operates for a free-stress language like English. But even in languages with

other prosodic structures there might still be quite similar possibilities for segmentation routines.

Getting back to the verb stem in SiSwati, the prosodic situation in the verb stem is complicated by the fact, which holds throughout the language, that onsets are obligatory in SiSwati except word-initially. Although there is a two-syllable minimality requirement in the stem just as there is in the word as a whole, the stem is different than the word in that minimality does not always hold. The reason for this is perhaps because the stem is usually embedded in a word which is at least two syllables long (simply because of morphological considerations), so even if the stem itself is monosyllabic, the word as a whole is still bisyllabic and hence pronounceable. Evidence for minimality in the stem comes from augmentation. Stems which are constructed from shorter roots may include more material among their affixes than stems which are constructed from longer roots. Again, stem-minimality is a measure of well-formedness, but it is not assumed that prosodic constituents are generalized to occur everywhere. Minimality is simply interpreted as a measure when there is actual evidence of a length-based alternation.

Furthermore, there are edge-based alternations in the stem which seem to make a stronger edge, hence, beneficial for parsing. The edge which is "strong" is not the edge of the morphological stem but rather the edge of some prosodic constituent, which will be argued here to be bisyllabic because of the minimality requirements. Although the exclusion of onsetless initial vowels from the prosodic structure does make a strong left edge for the prosodic domain, this would be problematic for a model of lexical access such as the cohort model (Marslen-Wilson and Welsh, 1978), which begins lexical access at the left edge of words (or stems, presumably, in this case), since the left edge of the prosodic domain actually excludes material which is morphologically part of the root and which must be part of its lexical entry.

The next data relating to prosodic structure come from reduplication. The reduplicant in SiSwati is prefixal and two syllables long. Evidence for bisyllabic minimality comes from forms with shorter roots which have augmentative material in the reduplicant, since the root itself, without suffixes or final vowels, acts as the base for reduplication in SiSwati.

The final data related to prosodic structure come from two of the noun class prefixes, which are reduced unless that would make the word less than two syllables long (ignoring initial onsetless vowels, which, as noted earlier, have a different status in SiSwati than vowels with onsets).

Although there is evidence for prosodic structure in SiSwati from alternations and augmentation, there is no evidence (psychological or neurological) as to how this structure is assigned and parsed by the native speaker – whether by rules, constraints, neural networks, stochastic calculations or some other mechanism. Grammatical rules, constraints, and any such mechanisms are not psychologically valid, they are simply expository devices. In a sense, they are metaphors for language processing. This paper will not deal with the types of metaphors which "build" prosodic structure but rather will be confined to describing linguistic evidence (of the type that can be transcribed) which can be interpreted as support for prosodic structures. Furthermore, in many cases of alternation there is no evidence supporting one or the other form as more basic or "underlying." As such, the alternations will simply be stated, without choosing one or the other as underlying.

The paper is organized as follows. In section 2, background information on the phonology and morphology of SiSwati is given in order to enable the reader to understand the examples. In section 3, examples of word-minimality which point to bisyllabic minimality are given, using data from imperative formation. In section 4, the phonological patterns in the stem which point to a bisyllabic prosodic domain in the stem are presented.

Such data include stem-minimality data from passive formation, evidence from tonal phenomena, and edge effects (including a case of complementary distribution and a case of palatalization). Section 5 entertains the question of whether there is evidence for overlapping prosodic domains. In section 6, minimality data from reduplication are discussed. Finally, in section 7, minimality data from two of the noun-class prefixes are discussed.

2 Background Information on SiSwati

2.1 Phoneme Inventory

SiSwati has a canonical five-vowel system, consisting of the vowels /a e o i u/. Only the three non-high vowels may occur root-initially in verbs.

SiSwati has a rich consonant inventory, as shown in (3). In this table, /p' t' k' č'/ are ejectives and /b̤ d g v j ɦ ɮ ç dv/ are depressor consonants. The consonants listed as [tsʰ] and [tf] are allophonic, with [tf] occurring before labials and [tsʰ] occurring elsewhere.

(3)

	labial	coronal	dorsal	laryngeal
stop	pʰ p' b b̤	tʰ t' d	kʰ k' k g	
fricative	f v	s ɬ ʃ ɮ		h ɦ
affricate		tsʰ/tf č' dv j		
click		cʰ c č ç		
nasal	m	n ny	ŋ	
approx.		l		

2.2 Syllable Structure

Onsets are maximized. This means that all consonants are syllabified into the onset, which may contain up to three consonants. Coda consonants are not allowed. As discussed below, although there are morphemes that end in consonants, such morphemes are always followed by another morpheme that begins with a vowel, allowing the consonant to be syllabified as an onset. Hiatus is not allowed. Hiatus is resolved by glide formation of the first vowel if it is high and deletion of the first vowel otherwise.

2.3 Tone

High and Low tones may occur anywhere in a word. Voiced stops, voiced fricatives, and sometimes /l m w y/ are depressor consonants. In words where the onset of the expected tone-bearing syllable is a member of the class of depressor consonants, the H tone is realized one syllable to the right of its position in words of the same length that do not contain depressor consonants. This phenomenon, however, does not occur when the onset of the following syllable is a depressor consonant. A H tone surrounded by two depressor consonants is realized as a rising tone. H tones on the penult[1] are realized as Falling tones. Tone will not be transcribed here except in the section dealing with tonal phenomena.[2]

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[1] The penult is longer than other syllables on words in isolation but is not longer on phrase-medial words, implying that it is phrase-level lengthening.

[2] Bradshaw (1996) gives a comprehensive account of tone in SiSwati in which she argues for H, M, and L tones, where the L tones involve depression and the M tone is phonologically unspecified.

2.4 Verb Structure

SiSwati has agglutinative morphology. Much of the evidence presented in this paper comes from the "verb complex," a morphologically complex word. The verb complex consists of prefixes; the root; verbal suffixes (called "extensions"), of which there can be several concatenated together; and a final vowel, of which there is only one (it is obligatory and is always the last suffix).

(4) subject prefix + object prefix + verb root + verbal suffix + final vowel

Prefixes include subject concords and object concords. There are 13 noun classes in SiSwati (including the infinitive), each of which has its own subject and object markers. Thus the verb may show agreement with the noun class of the subject and with the noun class of the object. Prefixes may also include such tense markings as the progressive [ya-] and the future [t'au-].[3]

Roots may be either H-toned or toneless. Roots may have any of the different shapes shown in (5), but they are always consonant-final. This is not prosodically well-formed (since codas are not allowed), but the root never occurs alone, always with a final vowel or a suffix. ("C" stands for one or more consonants.)

(5)	-C-	-CVC-	-CVCVC-
	-VC-	-VCVC-	-VCVCVC-

The verbal suffixes known as extensions include such categories as the applied /-el/ (known as "benefactive" in non-Bantu languages), the causative /-is/, the reciprocal /-an/, and the perfective /-ile/. Final vowels, which occur after verbal suffixes, include such categories as the positive indicative /-a/, the subjunctive /-e/, and the negative /-i/. Some examples of verb complexes are given in (6).

(6)

a. kulima:	ku	lim	a		
"to plow"	*infinitive*	*root*	*final vowel*		
b. kuŋalimi :	ku	ŋa	lim	i	
"to not plow"	*infinitive*	*neg. marker*	*root*	*final vowel*	
c. kulimisa :	ku	lim	is	a	
"to cause to plow"	*infinitive*	*root*	*causative*	*final vowel*	
d. kulimisana :	ku	lim	is	an	a
"to cause e/o to plow"	*infinitive*	*root*	*causative*	*reciprocal*	*final vowel*
e. ŋiyalima :	ŋi	ya	lim	a	
"I plow"	*1st sg. subj.*	*progressive*	*root*	*final vowel*	
f. ŋiyayilima :	ŋi	ya	yi	lim	a
"I plow it (a field)"	*1st sg. subj.*	*progressive*	*class 9 object*	*root*	*final vowel*

"Stem," a morphological construct, refers to the root and any following material, including suffixes and final vowels. For a more thorough treatment of SiSwati verb structure, see Ziervogel and Mabuza (1976) or Taljaard, Khumalo, and Bosch (1991).

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[3] An alternative transcription is [t'awu], which does not contradict the generalization that hiatus is prohibited in SiSwati.

3 Word minimality

There is no word in SiSwati that is shorter than two syllables long. (With a word in the phonological sense being something which can stand by itself.) Usually, satisfying bisyllabic minimality is not an issue in building the verb complex since there is usually at least one prefix and one final vowel, adding up to two syllables. However, imperatives may occur without prefixes.

(7)

a. ku-bon-a	to see	e. bon-a	see!
b. ku-ḅal-a	to write	f. ḅal-a	write!
c. ku-lim-a	to plow	g. lim-a	plow!
d. ku-bal-a	to count	h. bal-a	count!

If there is an imperative of a verb root consisting of a single consonant, without any prefixes, then that would be one syllable long, which would be sub-minimal. This situation is averted by the use of an extra syllable, [-ni] in just the cases which would otherwise be too short (seen in the representative forms in (8f-j)). Augmentation of shorter forms can be seen in a comparison of the imperatives of -C- verb roots like [-k^h-] (8g) with the imperatives of -CVC- and longer verb roots (as in the representative forms shown in (7e-h)).

(8)

a. ku-y-a	to go	f. y-a-ni	go!
b. ku-k^h-a	to pick	g. k^h-a-ni	pick!
c. ku-b-a	to be	h. b-a-ni	be!
d. ku-ts^h-a	to say	i. ts^h-a-ni	say!
e. ku-ɮ-a	to eat	j. ɮ-a-ni	eat!

It is not simply the case that -C- verbs automatically require the longer form of the imperative, as seen by -C- verbs which take either an object prefix or a negative prefix. Representative examples of -C- verbs like [-ɮ-] when they are in the imperative with object prefixes or negative prefixes are shown in (9). These verbs, in which the verb complex is at least two syllables long, do not have the extra syllable [-ni-]. Thus, the use of the longer form with [-ni-] in it is dependent on the actual structure of the verb complex, not on the shape of the verb root itself. That is, the criterion for using the syllable [-ni-] is whether the word itself is one syllable long or not, not whether the verb root is of the form -C-. (Unfortunately, the only forms available to show this here are either in the subjunctive with final vowel [-e] or in the negative with final vowel [-i], making them not entirely comparable to the forms in (7) and (8) which have final vowel [-a].)

(9)

a. ɡu-ɮ-e (go ahead and) eat it! (the food) b. uŋa-f-i don't die!

Examples of -CVC- verbs like [-bal-] with object prefixes and negative prefixes are shown in (10) for comparison with (9).

(10)

a. t'i-bal-e (go ahead and) count them! (the shoes) b. uŋa-bal-i don't count!

What might at first glance appear to be evidence contradicting the point illustrated by the data in (9) comes from the plural marker in the imperative, which is also the syllable [ni].

(11)

a. ku-bal-a to count b. bal-a-ni count! (pl.)

Use of augmentative [-ni-] occurs even with the plural marker [-ni-].

(12)

a. ku-m-a	to stand	c. m-a-ni-ni	stand! (pl.)
b. ku-ɮ-a	to eat	d. ɮ-a-ni-ni	eat! (pl.)

However, this could be explained if the plural marker were outside of the phonological unit, perhaps acting as a clitic. The tonal data on this point are ambiguous. In the imperative of toneless verbs, there is a H tone on the penult unless that is also the stem-initial syllable, in which case the H tone is on the final syllable.

(13)

a. limá	plow!	b. liméla	plow for!

Furthermore, the augmentative syllable does not receive a H tone, even if it that means that the H must be on the stem-initial syllable.

(14)

a. yáni	go!	b. * yaní	

Given these two facts of tone assignment, the plural imperative could be interpreted either way. Either the [ni] is part of the unit and the H is on the penult or else [ni] does not count as part of the phonological unit but the H is avoiding the stem-initial syllable.

(15)

a. bicáni	mix! (pl.)	b. limâni	plow! (pl.)

Further data about the status of the plural marker come from penult-lengthening. Although it is the syllable before [-ni-] which is lengthened and that is the penultimate syllable in the word (which might be interpreted as implying that the [-ni-] is being included in the phonological word), what might actually be happening is that it is the phrase penult which is lengthened and not the word-penult. In that case the lengthening would imply that the suffix is excluded from the phonological word but that it is included in the phonological phrase. Thus the data about [-ni-] will not be taken as contradictory data, and it will be maintained that the augmentative [-ni-] in the imperative is only used if the word itself is less than two syllables long.

4 The Verb Stem

Downing (1994, 1995) argues for a prosody/morphology mismatch in SiSwati (based on data from reduplication and tone). She postulates the existence of a "prosodic stem," which is an unbounded prosodic structure related to, but not isomorphic with, the morphological stem. In the following examples from Downing, the symbols () mark the "prosodic stem" while the symbols [] mark the morphological stem.

(16)

a. [(khulúma)]	talk	c. [(tfútsa)]	move house
b. [e(hlukánisa)]	distinguish	d. [e(tsaméla)]	bask

It will be shown below that mimimality data, tonal effects, and edge effects show that onsetless vowels are excluded from the prosodic entity (called the "prosodic stem" by Downing) while they are included in the morphological stem. So, as Downing claims, there is some prosodic entity present that is not isomorphic with the stem. Minimality data presented below, though, argue for this prosodic entity being bisyllabic, not an unbounded "prosodic stem" as Downing claims. None of the data presented here require an unbounded "prosodic stem." In this section, evidence for the bisyllabicity of the prosodic structure of the stem will be shown based on minimality considerations, followed by a discussion of edge effects which support the existence of prosodic structure in the stem.

4.1 Stem Minimality

At the stem level, there are many examples where the stem (root and following material) is less than two syllables long. Any example with a -C- root and a single final vowel constitutes an example. For example, in (17) the infinitive prefix [ku] does not count as part of the stem, leaving only [-Ca-] (which is one syllable) in the stem. In such cases, there is no augmentation.

(17)

a. ku-ɮ-a	to eat	e. ku-f-a	to die
b. ku-lẇ-a	to fight	f. ku-k^h-a	to pick
c. ku-y-a	to go	g. ku-m-a	to stand
d. ku-w-a	to fall		

Thus, the stem does not manifest the same kinds of minimality requirements that the whole word does. However, in a certain class of examples, shorter roots take a different (longer) form of the affix than longer roots do. For example, roots consisting of a single consonant have the form C-i-w-a in the passive, where C is the root and [a] is the final vowel. The [-i-] can be interpreted as an augmentative element.[4,5] The crucial difference between the examples in (17) and (18) is that in (18) a single vowel more among the affixes (where "more" means more as compared with what appears among the affixes in the passive form of longer roots) makes the stem bisyllabic, since the /w/ of the passive can provide an onset. On the other hand, an entire syllable more (again, with "more" meaning more as compared with what appears among the affixes in the infinitive of longer roots) would be needed to make the stem of the infinitive forms bisyllabic. Although both a vowel and an entire syllable change the prosodic structure and the syllable count of the affixes when comparing shorter and longer roots, it seems that a difference of an entire syllable might be too "expensive" prosodically at the level of the stem, especially since the word itself, including the prefix, is bisyllabic anyhow and hence pronounceable as a word. The implication is that the presence of the longer form is not due to the passive construction per se, but rather to the fact that the passive suffix only needs one vowel to make the difference between shorter and longer affixes, since there is a single consonant present either way which can serve as a syllable onset.

(18)

a. banana wa-k^h-i-w-a	the banana was picked
b. lubisi lwa-ɮ-i-w-a	the milk was eaten
c. imali ya-p^h-i-w-a	the money was given

The bisyllabic domain would begin at the left edge of the stem (although with these examples it is not crucial whether it is the left or the right edge of the stem, see (35) for evidence in this regard). In the following examples, square brackets indicate the presence of a prosodic domain.

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[4] The [-i-] which augments the passive suffix [-w-] is the most constricted, and hence least vowel-like, vowel, which seems to involve the least amount of displacement of the articulators between consonants and so is chosen as the contentless augmentative element. Although [-u-] is just as constricted height-wise as [-i-], it involves the additional activity of lip-rounding. Other languages which choose [-a-] as the epenthetic element might be choosing the most sonorous, most vowel-like sound as epenthetic. The choice of [ə] as the epenthetic element in some languages may involve reinterpretation of a consonant burst as a vocalic element (suggested by Beckman, p.c.).

[5] Alternatively, the [i] could be part of the lexical entry for the suffix but reduced everywhere except where that would make the stem subminimal. A third alternative is just to state that the passive suffix is [iw] with shorter stems and [w] with longer stems, without choosing which is more basic or underlying.

(19)

a. wa-[k^{h}-i-w-a]	was picked
b. lwa-[ɮ-i-w-a]	was eaten
c. ya-[p^{h}-i-w-a]	was given

Longer roots which are CVC or longer, like [-bon-], simply have the suffix [w] in the passive. Notice that there are voiceless obstruents (20f,g) just before the passive suffix, exactly as there were in (18) above. In (20), the -C-w- sequences are onsets, since all consonants are syllabified into the onset in SiSwati. The -C-w- sequences in (18) which would have arisen without the [-i-] would have been perfectly syllabifiable as onsets. Thus the presence of [i] in (18) cannot be driven by syllabification, because if it were, then one would expect a similar pattern, with C-i-w-a, in (20f-g) as well.

(20)

a. indvodza ya-bon-w-a	the man was seen
b. inɮu ya-pend-w-a	the house was painted
c. t'iŋk^{h}uni t'a-bondv-w-a	the firewood was chopped
d. lipot'o la-mbonjot'-w-a	the pot was covered
e. umntfwana wa-p^{h}ekel-w-a	the child was bothered
f. luswat'i lwa-goč-w-a	the small stick was bent
g. umfat'i w-etfuk-w-a	the woman was insulted

Roots which are of the form -VC- pattern with roots of the shape -C- in that they have an [i] in the passive suffix, indicating the exclusion of the initial vowel from the prosodic structure of the stem. In (21), even though the initial vowel is morphologically part of the stem in that it must be part of the lexical entry of the stem, it is not counted toward satisfying bisyllabic minimality in the stem. For example, the root in (21a) is [-ok^{h}-], which appears with the noun-class prefix [wa-]. However, [wok^{h}wa] does not satisfy bisyllabic minimality. Thus, the morphological structure alone is not adequate to describe the pattern, indicating that prosodic structure is also necessary.

(21)

a. k-ok^{h}-a	to light	h. umlilo w-ok^{h}-i-w-a	the fire was lit
b. k-os-a	to roast	i. inyama y-os-i-w-a	the meat was roasted
c. kw-al-a	to refuse	j. imali y-al-i-w-a	the money was refused
d. kw-ak^{h}a	to build	k. inɮu y-ak^{h}-i-w-a	the house was built
e. kw-ets^{h}-a	to pour	l. emanti ets^{h}-i-w-a	the water was poured
f. kw-eb-a	to steal	m. imb̤ut'i y-eb-i-w-a	the goat was stolen
g. kw-el-a	to winnow	n. umb̤ila w-el-i-w-a	the maize was winnowed

Here the bisyllabic domain would begin not at the left edge of the stem, but at the first onset in the morphological stem. The square brackets show the location of the prosodic domain.

(22)

a. w-o[k^{h}-i-w-a]	was lit
b. y-o[s-i-w-a]	was roasted
c. w-e[mb-i-w-a]	was dug

Again, it is not crucial if this prosodic domain is constructed at the left edge of the stem (but ignores material which is syllabified with non-stem material) or whether the prosodic domain is constructed at the right edge of the stem. The problem is that the only time there is evidence at all for prosodic structure with the passive construction is when the longer form of the passive suffix is used: [Ciwa] or V[Ciwa]. Thus there is crucially a lack of evidence as to where the prosodic domain begins. A different type of evidence, discussed below in (35), shows that the domain must in fact be at the left edge of the morphological stem, not at the right edge.

Downing states a minimality requirement in terms of the inclusion of at least one root vowel in the prosodic stem. However, as shown above in (21), the prosodic structure does not include the root vowel (as shown by the presence of the longer form of the passive with -VC- verbs), although it does include final vowels in satisfying bisyllabic minimality.

The exclusion of the initial onsetless vowel from the prosodic structure of the stem can be compared with imperatives of -VC- verbs, which take the shorter allomorph (as seen in the representative forms in (23)). The fact that they are vowel-initial can be seen from their infinitives, which show the coalesced form of the infinitive prefix [ku]. These forms just have the final vowel, without the augmentative syllable [-ni-]. (Recall that subminimal forms in the imperative take a longer form of the imperative suffix with the additional syllable [ni]. See in (8) above.) This implies that they are already two syllables long, so the initial vowel must be included in the syllable count.

(23)

a. $kw-ak^{h}-a$	to build	i. $y-ak^{h}-a$	build!
b. kw-ab-a	to share	j. y-ab-a	share!
c. $k-ok^{h}-a$	to light	k. $y-ok^{h}-a$	light!
d. k-on-a	to damage	l. y-on-a	damage!
e. $kw-ets^{h}-a$	to fill up	m. $y-ets^{h}-a$	fill up!
f. kw-el-a	to winnow	n. y-el-a	winnow!
g. kw-endz-a	to marry	o. y-endz-a	marry!
h. kw-enç-a	to surpass	p. y-enç-a	surpass!

The initial [y-] in the examples in (23) is epenthetic. Although the epenthetic [-y-] might seem to be preventing the verb complex from being vowel initial, the situation is actually more complicated since there are in fact vowel-initial prefixes which do not take initial [y-] (seen in (24)). This cannot be a restriction forcing stems to be consonant-initial either, since there are in fact vowel-initial stems which must be listed as such. The generalization seems to be that [-y-] occurs only when a vowel-initial stem would otherwise be word-initial.

(24)

a. u-fik-ile	he arrived	c. a-ŋi-bon-i	I don't see
b. u-b̤udz-ile	he dreamed	d. a-ŋi-b̤al-i	I don't write

In summary, the stem also shows a bisyllabic minimality effect, although the effect is more intricate than the word-minimality effects, since factors like the syllabification of onsetless vowels with prefixes must be taken into account.

4.2 Tonal effects

Another effect of the prosodic domain is in the area of tone. Toneless verbs whose stem is longer than bisyllabic have a H tone on the penult in the remote past tense (which is realized as F). The other H or R tone is contributed by the prefix, for example in (25a) by [á], where [wá] is a fusion of [u + á] and [u] is the third singular marker.

(25)

a. wá-ɬakûl-a	s/he weeded
b. ŋǎ-ɬakûl-a	I weeded
c. sǎ-lim-el-ân-a	we plowed for each other

Toneless verbs whose stem is two syllables long or shorter have a H tone on the final syllable.

(26)

a. wá-lim-á	s/he plowed	c. wâ-y-á	s/he went
b. ŋǎ-lim-á	I plowed	d. wâ-b-á	s/he was
		e. wâ-ts^{h}-í	s/he said

This is again a length-based phenomenon. In general, the H tone is realized on the penult. In the shorter cases in (26 a-b), there are two possible generalizations accounting for realization of grammatical H on the final syllable instead of on the penult (in two syllable words the H is on the final syllable because that is the only available syllable):

(27)

a. a general avoidance of having the grammatical H tone on the first syllable of the prosodic domain;

b. an obligatory contour principle (OCP) effect causing the H of the subject marker and the grammatical H to be non-adjacent.

Toneless verb roots which are vowel-initial and whose stem is three syllables long have a H tone on the final syllable, not on the penult (as seen in (28)). This evidence could support either hypothesis (a) or (b). This could be a general avoidance of the first syllable of the prosodic domain (which is marked with the symbols []), with the initial onsetless vowel excluded from the prosodic domain. On the other hand, due to resolution of hiatus, the [-a-] of the subject prefix is not realized, which would cause an OCP violation if the H of the grammatical tone were realized on the penult.

(28)

a. w-é[lap^{h}-á]	s/he healed	d. w-é[ŋget'-á]	s/he added
b. w-é[tfuk-á]	s/he was surprised	e. w-é[ŋgul-á]	s/he skimmed off
c. w-é[ŋgam-á]	s/he towered over	f. w-é[lus-á]	s/he herded

Thus, more evidence is needed to decide which of the generalizations about shorter stems is correct. If hypothesis (b) were the case, one might expect the second H tone to not surface at all in (26d-f), since the H is adjacent to another H tone, violating the OCP. Another argument against hypothesis (b) is that adjacent H tones are in fact tolerated in SiSwati in other forms, such as in the infinitive.

(29)

a. kú-lúm-a	to bite
b. kú-ts^{h}éŋ-a	to buy

What would be needed to make the case for either hypothesis (a) or hypothesis (b) would be if there were a toneless prefix, for example, [u + a = wa] instead of the actually occurring [u + á = wá]. Then if the grammatical H still appeared on the final syllable, for example in [wa-lim-á], then a general restriction on having the H on the first syllable of the prosodic domain could be implicated in the realization of the H on the final syllable. If, on the other hand, there were a toneless prefix like [wa] and the grammatical H appeared on the penult, for example as [wa-lím-a], then the OCP could be implicated in the realization of the H on the final syllable in (26). That is, if the H tone appeared on the final syllable only when it would otherwise be adjacent to another H tone, then that would be motivation for citing an OCP effect. However, all of the prefixes have either a high tone or a rising tone, making it impossible to test these two ideas against each other.

(30)

a. ŋă-lim-á	I plowed	d. să-lim-á	we plowed
b. wă-lim-á	you(sg) plowed	e. nă-lim-á	you(pl.) plowed
c. wá-lim-á	he plowed	f. bá-lim-á	they plowed

Thus, both proposals are viable, but there is some evidence against the OCP account, indicating that the proposal which makes reference to the first syllable of the prosodic domain is to be preferred, especially given the other evidence for the prosodic domain.

4.3 Edge Effects at the the Stem Level
4.3.1 Distributional Evidence

[ŋg] and [ŋ] are in complementary distribution. [ŋg] appears as the onset of stem-initial syllables and [ŋ] appears everywhere else.

(31)

a. ku-ŋgabat'-a	to doubt	b. ku-ŋgen-a	to enter

[ŋ] appears as the onset of syllables which are not stem-initial.[6] The [ŋ] may be the onset to a stem medial syllable (as in (32e)) or it may be the last part of the root which surfaces as the onset of the stem-final syllable with the addition of the final vowel (as in (32a-d)).

(32)

a. ku-ɓoŋ-a	to bellow	d. ku-seŋ-a	to milk
b. ku-ceŋ-a	to filter	e. ku-biŋel-el-a	to greet
c. ku-ts^{h}eŋ-a	to buy		

Thus, the appearance of [ŋg] vs. [ŋ] serves as a diagnostic which gives evidence about the left edge of the prosodic constituent.

This distribution seems to give a strong edge to the prosodic constituent. Having a strong edge could be beneficial for parsing by helping to identify the left edge of the root and hence the left edge of the stem. Ohala (1992) writes that "...as the closure gets further back the nasal consonants that result get progressively less consonantal." Thus, having a release burst (due to closure of the velum before the vowel begins) may serve to make [ŋg] a better, more consonantal, edge for the prosodic domain because of the perceptual salience of the burst. The [ŋ], which does not have a release burst because of the lack of pressure build-up in the oral cavity (due to nasal airflow releasing pressure), does not make as good an edge. Again, this can be described simply as a distribution, not a lenition medially or a fortition stem-initially, although there is in this case one argument that it is a lenition since [ŋ] acts a depressor with the class of depressors often defined as voiced obstruents (Bradshaw, 1996).

This distribution applies only to the stem, not to the word, because there are subject prefixes beginning with [ŋ] which appear word-initially.

(33)

a. ŋi-t'au-lim-a	I will plow
b. ŋi-t'au-lum-a	I will bite
c. ŋi-bon-a	I see

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[6] Stems which seem to have lexicalized reduplication may have [ŋg] stem-internally, as in (a) and (b) below, but these could be interpreted as having [ŋg] at the edge of the reduplicant as well as [ŋg] at the edge of the stem. However, these lexicalized examples do not have the general shape of reduplicants discussed in section 6.

a. ku-ŋgiŋgit'-a	to stammer
b. ku-ŋgwiŋgwilit'-a	to skim

With vowel-initial stems, since hiatus is not tolerated and glide-formation or deletion result, the initial vowel of the root is syllabified with the prefix. (The /u/ of the infinitive prefix /ku-/ surfaces as a glide before a vowel, but does not surface before /o/.) Even though this vowel is syllabified with the prefix, morphologically it is still part of the stem (which, as noted above, is a morphological entity). The evidence from the distribution of [ŋg] vs. [ŋ] shows that the stem-initial vowel is excluded from the prosodic domain, since it is [ŋg] which appears after the initial vowel (even though in (34d) and (34e) this means that there is positive evidence that the stem is sub-minimal). Referring to the "stem" is not adequate here since the vowel is part of the morphological stem but is not part of the prosodic structure based on the stem. Thus, reference to a prosodic construct, namely to the prosodic domain which is motivated above by the minimality effect, must be made in order to explain the appearance of [ŋg] as the onset of a syllable which is not stem-initial.

(34)

a. kw-eŋgam-a	to tower over	d. kw-aŋg-a	to hug and kiss
b. kw-eŋget'-a	to add	e. k-oŋg-a	to economize
c. kw-eŋgul-a	to skim off		

Evidence here does show that the prosodic constituent must occur at the left edge of the stem and not at the right edge because left-edge effects are seen even in longer forms. In (35a) for example, the prosodic domain is at the left edge of the stem so the initial onset of the prosodic domain is "strong" (it has an oral release burst). In (35b), on the other hand, the prosodic domain extends two syllables from the right edge of the stem. In this case, the stem-initial onset [ŋ] would not be the prosodic-domain-initial onset, so it would not be "strong." This would yield the incorrect form.

(35)

a. ku-[ŋgaba]t'-a   to doubt   b. *ku-ŋa[bat'-a]

4.3.2 Palatalization Edge Effects

Labial consonants which are not stem-initial are palatalized in the passive form. A labial consonant which is root-final (36) or root medial (37) (neither of which is stem-initial) is palatalized in the passive. The infinitive forms are shown below each passive to motivate the claim that there is an alternation between a labial consonant and a palatal consonant.

(36)

a. indvodza y-elaʃ-w-a	the man was healed
b. kw-elap^h-a	to heal
c. inja ya-nçwač-w-a	the dog was buried
d. ku-nçwab-a	to bury
e. luswat'i lwa-goč-w-a	a small stick was bent
f. ku-gob-a	to bend
g. umuntfu w-esač-w-a	the person was afraid
h. kw-esab-a	to be afraid
i. umuno wa-luny-w-a	the finger was bitten
j. ku-lum-a	to bite
k. insimu ya-liny-w-a	the field was plowed
l. ku-lim-a	to plow

m. umntfwana wa-lany-w-a	baby born after you
n. kw-elam-a	to come after
o. umntfwana wa-banj-w-a	the child was held
p. ku-bamb̪-a	to hold
q. umntfwana wa-meny-w-a	the child was carried on the back
r. ku-mem-a	to carry

(37)

a. lipot'o la-mbonjot'-w-a	the pot was covered
b. ku-mb̪omb̪ot'-a	to cover
c. t'inb̪ebe t'a-b̪ojos-w-a	ears were pierced
d. ku-b̪obos-a	to pierce

However, labials which are stem-initial (and root-initial) are not palatalized.

(38)

a. inb̪u ya-pend-w-a	the house was painted
b. ku-pend-a	to paint
c. umuntfu wa-p^{h}ucul-w-a	the person was civilized
d. ku-p^{h}ucul-a	to civilize
e. umtfwana wa-p^{h}ekel-w-a	the child was bothered
f. ku-p^{h}ekel-a	to bother
g. imali ya-p^h-i-w-a	the money was given
h. ku-p^{h}a	to give
i. umsebenti wa-p^{h}awul-w-a	the work was distinguished
j. ku-p^{h}awul-a	to distinguish
k. emanti a-bilis-w-a	the water was boiled
l. ku-bilis-a	to boil
m. indvodza ya-bon-w-a	the man was seen
n. ku-bon-a	to see
o. umntfwana wa-banj-w-a	the child was held
p. ku-bamb̪-a	to hold
q. umntfwana wa-meny-w-a	the child was carried on the back
r. ku-mem-a	to carry

Labials which are preceded only by an onsetless syllable, but where the labial is the first onset in the stem, also are not palatalized. Again, this is evidence that the stem-initial onsetless vowel, which is syllabified with the prefix but is morphologically part of the stem, is not included in the prosodic domain. So referring to the "stem" is inadequate, because the "stem" is a morphological entity which does include the initial vowel, but according to the distribution of labials in the passive forms, the initial vowel is prosodically excluded.

(39)

a. imot'o y-ebolek-w-a	a car was borrowed
b. kw-ebolek-a	to borrow
c. siłała s-ebul-w-a	the tree was peeled
d. kw-ebul-a	to peel
e. emanti ab-i-w-a	the water was shared out
f. kw-ab-a	to share
g. babe w-emḇul-w-a	the father was uncovered
h. kw-emḇul-a	to uncover
i. t'inłuku t'-omis-w-a	the nut was made dry
j. k-omis-a	to dry
k. insondvo y-ep^{h}otʃ-w-a	the wool was twisted
l. kw-ep^{h}ots^h-a	to twist

There are stems beginning with palatal consonants, so the restriction on palatalizing stem-initial labials cannot simply be a blanket restriction on stem-initial palatal consonants.

(40)

a. ku-ʃaḇ-a	to repair	c. ku-ʃaḏ-a	to get married
b. ku-ʃ-a	to be burnt	d. ku-jayiv-a	to dance

Chen and Malambe (1995), who analyze palatalization in SiSwati, suggest that the passive suffix consists of a floating "palatal" feature. Chen and Malambe's suggestion of a floating feature for palatalization distinguishes underlying stem-initial palatal consonants, which are licit, from stem-initial palatal consonants created by passive palatalization, which are not allowed.

Again, this seems to be an edge effect on the prosodic constituent, preserving the unpredictable stem-initial place of articulation and so making it "stronger" in some sense by making it easier to access.

5 Overlapping prosodic constituents?

It has been argued that there is a prosodic consituent measuring word minimality and a prosodic constituent based on the stem, but since the stem is embedded in the word and usually preceded by prefixes, one possible concern is that the two constituents might overlap. This would be problematic because prosodic structures are not supposed to overlap – that would defeat their organizational purpose. Kisseberth (1994) assumes that domains of a given type do not overlap. He claims that "domain structures such as the following:

$$\ldots {}_o[^x \; {}_p[^y]_o \; {}^z]_p \ldots$$

are considered ill-formed." In order to get evidence for overlapping prosodic constituents from the stem and word domains, there would need to be a particular configuration giving evidence for both types of structures in the same word. Again, it is not claimed that every word or every stem has a binary prosodic domain imposed on it. The domains are only claimed to occur when there is actual evidence for them. The evidence from the word as a whole is minimality, in the form of the augmentative syllable [-ni-] in the imperative of -C- verbs. The evidence for prosodic structure from the stem is either the augmentative [-i-] in the passive, having a H tone on the final syllable in the remote past tense, the [ŋg]/[ŋ] distribution, or the distribution of palatalization in passives. Thus [-ni-] would have to appear with one of the other types of evidence. For example, if there were an imperative form of a -C- verb consisting of [-ŋg-], with the form [ŋg-a-ni], that would give evidence for prosodic structure for both the word and the stem (even though the two structures in that case could be construed as hierarchically arranged [[ŋg-a-ni]$_{stem}$]$_{word}$, not as overlapping). However, there is no such verb. Or, there could be an imperative form of a passive verb, such as [ɮ-i-w-a] "be eaten!", or an imperative of a remote past tense verb, which cannot be elicited because an imperative can be inflected for neither tense nor subject while a remote past verb would have to be inflected for both tense and subject. In any of these cases, though, the word would have to be exactly two syllables long, but that would not be long enough for a structure like $_{a}$[syll.1 $_{b}$[syll.2]$_{a}$ syll.3]$_{b}$. Thus evidence as to what happens when there are overlapping prosodic constituents is hard to come by, since evidence for having prosodic structure in the word as a whole is limited to -C- root imperatives.

6 Reduplication

In SiSwati, the reduplicant is two syllables long (as noted by Kiyomi and Davis (1992) and by Downing (1994, 1995)). This has been analyzed as a foot-shaped template, but as mentioned above, the primitive notion of "foot" has been decomposed here into the idea of binarity applied to a prosodic domain. Thus the reduplicative template, while it is bisyllabic, is not called a "foot" here. Reduplication adds the meaning of doing something "a little" to the verb. If the root itself is at least as long as CVCVC (remembering that roots themselves are actually always consonant-final), then the reduplicant simply copies the melody of the first two syllables of the root. The reduplicant is underlined in all of the following examples.

(41)

a. ku-<u>tfuku</u>-tfukuts^{h}elisa	to cause to get a little mad
b. ku-<u>k^{h}ulu</u>-k^{h}uluma	to say a little
c. ŋi-ya-<u>tfuku</u>-tfukutsela	I get a little mad
d. ŋa-<u>tfuku</u>-tfukutsela	I got a little mad
e. ŋi-<u>k^{h}ulu</u>-k^{h}ulumile	I've said a little
f. ŋi-<u>ŋgwiŋgwi</u>-ŋgwiŋgwilit'ile	I've skimmed a little
g. ku-ŋa-<u>tfuku</u>-tfukutseli	to not be a little mad
h. ku-ŋa-<u>k^{h}ulu</u>-k^{h}ulumi	to not say a little

If the root itself is only of the form -CVC-, then the second vowel in the reduplicant is always [a], no matter what the second vowel of the stem is.[7] In this regard, note especially examples (42g-i) and (42l), in which the second stem vowel is the [-i-] of the suffix [-ile-] or of the final vowel [-i] but the last vowel in the reduplicant is nevertheless still [-a-]. Thus, the reduplicant seems to have a bisyllabic template in which the root melody is filled in, but it is augmentable with other material if necessary. Here it should be noted that although Downing (1994, 1995) uses two types of evidence for the prosodic stem, reduplication and tone, the base for reduplication is the root itself whereas the application of local shift (a tonal process in which the H is realized one syllable over from where it is morphologically) includes the object prefix and any suffixes.

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[7] Downing (1996) gives examples of -CVC- roots with the benefactive derivational suffix [-el]. She says that such stems may have either a reduplicant of the form -CVCa- or a reduplicant of the form -CVCe-. She suggests that examples which always have the final vowel [a] in the reduplicant (such as in (42)) are assuming the shape of the "canonical stem" with the "predictable, regular inflectional final suffix."

(42)

a. ku-lima-lima	to plow a little
b. ku-bona-bona	to see a little
c. ŋi-ya-lima-lima	I plow a little
d. ŋi-ya-bona-bona	I see a little
e. ŋa-lima-lima	I plowed a little
f. ŋa-bona-bona	I saw a little
g. ŋi-k^{h}ula-k^{h}ulile	I've grown a little
h. ŋi-bona-bonile	I've seen a little
i. ŋi-lima-limile	I've plowed a little
j. ŋi-ya-li-bona-bona ligundvwane	I see it a little (a mouse)
k. ŋi-ya-yi-lima-lima iŋgadze	I plow it a little (a garden)
l. ku-ŋa-bona-boni	to not see a little

There is another effect that motivates positing the root by itself, without suffixes or final vowels, as the "base" of reduplication. If the root (without the final vowel) is at least two syllables long, then the lexical tone is realized on the base, not on the reduplicant. If the root (without the final vowel) is shorter than two syllables, then the lexical tone is realized on the reduplicant, not on the base. This phenomenon supports the idea that there is a "base" for reduplication from which the reduplicant is copied and that the base is the root itself.

(43)

a. yok^{h}á-yok^{h}a roast it a little! b. yok^{h}e-yok^{h}éla roast it (for someone) a little!

The -VC- roots do not fill up the bisyllabic reduplicative template either, just like the -CVC- roots. In these cases also, the second vowel of the reduplicant is [a] no matter what the second stem vowel is. In the forms in (44v-hh), the second vowel of the stem is always [a], even when the second vowel of the stem is [-i-]. This [i] is either part of the perfective suffix [-ile-] (44v-ee) or else the [-i-] of the negative final vowel (44ff-hh).

In the case of reduplication involving -VC- roots, there are two places where hiatus could potentially arise. One place where hiatus could arise is between the reduplicant and the stem. An epenthetic [y-] is used to resolve hiatus here because glide-formation or deletion are not options (glide formation because the first vowel is not high and deletion because that would make the reduplicant less than two syllables long).[8] Another place where hiatus could arise is between the prefix and the reduplicant. In this case, hiatus is resolved by having the [-u-] of the infinitive prefix be realized as a glide (just as it does in non-reduplicative forms, i.e. (21)).

(44)

a. kw-andza-y-andza	to increase a little
b. kw-ala-y-ala	to refuse a little
c. k-ok^{h}a-y-ok^{h}a	to light a little
d. k-osa-y-osa	to roast a little
e. k-ona-y-ona	to damage a little
f. kw-ela-y-ela	to winnow a little
g. kw-enya-y-enya	to soak a little
h. kw-eba-y-eba	to steal a little

[8] The epenthetic [-y-] is not copied in the reduplicant (as also noted by Downing (1994)), perhaps because it is not morphologically part of the root which is serving as the base for reduplication.

i. ŋi-y-aba-y-aba	I share a little
j. ŋi-y-ala-y-ala	I refuse a little
k. ŋi-y-osa-y-osa	I roast a little
l. ŋi-y-ona-y-ona	I damage a little
m. ŋi-y-ets^{h}a-y-ets^h-a	I fill up a little
n. ŋi-y-ela-y-ela	I winnow a little
o. ŋ-andza-y-andza	I increased a little (remote)
p. ŋ-ala-y-ala	I refused a little (remote)
q. ŋ-osa-y-osa	I roasted a little (remote)
r. ŋ-ona-y-ona	I damaged a little (remote)
s. ŋ-ets^{h}a-y-ets^{h}a	I filled up a little (remote)
t. ŋ-ela-y-ela	I winnowed a little (remote)
u. ŋ-eba-y-eba	I stole a little (remote)
v. ŋ-ak^{h}a-y-ak^{h}ile	I've built a little
w. ŋ-aba-y-abile	I've shared a little
x. ŋ-ala-y-alile	I've refused a little
y. ŋ-ok^{h}a-y-ok^{h}ile	I've lit a little
z. ŋ-osa-y-osile	I've roasted a little
aa. ŋ-ona-y-onile	I've damaged a little
bb. ŋ-ets^{h}a-y-ets^{h}ile	I've poured a little
cc. ŋ-ela-y-elile	I've winnowed a little
dd. ŋ-ença-y-ençile	I've surpassed a little
ee. ŋ-eba-y-ebile	I've stolen a little
ff. ku-ŋ-ala-y-ali	to not refuse a little
gg. ku-ŋ-osa-y-osi	to not roast a little
hh. ku-ŋ-ela-y-eli	to not winnow a little
ii. ŋi-ya-y-ak^{h}a-y-ak^{h}a inɠu	I build it a little (a house)
jj. ŋi-ya-s-ak^{h}a-y-ak^{h}a sit'ulo	I build it a little (a stool)
kk. ŋi-ya-t'-aba-y-aba t'içoko	I share them a little (hats)
ll. ŋi-ya-y-ala-y-ala imɓuya	I refuse it a little (kind of vegetable)
mm. ŋi-ya-y-ok^{h}a-y-ok^{h}a imot'o	I light it a little (a car)
nn. ŋi-ya-w-ok^{h}a-y-ok^{h}a umlilo	I light it a little (a fire)
oo. ŋi-ya-y-osa-y-osa inyama	I roast it a little (meat)
pp. ŋi-ya-w-osa-y-osa umɓila	I roast it a little (corn)
qq. ŋi-ya-l-ela-y-ela liheleyisi	I winnow it a little (ground dry corn)
rr. ŋi-ya-y-ets^{h}a-y-ets^{h}a imot'o	I fill it up a little (the car)

Below, it will be shown that in -C- roots, the augmentative [-a] is not enough to fill the bisyllabic reduplicative template, so an entire augmentative syllable [yi] is used. The question is whether the [y-] seen between the reduplicant and the base in (44) should be analyzed as (a reduction of) the epenthetic syllable [yi-]. Evidence that this is just an epenthetic [y] resolving hiatus and not an augmentative syllable comes from longer vowel-initial words, where the [y] is still inserted between the reduplicant and the stem. Although there are very few underived 3-syllable or longer vowel-initial stems, there is one example provided by Downing which fits these criteria and which does still show a [y] between the reduplicant and the base, indicating that the [y] is used simply to resolve hiatus.

(45)

a. -ona-yonákala	get spoilt

If the root is even shorter, namely, -C-, then the reduplicant is of the form C-a-yi, as first noted by Ziervogel and Mabuza (1976) and analyzed by Kiyomi and Davis (1992) to be a constraint on the form of the reduplicant. The same [y] is used as epenthetic in imperatives and in vowel-initial roots in reduplication and the same [i] is seen as augmentative in passives. It is interesting that the syllable [-ni-] is used to satisfy word-minimality, while the syllable [yi] is used in the reduplicant. This seems to reinforce the idea that the derivational morphology of the reduplicant is a distinct morphological domain. The problem is accounting for the [a] in the reduplicant. Why is the reduplicant C-a-yi and not C-i-yi or C-i-ya? It might be suggested that the base for reduplication, besides being specified as a root, must also be a unit, namely, a syllable. This would explain (46a-f) and (46h-i), which contain the syllable [Ca] in the base, but not the perfective form in (46g) and the negative form in (46j), which have instead the syllable [Ci] in the base. This is left as an open problem.

(46)

a. ku-$\underline{\text{k}^{\text{h}}\text{ayi}}$-$\text{k}^{\text{h}}$a	to pick a little
b. ku-$\underline{\text{ɦayi}}$-ɦa	to eat a little
c. ŋi-ya-$\underline{\text{k}^{\text{h}}\text{ayi}}$-$\text{k}^{\text{h}}$a	I pick a little
d. ŋi-ya-$\underline{\text{ɦayi}}$-ɦa	I eat a little
e. ŋa-$\underline{\text{k}^{\text{h}}\text{ayi}}$-$\text{k}^{\text{h}}$a	I picked a little (remote)
f. ŋa-$\underline{\text{ɦayi}}$-ɦa	I ate a little (remote)
g. ŋi-$\underline{\text{k}^{\text{h}}\text{ayi}}$-$\text{k}^{\text{h}}$ile	I've picked a little
h. ŋi-ya-t'i-$\underline{\text{k}^{\text{h}}\text{ayi}}$-$\text{k}^{\text{h}}$a t'inçozi	I pick it a little (kind of fruit)
i. ŋi-ya-wa-$\underline{\text{k}^{\text{h}}\text{ayi}}$-$\text{k}^{\text{h}}$a emanti	I fetch it a little (water)
j. ku-ŋa-$\underline{\text{k}^{\text{h}}\text{ayi}}$-$\text{k}^{\text{h}}$i	to not pick a little

One remaining problem is that verbs with initial [e-] may show infixing reduplication.

(47)

a. kw-e-$\underline{\text{tfuka}}$-tfuka	to surprise a little	d. kw-e-$\underline{\text{lusa}}$-lusa	to herd a little
b. kw-e-$\underline{\text{łuka}}$-łukanisa	to divide a little	e. kw-e-$\underline{\text{lap}^{\text{h}}\text{a}}$-$\text{lap}^{\text{h}}$a	to heal a little
c. kw-e-$\underline{\text{nɦula}}$-nɦula	to pass by a little		

On the basis of the infixation, Downing (1994, 1995) motivates a morphology/prosody mismatch. She claims that the initial [e] cannot be excluded from the stem on phonological or morphological grounds. However, as seen below, initial [e] is only variably present in reduplication. Both the forms in the column on the right with initial [e], which show infixation, and the forms in the column on the left without initial [e], which act like typical consonant-initial roots, are acceptable forms.

(48)

a. ku-$\underline{\text{bayi}}$-ba / kw-$\underline{\text{eba}}$-y-eba	to steal a little
b. ku-$\underline{\text{tfuka}}$-tfuka / kw-e-$\underline{\text{tfuka}}$-tfuka	to surprise a little
c. ku-$\underline{\text{lap}^{\text{h}}\text{a}}$-$\text{lap}^{\text{h}}$a / kw-e-$\underline{\text{lap}^{\text{h}}\text{a}}$-$\text{lap}^{\text{h}}$a	to heal a little
d. ku-$\underline{\text{łuka}}$-łukanisa / kw-e-$\underline{\text{łuka}}$-łukanisa	to divide a little
e. ku-$\underline{\text{lusa}}$-lusa / kw-e-$\underline{\text{lusa}}$-lusa	to herd a little
f. ku-$\underline{\text{nɦula}}$-nɦula / kw-e-$\underline{\text{nɦula}}$-nɦula	to pass by a little

In fact, the variability of the vowel [e] is not limited to reduplication, but occurs throughout the verb paradigms. Again, the forms in the column on the right with initial [e], which pattern like other vowel-initial roots, and the forms in the column on the left without initial [e], which pattern just like other consonant-initial roots, are acceptable forms.

(49)

a. ku-b-a / kw-eb-a	to steal
b. ku-tfuk-a / kw-etfuk-a	to be surprised
c. tfuk-a / y-etfuk-a	insult!
d. ts^hiy-a / y-ets^hiy-a	trap!
e. ŋa-suts-a / ŋ-$esuts^h$-a	I was full
f. ŋa-lap^h-a / ŋ-$elap^h$-a	I healed
g. ŋi-sab-ile / ŋ-esab-ile	I was afraid
h. ŋi-yam-ile / ŋ-eyam-ile	I leaned against

There may be some social marking associated with the presence vs. absence of this vowel. The presence of the [e] is perceived as more "SiSwati" while the absence of the [e] is perceived as more "Zulu" (a closely related language). Thus, it can be concluded that "domain mismatches" described by Downing involving onsetless initial [e] may simply be a by-product of the fact that all onsetless, stem-initial vowels are excluded from the prosodic domain of the stem. That leaves only the cases with infixing reduplication with [e], which may be due to the special status of [e] vs. the other vowels, not to the special status of onsetless vowels in general.

7. Noun-Class Prefix

There are two noun class prefixes (class 3 and class 1) which provide evidence for a bisyllabic prosodic domain outside of the verbal domain. These prefixes both have the form [um-] (seen in (50)) unless the noun has the shape -CV-, in which case it is [umu-] (seen in (51)). This is another case of a length-based alternation. Given that onsetless vowels have a different status than vowels with onsets, as discussed above, it can be seen that when the onsetless vowel is excluded from the count, then the word must be at least two syllables long.

(50)

a. uṃ-k^hono	arm	d. uṃ-galu	marula tree
b. uṃ-lilo	fire	e. uṃ-fula	river
c. uṃ-ntfwana	child		

(51)

a. umu-no	finger	c. umu-k^hwa	knife
b. umu-t'i	homestead	d. umu-ts^hi	medicine
c. umu-ntfu	person		

The -CV- nouns can be compared with the plural forms in order to show that the nouns are indeed of the form -CV- and not of the form -uCV-.

(52)

a. imi-nwe	fingers	c. imi-k^hwa	knife
b. imi-t'i	homesteads	d. imi-ts^hi	medicines

Excluding the initial onsetless vowel from consideration, this seems to be another case of the size of the affix depending on the size of the base– together, they must be a least bisyllabic.

8. Conclusion

In conclusion, a different type of prosodic structure has been described here. This type of structure, rather than being a rhythmic, strictly layered primitive which applies to all syllables, is better considered as a product of two concepts, binarity and domains. The bisyllabic prosodic domain is not claimed to exist over all syllables throughout the language, but only where there is evidence such as length-based alternations or edge-effects. Furthermore, this bisyllabic prosodic domain need not be present for a syllable to be pronounced. Thus, this study of SiSwati prosodic structure provides new insight into the types of prosodic systems possible in natural language.

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The Deletion of *w* in Seoul Korean and its Implications*

Hyeon-Seok Kang

1. Introduction

In Korean, the labiovelar *w* is often observed to delete in speech (e.g., /cuk'wən/ —> [cuk'ən] 'sovereignty', /pwa/ –> [pa] 'look!', /sakwa/ —> [saga][1] 'apple'). This process has been discussed by some scholars. For instance, P. K. Lee and K. R. Park (1992:19) observe that the deletion of *w* occurs frequently after bilabial consonants and suggest that *w* deletion is a dissimilatory process to avoid successive labiality. Martin (1992) also makes noteworthy observations. He (1992:36) notes, "the phoneme *w* freely drops after *p, ph, ps, m, wu* ([u]), or *o* ... in sloppy speech (and widely in Seoul) *w* often disappears after nonlabial sounds, too...". Martin's remarks indicate that he is keenly aware that *w* deletion is a variable process and that it occurs more often in certain phonological contexts.

These scholars' observations are, though insightful, impressionistic. The pioneering study of *w* deletion based on real speech data was that of Silva (1991). He suggests that *w* deletion is conditioned by such linguistic factors as the articulation point and phonation manner of the preceding consonant and also by the frontness/backness of the following vowel. He also suggests that *w* deletion is sensitive to such external factors as speech style and the social status of the speaker. His study clearly shows that the deletion of *w* is a sociolinguistic process conditioned both by linguistic and external factors. In addition, Silva (1991) attempts to explain the deletion of *w* in terms of phonological theory using notions of feature geometry and the Obligatory Contour Principle.

Silva's study, however, has two problematic points. One is his assumption that *w* deletion occurs only after a preceding consonant, while the fact is that *w* deletion can occur with or without a preceding consonant (Martin 1992, K. W. Nam 1984). The other point is that his study is based solely on read speech, which can be considerably different from

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[1] Korean has a voicing rule that changes voiceless lax plosives into their voiced counterparts between voiced segments.

spontaneous speech or from vernacular speech (Labov 1972), where the most interesting patterns of variation are believed to be found.[2]

Tackling these two problematic points in Silva's study, the current study reexamines the variable deletion of *w* on the basis of a larger database. The examination of my data produces somewhat different results from those of Silva's (1991). Especially, unlike Silva's study, the current research finds that bilabial and nonbilabial consonants preceding *w* show dichotic behavior in their effects on *w* deletion, i.e., *w* is found to delete significantly more often after bilabial consonants than after the other types of consonants. To account for these results, I present explanations along a different line from that of Silva. I will suggest that the finding that *w* deletion occurs predominantly after bilabial consonants can be explained by the notion of the Obligatory Contour Principle as a rule trigger (Yip 1988).[3] I will also show that the loss of *w* that has occurred in many lexical items of Korean containing the 'labial consonant + *w*' sequence is one of those perception-based changes that Ohala (1981:187) calls "sound change by the listener".

The organization of this paper is as follows. In Section 2, I will provide some background information on *w* deletion in Seoul Korean for the readers. I will discuss the data and explain the methods used for the analysis of the data in Section 3. The results of the statistical analyses will be given in Section 4, and their implications will be discussed in Section 5. I will attempt to provide phonological explanations of the synchronic deletion of *w* and phonetic explanations of the diachronic loss of *w* in Section 6, followed by concluding remarks in Section 7.

2. Background

In this section, I will discuss some basic concepts in Seoul Korean phonology that will be essential to understand the methods and results of the present study. The syllable structure of Seoul Korean can be schematized as Figure 1. The minimal syllable is V with three optional elements: an onset, a glide and a coda. The internal structure of the Seoul Korean syllable is not without controversy. Following Sohn (1987) and H. Y. Kim (1990), I will assume that GV sequences in Seoul Korean are rising diphthongs.

$$\begin{array}{c}\sigma\\ \text{(C)(G)V(C)}\end{array}$$

Figure 1. Syllable structure of Seoul Korean

Following Kim-Renaud (1974) and K. R. Park (1992), I also assume that contemporary Seoul Korean has the monophthongs in Table 1. That is, I assume that vowels *ü* and *ø* have changed to diphthongs *wi* and *we* in Seoul Korean and that they are no longer monophthongs of this dialect. The present study also assumes (following Hong 1988 and H. B. Lee 1971) that the vowels *e* and *ε* have (near-)merged to *e*. Table 2 gives the current system of *w* diphthongs in Seoul Korean. The *w* diphthongs are all rising (C. S. Lee 1994, Martin 1992). One thing to note is that *w* cannot be combined with round vowels. In other words, *w* cannot form a diphthong combined with [labial] vowels.

[2]See Macaulay and Trevelyan (1973) for the discussion of the differences between read and spontaneous speech in this respect.

[3]As noted earlier, Silva (1991) also tries to explain the variable patterns of *w* deletion using the notion of the OCP. However, his explanation of *w* deletion relies on the notion of multiple linking (of the [+back] feature) caused by the OCP rather than the rule triggering effect of the OCP.

Table 1. Monophthongs of Seoul Korean

[-bk]	[+bk]	
i	ɨ	u
e	ɔ	o
(ɛ)	a	

Table 2. *w* Diphthongs of Seoul Korean

[-bk]	[+bk]	
wi	*wɨ	*wu
we	wə	*wo
(wɛ)	wa	

The current consonant system of Seoul Korean is given in Table 3. Table 3 shows that Korean plosives have a three way distinction in phonation type, i.e., lax, reinforced and aspirated. As Figure 1 suggests, consonants can precede and combine with *w* diphthongs, though not all logical possibilities are actually implemented. When a consonant precedes *w* diphthongs, there are cases where a morpheme boundary is present between the consonant and *w* (e.g., /sam+wəl/ 'March (three+month)', /man+wən/ 'full house (full+people)') and cases where a morpheme boundary is not present between the two (e.g., /kyo+hwan/ 'exchange (inter+exchange)', /so+nwe/ 'cerebellum (little+brain)'). *w* can occur after a vowel (e.g., /sawəl/ 'April', /kuwən/ 'salvation') and also at the word-initial position (e.g., /wicaŋ/ 'stomach', /wənin/ 'reason').

Table 3. Consonants of Seoul Korean

	bilabial	alveolar	palatal	velar	glottal
stop	p, p', pʰ	t, t', tʰ		k, k', kʰ	
affricate			c, c', cʰ		
fricative		s, s'			h
nasal	m	n		ŋ	
liquid		l			

In addition to underlying /w/, *w* can also arise derivationally through /glide formation/ (*o* —> *w* / _____ + V (e.g., /no+a/ —> [nwa] 'release!', /s'o+a/ —> [s'wa] 'shoot!')) and /vowel contraction/ (*u* —> *w* / C _____ V, e.g., /cuəssta/ —> [cwətt'a][4] '(I) gave', /muəs/ —> [mwət] 'what' (cf. Eom T. S. 1993)). Underlying *w* and derivational *w* do not show different behavior with respect to *w* deletion.

3. Methods

3.1. Data

The data were collected during the author's stay in Seoul, Korea in the summer of 1994 and the winter to early Spring of 1995. Approximately 30 minutes of recordings were made from 77 speakers. The speakers were stratified by age, social status and sex. There were 2 gender groups, 3 age groups, 3 social status groups, making 18 cell groups.

[4]Korean has a rule that simplifies the syllable-final consonant cluster, a coda neutralization rule that neutralizes obstruents to lenis voiceless stops at the coda position, and an obstruent tensing rule that fortifies a lax obstuent to its tense counterpart after an obstruent.

Four different styles of speech were elicited — two styles of spontaneous speech: interview speech and in-group speech; and two styles of read speech: sentence reading and word-list reading. The data used for the present study come from the recordings of four different styles of speech from 71 speakers (six speakers were found not to be native speakers of Seoul Korean, so their speech data were not used for analysis). Interview and ingroup speech were elicited from 54 speakers and from 35 speakers, respectively (eighteen speakers overlap).

For the analysis of spontaneous speech, recordings of interview speech and ingroup speech were used. The tokens which appear in the last 20 minutes of the recording were selected as the tokens for this study. On average, approximately 20 to 30 tokens were found for the interview speech of each speaker in this portion of the recording, and 10 to 20 tokens were found for the ingroup speech.[5] The sentences and words chosen for sentence list and word list readings were also designed to contain many tokens of *w* deletion. The sentence list and the word list contained 52 and 43 potential tokens of the variable (w), respectively. These potential tokens were designed to reveal the effects of various constraints on *w* deletion that will be discussed in the following subsection. Speakers sometimes misread potential tokens. These cases were not taken as tokens of (w).

The judgment regarding the presence or the absence of the glide was made at the time of transcription and rechecked later. Each token was judged {w}, {ø} or 'ambiguous'. Ambiguous cases accounted for approximately 7 percent (N = 601) of the tokens (N = 8603). These tokens were excluded from analysis. One hundred tokens were selected from each of the three groups of tokens, i.e., from each group of the tokens identified by the researcher as {w}, {ø} and 'ambiguous'. Another Seoul Korean speaker checked these tokens independently. Her judgment and mine showed 88, 87 and 78 percent of agreement in the {w} group, in the {ø} group and in the 'ambiguous' group, respectively. This study is based on 8002 tokens of the variable (w) from 71 speakers' data containing both spontaneous (ingroup + interview) and read speech.

3.2. Variable rule analysis

Silva (1991) formulates the following basic rule of *w* deletion.

(1) *w* —> ø / C _____ V

However, as Martin (1992) and K. W. Nam (1984) suggest, *w* deletion is not confined to this environment. *w* deletion can occur even when a preceding consonant is not present, e.g., /howi/ —> [hoi] 'defense', /kiwa/ —> [kia] 'roof tile', /suwən/ —> [suən] 'origin of a stream'. Accordingly, I suggest that rule (2) is a more correct representation of the environments where this process occurs.

(2) *w* —> ø / (C) _____ V

The specific environments where *w* deletion occurs are more explicitly shown by (3) and (4).

(3) *w* —> ø / C _____ V

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[5] The number of tokens in the recording of ingroup speech was partly dependent on those who were present as participating members. For instance, if the members who took part in the dialogue interaction belonged to the same social group (i.e., same sex, social status and age group), the number of the tokens for that particular group increased, because it was possible to include the tokens of *w* from all participants.

(4) $w \longrightarrow ø$ / {V, #} ____ V

That is, *w* can delete between a consonant and a vowel, between two vowels, and word-initially before a vowel. The deletion of *w* is very sensitive to whether there is a preceding consonant. According to the analysis of my data, *w* is deleted approximately 5% (83/1752) when there is no preceding consonant and 26% (1634/6250) when there is one (cf. Tables 7 and 8 in Section 4).

Furthermore, (3) and (4) are affected by somewhat different constraints. Silva (1991) suggests that (3) is affected by the place of articulation and the phonation type of the preceding consonant. A morpheme boundary between the preceding consonant and *w* can also be a factor in (3). On the other hand, Martin (1992) and K. W. Nam (1984) suggest that the deletion of *w* after a vowel is sensitive to whether the preceding vowel is round or not.

Because of these two reasons, i.e., because (3) and (4) have a significant difference in deletion rate and are sensitive to partly different constraints, two separate Goldvarb (Goldvarb 2.1. Rand and Sankoff 1992) analyses were performed. The number of the tokens for *w* deletion after a consonant was 6250 and *w* deletion without a preceding consonant had 1752 tokens.

3.2.1. Factor groups considered for the Goldvarb analysis of the deletion of *w* with a preceding consonant

Silva (1991) examines the factor groups listed in Table 4 in his Varbrul analysis. All the linguistic factor groups considered in Silva's study were also included in my analysis of *w* deletion with a preceding consonant. However, slight modifications were made. First, in my analysis, five different factors were included under the factor group 'preceding consonant (place)'. In addition to labial, alveolar, palatal and velar places, the glottis was also included as a place for the analysis of the *h* + *w* sequence. Secondly, though the presence of the morpheme boundary between the preceding consonant and *w* was included as a factor group, only two factors, i.e., ø/present, were coded. The reason that I did not divide morpheme boundary into Sino-Korean morpheme boundary and native Korean morpheme boundary was that few tokens (only 8 among 6250 tokens) in my data had a native Korean morpheme boundary. As in Silva's study, the factor group 'preceding consonant ((phonation) manner)' (i.e., whether the preceding consonant is lax, aspirated or reinforced) was considered only for the plosives, and the factor group 'following vowel' was divided into [-back] and [+back] vowels.

Table 4. Factor groups considered in Silva (1991:159)

Factor groups	Factors
*1. preceding consonant, place	labial, alveolar, palatal, dorsal
*2. preceding consonant, manner	lax, aspirated, reinforced
*3. following vowel	front, nonfront
4. morpheme boundary preceding *w*	none, Sino-Korean, native
*5. speech style	minimal pairs, word list, sentences, text
6. age	teen, adult
*7. gender	female, male
8. education level	high school or less, college
9. hometown	Seoul area, other
*10. Father's occupational prestige	higher, lower

*The starred factor groups mark those chosen in the stepwise regression analysis.

Two additional linguistic factor groups were included in my analysis. The first concerns whether *w* occurs in the initial or a noninitial syllable of the word. The distinction between initial vs. noninitial syllable has played an important role both in diachronic phonological changes and synchronic variation in Seoul Korean. The sound change of /ʌ/ to /a/ and /ɨ/, which happened during the Middle Korean period, is one example. The now lost vowel /ʌ/ changed, in most cases, to /a/ in the initial syllable of the word and to /ɨ/ in a noninitial syllable, e.g., /pʰʌri/ > /pʰari/ 'fly' but /namʌrata/ > /namɨrata/[6] 'reprimand'. The change from /o/ to /u/, which began early in the 16th century, occurred mostly in a noninitial syllable of the word, e.g., /kochо/ > /kochu/ 'hot pepper', /namo/ > /namu/ 'tree'. Tensification of obstruents, an ongoing change in Seoul Korean, occurs mostly in the initial syllable, e.g., /kwa+samusil/ —> [k'wa+samusil] 'department office', /tarin/ —> [t'arɨn] 'other'. The realization of the diphthong /ɨy/ as [ɨy] occurs considerably more often in the initial syllable than a noninitial syllable, e.g., /ɨysa/ —> [ɨysa] 'doctor' vs. /yuɨy/ —> [yui] 'attention'. The deletion of *y* before the vowel /e/ is more frequent in the noninitial syllable than in the initial syllable, e.g., /yesul/ —> [yesul] 'art' vs. /toye/ —> [toe] 'ceramic art'. Because of phonological similarities of *w* deletion to *y* deletion and because of my impression that *w* deletion is another process sensitive to the syllable position within the word, I included this factor group in the Goldvarb analysis.

The other linguistic factor group added in the Goldvarb analysis is the presence of the coda consonant in the syllable where *w* appears. Current phonological theories (e.g., Prince and Smolensky 1993, McCarthy and Prince 1995, Rosenthall 1994) suggest that both codas and diphthongs make syllable structure more marked. Syllable structure CGVC is believed to be less natural than CGV, since the former has two marked features (coda and diphthong), while the latter has only one (diphthong). One possibility worth checking is whether *w* deletion occurs more frequently in a more marked structure (CGVC) than in a less marked structure (CGV), i.e., whether markedness in the coda position affects markedness in the syllable nucleus.

Four potential external constraints, 'speech style', 'gender', 'social status' and 'age', were also considered in my analysis. Table 5 lists the factor groups (and their factors) examined in the Goldvarb analysis of the deletion of *w* without a preceding consonant. Since the number of the tokens (N = 6250) was large enough to allow Varbrul analyses on subsets of tokens, the tokens of three different styles of speech (spontaneous, sentence reading, word-list reading) were also subject to separate Varbrul analyses. The results are given in the Appendix I for reference.

Table 5. Factor groups considered in the variable rule analysis of the deletion of *w* with a preceding consonant

Factor groups	Factors
1. preceding consonant, place	labial, alveolar, palatal, velar, glottal
2. preceding consonant, manner	lax, aspirated, reinforced
3. following vowel	[-back], [+back]
4. syllable type	initial, non-initial
5. morpheme boundary preceding *w*	ø, present
6. presence of the coda	ø, present
7. speech style	ingroup, interview, sentence reading, word-list reading
8. gender	female, male
9. social status	upper, middle, lower
10. age	16-25, 26-45, 45 and older

[6]/namɨrata/ later changes to /namurata/ through vowel labialization.

3.2.2. Factor groups considered for the Goldvarb analysis of the deletion of *w* without a preceding consonant

The Varbrul analysis of *w* deletion without a preceding consonant considered the factor groups given in Table 6. Three factor groups, 'preceding consonant (place)', 'preceding consonant (manner)' and 'morpheme boundary between *w* and the preceding consonant', were naturally excluded in this analysis. However, following the suggestions of Martin (1992) and K. W. Nam (1984) that *w* is more apt to delete after a round vowel, the round/nonround vowel parameter was added as another factor group. This factor group was considered only for those tokens where *w* occurs after a vowel.

Table 6. Factor groups considered in the variable rule analysis of the deletion of *w* without a preceding consonant

Factor groups	Factors
1. following vowel	[-back], [+back]
2. syllable type	initial, noninitial
3. presence of the coda consonant	ø, present
4. preceding vowel	round, nonround
5. speech style	ingroup, interview, sentence reading, word-list reading
6. gender	male, female
7. social status	upper, middle, lower
8. age	16-25, 26-45, 45 and older

4. Results

The results of the Goldvarb analysis of *w* deletion after a consonant are given in Table 7. Those factor groups that show a difference in weight bigger than 0.1 between the two most distinct factors and thus show a relatively clear difference among the factors were factor groups 'preceding consonant (place)', 'style', 'syllable type', 'social status', and 'age'. These factor groups were all chosen in the stepwise regression analysis. Though the factor groups 'preceding consonant (manner)', 'following vowel', 'presence of the coda' and 'gender' were also selected in the same analysis, they showed only minor probability differences (smaller than 0.1) among their factors. The reason that these factor groups were selected in the stepwise regression analysis is probably attributable to the large number of the tokens (N = 6250), since a large sample size can make a small amount of difference in probability statistically significant — i.e., a larger sample size increases the power of significance tests (Hays 1988, Popham and Sirotnik 1992). The detailed results of the stepwise regression analysis are given in (5).

(5) Groups chosen in the stepwise analysis and the order of selection[7]

1. preceding consonant (place)
2. speech style
3. syllable type
4. social status
5. preceding consonant (manner)
6. age
7. presence of the coda consonant
8. following vowel
9. gender

[7]The order of selection in the step-up analysis and the order of elimination in the step-down analysis were exactly the opposite (mirror images) in this analysis.

Table 7. Goldvarb probabilities for factors for *w* deletion after a consonant

Factor groups	Factors	Weight	% Applications	Total N
*Preceding C (place)	bilabial	0.955	81	886
	alveolar	0.454	23	1860
	palatal	0.298	11	836
	velar	0.354	16	1774
	glottal	0.346	12	894
*Preceding C (manner)	lax	0.509	30	2718
	aspirated	0.475	14	600
	reinforced	0.488	19	810
*Following vowel	[-bk]	0.531	22	3205
	[+bk]	0.468	31	3045
*Syllable type	initial	0.421	24	3721
	noninitial	0.615	29	2529
Morph. boundary	zero	0.504	25	5661
	present	0.459	38	589
*Presence of coda	zero	0.522	26	4049
	present	0.459	27	2201
*Speech Style	in-group	0.667	39	850
	interview	0.631	30	1421
	sentence R	0.427	22	2230
	word list R	0.402	21	1749
*Gender	male	0.476	24	3188
	female	0.525	28	3062
*Social Status	upper	0.414	22	2103
	middle	0.498	25	2087
	lower	0.590	32	2060
*Age	16-25	0.545	30	2111
	26-45	0.524	27	2099
	46+	0.429	21	2040

number of cells: 2585 total chi-square = 3004.0572
chi-square/cell = 1.1621 loglikelihood = – 2654.210 Input = 0.235
overall deletion rate = 26.1%

The results of the Goldvarb analysis of *w* deletion without a preceding consonant are somewhat different from those of the previous analysis. These results are given in Table 8. Five factor groups show a relatively clear weight difference (bigger than 0.1) between the most favorable factor to *w* deletion and the least favorable. These are factor groups 'syllable type', 'preceding vowel', 'social status', 'age', and 'style'. However, the factor group 'style' was not chosen in the step-up analysis, though it was eliminated last in the step-down analysis. The detailed results of the stepwise regression analysis are given in (6).

Table 8. Goldvarb probabilities for factors for the deletion of *w* without a preceding consonant

Factor groups	Factors	Weight	% Applications	Total N
Following vowel	[-bk]	0.504	4	657
	[+bk]	0.497	5	1095
*Syllable type	initial	0.303	1	1090
	noninitial	0.797	10	662
Presence of coda	zero	0.520	5	861
	present	0.480	4	891
*Preceding vowel	[+rnd]	0.738	19	200
	[-rnd]	0.389	6	462
Speech Style	in-group	0.578	5	277
	interview	0.549	5	465
	sentence R	0.477	4	501
	word list R	0.436	5	509
Gender	male	0.524	5	869
	female	0.476	4	883
*Social Status	upper	0.385	3	584
	middle	0.501	4	585
	lower	0.614	7	583
*Age	16-25	0.608	7	601
	26-45	0.486	4	553
	46+	0.404	3	598

number of cells: 523 total chi-square = 516.0708
chi-square/cell = 0.9868 loglikelihood = – 272.459 Input = 0.022
overall deletion rate = 4.7%

(6) Results of the stepwise regression analysis

A. factor groups selected in the step-up analysis and the order of selection

1. syllable type
2. preceding vowel
3. social status
4. age

B. groups eliminated in the step-down analysis and the order of elimination

1. following vowel
2. presence of the coda consonant
3. gender
4. style

5. Discussion

The results of the two Goldvarb analyses suggest that the articulation point of the preceding consonant, the roundness of the preceding vowel and syllable type are the important linguistic constraints conditioning the deletion of *w* in Seoul Korean. Though factor groups 'preceding consonant (manner)', 'following vowel (backness)' and 'presence of the coda' were selected in one of the two stepwise regression analyses, the minor differences in Goldvarb weight among the factors do not provide support to the interpretation that the effects of these constraints are strong in the variability of *w* deletion. Especially the fact that the 'ø' coda factor had higher probability of *w* deletion than the 'present' coda factor is not expected and presumed to be a reflection of random variation. The fact that the two gender groups show conflicting results in the two Goldvarb analyses also suggests that the two are not really different in their behavior toward *w* deletion.

As in Silva's (1991) study, the results of the Goldvarb one-level and stepwise-regression analysis of *w* deletion after a consonant identifies the articulation place of the preceding consonant to be the most important constraint. However, in contrast to Silva's research, dorsal consonants and nondorsal consonants do not show a dichotomy in their conditioning of *w* deletion; rather my data indicate that bilabial and nonbilabial consonants show a clearly different behavior toward *w* deletion. These results support previous descriptive statements by Lee and Park (1992) and Martin (1992) suggesting that *w* deletes predominantly after labial consonants. The finding that *w* is deleted significantly more often after a round vowel than after a nonround vowel is consistent with the result that *w* deletes considerably more frequently after labial consonants than after nonlabial consonants, because round vowels and labial consonants are both labial segments.

There are three possible explanations of why *w* deletes in the initial syllable of the word significantly less often than in a noninitial syllable. The first and most convincing one is the explanation given by principles of word processing along the lines of Cutler, Hawkins and Gilligan (1985) and Hall (1992). They suggest that since words are processed from 'left to right', i.e., since lexical access is typically achieved on the basis of the initial part of the word, synchronic and diachronic processes of phonological reduction (weakening, attrition and loss) do not typically take place at the beginning of the words, but in word-medial or word-final position. (For supporting examples of diachronic processes, refer to Chen 1973 and Maran 1971; for examples of synchronic processes, see Clements and Keyser 1983 and Hyman 1975.)

The second possible explanation is given by some Korean phoneticians (e.g., H. Y. Lee 1990, H. B. Lee 1973)[8] who claim that Korean is primarily a language with primary stress on the first syllable of the word. If Korean has stress on the initial syllable and if Korean is primarily a duration accent language, the initial syllable will tend to be lengthened (Klatt 1973, Fry 1955) and the chance of *w* deletion will be significantly lowered. However, the claim that Korean is a stress language has not been rigorously examined. Jun's (1995) recent study, which suggests that stress in Korean usually falls on the second syllable of the accentual phrase (an intonational unit intermediate between prosodic word and intonational phrase), seems to weaken the claim that Korean is primarily a language with stress on the initial syllable of the word.

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[8] H. Y. Lee (1990:51) formulates his Korean stress rule as follows:

1) Two syllable morphemes:
   stress falls on the first syllable.
2) Three or more syllable morphemes:
   If the first syllable is heavy, stress falls on that syllable. Otherwise either on the first or second syllable with no important linguistic difference implied.

Seoul Korean has been known as one of the Korean dialects which has underlying long vowels and uses vowel duration phonemically (e.g., /pa:m/ 'chestnut' vs. /pam/ 'night', /nu:n/ 'snow' vs. /nun/ 'eye'). A third possible explanation for the uneven deletion of *w* in initial vs. noninitial syllables is that this pattern of variation occurs because long vowels occur only in word-initial syllables[9] and long vowels tend not to trigger the deletion of *w*. Though recent studies (e.g., Magen and Blumstein 1993) suggest that long vowels and phonemic length distinction are disappearing even at the word-initial position in Seoul Korean, I examined whether this factor makes any significant difference in the deletion rate of *w* between initial vs. noninitial syllable.

Since there are also claims (C. S. Lee 1994, Jun p.c.) that long vowels appear not at the word-initial syllable but at the initial syllable of the 'prosodic phrase',[10] only the tokens on the word list were used to examine the phonemic vowel duration effect. This decision was made because in word list reading, each word is produced both as one prosodic word and as one prosodic phrase. The New Korean Dictionary (H. S. Lee 1993) was referred to for the underlying long vs. short status of the vowel in the initial syllable of each word. A Goldvarb run incorporating factor group 'vowel length (long vs. short)' to the (slightly modified) existing statistical model[11] was performed on the tokens of word list readings. Only the tokens where *w* appears in the initial syllable were subject to the analysis. The word /hwankak/ 'illusion' or 'return', which according to H. S. Lee (1993) has a long initial vowel when used to mean 'illusion' but a short vowel when used as meaning 'return', was excluded from the analysis because of its ambiguity in vowel length. The results (see Appendix II) did not show a significant difference in the triggering of *w* deletion between phonemically long and short vowels (0.466 vs. 0.543 in probability). The factor group 'vowel length' was not chosen in the stepwise regression analysis either. These results suggest that the initial/noninitial syllable constraint on *w* deletion does not come from the phonemic vowel length difference.

The results that factor groups 'style', 'social status' and 'age' were found to be significant make it clear that *w* deletion is a sociolinguistic process. The conditioning effects of the four factors of the group 'style' show that the deletion rate of *w* decreases as the degree of monitoring one's speech increases. This result shows that the {ø} variant of the (w) variable is not a standard or prestigious variant.

The results show different rates of *w* deletion within both age groups and social status groups. The deletion rate of *w* increases as the social status and age scale go down. The gradual increase in the deletion rate of *w* down the age scale may suggest an ongoing change, since it is probably not the case that older Korean speakers produce speech significantly more carefully than younger speakers. This interpretation gets some support from the existence of other Korean dialects such as Kyongpuk and Kyongnam dialects, where *w* diphthongs have already gone through a monophthongization process. T. Y. Choi (1983) suggests that words containing *w*-diphthongs are gradually losing *w* in Chonpuk dialect at an early stage of monophthongization process. This lexical diffusion type of change may be what is happening in Seoul Korean too. However, since there is no conclusive evidence, the claim that *w* deletion is an ongoing change needs further investigation.

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[9]The underlying long vowel is shortened when it occurs at a noninitial syllable of the word (e.g., /kun+pa:m/ —> [kunbam] 'roasted chestnut', /s'arak+nu:n/ —> [s'ar agnun] 'powder(y) snow').

[10]According to this claim, when a speaker produces /i pa:m/ 'this chestnut' as one 'prosodic' phrase (whether the 'prosodic phrase' is an accentual phrase (Jun 1993), phonological phrase (Cho 1990) or rhythmic unit (H. Y. Lee 1990)), it will be pronounced as [i bam], but when a speaker produces /i pa:m/ 'this chestnut' as two prosodic phrases, it will be pronounced as {i} {pa:m}.

[11]The factor group 'morpheme boundary', which was not chosen as significant in any of the previous analyses, was excluded from the model. Naturally the initial/noninitial syllable parameter was also excluded.

6. Toward explanations

6.1. Phonological explanations

As some previous studies (e.g., Yip 1988, Clements and Keyser 1983, McCarthy 1981) have shown, there are languages (e.g., English, Cantonese, Lami, Akkadian, Yao) which have restrictions on adjacent labial segments. For instance, English does not allow successive labial consonants (*pw, *bw...) at the beginning of the syllable (Clements and Keyser 1983). Cantonese (Yip 1988) has a constraint that prohibits the cooccurrence of labial consonants in the onset and coda positions of the same syllable (e.g., *pim, *ma:p) and also a weaker constraint against the combination of a labial consonant with a round vowel (*tup, *köm). Akkadian allows only one labial consonant per word root (McCarthy 1981). While English does not allow successive labial consonants at the beginning of the syllable, Korean allows them phonemically but rarely does phonetically. This is shown by the fact that Korean speakers delete *w* 85% of the time in spontaneous speech (cf. Appendix I.1.). Korean may have one of the stronger constraints against the combination of *w* with an adjacent labial segment among languages.[12] This claim is supported by the following three pieces of evidence.

First, as was shown in Table 2, *w* can be combined with only 'nonlabial' vowels, which is different from such languages as English (e.g., *would, won't*) or Simakonde (one of the languages spoken in Mozambique: e.g., *woe* 'a lot of' or *kuwuula* 'to be sick'). Second, there exist many lexical items in Korean that have lost *w* after labial consonants (e.g., /mweari/ > /meari/ 'echo', /pwe/ > /pe/ 'hemp cloth', /pʰwita/ > /pʰita/ 'blossom'). This process seems to be at the stage of near-completion, since only a few existing words contain an underlying sequence of a bilabial consonant + *w* (cf. C. A. Kim 1978). The third piece of evidence is the clearly different conditioning effects of labial vs. nonlabial vowels on *w* deletion. As shown in Table 8, *w* deletes significantly more often after labial vowels than nonlabial vowels — 19% vs. 6% in percentage (chi-square = 126.02, $p < .01$) and 0.738 vs. 0.389 in probability.

Unlike Silva's study, where dorsal and nondorsal consonants showed dichotic effects in the conditioning of *w* deletion, the present study finds rather that labial and nonlabial consonants show clearly different conditioning on *w* deletion. As shown in Appendix I, read speech and spontaneous speech show no difference in this respect. Silva (1991:165) claims that *w* is deleted less often after a dorsal consonant because the feature [+bk] is multiply linked to a dorsal consonant and *w* in order not to violate the OCP (which he defines as "at the melodic level, adjacent identical elements are prohibited" following McCarthy (1986:208)) and because multiple linking "maintains the integrity of the two segments as a unit" and resists the application of deletion or insertion rules. Silva's (1991) proposal is illustrated in Figure 2.

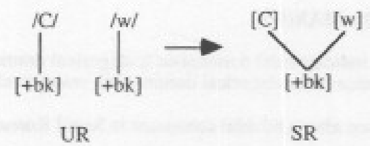

Figure 2. Silva's (1991) proposal

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[12]Korean, however, allows the combination of a bilabial consonant and a labial vowel, as shown in the following examples: /mom/ 'body', /mapu/ 'horse-coach driver', /muu/ 'radish'.

I will provide a different line of explanation to account for the clear difference in behavior toward *w* deletion between labial and nonlabial consonants. I suggest that *w* deletion is triggered mainly by OCP effects. In other words, I claim that in Korean *w* deletes predominantly after labial consonants so at to observe the OCP. This is illustrated in Figure (3). The deletion of a segment triggered by the OCP is found in such languages as Seri (Marlet and Stemberger 1983) and Leti (Hume 1995). One important difference between the processes in these languages and *w* deletion in Seoul Korean is that the latter is a variable process.

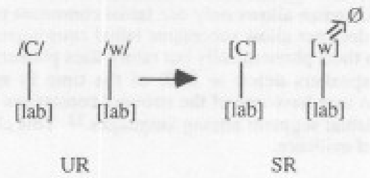

Figure 3. Kang's proposal

The predominant deletion of *w* after a labial consonant can also be explained in the framework of Correspondence Theory (McCarthy and Prince 1995), the current version of Optimality Theory, if we incorporate the concept of variable dominance (cf. Kiparsky 1993) to the theory. The constraints listed in (7) will be required. Refer to McCarthy and Prince 1995 for MAX family constraints. Seoul Korean has such pairs as *ui* 'the ear of a cow' vs. *wi* 'top' and *kiun* 'power' vs. *kyun* 'germ' that distinguish vowel and glides underlyingly. Accordingly, following Hayes (1989) and Y. S. Lee (1993) I assume that glides and vowels are underlyingly different in this language.

(7) Constraints required

1. OCP [lab] : The C[lab] C[V-pl, lab] sequence is prohibited.

2. MAX(C) : Every consonant in underlying representation has a correspondent in surface representation.

3. MAX(G): Every glide in underlying representation has a correspondent in the surface representation.

The ranking in (8) of the above three constraints in Seoul Korean accounts for the high deletion rate of *w* after a bilabial consonant in Seoul Korean, as shown in Table 9.

(8) Max(C) >> OCP[lab] > MAX(G)

N.B. '>>' and '>' indicate hard dominance (categorical dominance) and soft dominance (noncategorical dominance), respectively.

Table 9. *w* deletion after a bilabial consonant in Seoul Korean

	/pweta/	MAX(C)	OCP[lab]	MAX(G)
a.	pweta		*!	
b.	☞ peta			*
c.	weta	*!		

N.B. The thick and double lines indicate hard and soft dominance, respectively.

6.2. Phonetic explanations

The loss of *w* after bilabial consonants found in many lexical items of Seoul Korean can be considered as a case where the OCP plays the role of a "diachronic rule trigger" (Yip 1988:86). There have been suggestions (e.g., Kenstowicz 1994, Zubritskaya and Sheffer 1995) that the OCP, a phonological configurational constraint, may have a phonetic, perceptual basis. I will show in this section that the loss of *w* after bilabial consonants observed in Seoul Korean is one case which supports these suggestions. I will argue that perceptual factors play an important role in this linguistic change.

The acoustic cue of *w* or any labial consonant is mainly the lowering of the second and third formants of the adjacent vowel (cf. Lieberman et al. 1956, Kent and Read 1992). When a nonlabial consonant precedes *w*, this acoustic cue of *w* remains intact. However, when a labial consonant like *b, p, m* precedes *w*, the acoustic cue of *w* becomes blurred and attenuated, since the preceding labial consonant provides essentially the same acoustic cue.

As a result, listeners have to distinguish the 'bilabial consonant + *w* + V' sequence and the 'bilabial consonant + V' sequence without the cue of formant transition. That is, they have to distinguish the two exclusively on the basis of a timing (or duration) difference (and a minor difference in the patterns of the stop burst, if the preceding consonant is an oral stop).[13] However, all the main cues are available for listeners' distinction of the 'nonlabial consonant + *w* + V' sequence and its *w*-less counterpart. This is shown in Figure 5 on the following page.

The acoustic ambiguity between the 'bilabial consonant + *w* + V' sequence and the 'bilabial consonant + V' sequence introduces confusion in the perception of listeners, and consequently leads them to attribute the acoustic cue of *w* to the preceding bilabial consonant. That is, listeners reinterpret the 'bilabial consonant + *w* + V' sequence as 'bilabial consonant + V'. This reinterpretation process results in new underlying forms of lexical items, as exemplified in Figure 4. I suggest that diachronic changes that happened to the words with the 'bilabial consonant + *w*' sequence in Seoul Korean, an OCP-triggered change in Yip's (1988) terms, are perceptually-motivated and can be explained as one of those cases which Ohala (1981:187) calls "sound change by the listener".

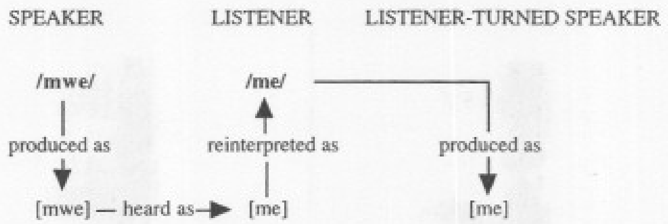

Figure 4. Sound change by the listener: from /mwe/ to /me/ 'mountain'

[13] *w* occurring after a bilabial stop has the effect of lowering the frequency position of the stop burst and making its spectral patterns more compact (Blumstein 1986).

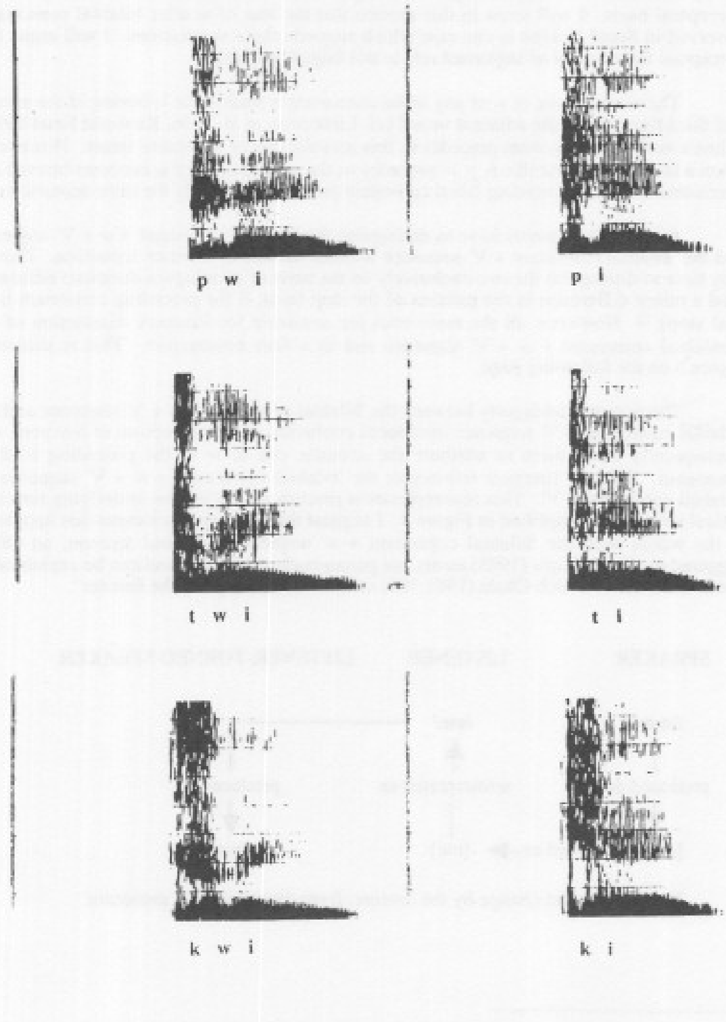

Figure 5. Spectrograms for [pwi] vs. [pi], [twi] vs. [ti], [kwi] vs. [ki]

7. Concluding remarks

The present study has examined the deletion of *w* in Seoul Korean on the basis of a large sociolinguistic database. The results of the statistical analyses of the data reveal that the deletion of *w* in Seoul Korean occurs more often in some phonological contexts than in others. Most notably it was found that *w* deletes significantly more often after labial segments. Crucially using the notion of the OCP, I have attempted to explain this pattern of variation phonologically in the framework of Correspondence Theory incorporating the notion of variable dominance. I claimed that *w* deletion in Seoul Korean is one case which shows that the OCP can trigger not only a categorical process but also a variable process. I also suggested that the loss of *w* after a bilabial consonant observed in many lexical items of Korean is an example where the OCP plays the role of the "diachronic rule trigger" (Yip 1988). I argued that this OCP-triggered change can also be explained in perceptual terms along the lines of Ohala (1981): similar acoustic cues of bilabial consonants and *w* cause listeners' misinterpretation of speakers' productions, which has introduced new *w*-less underlying forms into Seoul Korean.

* Earlier versions of this paper was presented at the 1995 NWAV conference and the 1996 LSA annual meeting. I thank Beth Hume, Donald Winford, Keith Johnson and Mary Beckman for their helpful comments and suggestions.

Appendix I.

1. Probabilities for factors for *w* deletion after a consonant in spontaneous speech

Factor groups	Factors	Weight	% Applications	Total N
*Prec. C (place)	bilabial	0.951	85	289
	alveolar	0.438	34	873
	palatal	0.335	20	135
	velar	0.366	22	661
	glottal	0.359	17	313
*Prec. C (manner)	lax	0.501	37	1194
	aspirated	0.433	26	117
	reinforced	0.537	31	192
*Following vowel	[-bk]	0.575	33	1134
	[+bk]	0.425	35	1137
*Syllable type	initial	0.462	37	1413
	noninitial	0.562	28	858
Morph. boundary	zero	0.489	39	1899
	present	0.556	27	358
*Presence of coda	zero	0.563	39	1273
	present	0.420	27	998
Speech Style	in-group	0.527	39	850
	interview	0.484	30	1421

*Gender	male	0.466	30	1194
	female	0.538	38	1077
*Social Status	upper	0.435	29	765
	middle	0.518	33	754
	lower	0.548	38	752
Age	16-25	0.520	39	783
	26-45	0.509	33	767
	46+	0.469	29	721

number of cells: 861 total chi-square = 1053.6709
chi-square/cell = 1.2238 loglikelihood = – 1184.070 Input = 0.353

2. Probabilities for factors for *w* deletion after a consonant in sentence reading speech

Factor groups	Factors	Weight	% Applications	Total N
*Prec. C (place)	bilabial	0.962	80	321
	alveolar	0.476	17	629
	palatal	0.249	08	413
	velar	0.340	13	584
	glottal	0.385	10	283
*Prec. C (manner)	lax	0.511	25	957
	aspirated	0.488	10	216
	reinforced	0.477	17	328
Following vowel	[-bk]	0.522	18	1047
	[+bk]	0.480	26	1183
*Syllable type	initial	0.394	18	1249
	noninitial	0.634	28	981
Morph. boundary	zero	0.503	20	1047
	present	0.449	52	1183
Presence of coda	zero	0.488	20	1513
	present	0.525	26	717
Gender	male	0.475	21	1113
	female	0.525	23	1117
*Social Status	upper	0.391	17	749
	middle	0.491	21	749
	lower	0.620	28	732
*Age	16-25	0.567	25	746
	26-45	0.545	24	747
	46+	0.387	17	737

number of cells: 941 total chi-square = 1017.2677
chi-square/cell = 1.0811 loglikelihood = – 812.533 Input = 0.186

3. Probabilities for factors for *w* deletion after a consonant in word-list reading speech

Factor groups	Factors	Weight	% Applications	Total N
*Prec. C (place)	bilabial	0.953	77	276
	alveolar	0.346	10	358
	palatal	0.369	12	288
	velar	0.418	12	529
	glottal	0.287	10	298
Prec. C (manner)	lax	0.489	24	567
	aspirated	0.534	12	267
	reinforced	0.490	13	290
Following vowel	[-bk]	0.475	14	1059
	[+bk]	0.535	32	690
*Syllable type	initial	0.368	14	1005
	noninitial	0.696	32	
Morph. boundary	zero	0.511	19	1632
	present	0.338	58	102
Presence of coda	zero	0.493	19	1263
	present	0.519	28	486
Gender	male	0.500	21	881
	female	0.500	22	868
*Social Status	upper	0.387	17	589
	middle	0.469	20	584
	lower	0.645	28	576
*Age	16-25	0.574	25	582
	26-45	0.543	23	585
	46+	0.384	17	582

number of cells: 783 total chi-square = 816.7801
chi-square/cell = 1.0431 loglikelihood = – 593.887 Input = 0.128

Appendix II.

Probabilities for factors for *w* deletion after a consonant in word-list reading speech (N.B. only the tokens where *w* occurs in the initial syllable of the word were subject to the analysis.)

Factor groups	Factors	Weight	% Applications	Total N
*Prec. C (place)	bilabial	0.983	73	120
	alveolar	0.281	03	204
	palatal	0.499	07	140
	velar	0.432	05	337
	glottal	0.267	03	204

Prec. C (manner)	lax	0.569	17	308
	aspirated	0.391	04	157
	reinforced	0.441	04	142
Following vowel	[-bk]	0.483	07	650
	[+bk]	0.531	23	355
Presence of coda	zero	0.431	12	667
	present	0.535	15	338
Phonemic V length	long	.466	11	562
	short	.543	14	443
Gender	male	0.465	12	510
	female	0.536	13	495
*Social Status	upper	0.292	08	338
	middle	0.441	10	332
	lower	0.756	20	335
*Age	16-25	0.684	17	332
	26-45	0.533	14	339
	46+	0.289	07	334

number of cells: 505 total chi-square = 478.6529
chi-square/cell = 0.9478 loglikelihood = – 197 137 Input = 0.042

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Tense, Aspect, and Bukusu Verb Tones*

Nasiombe Mutonyi

0 Introduction

It has long been known that in many tone languages, especially Bantu languages, tense and aspect play a crucial role in determining the surface tone patterns of verb structures by "imposing" tone patterns which override any other pattern that the verb may already have (for studies on other Bantu languages, see Cassimjee 1995, Downing 1990, McHugh 1990, Odden 1990a, b,c, and others). Therefore, for an account of verbal tones in such languages to be complete, it must recognize this by teasing out any alternations caused by changes in a verb's tense and aspect (henceforth, simply "tense"). Any theory faced with a tense-determined tone system has to deal with the challenge of balancing between what it considers universal and language-specific idiosyncracies as dictated by the individual tenses, as well as the entire verb system. The crucial question is: can the system be explained uniformly using a single set of principles? As I demonstrate in this study, a derivational autosegmental account covers a lot of ground as far as the Bukusu facts go. However, sometimes it resorts to extra stipulations to explain phenomena that do not fall out automatically from its tenets.

Bukusu, which has preserved the Proto-Bantu H(igh)/Low lexical tone contrast in its verbs, displays classic tense-determined tone alternations that divide up into three main categories, which will henceforth be referred to as Classes[1] One, Two, and Three. Despite their differences, these classes share certain basic principles. For instance, each class has some version of a rule that docks the melodic H tone to a specific vowel either in the prefix or stem as required by the tenses involved.

The goal of this study is two-fold: (i) to describe, in sufficient detail, the various tenses potentially available to a Bukusu verb, and the different H tones constituting the input to the system that generates the desired surface tone patterns; and (ii) to provide a derivational account of the tone system of Bukusu verbs. In particular, it will be shown that there are at least three kinds of H tones involved. These include two lexical H tones, which are the stem H and object prefix H tones, a tense-aspect imposed melodic H, and a phrasal H tone inserted between any two adjacent words. These tones spread, delete, and trigger deletion of each other as dictated by principles that we shall determine below.

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[1] I use the term "class" here in the atheoretical sense of a set of things sharing some features, not as a primitive linguistic unit, such as a syntactic or semantic category, or a unified morphemic category.

I have divided up the presentation as follows. Section 1 first provides basic evidence of H(igh)/Low contrast in Bukusu verb stems. Then the focus quickly shifts to motivating the set of Class One tenses, based on certain shared tonal features. Section 2 takes an indepth look at the infinitive pattern by comparing verbs with different stem lengths both with and without an object prefix. These verbs are also examined in a phrasal context to see the effects that toneless and H toned complements have on a verb's tone. In Section 3, I look at the Class Two pattern, as represented by the Immediate Future tense. Section 4 examines the "Subjunctive Pattern", whereas Section 5 presents three "Residual Cases" which exhibit idiosyncractic patterns that require them to be treated separately. The summary and conclusion are given in Section 6.

1 Background to Bukusu Verbs

Bukusu has maintained the Proto-Bantu H(igh)/Low tone contrast in its verb stems. Thus, the infinitive form of a toneless verb does not bear a H tone in its surface representation (1). A high toned verb, on the other hand, exhibits one H tone on its prefix, and a second one on the stem in case the stem is at least two syllables long, as in (2):

(1) **Toneless Verbs**

/xu-xu-kalam-a/	[xuukalama]	'to look up'
/xu-xu-saß-a/	[xuusaßa]	'to beg'
/xu-xu-kend-a/	[xuukeenda]	'to walk'

(2) **High Toned Verbs**

/xu-xu-ßukul-a/	[xúußukúlá]	'to take'
/xu-xu-sam-a/	[xúusamá]	'to bark'
/xu-xu-kaan-i-a/	[xúukaanyá]	'to rebuke/ban'

The non-occurrence of a prefixal H tone in toneless infinitives serves as evidence that the infinitive prefix is underlyingly toneless, which means that the H tone surfacing on the prefix in H toned infinitives originates in the stem. Independent evidence to this effect comes from adding an object prefix to the toneless verbs in (1) to yield the forms in (3):

(3) **Toneless Verbs with Object Prefixes**

/xu-xu-mu-kalam-a/	[xúumukálámá]	'to look up at him'
/xu-xu-mu-saß-a/	[xúumusáßá]	'to beg her'
/xu-xu-lu-kend-a/	[xúulukééndá]	'to walk it (cl.11)'

Note that the infinitive prefix now bears a H tone, which we assume originates from the object prefix, and "spreads" leftward to the prefix-initial vowel.

Another crucial difference between the forms in (3) and their counterparts in (1) is that in (3), there is a string of H's at the right edge of the verb. Since only one H comes with the object prefix, we assume that the stem final H is a (morphological) property of the infinitive. Later, we will determine why this H fails to surface in toneless verbs lacking an object prefix, e.g. *xuulima* 'to cultivate' and *xuukalama* 'to look up', given that all infinitives have a melodic H.

(4) **High Toned Verbs with Object Prefixes**

/xu-xu-mu-ßukul-a/	[xúumußukúlá]	'to take him'
/xu-xu-mu-sam-a/	[xúumusamá]	'to bark at him'
/xu-xu-mu-kaan-i-a/	[xúumukaanyá]	'to rebuke/ban him'

A glance at the examples in (4) gives the false impression that H toned verbs are not affected by the addition of an object prefix. The fact, however, is that the H that comes with the object prefix fails to surface, because a H deletion process gets rid of it.

The infinitive shares its tone patterns with four other tenses: the Immediate (today) Future (5), the Intermediate (post-today) Future (6), the Inceptive (7), and the Recent Perfective (8).

(5) **The Immediate Future**

a. Toneless Verbs

/a-la-kalam-a/	[alakalama]	's/he'll look up'
/a-la-saß-a/	[alasaßa]	's/he'll beg'
/a-la-kend-a/	[alakeenda]	's/he'll walk'

b. H Toned Verbs

/a-la-ßukul-a/	[aláßukúlá]	's/he'll take'
/a-la-sam-a/	[alásamá]	's/he'll bark'
/a-la-kaan-i-a/	[alákaanyá]	's/he'll rebuke/ban'

(6) **The Intermediate Future**

a. Toneless Verbs

/a-xa-kalam-e/	[axakalame]	's/he'll look up'
/a-xa-saß-e/	[axasaße]	's/he'll beg'
/a-xa-kend-e/	[axakeende]	's/he'll walk'

b. H Toned Verbs

/a-xa-ßukul-e/	[axáßukúlé]	's/he'll take'
/a-xa-sam-e/	[axásamé]	's/he'll bark'
/a-xa-kaan-i-e/	[axákaanyé]	's/he'll rebuke/ban'

(7) **The Inceptive**

a. Toneless Verbs

/a-a-kalam-a/	[aakalama]	'there s/he looks up'
/a-a-saß-a/	[aasaßa]	'there s/he begs'
/a-a-kend-a/	[aakeenda]	'there s/he walks'

b. H Toned Verbs

/a-a-ßukul-a/	[ááßukúlá]	'there s/he takes'
/a-a-sam-a/	[áásamá]	'there s/he barks'
/a-a-kaan-i-a/	[áákaanyá]	'there s/he rebukes/bans'

(8) **The Recent Perfective**

a. Toneless Verbs

/a-a-kalam-il-e/	[aakalaame]	's/he has looked up'
/a-a-saß-il-e/	[aasaßile]	's/he has begged'
/a-a-kend-il-e/	[aakeendile]	's/he has walked'

b. H Toned Verbs

/a-a-ßukul-il-e/	[ááßukúúlé]	's/he has taken'
/a-a-sam-il-e/	[áásamílé]	's/he has barked'
/a-a-kaan-i-il-e/	[áákaaníísyé]	's/he has rebuked/banned'

The common factor in the patterns in (5) - (8) is that tone assignment is sensitive to two other factors besides tense: (a) the underlying tone of the verb, and (b) the presence or absence in the verb of an object prefix. Thus, toneless verbs that have no object prefix bear no H tone, whereas H toned verbs exhibit two H tones: one in the prefix structure, and another at the right edge of the stem. We will henceforth refer to these tenses as the Class One tenses, including the infinitive. In the next section we examine the Infinitive in more detail to determine how the Class One pattern is derived.

2 The Class One Tenses

A toneless monosyllabic infinitive bears a H tone that docks to the prefix, as in (9a) below, while the stem surfaces without a H tone. Longer verbs, on the other hand, are toneless both in the prefix domain and in the stem, as in (9b,c).

(9) **Toneless Verbs**

a. Monosyllabic Stems

/xu-xu-se-a/	[xúusya]	'to grind'
/xu-xu-ku-a/	[xúukwa]	'to fall'

b. Disyllabic Stems

/xu-xu-lim-a/	[xuulima]	'to cultivate'
/xu-xu-tuum-a/	[xuutuuma]	'to skip'

c. Polysyllabic Stems

/xu-xu-kalam-a/	[xuukalama]	'to look up'
/xu-xu-loleelel-a/	[xuuloleelela]	'to stare at'

H toned monosyllabic verbs exhibit a tone pattern identical to that of monosyllabic toneless verbs, as in (10a). However, longer H toned verbs exhibit two H tones in their structure, the first of which docks in the prefix domain while the second attaches to the stem, as in (10b,c):

(10) **H Toned Verbs**

a. Monosyllabic Stems

/xu-xu-ku-a/	[xúukwa]	'to fall'
/xu-xu-li-a]	[xúulya]	'to eat'

b. Disyllabic Stems

/xu-xu-ßon-a/	[xúußoná]	'to see'
/xu-xu-teex-a/	[xúuteexá]	'to cook'

c. Polysyllabic Stems

/xu-xu-ßukul-a/	[xúußukúlá]	'to take'
/xu-xu-xalak-il-a/	[xúuxalákílá]	'to cut for'

In general, toneless and H toned infinitives have very different surface tone patterns, despite the neutralization of high/low tone contrast in monosyllabic verbs.

Two simple tests can be used to tell the underlying tone pattern of a monosyllabic verb. First, when lengthened via suffixation, an underlyingly toneless monosyllabic verb surfaces without a H tone. For instance, addition of the applied suffix to *xúusya* 'to grind' creates toneless *xuusyeela* 'to grind for.' In contrast, a high-toned monosyllabic verb not only retains its prefix H when lengthened by suffixation, but exhibits a stem H that falls on the second and subsequent syllables of the derived stem, in which case *xúulya* 'to eat' becomes *xúuliilá* 'to eat for,' *xúuliiláná* 'to eat for each other,' and so forth.

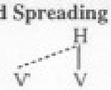
The second test involves adding an object prefix to the applied forms of monosyllabic verbs. In the resultant structures, the stem H docks to the stem initial syllable in case the verb is underlyingly toneless, but only to syllable two in a H toned verb. Thus, toneless *xuusyeela* 'to grind for' becomes *xúumusyéélá* 'to grind for her' with H on the stem-initial syllable, whereas H toned *xúuliilá* 'to eat for' goes to *xúumuliilá* 'to eat for her' with H on the second stem syllable.

The tonelessness of monosyllabic verbs after suffixation makes their being H toned in basic forms peculiar. However, this might reflect a "minimality" condition requiring every stem to have a certain minimum size. (Monosyllabic verbs behave similarly in SeTswana, a Southern Bantu language, so the Bukusu case is not an isolated case.[2]) Stems that fail to meet this requirement compensate by making their only stem syllable prominent - i.e. by assigning it a H tone.

2.1 Deriving the Class One Pattern

First, consider the appearance of the lexical stem H onto the prefix. In a classical autosegmental analysis this can be derived by spreading the H from it underlying locus to its surface position. Two successive processes get the lexical H from its sponsor in the stem to the prefix: Leftward Spreading (11) and Right Sister Delinking (12).

(11) **Leftward Spreading (Iterative R to L.)**[3]



(12) **Right Sister Delinking**

Leftward Spreading (11) is there to ensure that underlying H's "spread" to vowels earlier in the word that do not already have a H tone. Right Sister Delinking (12), on the other hand, delinks all the association lines except the one linking it to the prefix. This way the system derives the desired singly linked H tone instead of a string.

Whereas Leftward Spreading (11) is a general process that applies to any H tone, as independently shown by the multiply-linked stem H in *xúuβukúlá* 'to take,' Right Sister Delinking (12) only applies to a H tone whose leftmost branch is attached to a prefix vowel. This two-rule account is a derivative of an assumption in the theory that tones "spread" iteratively from one potential anchor to another till they reach their target.

After an object prefix has been added to a toneless verb, a H tone surfaces in the stem. This shows two things: (i) that there is a melodic H tone associated with the Class One tenses, and (ii) that the surfacing of the melodic H is dependent on the presence of the H on the prefix. That would explain the drastic change from toneless *xuukalama* 'to look up' to *xúumukálámá* 'to look up at him.'

To determine how the surface patterns are derived, let us assume, without going into specific reasons why, that the melodic H first docks to the final vowel, as in (13) below, and then undergoes Leftward Spreading (11). Because the lexical stem H is docked to the stem-initial syllable in H toned verbs, the melodic H can only spread as far left as the

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[2] David Odden (personal communication).

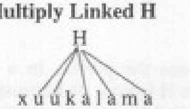
[3] V' designates a toneless vowel.

second stem syllable. H toned verbs do not have a lexical stem H tone, so the melodic H will spread all the way to the initial syllable.

(13) **Melodic H Docking**[4]

The leftward spreading of the melodic H in a toneless verb yields a structure with a mutiply-linked single H tone, as in the representation of *xuukalama* 'to look up' in (14):

(14) **Multiply Linked H**



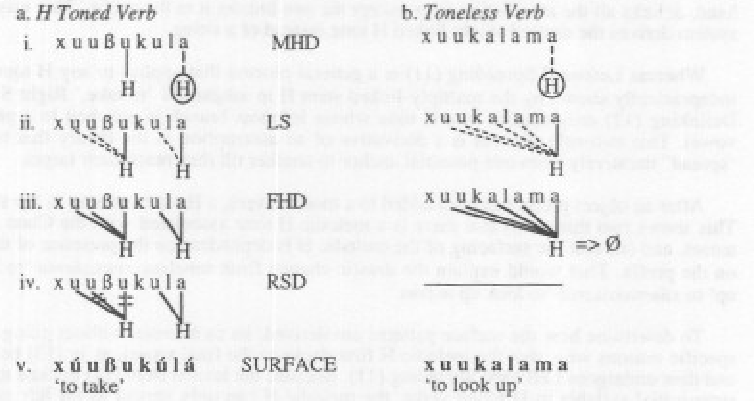
Since the language has no verbs with the pattern in (14), it is feasible that a subsequent rule, formulated as (15), deletes the H tone because it is linked to both ends of the verb.[5]

(15) **Final H Deletion**

Final H Deletion (15) does not apply to H toned verbs because the melodic H never spreads all the way to the initial syllable in such verbs.

(16) **Derivations**

a. *H Toned Verb* b. *Toneless Verb*



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[4] The circle around H designates "floating tone."

[5] The reason for being category-specific is that in phrases nouns and adjectives exhibit strings of H's that span the entire word (cf. *βaβaandu* 'people', but *βáβáándá βáakali* 'many people').

The derivations in (16) show how the patterns of verbs without an object prefix are reached. After docking to the final syllable, the melodic H undergoes Leftward Spreading (LS), spreading either till hits the initial syllable or it is blocked by a lexical stem H. In toneless verbs, the pattern created by the spreading has the right conditions for Final H Deletion (FHD), which deletes the melodic H altogether. In a H toned verb, the lexical stem H spreads to the prefix. Final H Deletion cannot happen in H toned verbs because the melodic H never spreads to the initial syllable. To create the correct surface patterns, Final H Deletion and Right Sister Delinking (RSD) are crucially ordered after Leftward Spreading but they are not ordered with respect to each other.

The derivations in (16) apply as much to monosyllabic and disyllabic verbs as they do to longer verbs, except that in toneless monosyllabic verbs a H tone is assigned very early to ensure that the only stem syllable is prominent, given that the stem is shorter than the required minimal length. Once the H has been assigned, the surface pattern of a toneless monosyllabic verb undergoes the same derivational process as its H toned counterpart.

Now consider what happens when an object prefix is added to the forms in (9) and (10). The corresponding forms are given in (17) and (18), respectively:

(17) **Toneless Verbs with Object Prefix**

a. Monosyllabic Stems

/xu-xu-mu-se-a/	[xúumusya]	'to grind him/her'
/xu-xu-ku-ku-a/	[xúukukwa]	'to fall it (cl.3)'

b. Disyllabic Stems

/xu-xu-ku-lim-a/	[xúukulímá]	'to cultivate it (cl.3)'
/xu-xu-ku-tuum-a/	[xúukutúúmá]	'to skip it (cl.3)'

c. Polysyllabic Stems

/xu-xu-mu-kalam-a/	[xúumukálámá]	'to look up at him/her'
/xu-xu-mu-loleelel-a/	[xúumulóléélélá]	'to stare at him/her'

(18) **H Toned Verbs with Object Prefix**

a. Monosyllabic Stems

/xu-xu-mu-ri-a/	[xúumurya]	'to fear him/her'
/xu-xu-ßu-li-a]	[xúußulya]	'to eat it (cl.14)'

b. Disyllabic Stems

/xu-xu-mu-ßon-a/	[xúumußoná]	'to see him/her'
/xu-xu-ki-teex-a/	[xúukiteexá]	'to cook it (cl.10)'

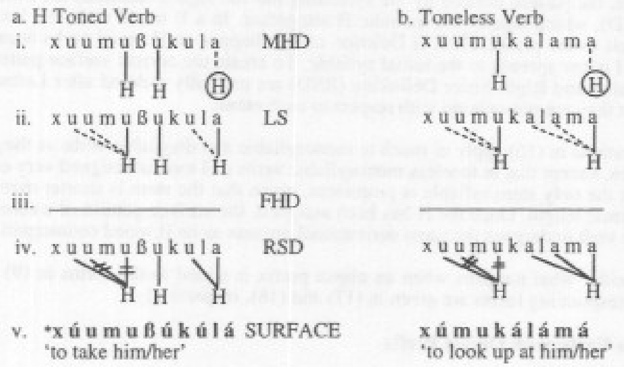
c. Polysyllabic Stems

/xu-xu-ka-ßukul-a/	[xúukaßukúlá]	'to take them (cl.6)'
/xu-xu-si-xalak-il-a/	[xúusixalákílá]	'to cut it (cl.7) for'

Not only does the change in toneless verbs (17) from being toneless to having two H tones after object prefix addition confirm that all infinitives receive a melodic H, but also shows that object prefixes are H toned. The H tone that comes with the object prefix spreads onto the infinitive prefix whereas the melodic H docks within the stem. Therefore the patterns in (17) can be derived with the rules in the derivations in (16).

Although the rules postulated to explain the Class One pattern predict the correct output for toneless verbs (19b), they will yield the wrong output for a H toned verb (19a). Thus, instead of *xúumußukúlá* 'to take him,' the system predicts **xúumußúkúlá*, which has the H that comes with the object prefix spreading to the prefix but the lexical stem H remains undeleted:

(19) **Derivations**

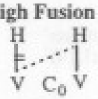


What is needed is Reverse Meeussen's Rule (20) to delete the stem-initial H, and in so doing remove an OCP violation created by spreading the melodic H tone:

(20) **Reverse Meeussen's Rule**[6]

An alternative account might assume that the stem-initial H and the H on the object prefix undergo High Fusion (21) before spreading to the prefix. Then Right Sister Delinking erases all but the leftmost association line of the derived multiply-linked H:

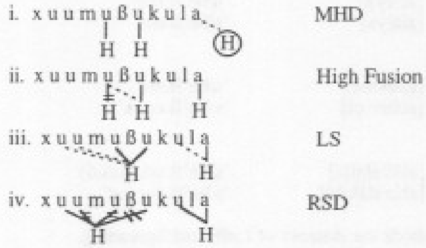
(21) **High Fusion**



The derivation in (22) below captures the scenario adequately. Although Reverse Meeussen's Rule and High Fusion yield the same results they make different predictions concerning the deletion of adjacent H tones. Crucially, whereas High Fusion is ordered before Leftward Spreading, Reverse Meeussen's Rule is ordered after the spreading.This predicts that there are no structures in the language where the first of two adjacent H's fails to delete, whether the adjacency is underlying or derived. Although such a pattern is unattested in the Class One tenses, the language has forms like *daamúkálámá* 's/he already looked up at him' whose string of H's must have resulted from the object prefix H combining with the Melodic H tone. High Fusion, on the other hand, only affects H tones that are adjacent underlyingly, in which case it allows for a spreading H tone to end up on a syllable that is adjacent to the one bearing a lexical H tone. Nothing of importance hinges on whether we prefer Reverse Meeussen's Rule over H Fusion of vice versa.

[6] As I show later, Meeussen's Rule applies between the object prefix H and the stem initial H, but Reverse Meeussen's Rule deletes a stem H that is adjacent to a melodic H to its right. This raises the curious question why "Inserted" tones tend to delete later than lexical H tones, and whether this is a language-specific or cross-linguistic feature.

(22) **Deriving the H Toned + Object Prefix Pattern**



v. **x ú u m u ß u k ú l á** 'to take him' SURFACE

If indeed both the object prefix H and the melodic H are retained in *áamúkálámá*, it is possible that this is a tense-imposed property that does not necessarily derive via successive application of the set of rules motivated so far.

In summary, the following rules, and crucial orderings, create the Class One pattern:

(23) **Rules**

i. Melodic H Docking

ii. High Fusion

iii. Leftward Spreading

iv. Reverse Meeussen's Rule

v. Final H Delinking

vi. Right Sister Delinking

Before concluding this section, let us briefly return to the spreading of lexical stem H to the prefix domain. Recall that in infinitive structures, the lexical stem H spreads to the infinitive prefix (i.e. the leftmost syllable). This targeting of the initial syllable does not happen in Class One tenses when a subject prefix is present, as shown by the following forms from the Immediate Future:

(24) **Toneless Verbs**

a. Monosyllabic Stems

/a-la-se-a/	[alásya]	's/he'll grind'
/a-la-ku-a/	[alákwa]	's/he'll fall'

b. Disyllabic Stems

/a-la-lim-a/	[alalima]	's/he'll cultivate'
/a-la-tuum-a/	[alatuuma]	's/he'll skip'

c. Polysyllabic Stems

/a-la-kalam-a/	[alakalama]	's'he'll look up'
/a-la-loleelel-a/	[alaloleelela]	's/he'll stare'

(25) **H Toned Verbs**

a. Monosyllabic Stems

/a-la-ri-a/	[alárya]	's/he'll fear'
/a-la-li-a]	[alálya]	's/he'll eat'

b. Disyllabic Stems

/a-la-ßon-a/	[aláßoná]	's/he'll see'
/a-la-teex-a/	[aláteexá]	's/he'll cook'

c. Polysyllabic Stems

/a-la-ßukul-a/	[aláßukúlá]	's/he'll take (cl.6)'
/a-la-xalak-il-a/	[aláxalákílá]	's/he'll cut for'

Apparently, the subject prefix falls outside the domain of Leftward Spreading.

Because H never docks to the subject prefix in a form like *alakalama* 's/he'll look up,' we must modify the domain of Final H Deletion (FHD) to avoid generating unattested **alákálámá*, because as stated in (15), FHD can only delete a H tone that simultaneously links to the initial and final syllables. However, the facts in (25) require that the domain of Final H Deletion be defined so as to include the infinitive and tense prefixes but exclude the subject prefix. Since such a structure is neither a stem nor a word, I arbitrarily assign the name G to the domain of both Leftward Spreading and Final H Deletion. This calls for a replacement of "WORD" in the statement (15) with "G."

Having determined that the subject prefix falls outside the domain of Leftward Spreading, now consider the Inceptive forms in (26) and (27):

(26) **Toneless Verbs**

a. Monosyllabic Stems

/a-a-se-a/	[áásya]	's/he'll grind'
/a-a-ku-a/	[áákwa]	's/he'll fall'

b. Disyllabic Stems

/a-a-lim-a/	[aalima]	'there s/he cultivates'
/a-a-tuum-a/	[aatuuma]	'there s/he skips'

c. Polysyllabic Stems

/a-a-kalam-a/	[aakalama]	'there she looks up'
/a-a-loleelel-a/	[aaloleelela]	'there s/he stares'

(27) **H Toned Verbs**

a. Monosyllabic Stems

/a-a-ri-a/	[áárya]	'there s/he fears'
/a-a-li-a]	[áálya]	'there s/he eats'

b. Disyllabic Stems

/a-a-ßon-a/	[ááßoná]	'there s/he sees'
/a-a-teex-a/	[ááteexá]	'there s/he cooks'

c. Polysyllabic Stems

/a-a-ßukul-a/	[ááßukúlá]	'there s/he takes (cl.6)'
/a-a-xalak-il-a/	[ááxalákílá]	'there s/he cuts for'

The H tone on the initial syllable in H toned verbs (27) makes it seem like the subject prefix was targeted by the spreading lexical stem H tone, and in turn gives these data the appearance of counter-evidence to the notion that the subject prefix is outside the domain of H spreading.

However, notice that there is a structural difference between the prefixes marking the Immediate Future and the Inceptive: i.e, the former is a full CV syllable whereas the latter only consists of a vowel. When the 3 sg. subject prefix and the Inceptive tense marker are juxtaposed, the subject prefix deletes by a general process which eliminates a non-high vowel that precedes another vowel. Subsequent compensatory lengthening reassociates the derived "floating" mora to the surviving vowel. Because the H tone in question is associated with this second vowel, it is possible that the derived long syllable has a rising tone that a phonetic implementation rule turns into a level H. After all, the language does not contrast level H and rising tones word-initially.

2.2 Class One Tenses in Phrases

There are structural restrictions to remember as we examine verbs in phrases. First, a Bukusu verb can have a verb-internal marking of an object by showing in its structure an object prefix that refers to the object in question. Alternatively, the verb can be followed by an overt object NP, which rules out the possibility of the verb cannot containing the prefix referring to the object. Therefore, the verb *xúulya* 'to eat,' can take the object prefix *βu* to become *xúuβulyá* 'to eat it (cl.14),' or be followed by a nominal complement, as in *xúulyá βúusuma* 'to eat porridge,' but not **xúuβulyá βúusuma* (= 'to eat porridge'). An adverbial complement such as *βwaangu* 'quickly,' *lúukali* 'much,' *luundi* 'again', and so forth influences the verb's tone the same way a noun does.

Also to remember is the fact that a Bukusu verb can have only one object prefix in its structure at a time. As a consequence, a ditransitive verb like *xúuwa* "to give" can only contain an indirect object prefix in its structure; the direct object has to occur as a separate word. Therefore, we find *xúumuwa kamalesi* 'to give him medicines,' but never **xúumukawa* or **xúukamuwa* meaning to 'give them to him.'

Because of the first restriction, we will use postverbal complements that are not noun phrases if and when they become necessary. Although this removes consistency, given that a verb takes a nominal complement when it has no object prefix and an adverbial complement after an object prefix has been added, it does not affect the basic fact that the tone mapping rules in the two types of phrases are the same regardless of the syntactic function of the postverbal complement. The second restriction does not bear directly on our study, so we will ignore it for now.

(28) **Toneless Verbs with Toneless Object**

a. Monosyllabic Verbs

xúusya ßuufu	'to grind flour'
xúukwa kumuɲixa	'to fall a fall'[7]

b. Disyllabic Verbs

xúulima kumukuunda	'to cultivate a farm'
xúutuuma kumukoye	'to skip a rope'

c. Polysyllabic Verbs

xúuloleelela mwiikulu	'to stare at the sky'

[7] Most verbs designated as intransitive in English take an "object" in Bukusu that refers to the action or state denoted by the verb. Thus a person sleeps sleep, walks a walk, dies a death, etc. To that extent, we treat them as transitive.

When followed by a noun of any tone, a toneless verb will exhibit a H tone on the infinitive prefix. Note that in (28), a toneless noun causes a H tone to appear on the prefix of a preceding toneless verb. The same pattern is repeated before H toned complements for verbs whose stems are at least two syllables long. Clearly, a phrasal H tone gets assigned to a verb before a complement. This phrasal H docks as far left in the verb as possible, which in toneless verbs is the initial syllable (in infinitives).

(29) **Toneless Verbs with H Toned Object**

a. Monosyllabic Verbs

xúusyá ßúulo	'to grind millet'
xúukwá kámalalu	'to become mad'[8]

b. Disyllabic Verbs

xúulima ßúulime	'to cultivate land'
xúutuuma kámawa	'to skip (over) thorns'

c. Polysyllabic Verbs

xúukalama ßáaloosi	'to look up at old women'
xúuloleelela múungaaki	'to stare up(ward)'

Disyllabic and polysyllabic verbs keep the same tone pattern when followed by a H toned word(29b,c), but monosyllabic verbs surface with a H tone on the stem vowel (29a) in addition to the H in the prefix. Because this makes monosyllabic verbs similar to H toned verbs, they must be treated as H toned verbs, whose patterns we now examine.

(30) **H Toned Verbs with Toneless Object**

a. Monosyllabic Verbs

xúulya ßuufu	'to eat flour'
xúurya čitalaŋi	'to fear lions'

b. Disyllabic Verbs

xúußona ßaalosi	'to see witches'
xúuteexa kamalesi	'to cook medicines'

c. Polysyllabic Verbs

xúußukúla ßaalosi	'to take witches'
xúuxalákila ßaßaandu	'to cut for (also: *judge*) people'

(31) **H Toned Verbs with H Toned Object**

a. Monosyllabic Verbs

xúulyá ßúusuma	'to eat porridge'
xúuryá kámaxala	'to fear crabs'

b. Disyllabic Verbs

xúußoná ßáalosi	'to see women'
xúuteexá kámátóore	'to cook plantains'

c. Polysyllabic Verbs

xúußukúla ßáaloosi	'to take old women'
xúuxalákila ßáaxaana	'to cut for (also: *judge)* girls'

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[8] Literally 'to fall madness,' but with the logical reading 'for madness to befall...'

Because the melodic H always docks to the second stem syllable in H toned verbs, it will surface when the verb is followed by a complement that is either toneless or H toned if the stem is longer than two syllables. However, the melodic H always deletes in a monosyllabic or disyllabic verb whenever the complement is toneless, because in such a verb the H is always word-final, in which case it always falls adjacent to a toneless word. This explains why H surfaces without an problem in the following extended forms of the verbs in question:

(32) **Extended H Toned Verbs with Object NP**

a. Monosyllabic Verbs

xúuliila ßaßaandu	'to eat for people'
xúuliilána ßuufu	'to eat flour for e.o.'
xúuliilána ßúusuma	'to eat porridge for e.o.'

b. Disyllabic Verbs

xúußonéla ßaßaandu	'to see for people'
xúußonélana ßaalosi	'to see witches for e.o.'
xúußonélana ßáaloosi	'to see old women for e.o.'

The melodic H tone targets the second stem syllable in H toned verbs, which is expected given that the stem-initial syllable in such verbs is the lexical stem H sponsor. Because a monosyllabic verb has only one stem syllable, the melodic H is forced to dock to the stem-initial syllable despite its being the sponsor of lexical stem H. Disyllabic and polysyllabic verbs are long enough for the melodic H to find the appropriate anchor. But a disyllabic stem is not long enough to protect the H from undergoing pre-toneless word deletion (33), a very general process that applies between any two words that do not necessarily constitute a syntactic or semantic category.

(33) **Deletion of H before a Toneless Complement**

Delete a word-final H tone in case the next word is toneless.

In sum then, a verb selecting a Class One tense will exhibit the following features in isolation: (i) it surfaces as toneless if it is underlyingly toneless, and exhibits two H tones if it is underlyingly H toned; and (ii) the addition of an object prefix causes a toneless verb to acquire the tone pattern of a H toned verb, whereas a H toned verb retains its pattern. If we consider Meeussen's and Reverse Meeussen's as flip sides of the same rule, and High Fusion as an alternative to either of them, a total of five rules are needed to explain the Class One tone pattern. These include: (1) Melodic H Docking, (2) Leftward Spreading, (3) Meeussen's/Reverse Meeussen's Rule, (4) Right Sister Delinking, and (5) Final H Deletion. At phrase level, the string of H's appearing at the right edge of a verb delinks, and is replaced with a H that singly links to the stem-initial syllable if the verb is underlyingly toneless, and to the second stem syllable in an underlyingly H toned verb. A H docked to the verb's final syllable will delete in case the next word is toneless. As we now turn to other tone Classes, it is relevant to ask which of these rules apply there as well. The answer will become evident as the facts unfold.

3 The Class Two Tenses

The Class Two pattern appears in the Intermediate Past, Remote Future, Simple Present, and the Progressive. For an overview of the tone features shared by these tenses, let us begin with a look at data from the Intermediate Past. Perhaps the most notable thing about these examples is that in the Class Two pattern all verbs bear a H tone in their surface representation regardless of their underlying tone. Recall that toneless verbs surfaced as toneless in the Class One pattern.

(34) **Toneless Verbs**

a. Monosyllabic Stems

/a-a-se-il-e/	[aasyéele]	's/he ground'
/a-a-ku-il-e/	[aakwíile]	's/he fell'

b. Disyllabic Stems

/a-a-lim-il-e/	[aalímile]	's/he cultivated'
/a-a-tuum-il-e/	[aatúumile]	's/he skipped'

c. Polysyllabic Stems

/a-a-kalam-il-e/	[aakálaame][9]	's/he looked up'
/a-a-loleel-il-e/	[aalóleeleele]	's/he stared'

(35) **H Toned Verbs**

a. Monosyllabic Stems

/a-a-li-il-e/	[aaliíle]	's/he ate'
/a-a-ri-il-e/	[aariíre]	's/he feared'

b. Disyllabic Stems

/a-a-ßon-il-e/	[aaßoóne]	's/he saw'
/a-teex-il-e/	[aateexíle]	's/he cooked'

c. Polysyllabic Stems

/a-a-ßukul-il-e/	[aaßukúule]	's/he took'
/a-a-xalak-il-il-e/	[aaxalákiile]	's/he judged'

Also significant about the Intermediate Past pattern is that rather than surface as a string of H's, the melodic H docks to a single syllable. It docks to the stem-initial syllable in an underlyingly toneless verb, surfacing as a falling tone if the targeted syllable is long. In contrast, it docks to the second stem syllable in a H toned verb, but only if the verb is longer than two syllables. Apparently, the H tone looks for and finds the stem-initial syllable in toneless verbs but not in H toned verbs because of the lexical stem H. As an alternative to the stem-initial syllable, the H docks to the second syllable, the leftmost toneless stem syllable available.[10] The melodic H fails to surface if the verb stem is shorter than three syllables. But in a disyllabic verb that has a long stem-initial syllable, the melodic H surfaces on the second mora of the long syllable, as seen in *aaliíle* 's/he ate' (35a) and *aaβoóne* 's/he saw' (35b). This shows that in the Class Two tenses docking of the melodic H in the stem pays attention to the position of the target syllable. Specifically, the H avoids the second stem syllable that is also word final. That would explain why the applied (perfective) forms in (36) do not have a rising tone on the penult, as their second syllable is non-final.

(36) **Applied Intermediate Past**

/a-a-li-il-il-e/	[aaliilíile]	's/he ate for/with'
/a-a-ßon-il-il-e/	[aaßonéele]	's/he saw for/with'

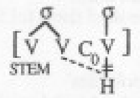
In summary, a Class two tense requires that each verb surface with melodic H tone regardless of the verb's underlying tone. Secondly, the lexical stem H tone cannot spread to the subject or tense prefixes. Thirdly, these tenses impose a one-H-per-stem restriction that causes deletion of the lexical stem H once the melodic H has docked. We have noted further that these tenses prohibit word-final H tones. Consequently, in a disyllabic H

[9] The penult syllable lengthens compensatorily following imbrication of the perfective suffix *-il-*.

[10] This targetting of V2 by H is also found in Runyankore, a Bantu language of Uganda (Poletto, this volume).

toned stem, the H tone will retract to the second mora of the stem-intial syllable in case that syllable is long (34a). But retraction will not apply if the stem-initial syllable is short. Thus, the Remote Future form *aliβona* 's/he'll see' is toneless, but when the applied suffix is added, a H appears on the second stem syllable (cf. *aliβonéla* 's/he'll see for'). Final H Retraction can be formalized as follows:

(37) **Final H Retraction**



Now consider what happens when an object prefix is added to toneless verbs in the Class Two tenses. Once again, the examples are from the Intermediate Past:

(38) **Toneless Verbs**

a. Monosyllabic Stems

/a-a-mu-se-il-e/	[aamúsyeele]	's/he ground him'
/a-a-ku-ku-il-e/	[aakúkwiile]	's/he fell it (cl.3)'

b. Disyllabic Stems

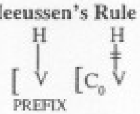
/a-a-βu-lim-il-e/	[aaβúlimile]	's/he cultivated it (cl.14)'
/a-a-ku-tuum-il-e/	[aakútuumile]	's/he skipped it (cl.3)'

c. Polysyllabic Stems

/a-a-mu-kalam-il-e/	[aamúkalaame]	's/he looked up at him'
/a-a-mu-loleelel-il-e/	[aamúloleeleele]	's/he stared at him'

In the forms in (38), a high tone invariably surfaces on the object prefix. Since the object prefix is high toned, and because H tones generally do not "spread" to a syllable that already functions as a H tone anchor, we assume that when the melodic H tone docks to the stem initial syllable in a verb selecting the Class Two pattern, it ends up being (syllable) adjacent to the H on the object prefix. The resultant structure needs Meeussen's Rule (39) to eliminate the stem-initial H in order to remove the derived OCP violation. Meeussen's Rule must be constrained to only target a stem H tone that follows a H tone docked to a prefix. This will ensure that it does not apply between adjacent H tones within the stem, which is the domain of Reverse Meeussen's Rule. This correctly predicts that Class Two does not show strings of H's extending from the object prefix to the stem.

(39) **Meeussen's Rule**



A H toned verb will exhibit the patterns in (40) below when an object prefix is added. Addition of an object prefix to a verb with a retracted stem H tone(40a,b) causes a bridge effect between the H tone on the object prefix and the retracted melodic H tone. This particular docking only happens in the Class Two tenses, and is what most distinguishes Class Two from the Class One pattern.[11]

[11] Poletto (1994) reports a similar bridging effect in OluSamia, also a Bantu language of Kenya.

(40) **H Toned Verbs with Object Prefix**

a. Monosyllabic Stems

/a-a-ßu-li-il-e/	[aaßúlíle]	's/he ate it (cl.14)'
/a-a-mu-ri-il-e/	[aamúríire]	's/he feared him'

b. Disyllacbic Stems

/a-a-mu-ßon-il-e/	[aamúßóóne]	's/he saw him'
/a-a-ka-teex-il-e/	[aakáteexíle]	's/he cooked them (cl.6)'

c. Polysyllabic Stems

/a-a-mu-ßukul-il-e/	[aamúßukúule]	's/he took him'
/a-a-ßa-xalak-il-il-e/	[aaßáxalákiile]	's/he judged (cut for) them'

I propose that the bridge effect is caused by a late phonetic implementation process which applies when a prefixal H is followed by a rising contour created by melodic H retraction. This only happens when the syllable bearing the melodic H is long and the H falls on the second of its moras, because it does not apply in a form like *alimwáaßúlila* 's/he'll split for him' even though the object prefix H is also adjacent to the melodic H.

Let us now examine data from the other tenses exhibiting the Class Two pattern.

(41) **The Remote Future**

a. Toneless Verbs

/a-li-kalam-a/	[alikálama]	's/he'll look up'
/a-li-lim-a/	[alilíma]	's/he'll cultivate'
/a-li-tuum-a/	[alitúuma]	's/he'll skip'

b. H Toned Verbs

/a-li-ßukul-a/	[alißukúla]	's/he'll take'
/a-li-sam-a/	[alisama]	's/he'll bark'
/a-li-teex-a/	[aliteéxa]	's/he'll cook'

(42) **The Simple Present**

a. Toneless Verbs

/a-kalam-a/	[akálama]	's/he looks up'
/a-lim-a/	[alíma]	's/he cultivates'
/a-tuum-a/	[atúuma]	's/he skips'

b. H Toned Verbs

/a-ßukul-a/	[aßukúla]	's/he takes'
/a-sam-a/	[asama]	's/he barks'
/a-teex-a/	[ateéxa]	's/he cooks'

(43) **The Present Progressive**

a. Toneless Verbs

/a-líxó a-kalam-a/	[alíxáakálama]	's/he's looking up'
/a-líxó a-lim-a/	[alíxáalíma]	's/he's cultivating'
/a-líxó a-tuum-a/	[alíxáatúuma]	's/he's skipping'

b. H Toned Verbs

/a-líxó a-ßukul-a/	[alíxáaßukúla]	's/he's taking'
/a-líxó a-sam-a/	[alíxáasama]	's/he's barking'
/a-líxó a-teex-a/	[alíxáateéxa]	's/he's cooking'

Notice that, just like in the Intermediate Future forms given above, all verbs have a surface H tone that singly links to the stem-initial syllable in toneless verbs and to the second stem syllable in H toned verbs. Another shared feature is final H retraction (or deletion where appropriate) in disyllabic H toned verbs (cf. *aliteéxa* and *alisama* (41b), *ateéxa* and *asama* (42b), etc.).

When an object prefix is added to a verb selecting any of these tenses, the object prefix displays a H, but the adjacent stem-initial syllabl is toneless. In fact, a toneless verb has no H tone in the entire stem, indicating that Meeussen's Rule kicks in to eliminate the OCP violation resulting from juxtaposition of the object prefix H and the melodic H.

(44) **The Remote Future**

a. Toneless Verbs

/a-li-mu-kalam-a/	[alimúkalama]	's/he'll look up him'
/a-li-mu-lim-a/	[alikúlima]	's/he'll cultivate it (cl.3)'
/a-li-mu-tuum-a/	[alimútuuma]	's/he'll skip him'

b. H Toned Verbs

/a-li-mu-ßukul-a/	[alimúßukúla]	's/he'll take him'
/a-li-mu-sam-a/	[alimúsama]	's/he'll bark at him'
/a-li-mu-teex-a/	[alimútééxa]	's/he'll cook him'

(45) **The Simple Present**

a. Toneless Verbs

/a-mu-kalam-a/	[amúkalama]	's/he looks up at him'
/a-mu-lim-a/	[akúlima]	's/he cultivates it (cl.3)'
/a-mu-tuum-a/	[amútuuma]	's/he skips him'

b. H Toned Verbs

/a-mu-ßukul-a/	[amúßukúla]	's/he takes him'
/a-mu-sam-a/	[amúsama]	's/he barks at him'
/a-mu-teex-a/	[amútééxa]	's/he cooks him'

(46) **The Present Progressive**

a. Toneless Verbs

/a-líxó a-mu-kalam-a/	[alíxáamúkalama]	's/he's looking up at him'
/a-líxó a-mu-lim-a/	[alíxáakúlima]	's/he's cultivating it (cl.3)'
/a-líxó a-mu-tuum-a/	[alíxáakútuuma]	's/he's skipping it (cl.3)'

b. H Toned Verbs

/a-líxó a-mu-ßukul-a/	[alíxáamúßukúla]	's/he's taking him'
/a-líxó a-mu-sam-a/	[alíxáamúsama]	's/he's barking at him'
/a-líxó a-mu-teex-a/	[alíxáamútééxa]	's/he's cooking him'

To recapitulate, a verb bearing a Class Two tense must have at least one surface H tone, except H toned verbs with stems that have two or fewer syllables. The Class Two pattern is created by the melodic H directly targeting the left edge of the stem, and docks to the stem-initial syllable in toneless verbs, and the second syllable in a H toned verb. The subject and tense prefixes are not eligible anchors. This forces the lexical stem H to remain on the stem-initial syllable until it is deleted in accordance with the requirement that each stem have only one H tone. A stem H tone falling on the final syllable either retracts if the stem-initial syllable is long, or deletes to avoid violating the prohibition against word-final H's. Finally, an object prefix keeps its H in the absence of an eligible anchor to its left, and as a result Meeussen's Rule deletes the melodic H docked on the stem-initial syllable of a toneless verb.

3.1 Deriving the Class Two Pattern

The Class Two pattern shares with the Class One pattern the property of having two domains that are targeted by Leftward Spreading (11): the prefix domain for the lexical stem H tone, and the stem for the melodic H tone. The Class Two pattern does not allow H to surface either on the subject or tense prefixes, making this pattern both similar to, and different from, the Class One pattern: similar because the subject prefix is ineligible, but different because the tense prefix is also excluded. Since there is no evidence that the melodic H tone ever docks on the final syllable in the Class Two pattern, we revise Melodic H Docking (13) as follows:

(47) **Melodic H Docking - II**

H

$[_{\text{STEM}}\ C_0 V' \ldots$

Once the melodic H tone has docked in a verb selecting the Class Two pattern, any lexical stem H that cannot spread to the prefix structure gets deleted. The deletion is an effect of a restriction that allows only one surface H tone in the stem.

The surface tone of toneless verbs is derived in a single step by directly docking the melodic H tone to the stem initial syllable via Melodic H Docking-II (47). But a H toned verb requires an extra rule to delete the lexical stem H tone "stranded" on the stem-initial syllable. (Revised) Reverse Meeussen's Rule is such a rule.

(48) **Reverse Meeussen's Rule (Revised)**

H H

$[_{\text{STEM}}\ V \quad C \quad V \ldots]$

The Reverse Meeussen's Rule is confined to the stem because, as seen from (38) above, melodic H tone never triggers deletion of a H linked to a prefix.

(49) **Derivations**

	a. H Toned Verb		b. Toneless Verb
i.	a a ß u k u u l e H H	MHD-II	a a k a l a a m e H
ii.	a a ß u k u u l e H H	RMR	________
iii.	**a a ß u k ú u l e**	SURFACE	**a a k á l a a m e**

As the derivations in (49) illustrate, the Class Two pattern utilizes at most two rules to create the isolation tone pattern of a verb that has no object prefix. These are Melodic H Docking - II (47) and Reverse Meeussen's Rule (48).

The fact that the object prefix serves as a H tone anchor in the Class Two tenses has two interpretations: first, it suggests that the object prefix is not a part of the stem proper, or its H tone would be deleted by Reverse Meeusen's Rule in accordance with the one-H-per-stem restriction. Second, one could assume that the object prefix combines with the stem to create a domain that is intermediate in size between the stem proper and the larger domains created by adding the subject and tense prefixes.

A H toned verb that has an object prefix has at least three underlying H tones. These include the lexical H tone that comes with the root, the melodic H, and the H that comes with the object prefix. A toneless verb bearing an object prefix, on the other hand, has two underlying H tones: the H tone contributed by the object prefix and the melodic H. Given these facts, consider the following examples:

(50) **Toneless Verbs**

a. Disyllabic Verbs

aalímile	's/he cultivated'
aamúlimiile	's/he cultivated for her'
aatúumile	's/he skipped'
aamútuumiile	's/he skipped for him

b. Polysyllabic Verbs

aakálaame	's/he looked up'
aamúkalaame	's/he looked up at him'
aalóleeleele	's/he stared'
aamúloleeleele	's/he stared at him'

(51) **H Toned Verbs**

a. Disyllabic Verbs

aaβoóne	's/he saw'
aamúβóóne	's/he saw him'
aateexíle	's/he cooked'
aamúteexíle	's/he cooked him'

b. Polysyllabic Verbs

aaβukúule	's/he took'
aamúβukúule	's/he took him'
aaxalákiile	's/he cut for/sentenced'
aamúxalákiile	'she cut for (or sentenced) him'

A toneless verb that has no object prefix exhibits the melodic H on the stem-initial syllable (50). When an object prefix is added, the verb still has a single H tone, but now the H anchors on the object prefix whereas the stem-initial syllable is toneless. This must be the H that comes with the object prefix, given that generally H tones do not dock or spread to syllables already having a H tone. It also means that the melodic H has deleted after the object prefix H tone in a deletion that requires syllable adjacency between the triggering H tone and the target H tone, as the melodic H does not delete in *aamúteexíle* 's/he cooked him' (51a), *aamúβukúule* 's/he took him' (51b), and so forth.

In a H toned verb that has no object prefix, the melodic H triggers deletion of the lexical stem H tone, but only after the lexical H tone has blocked the melodic H from docking to the stem-initial syllable. This serves as evidence that deletion of the lexical H tone is ordered after Melodic H Docking (47). Once the melodic H has docked it triggers either Reverse Meeussen's Rule or Meeussen's Rule to eliminate the derived H tone adjacency. The derivations in (52) illustrate the interaction of Melodic H Docking, Reverse Meeussen's Rule, and Meeussen's Rule in verbs that have an object prefix.

(52) **Derivations**

a. H Toned Verb		b. Toneless Verb
i. a a m u ß u k u u l e H H (H)	MHD	a a m u k a l a a m e H (H)
ii. a a m u ß u k u u l e H H H	MR/RMR	a a m u k a l a a m e H H
iii. **a a m ú ß u k ú u l e**	SURFACE	**a a m ú k a l a a m e**

To summarize, by assuming that the melodic H tone docks directly to the left edge of the verb stem, we can derive the appropriate surface tone patterns of both toneless and H toned verbs with two rules: Melodic H Docking and Meeussen's (or Reverse Meeussen's) Rule. Apparently, Meeussen's Rule is specific to the Class Two pattern, only targeting a stem H after an object prefix H, as in *aamúkalaame* 's/he looked up at him.' Melodic H docking precedes Meeussen's and Reverse Meeussen's Rules.

3.2 The Class Two Tenses in Phrases

First, consider the data in (53) - (56):

(53) **Toneless Verbs with Toneless Objects**

a. Monosyllabic Verb

/a-a-se-il-e ßuufu/	[aasyéele ßuufu]	's/he ground flour'

b. Disyllabic Verb

/a-a-tuum-il-e kumukoye/	[aatúumile kumukoye]	's/he skipped a rope'

c. Polysyllabic Verb

/a-a-loleel-il-e čiŋeeni/	[aalóleeleele čiŋeeni]	's/he stared at fish'

(54) **Toneless Verbs with H Toned Objects**

a. Monosyllabic Verbs

/a-a-se-il-e ßúulo/	[aasyéele ßúulo]	's/he ground millet'
/a-a-ku-il-e kámalalu	[aakwíile kámalalu]	's/he became mad'

b. Disyllabic Verbs

/a-a-lim-il-e ßúulime/	[aalímile ßúulime]	's/he cultivated a garden'
/a-a-tuum-il-e kámawa/	[aatúumile kámawa]	's/he skipped thorns'

c. Polysyllabic Verbs

/a-a-kalam-il-e ßáaloosi/	[aakálaame ßáaloosi]	's/he looked at old women'
/a-a-loleel-il-e ßáaxasi/	[aalóleeleele ßáasaani]	's/he stared at men'

(55) **H Toned Verbs with Toneless Objects**

a. Monosyllabic Verbs

/a-a-li-il-e ßuufu/	[aalíile ßuufu]	's/he ate flour'
/a-a-ri-il-e/	[aaríire kumuɲixa]	's/he feared a fall'

b. Disyllabic Verbs

/a-a-ßon-il-e kumukuunda/	[aaßoóne kumukuunda]	's/he saw a farm'
/a-teex-il-en kumukoye/	[aateexíle kumokoye]	's/he cooked a rope'

c. Polysyllabic Verbs

/a-a-ßukul-il-e ßaalosi/	[aaßukúule ßaalosi]	's/he took witches'
/a-a-xalak-il-il-e/	[aaxalákiile čiɲeeni]	's/he sentenced fish'

(56) **H Toned Verb with H Toned Objects**

a. Monosyllabic Verbs

/a-a-li-il-e ßúulo/	[aalíile ßúulo]	's/he ate millet'
/a-a-ri-il-e kámalalu/	[aaríire kámalalu]	's/he feared madness'

b. Disyllabic Verbs

/a-a-ßon-il-e ßúulime/	[aaßoóne ßúulime]	's/he saw a garden'
/a-teex-il-e kamáwa/	[aateexíle kámawa]	's/he cooked thorns'

c. Polysyllabic Verbs

/a-a-ßukul-il-e ßáaloosi/	[aaßukúule ßáaloosi]	's/he took witches'
/a-a-xalak-il-il-e číxaafu/	[aaxalákiile číxaafu]	's/he sentenced cows'

In general, verbs selecting a Class Two tense maintain their isolation pattern when placed in phrases, regardless of the tone of the word following the verb. This contrasts with the Class One tenses where a string of H's is replaced by a singly linked H in the same context.

Besides keeping their isolation pattern, the verbs in (53)-(56) show no evidence of a phrasal H tone being inserted. This could mean that (i) the phrasal H triggers deletion of the melodic H then docks to the melodic H anchor, (ii) the phrasal H fails to dock because its target, the stem-initial syllable, is already H toned, or that (iii) phrasal H docks to the final syllable then deletes because of a prohibition against final H tones. Either (ii) or (iii) accounts for this pattern, but the point is that phrasal H fails to surface in the verb.

Also significant in the above data is that in forms like *aaßoóne* 's/he saw', *aalíile* 's/he ate', and so forth the retracted H remains retracted even when the verb is no longer prepausal. This makes final H retraction a word-level process whose effects cannot be reversed during phrase formation.

4 The Class Three Tense

We now turn to what could very well be called the **Subjunctive Pattern**[12] even though it is shared by the *kene*-Immediate Future, which I will not discuss separately since everything said about the subjunctive applies to its pattern as well. The subjunctive exhibits a quite straightforward tone pattern, which involves a single H tone doubly linked to the first two vowels of the verb, the first of which is the subject prefix.

[12] Though cited in isolation here, the subjunctive is always preceded by a finite verb construction such as "tell him + Subjunctive", e.g. *mußoolélé ásyé* 'tell him (to) grind,' or *neé ɲá álíme* 'I want you (to) cultivate.' Therefore in the gloss, the English equivalent of the subjunctive does not show agreement with the 3 sg. subject.

According to the forms in (57) and (58), the subjunctive neutralizes the high/low tone contrast by assigning all verbs a uniform tone pattern. The simple rule seems to be: delete all underlying H tones, then doubly link the melodic H to the first two moras of the verb.

(57) **Toneless Verbs without Object Prefix**

a. Monosyllabic Verbs

/a-se-e/	[ásyé]	's/he grind'
/a-ku-e/	[ákwé]	's/he fall'

b. Disyllabic Verbs

/a-lim-e/	[álíme]	's/he cultivate'
/a-tuum-e/	[átúume]	's/he skip'

c. Polysyllabic Verbs

/a-kalam-e/	[ákálame]	's/he look up'
/a-loleelel-e/	[álóleelele]	's/he stare'

(58) **H Toned Verb without Object Prefix**

a. Monosyllabic Verbs

/a-li-e/	[ályé]	's/he eat'
/a-ri-e/	[áryé]	's/he fear'

b. Disyllabic Verbs

/a-ßon-e/	[áßóne]	's/he see'
/a-teex-e/	[átéexe]	's/he cook'

c. Polysyllabic Verbs

/a-ßukul-e/	[áßúkule]	's/he take'
/a-xalakil-e/	[áxálakile]	's/he sentence'

The pattern does not change with the addition of the object prefix, as in (59) and (60):

(59) **Toneless Verbs with Object Prefix**

a. Monosyllabic Verb

/a-xu-se-e/	[áxúsye]	's/he grind us'

b. Disyllabic Verb

/a-ku-tuum-e/	[ákútuume]	's/he skip it'

c. Polysyllabic Verb

/a-ßa-kalam-e/	[áßákalame]	's/he look up at them'

(60) **H Toned Verbs with Object Prefix**

a. Monosyllabic Verb

/a-mu-ri-e/	[ámúrye]	's/he fear him'

b. Disyllabic Verb

/a-ku-teex-e/	[ákúteexe]	's/he cook it'

c. Polysyllabic Verb

/a-mu-loleelel-e/	[ámúloleelele]	's/he stare at him'

Note that the melodic H tone docks to the two leftmost syllables of the verb, indicating that the object prefix falls within the domain of the rule assgining the subjunctive pattern.

Further evidence shows that the rule counts moras rather than syllables, because the two moras targeted by subjunctive H docking can be tauto-syllabic (cf. (61)). (The subject prefix vowel lengthens compensatorily before a nasal-consonant cluster created by placing the 1 sg object prefix [-n-] before the stem-initial consonant).

(61) **The Subjuntive with 1 sg. Object Prefix**

a. H Toned Verb

i. /a-n-ßukul-e/	[áámbukule]	's/he take me'
ii. /a-n-teex-e/	[ááпdeexe]	's/he cook me'

b. Toneless Verb

i. /a-n-kalam-e/	[áángalame]	's/he look up at me'
ii. /a-n-tuum-e/	[áánduume]	's/he skip me'

Informally stated, the rule deriving the subjunctive pattern reads as in (62):

(62) **Subjunctive H Docking**

Place the melodic H tone on the first two moras of the verb.

Because tones do not simultaneously dock to two moras in autosegmental phonology, we assume that the H first docks to the initial vowel, then doubles onto the following vowel to derive the double linkage. Apparently, the Subjunctive H Docking operates over a larger domain than Melodic H Docking (cf. §2 & §3). To illustrate the differences, consider the effect that the 1 sg subject prefix has on the Class One, Two, and Three patterns. (I use the Immediate Future (63a) to represent Class One, the Intermediate Past (63b) to represent Class Two, and the Subjunctive (63c) to represent Class Three.)

(63) **Toneless Verbs**

a. The Immediate Future

/n-la-lim-a/	[ndalima]	'I'll cultivate'
/n-la-tuum-a/	[ndatuuma]	'I'll skip'
/n-la-kalam-a/	[ndakalama]	'I'll look up'

b. The Intermediate Past

/n-aa-lim-il-e/	[naalímile]	'I cultivated'
/n-aa-tuum-il-e/	[naatúumile]	'I skipped'
/n-aa-kalam-il-e/	[naakálaame]	'I looked up'

c. The Subjunctive

/n-lim-e/	[n(d)íme]	'I cultivate'
/n-túum-e/	[ndúume]	'I skip'
/n-kalam-e/	[ngálame]	'I look up'

The Subjunctive pattern (63c) clearly has little in common with the Class One pattern (63a). However, it does share with Class Two (63b) the stem-initial H, a similarity that extends to forms that have an object prefix, as illustrated by the forms in (64). This similarity in the behavior of verbs selecting the Subjunctive and a Class Two tense raises the question whether the only thing differentiating the subjunctive and Class Two patterns is the docking of H on the subject prefix in the Subjunctive but not in Class Two.

(64) **Toneless Verbs**

a. The Intermediate Past

/n-aa-ku-tuum-il-e/	[naakútuumile]	'I skipped it'
/n-aa-ku-kalam-il-e/	[naakúkalaame]	'I looked up at it'

b. The Subjunctive

/n-ku-tuum-e/	[ngútuume]	'I skip it'
/n-ku-kalam-e/	[ngúkalame]	'I look up at it'

The answer lies in comparing the patterns of H toned verbs bearing either tense, which show clear differences between the two classes. Consider the forms in (65):

(65) **H Toned Verbs**

a. Intermediate Past

/n-aa-ßon-il-e/	[naaßoóne]	'I saw'	naaßonéele	'I saw for'
/n-aa-teex-il-e/	[naateexíle]	'I cooked'	naateexéele	'I cooked for'
/n-aa-ßukul-il-e/	[naaßukúule]	'I took'	naaßukúliile	'I took for'

b. The Subjunctive

/n-ßon-e/	[mbóne]	'I see'	mbónele	'I see for'
/n-teex-e/	[ndéexe]	'I cook'	ndéexele	'I cook for'
/n-ßukul-e/	[mbúkule]	'I take'	mbúkulile	'I take for'

The tonal differences in (65a) and (65b) should not occur if the Class Two pattern and the Subjunctive pattern are generated by the same principles. Notice specifically that suffixation causes pattern variation in Class Two whereas the Subjunctive pattern is invariable.

Another difference between Class Two and the Subjunctive emerges when an object prefix is added to a H toned verb that has the 1 sg subject prefix (66). Crucially, the Class Two pattern has two H tones: one on the object prefix and the other in the stem (66a), whereas the Subjunctive has only the object prefix H but no stem H (66b). Once again, suffixation has no effect on the Subjunctive pattern, which clearly shows that the shared properties between the Subjunctive and Class Two are a chance occurrence.

(66) **H Toned Verbs**

a. Intermediate Past

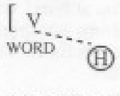
/n-aa-ku-ßon-il-e/	[naakúßóóne]	'I saw it'
/n-aa-ku-teex-il-e/	[naakúteexíle]	'I cooked it'
/n-aa-ku-ßukul-il-e/	[naakúßukúule]	'I took it'

b. The Subjunctive

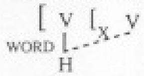
/n-ku-ßon-e/	[ngúßone]	'I see it'
/n-ku-teex-e/	[ngúteexe]	'I cook it'
/n-ku-ßukul-e/	[ngúßukule]	'I take it'

To recapitulate, the Subjunctive pattern results from the melodic H tone directly targeting the left edge of the verb, generally the subject prefix. Except for the cases involving the 1 sg. subject prefix, the H doubly links to the first two moras of the verb. As evidence from forms bearing the 1 sg. object prefix has demonstrated, the targeted moras could be tauto-syllabic. Forms with the 1 sg. subject prefix, on the other hand, add an interesting dimension to the behavior of the Subjunctive, because they suggest that the H tone actually surfaces on two separate domains; that is, after targeting the left edge of the verb, the H tone doubles onto the initial vowel of the next domain, which is either the structure created when an object prefix is added to a stem, or just the bare stem. If this is true, the Subjunctive pattern can be derived by successively applying the rules in (67) and (68), once all underlying H's have been eliminated:

(67) **Melodic H Docking - III**



(68) **(Subjunctive) H Doubling**[13]



Thus, in forms with the 1 sg. subject prefix, the melodic H targets the left edge of the verb, but because the subject prefix only consists of a nasal which is not a possible surface anchor, it doubles onto the next domain yielding a singly linked H in *ngálame* 'I look up' and *mbúkule* 'I take.' In forms that have both the 1 sg. subject prefix and an object prefix, the H singly links to the initial syllable of domain "G" (see discussion of Final H Deletion in §2.1) to create forms like *ngúkalame* 'I look up at it' and *ngúßukule* 'I take it.' The H cannot double onto the stem-initial syllable because if it did, it would be crossing two domain boundaries: i.e., that between the subject prefix and the G-Domain, and the one between the object prefix and the stem. The reason why we do not get double linking here is because the nasal prefix - a consonant - is not an eligible surface H tone anchor.

In phrases, verbs selecting the subjunctive tense keep their isolation tone pattern regardless of the tone of the next word (69a,b):

(69) **The Subjunctive in Phrases**

a. Toneless Verb

/a-kalam-e ßaalosi/	[ákálame ßaalosi]	's/he look up at witches'
/a-kalam-e ßáaloosi/	[ákálame ßáaloosi]	's/he look up at old women'

b. H Toned Verb

/a-ßukul-e ßaalosi/	[áßúkule ßaalosi]	's/he take witches'
/a-ßukul-e ßáaloosi/	[áßúkule ßáaloosi]	's/he take old women'

5 Residual Cases

The tenses we consider in this section do not constitute a set. Instead, each tense exhibits a feature (or set of features) which makes it unique. These tenses may share some properties with the Class One, Two, and Three tenses but differ from them by a feature or two. We begin by looking at the Remote Perfective.

5.1 The Remote Perfective

At first glance, the Remote Perfective pattern appears to combine the properties of Class One and Class Two tenses. However, a closer look reveals that it differs from them in a number of aspects. First, a H tone docks to the subject prefix in the Remote Perfective, which is not possible in the Class One and Two patterns. Second, the Remote Perfective has a H on the object prefix (cf. *áamúßoná* 's/he already saw him'), which is possible in

[13] X is a variable for the domain that the H tone doubles onto.

the Class Two pattern (cf. *alimúßona* 's/he'l see him') but not in Class One (cf. *alámußoná* 's/he'll see him'), although it might be argued that its failure to appear in the Class One pattern is an effect of Meeussen's Rule within the prefix domain. Third, in the Remote Perfective, Meeussen's Rule fails to delete the melodic H after the object prefix H. As a result we find forms like *áamúkálámá* 's/he already looked up at him,' where the string of H's extending from the object prefix must have come from combining two separate H tones. In Class Two, the melodic H deletes after the object prefix H. Therefore strings involving the object prefix H and the melodic H are not possible.

Consider the data in (70):

(70) **The Remote Perfective**

a. Toneless Verbs

/a-a-se-a/	[áasyá]	's/he already ground'
/a-a-ßu-se-a/	[áaßúsyá]	's/he already ground it'
/a-a-lim-a/	[áalímá]	's/he already cultivated'
/a-a-ku-lim-a/	[áakúlímá]	's/he already cultivated it'
/a-a-kalam-a/	[áakálámá]	's/he already did look up'
/a-a-mu-kalam-a/	[áamúkálámá]	's/he already did look up at him'

b. H Toned Verbs

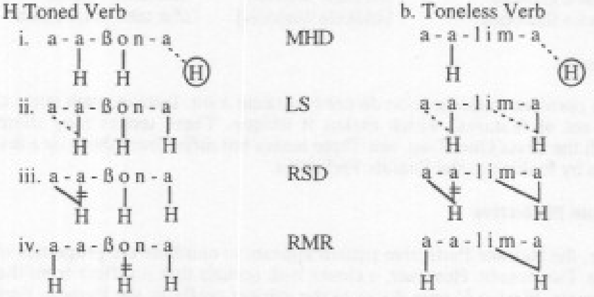
/a-a-li-a/	[áalyá]	's/he already ate'
/a-a-mu-li-a/	[áamúlyá]	's/he already ate him'
/a-a-ßon-a/	[áaßoná]	's/he already saw'
/a-a-mu-ßon-a/	[áamúßoná]	's/he already saw him'
/a-a-ßukul-a/	[áaßukúlá]	's/he already did take'
/a-a-mu-ßukul-a/	[áamúßukúlá]	's/he already did take him/her'

5.1.1 Deriving the Remote Perfective Pattern

Apparently, the tense prefix -A- is H toned. This H "spreads" onto the subject prefix, and then delinks from its sponsor by Right Sister Delinking (12).

(71) **Derivations**

a. H Toned Verb b. Toneless Verb



v. **á a ß o n á** 's/he saw' SURFACE **á a l í m á** 's/he cultivated'

Because the tense prefix is H toned, the H tone on the object prefix H cannot spread leftwards. As a result, the lexical H is forced to remain on the stem-initial syllable to remain on its sponsor. Subsequently, either the melodic H tone spreads leftwards from the final syllable then triggers Reverse Meeussen's Rule (47), or Meeussen's Rule (39) is activated by the sequence of adjacent H tones causing stem-initial H deletion. The point is that a H tone deletes.

5.1.2 The Remote Perfective in Phrases

In phrases, the melodic H tone, which appears as a string of H's at the right edge of the verb in isolation, delinks from all but its leftmost anchor, which creates a H that singly links to stem syllable one or two depending on the underlying tone of the verb. Consider the forms in (72) - (75):

(72) **Toneless Verb, Toneless Object**

/a-a-kalam-a/	[áakálámá]	's/he already looked up'
/a-a-kalam-a ßaalosi/	[áakálama ßaalosi]	's/he already looked up at witches'

(73) **Toneless Verb, H Toned Object**

/a-a-kalam-a ßáaxasi/	[áakálama ßáaxasi]	's/he already looked up at women'

(74) **H Toned Verb, Toneless Object**

/a-a-ßukul-a/	[áaßukúlá]	's/he already took'
/a-a-ßukul-a ßaalosi/	[áaßukúla ßaalosi]	's/he already took witches'

(75) **H Toned Verb, H Toned Object**

/a-a-ßukul-a ßáaxasi/	[áaßukúla ßáaxasi]	's/he already took women'

Now consider what happens in verbs that are derived from shorter stems:

(76) **Toneless Verb, Toneless Object**

a.	/a-a-lim-a/	[áalímá]	's/he already cultivated'
	/a-a-lim-a liiloßa/	[áalíma liiloßa]	's/he already dug up soil'
b.	/a-a-tuum-a/	[áatúúmá]	's/he already skipped'
	/a-a-tuum-a liiloßa/	[áatúuma liiloßa]	's/he already skipped soil'

(77) **Toneless Verb, H Toned Object**

a.	/a-a-lim-a ßúulime/	[áalíma ßúulime]	's/he already cultivated the garden'
b.	/a-a-tuum-a ßúulime/	[áatúuma ßúulime]	's/he already skipped the garden'

(78) **H Toned Verb, Toneless Object**

a.	/a-a-ßon-a/	[áaßoná]	's/he already saw'
	/a-a-ßon-a ßaalosi/	[áaßona ßaalosi]	's/he already saw witches'
b.	/a-a-teex-a/	[áateexá]	's/he already cooked'
	/a-a-teex-a liiloßa/	[áateexa liiloßa/	's/he already cooked soil'

(79) **H Toned Verb, H Toned Object**

a.	/a-a-ßon-a ßáaxasi/	[áaßoná ßáaxasi]	's/he already saw women'
b.	/a-a-teex-a ßáaxasi/	[áateexá ßáaxasi]	's/he already cooked women'

A toneless disyllabic verb exhibits two H tones before another word. One H tone docks to the subject prefix and the other to the stem-initial syllable, whether the complement is H toned or toneless (cf. (76; 77)). In contrast, a corresponding H toned verb alternates between having a final H before a H toned complement (79) and no H on the final syllable before a toneless complement (78). The verb final H deletes in *áateexa lìiloβa* 's/he already cooked soil' because retraction does not operate in this tense.

If the subject prefix did not have a H tone, the Remote Perfective would be a Class One tense because the melodic H, which surfaces as a string in isolation, appears as a singly linked H that deletes in case it is verb final and the complement is toneless. But the Remote Perfective also shares with Class Two tenses the H tone on the object prefix, which is not a property of the Class One pattern.

In the forms in (80) - (81), we see the effect of placing a complement after a verb that is in the Remote Perfective and has an object prefix. Basically, a toneless verb shows two H's when an object prefix is added (80; 81). The first H docks to the subject prefix while the second forms a string that stretches from the object prefix to the end of the verb. One might posit the object prefix as being toneless in this tense, which would mean that after docking to the final syllable, the melodic H spreads leftwards until it hits the object prefix. This creates a form like *áamúkálámá* 's/he already looked up at him.' In a phrase, the H string delinks all but its leftmost association line to yield a singly linked melodic H, as in *áamúkalama lulala* 's/he already looked up at him once.' The problem is that this solution makes the Remote Perfective the only tense where object prefixes are toneless.

(80) **Toneless Verb, Toneless Complement**

a.	áalílímá	's/he already cultivated it (cl.5)'
	áalílima lulala	's/he already cultivated it once'
b.	áakútúúmá	's/he already skipped it (cl.3)'
	áakútuuma lulala	's/he already skipped it once'
c.	áakúkálámá	's/he already looked up at it'
	áakúkalama lulala	's/he already looked up at it once'

(81) **Toneless Verb, H Toned Complement**

a.	áaβúlima lúukali	's/he already cultivated it a lot'
b.	áakútuuma lúukali	's/he already skipped it a lot'
c.	áakúkalama lúukali	's/he already looked up at it a lot'

(82) **H Toned Verb, Toneless Object**

a.	áakúβoná	's/he already saw it (cl.3)'
	áakúβona lulala	's/he already saw it once'
b.	áaβúteexá	's/he already cooked it (cl.14)'
	áaβúteexa lulala	's/he already cooked it once'
c.	áaβáβukúlá	's/he already took them (cl.2)'
	áaβáβukúla lulala	's/he already took them once'

(83) **H Toned Verb, H Toned Object**

a.	áaβáβoná lúukali	's/he already saw them a lot'
b.	áaβáteexá lúukali	's/he already cooked them a lot'
c.	áaβáβukúla lúukali	's/he already took them a lot'

The alternative is to consider the object prefix H toned, as in all the other tenses, then either assume that nothing happens after the leftward spreading of the melodic H, or posit H fusion that involves the object prefix H and the melodic H. If we take the nothing-happens approach, we have to assume further that in phrases the melodic H deletes before any word. But if we adopt the H fusion approach, the singly linked H that occurs in phrases can be obtained by applying Right Sister Delinking.

The forms involving H toned verbs (82; 83) reveal two things: (i) that the melodic H triggers deletion of the stem H in the Remote Perfective as well, and (ii) that a melodic H falling on the final syllable of a disyllabic verb gets deleted before a toneless complement (82a,b) but is preserved before a H toned complement (83a,b).

In summary, although the Remote Perfective shares some features with Class One and Two patterns, it differs from them because both the subject and object prefixes bear a H tone, and the melodic H fails to delete after an object prefix H. These features justify its being treated separately.

5.2 The Immediate (today) Past

Another tense that cannot be categorized in terms of the Class One, Two, and Three patterns is the Immediate (today) Past, which the following examples represent:

(84) **The Immediate (Today) Past**

a. H Toned Verb

/a-ßukul-il-e/	[aßukuule]	's/he took'
/a-mu-ßukul-il-e/	[amúßukuule]	's/he took 3sg.'

b. Toneless Verb

/a-kalam-il-e/	[akálaame]	's/he looked up'
/a-mu-kalam-il-e/	[amúkalaame]	's/he looked up at 3sg.'

In this tense, a H toned verb that has no object prefix surfaces without a H tone (84a), whereas a corresponding toneless verb has the melodic H on the stem-initial syllable (84b). The pattern of the H toned verb is surprising, given that such a verb has at least two underlying H tones. The H tone appearing in toneless verbs independently shows that this tense also assigns a melodic H to a verb, which then raises a number of questions if we assume that the melodic H tone causes deletion of the lexical stem H tone in H toned verbs. First, does the melodic H first dock to a syllable before triggering this deletion? If so, what syllable does it dock to? And why does it not surface on that syllable after causing the lexical stem H tone to delete?

In classical autosegmental phonology, a tone cannot trigger deletion of another tone while still in "floating" status, as the trigger and target would not be adjacent. Therefore the melodic H must dock somewhere in the verb before triggering deletion of of the lexical stem H tone. I assume that in this tense the melodic H tone first docks to the final syllable, and then looks for the left edge of the stem, because the tense absolutely requires that the melodic H surface on the stem-initial syllable. I assume further that this tense allows only one surface H tone in the stem. When the melodic H docks to the final syllable in a H toned verb, the derived structure violates this restriction because it now has two H tones in the stem. To correct the violation, the lexical stem H tone deletes, while the melodic H stays on the final syllable because the stem-initial syllable is already a lexical H tone sponsor. Subsequently, the melodic H undergoes Final H Deletion (15). Verbs with H toned complements probably provide the only evidence that the melodic H docks to the verb's final syllable (e.g. *aßukuulé ßáßaana* 's/he took children,' *ateexilé kámátóore* 's/he cooked plantains' (cf. *ateexile* 's/he cooked'), etc.), although the H in question could also be the phrasal H.

A H toned verb that has an object prefix has two lexical H tones underlyingly plus the melodic H tone. However, only the H on the object prefix surfaces (cf. *amúßukuule* 's/he took him.' In such a verb, the melodic H triggers deletion of the lexical stem H tone, but it cannot delete the H on the object prefix because the object prefix is in a domain that is larger than the stem, and so its H tone is not subject to the one-H-per-stem restriction. Final H Deletion eliminates any melodic H that gets "stranded" on the final syllable.

In a toneless verb, the melodic H finds the stem-initial syllable easily enough, and creates forms like *akálaame* 's/he looked up,' and *alímile* 's/he cultivated'. When an object prefix is added, the melodic H still docks to the stem-initial syllable, but deletes by Meeussen's Rule (39) triggered by the object prefix H. The resultant form has H on the object prefix, as in *amúkalaame* 's/he looked up at him' and *akúlimile* 's/he cultivated it.'

In summary, in order to explain the surface tonelessness of an underlyingly H toned verb, we have assumed that the Immediate Past tense requires that the melodic H surface on the stem-initial syllable or it does not surface at all. In a way, this requirement captures the general tendency for H tones to look for an anchor to the left of some domain, so it is not entirely unusual. The tense also bans more than one H per stem, and a H that falss on the final syllable gets deleted. These properties have already been noted with respect to Clases One and Two. This tense does not have the option of H docking on stem syllable two in the event that the initial syllable is unavailable.

5.3 The Remote Past Tense

The third and final tense considered residual is the Remote Past, examples of which are presented in (85) and (86). Note that the initial syllable is optionally long.

(85) **Toneless Verbs**

a. Monosyllabic Verbs

/a-a-se-a/	[á(a)sya]	's/he ground'
/a-a-ku-a/	[á(a)kwa]	's/he fell'

b. Disyllabic Verbs

/a-a-lim-a/	[á(a)lima]	's/he cultivated'
/a-a-tuum-a/	[á(a)tuuma]	's/he skipped'

c. Polysyllabic Verbs

/a-a-kalam-a/	[á(a)kalama]	's/he looked up'
/a-a-loleelel-a/	[á(a)loleelela]	's/he stared'

(86) **H Toned Verbs**

a. Monosyllabic Verbs

/a-a-li-a/	[á(a)lya]	's/he ate'
/a-a-ri-a/	[á(a)rya]	's/he feared'

b. Disyllabic Verbs

/a-a-ßon-a/	[á(a)ßona]	's/he saw'
/a-a-teex-a/	[á(a)teexa]	's/he cooked'

c. Polysyllabic Verbs

/a-a-ßukul-a/	[á(a)ßukula]	's/he took'
/a-a-xalakil-a/	[á(a)xalakila]	's/he sentenced'

In isolation, verbs marked for the Remote Past exhibit a single H tone that docks onto the word-initial vowel, which is the subject prefix in the forms in (85) and (86). Neither toneless nor H toned verbs bear a H tone in the stem, giving the impression that all lexical stem H tones delete before the melodic H docks to the word-initial syllable, as in the case of the subjunctive (see §4).

However, more data (cf. (87; 88)) indicates that the pattern observed in the toneless verbs in (85) must have come from successively applying Melodic H Docking, then Meeussen's Rule triggered by the H on the past tense -A- to delete the object prefix H. Thus, in a monosyllabic verb, the melodic H docks to the stem-initial syllable but deletes because the preceding object prefix has a H tone. The optional mora in the initial syllable must be "transparent" because Meeuseen's Rule normally does not apply between H tones that are not mora-adjacent (see forms like *áamúßukúlá* 's/he already took him' from the Remote Perfective where the object prefix H is syllable adjacent to the H on the initial syllable yet it still surfaces).

(87) **Toneless Verbs**

a. Monosyllabic Verbs

/a-a-mu-se-a/	[á(a)musya]	's/he ground him'
/a-a-ku-ku-a/	[á(a)kukwa]	's/he fell it (cl.3)'

b. Disyllabic Verbs

/a-a-ßu-lim-a/	[á(a)ßulíma]	's/he cultivated it (cl.14)'
/a-a-ßu-tuum-a/	[á(a)ßutúuma]	's/he skipped it'

c. Polysyllabic Verbs

/a-a-mu-kalam-a/	[á(a)mukálama]	's/he looked up at him'
/a-a-mu-loleelel-a/	[á(a)mulóleelela]	's/he stared at him'

(88) **H Toned Verbs**

a. Monosyllabic Verbs

/a-a-mu-li-a/	[á(a)mulya]	's/he ate him'
/a-a-ku-ri-a/	[á(a)kurya]	's/he feared it'

b. Disyllabic Verbs

/a-a-ßu-ßon-a/	[á(a)ßußona]	's/he saw it (cl.14)'
/a-a-ßu-teex-a/	[á(a)ßuteexa]	's/he cooked it'

c. Polysyllabic Verbs

/a-a-mu-ßukul-a/	[á(a)mußukula]	's/he took him'
/a-a-mu-xalakil-a/	[á(a)muxalakila]	's/he sentenced him'

To explain the pattern in (87), let us assume that after forcing the melodic H to be stranded on the final syllable (87a), the object prefix H deletes by Meeussen's Rule caused by the H on the subject prefix.[14] In longer stems (87b,c), the melodic H docks on a non-final syllable. Because Meeussen's Rule is a left-to-right rule, it first applies between the subject prefix H and the object prefix H. The output structure has a H tone on the subject prefix and another on the stem-initial syllable. The pattern in (88) remains a mystery that I will leave for further investigation.

The isolation pattern of a verb that is marked for the Remote Past is preserved at phrase level, as seen from the forms in (89) - (92). Note that the verb's tone pattern is unaffected by the tone of the following word. Among other things, these forms show verbs selecting the Remote Past as being generally unreceptive to "foreign" tones, including the phrasal H tone. While it appears that all H tones delete from the stem, it is hard to think of a derivational procedure that would produce this pattern, a pattern that we leave as a puzzle that our derivational account has no immediate answer for.

[14] This evidence forces a revision of the structural description of Meeussen's Rule by removing the "STEM" specification, as what is important is the fact that the triggering H tone links to a vowel in the prefix domain.

(89) **Toneless Verbs with Toneless Modifier**

a. Monosyllabic Verbs

/a-a-se-a ßuufu/	[á(a)sya ßuufu]	's/he ground flour'
/a-a-ku-a kumuɲixa/	[á(a)kwa kumuɲixa]	's/he fell a fall'

b. Disyllabic Verbs

/a-a-lim-a kumukuunda/	[á(a)lima kumukuunda]	's/he dug in the farm'
/a-a-tuum-a kumokoye/	[á(a)tuuma kumukoye]	's/he skipped a rope'

c. Polysyllabic Verbs

/a-a-kalam-a mwiikulu/	[á(a)kalama mwiikulu]	's/he looked into the sky'
/a-a-loleelel-a ßaalosi/	[á(a)loleelela ßaalosi]	's/he stared at witches'

(90) **Toneless Verbs with H toned Modifier**

a. Monosyllabic Verbs

/a-a-se-a ßúulo/	[á(a)sya ßúulo]	's/he ground millet'

b. Disyllabic Verbs

/a-a-lim-a ßúulime/	[á(a)lima ßúulime]	's/he dug in the garden'

c. Polysyllabic Verbs

/a-a-kalam-a múungaaki/	[á(a)kalama múungaaki]	's/he looked up'

(91) **H Toned Verbs with Toneless Modifier**

a. Monosyllabic Verbs

/a-a-li-a ßuufu/	[á(a)lya ßuufu]	's/he ate flour'
/a-a-ri-a kumuɲixa/	[á(a)rya kumuɲixa]	's/he feared a fall'

b. Disyllabic Verbs

/a-a-ßon-a kumukuunda/	[á(a)ßona kumukuunda]	's/he saw a farm'
/a-a-teex-a kumukoye/	[á(a)teexa kumukoye]	's/he cooked a rope'

c. Polysyllabic Verbs

/a-a-ßukul-a ßaalosi/	[á(a)ßukula ßaalosi]	's/he took witches'
/a-a-xalakil-a čiŋeeni/	[á(a)xalakila čiŋeeni]	's/he sentenced fish'

(92) **H Toned Verbs with H Toned Modifier**

a. Monosyllabic Verbs

/a-a-li-a ßóolu/	[á(a)lya ßúulo]	's/he are millet'
/a-a-ri-a kámawa/	[á(a)rya kámawa]	's/he feared thorns'

b. Disyllabic Verbs

/a-a-ßon-a ßúulime/	[á(a)ßona ßúulime]	's/he saw a garden'
/a-a-teex-a kámawa/	[á(a)teexa kámawa]	's/he cooked thorns'

c. Polysyllabic Verbs

/a-a-ßukul-a ßáaloosi/	[á(a)ßukula ßáaloosi]	's/he took old women'
/a-a-xalakil-a číixele/	[á(a)xalakila číixele]	's/he sentenced frogs'

6 Summary and Conclusion

he rich system of tenses that I have described here provides a challenging yet interesting testing ground for any theory of tones. An obvious fact is that in trying to explain the various tonal phenomena we have witnessed, one must recognize the crucial role that tense plays in determining the surface tone of a verb. Three main classes of tenses have been identified on the basis of certain shared properties both in isolation and within phrases. Apart from these classes, we have also examined three tenses whose unique features demand that they be treated separately. We conclude from this that though a unified account of the tone system of Bukusu verbs would be desirable, it would be hard to accomplish without paying attention to the idiosyncracies of certain tenses.

We have invoked various features to determine tense affiliation in the proposed classes. For instance, a Class One tense is identified by the following features: (i) a toneless verb remains toneless in isolation, whereas its H toned counterpart has one H in the prefix and another in the stem, (ii) both the lexical and melodic stem H tones "spread" leftwards from their underlying positions, (iii) in isolation, the melodic H surfaces as a string of H's at the right edge, and (iv) the subject prefix is not an eligible H tone anchor. The features that define the Class Two pattern are: (i) both toneless and H toned verbs must have a H tone in their surface structure, (ii) melodic H docks to the leftmost stem syllable, unless it is already H toned, (iii) both the subject and tense prefixes are excluded from possible melodic H anchors, and (iv) a prepausal H either retracts or deletes depending on the length of the penultimate syllable. Two primary features define the subjunctive pattern: (i) all verbs are assigned a surface H tone regardless of their underlying tone, and (ii) the melodic H is placed on the verb's initial syllable. Lastly, the "residual" tenses combine one or two other features with some of the characteristics of Classes One, Two, and Three.

Besides tense, the other factors that affect a verb's tone in most of these tenses are (i) stem length, (ii) the verb's underlying tone, (iii) the presence or absence of an object prefix, and (iv) whether the verb is in isolation or in the middle of a phrase.

The rules we have proposed to account for the tonal phenomena described in this study include: (1) Melodic H Docking (different versions), (2) Leftward Spreading, (3) (Reverse) Meeussen's Rule, (4) Right Sister Delinking, (5) Final H Deletion, and (6) Final H Retraction. A rule like Melodic H Docking operates across different tone classes, whereas other rules affect a specific tense or set of tenses. An adequate theory is one that explains the general and the specific without employing *ad hoc* stipulations that do not fall out of the theory in a principled way. One undesirable tactic used extensively here is the use of conditions, restrictions, and prohibitions to block the creation of impossible forms that our rules are not intrinsically equipped to avoid. An adequate theory should not allow loopholes of this nature.

The (recurrent) tendency for H tones to target certain syllables and "edges" within very specific domains is reported in other languages (e.g. Hubbard 1992 on Runyambo, Hyman and Byarushengo 1984 on Haya, Poletto 1995a on OluSamia, and Poletto 1995b and this volume on Runyankore). The fact that not all tenses select the same targets, or confine operations to the same domains, is an interesting challenge must be explained. Therefore, it is pertinent to ask whether a constraint-based approach, some version of Optimality Theory (e.g. Prince and Smolenksy 1993, McCarthy and Prince 1993, Cole and Kisseberth 1994a,b,c, etc.), would fare better than our derivational account. The goal of such a theory would be to use uniform principles to explain tone similarities and differences between the different tenses.

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Patterns of Reduplication in Kikerewe*

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1. Introduction

The principles governing reduplication have recently been subject to renewed scrutiny within Optimality Theory under the impetus of McCarthy & Prince 1995. Bantu languages have provided a rich empirical domain for investigation in this area (Odden & Odden 1985, 1996; Kiyomi & Davis 1992; Mutaka & Hyman 1990 and Downing 1994, 1996, inter alii), since reduplication in Bantu languages often interacts in sometimes unexpected ways with other aspects of the phonology. This paper investigates reduplicative constructions in the Bantu language Kikerewe, spoken on the Ukerewe Islands in Lake Victoria, Tanzania.

Kikerewe presents five distinct patterns of reduplication for numbers, adjectives, nouns, as well as productive and lexical patterns for verbs. Throughout the language, reduplication is influenced by a common core of principles. Reduplication in Kikerewe is complete as opposed to templatic (i.e. limited to a single CV core syllable as in intensive formation in Agta (Healey 1960) or a CVCV foot as is the case with the Nguni languages and Kinande (Downing 1996, Kiyomi & Davis 1992, Mutaka & Hyman 1990)). There are two patterns of reduplicant minimality, one governing the portion of the reduplicant which corresponds to the stem, and a second governing the entire reduplicant. Tones may be excluded from the reduplicant; and finally, phonological fusion between base and reduplicant may result in overcopying of prefixal material, in a fashion similar to that

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found in Kihehe (Odden & Odden 1985, 1996), Chumash (Applegate 1976, McCarthy & Prince 1995) and Tagalog (Bloomfield 1933, McCarthy & Prince 1995).

The issue of domains arises recurrently in analysing Kikerewe reduplication, and it will be shown that there are a number of subtle variations on the notion of 'stem'. For example, all forms of reduplication copy the 'stem', and there is optional deletion of *y* which is initial in the 'stem': however, it turns out that the strings characterized by these two pretheoretical notions of 'stem' are not identical.

The essence of the notion 'stem' in Kikerewe — as in all Bantu languages — is that the root and following derivational affixes define the stem. Verbs provide the greatest degree of flexibility in illustrating the stem, since they have the greatest morphological resources for stem formation. The data in (1) provide examples of different stems, indicated in bold. In these examples, the root *-bal-* is followed by any number of derivation suffixes, and ultimately by a final tense-aspect affix. In the examples below, the final inflectional affix is *-a*, which is the most general of the inflectional affixes.

(1)	ku-**bal-a**	'to count'
	ku-**bal-il-a**	'to count for'
	ku-**bal-isy-a**	'to cause to count'
	ku-**bal-an-a**	'to count each other'
	ku-**bal-il-an-a**	'to count for each other'
	ku-**bal-isy-aan-y-a**	'to cause each other to count'
	ku-**bal-il-isy-aan-y-a**	'to cause each other to count for'

Other final affixes may be used in particular tenses: these include *-e* 'subjunctive' and *-ile* 'perfective'.

(2)	ni-tu-bál-é	'we should count'	ni-tu-bal-án-é	'we should count each other'
	tu-baz-ílé	'we counted'	tu-baz-één-é	'we counted each other'

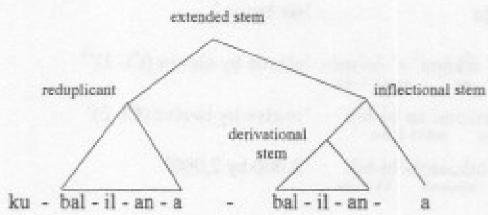
The stem forms an essentially autonomous morphological unit, where the structure of the stem is largely independent of the structure of the prefix domain.[1]

The term 'stem' will be used here to refer to the root, any derivational affixes, and the final tense affix. It has proven useful in the analysis of Bantu languages to be able to refer to the portion of the stem which excludes the final inflectional affix, so the combination of root plus derivational extensions, excluding the final inflection, will be referred to as the 'derivational stem', in contrast to the 'inflectional stem' which is the full stem, including the final tense inflection.

[1] Properties of the stem must of course be consistent with the overall morphosyntactic properties of the verb, so for example if the stem of a simple transitive verbs contains a reciprocal suffix, the subject prefix must be plural (that is to say *'I saw each other' is disallowed, but 'We saw each other' is possible). Similarly, if a verb is inflected in the perfective tense, that tense is marked by selection of appropriate prefixes as well as the perfective suffix, which is contained within the stem. Otherwise, though, the stem may be seen as morphologically completely independent from the prefixes of a verb.

There is a third notion of 'stem' which is relevant for the study of reduplication, and that is the structure which includes the reduplicant prefix plus the stem. The term 'extended stem' will be used to refer to this structure. Obviously, this structure is crucially distinct from the '(inflectional) stem' only in case a word is reduplicated: otherwise, the extended stem and (inflectional) stem are isomorphic.[2]

(3)



We will further assume that in Kikerewe the reduplicant mirrors the morphological structure of the primary stem: the reduplicant constitutes a stem domain as well, so reduplication is structurally similar to compounding. The assumption that the reduplicant defines a stem, in some sense, is motivated by the fact that the reduplicant itself behaves like a stem, in terms of a juncturally-defined tone rule.

A second notion which is important for the study of reduplication is that of the 'base'. It will be shown here that, unlike the stem, which is defined strictly by the morphology, the 'base' is a morpho-phonologically based construct with more flexible boundaries: it is, in fact, the same as the 'Phonological Stem' proposed in Downing 1996. Although the base tends to correspond to the morphological stem, it is not strictly restricted to the morphological stem, and its edges may be adjusted in response to phonological constraints. In this sense the 'base' is similar to the 'phonological word'. The phonological word generally corresponds to the grammatical word, but again its edges may be adjusted slightly in response to factors such as the presence of clitics, or size-requirements on reduplicants, inter alii.

We turn now to the reduplication constructions of Kikerewe.

2. Number Reduplication

Reduplication of numbers in Kikerewe straddles the boundary between word formation — reduplication proper — and syntactic concatenation. Numbers and number phrases are repeated in some fashion, to form the construction 'N by N', e.g. 'two by two'. It is argued that such repetition reflects reduplication in the case of a one-word

[2] The extended stem is distinct from the notion of 'macrostem' — cf. Mutaka & Hyman 1990, Odden 1996. The macrostem is the extended stem, as defined here, plus an object prefix. The notion 'macrostem', specifically including the object prefix, plays no apparent role in Kikerewe phonology or morphology. However, see Poletto (this volume) for a case showing that the macrostem is important in defining the base for reduplication in closely related Runyankore.

number, but syntactic concatenation in the case of a multiple word number expression. Examples of number reduplication and repetition are seen in (4).

(4)	gu-móó-gú-mo	'one by one (Cl. 3)'
	Cl. 3-one Cl. 3-one	
	ba-bili-bá-bíli	'two by two (Cl. 2)'
	Cl. 2-two Cl. 2-two	
	mukaaga-mukáága	'six by six'
	six six	
	ikúmí n' oo-mw' íí'kúmí' n' óó-mó	'eleven by eleven (Cl. 2)'[3]
	ten and Cl. 1-one ten and Cl. 1-one	
	ikúmí na bá-bíl' iikúmí na bá-bíli	'twelve by twelve (Cl. 2)'
	ten and Cl. 2-two ten and Cl. 2-two	
	bihuumbi bí-bíli bihuumbi bí-bíli	'2,000 by 2,000'
	thousands Cl. 8-two thousands Cl. 8-two	

The numbers 'one' through 'five' agree in noun class with their syntactic heads, an agreement which is realized as a prefix on the number (*ba-*, *o-*). Since identification of the number stem is important, the class agreement prefix is separated from the number stem by a hyphen.

There are phonological changes in this construction found only when the number being repeated is a single word, which argues that in such a case, true reduplication is involved rather than syntactic doubling. If the number stem is monosyllabic ('one', 'four'), the final vowel of the leftmost token of the number is lengthened.

(5)	gú-mó	'one (Cl. 3)'	gu-móó-gú-mo	'one by one (Cl. 3)'
	kí-mó	'one (Cl. 7)'	ki-móó-kí-mo	'one by one (Cl. 7)'
	lú-mó	'one (Cl. 11)'	lu-móó-lú-mo	'one by one (Cl. 11)'
	ká-mó	'one (Cl. 12)'	ka-móó-ká-mo	'one by one (Cl. 12)'
	bá-ná	'four (Cl. 2)'	ba-náá-bá-na	'four by four (Cl. 2)'
	bí-ná	'four (Cl. 8)'	bi-náá-bí-na	'four by four (Cl. 8)'

There is a general prohibition against long vowels at the end of the phonological word in Kikerewe, so lengthening here might seem to be problematic. However, if these structures represent reduplication rather than syntactic concatenation of independent words, such long vowels would be word-internal, hence not in violation of the constraint against final long vowels.

The examples of (5) can be contrasted with those of (6), which involve repetition of multiple-word number expressions. Note that the monosyllabic stems *-mo* and *-na* do not undergo lengthening here.

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[3] All vowel hiatus in Kikerewe is resolved into a single syllable — see Odden 1995a for discussion. Underlyingly, this example derives from *ikúmi na omó ikúmi na omó*.

(6)	makúmy' áá-bili na gú-mó tens Cl. 6-two and Cl. 3-one	'21 (Cl. 3)'
	makúmy' áá-bili na gu-mó má̀kúmy' áá-bili na gú-mó	'21 by 21 (Cl. 3)'
	maganá mwéénda na bá-ná hundreds nine and Cl. 2-four	'904 (Cl. 2)'
	maganá mwéénda na ba-ná máganá mwéénda na bá-ná	'904 by 904 (Cl. 2)'
	bihuumbi bi-ná thousands Cl. 8-four	'4,000'
	bihuumbi bi-ná bíhuumbi bí-ná	'4,000'

This difference in whether the vowel of a monosyllabic stem is lengthened provides one reason to treat single-number repetition as word formation — as reduplication — rather that as syntactic concatenation as is the case for multiple-word numbers. The overall target in this construction is a structure with two occurrences of the number. This target can be accomplished either through the syntactic means of concatenating identical phrases, or by a word-formation process. The word-formation process is the preferred strategy, but a word formation strategy is available only when a single word is involved. With a number which is longer than a single word, the expression of the derived number construction cannot be accomplished using only the resources of morphology. Therefore, syntactic concatenation is required for such numbers. Though a tonal difference between multiple-word repetitions and single-word reduplication will be considered below, the focus will henceforth be on single-word reduplications.

The next question to be addressed is what the source of this vowel lengthening might be. As the examples in (7) show, there is no lengthening associated with polysyllabic stems.

(7)	babili-bábili	'two by two (Cl. 2)'
	basatu-básátu	'three by three (Cl. 2)'
	bináá-bína	'four by four (Cl. 8'
	bataanu-bátáanu	'five by five (Cl. 2)'
	mukaaga-mukáága	'six by six'
	musaanzu-músáanzu	'seven by seven'
	munaana-munáána	'eight by eight'
	mweendá-mwéenda	'nine by nine'

One might assume that the stems *-mo* and *-na* underlyingly have long vowels, and that the long vowel in reduplicated numbers is simply retention of underlying length. However, there is evidence that these stems do not have long vowels, and that vowel length is generated as a result of reduplication itself. Except at the end of a phonological word where long vowels are prohibited, a vowel is always long if it is preceded by a sequence composed of a consonant plus a glide. If such a sequence appears at the end of a word, but is also followed by a clitic, then the vowel is not at the end of the phonological word, and therefore the word-final vowel surfaces as long.

(8)	okabóna	'you saw'	okabóꜝná-gá	'who did you see'
	okabásya	'you caught'	okabáꜝsyáá-gá	"who did you catch?"
	énká	'home'	nká-ꜝkí	"which home?"
	émbwá	'dog'	mbwáá-ꜝkí	"which dog?"[4]

If the number stems *-mo* and *-na* had underlying long vowel, then one would expect a long vowel to be preserved when these numbers are followed by a clitic. But as the data in (9) show, the vowel in these stems surfaces as short.

(9)	muuntw' oo-moꜝ-kí	'which one man?'
	banáꜝ-kí	'which four (Cl. 2)?'

Vowel lengthening is therefore a result of reduplication. In many languages, reduplicants are subject to a special prosodic condition of minimality: often, the reduplicant must be minimally bisyllabic or bimoraic (see for example Downing 1996, Kiyomi & Davis 1992, Mutaka & Hyman 1990). Apparently, this augmentation of monosyllabic stems in the reduplicant reflects a bimoraic minimality condition. Stems which are lexically bimoraic or longer naturally satisfy this reduplicant minimality condition.

There remains an important point to acknowledge, namely that, including the class agreement prefix, the reduplicant already contains two syllables. Considering ***ba-náá***+*bá-na* 'four by four (Cl. 2)', it should be noted that the ideal reduplicant *baná* is already bimoraic since it is bisyllabic, one syllable each being contributed by the agreement prefix and the stem. Given that the agreement prefix is included in the reduplicant, it becomes less obvious why the stem vowel is lengthened. This quandry can be resolved by imposing a size condition on the portion of the reduplicant that corresponds to the stem, whereby it must be minimally bimoraic. An alternative is to impose an overall size requirement on the reduplicant to the effect that it must be longer than bimoraic.[5] Since no data choose strongly between these alternatives at this point, and theoretical considerations do not weigh strongly in favor of one approach over the other, further refinement of the minimality condition will be suspended, and will be reconsidered after investigation of other conditions on the size of the reduplicant in other reduplication constructions. It will later be show that there are two minimality conditions on the reduplicant: it must be at least bisyllabic, and the stem portion of the reduplicant must be at least bimoraic.

Numeral reduplication is associated with alternation in tone as well; these alternations raise questions about distinguishing the base versus reduplicant. When the number's stem contains two or more moras, the reduplicant — the leftmost token of the stem — surfaces as toneless.

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[4] The initial vowel *e* is a prefix whose distribution is subject to complex syntactic and semantic conditioning: it is lacking in nouns modified by wh-words.

[5] Note that in all numerals lacking a class agreement prefix, such as *mweenda*, the stem contain three moras.

(10)	bábíli	'two (Cl. 2)'	babili-bábíli	'two by two (Cl. 2)'
	básátu	'three (Cl. 2)'	basatu-básátu	'three by three (Cl. 2)'
	bátáanu	'five (Cl. 2)'	bataanu-bátáanu	'five by five (Cl. 2)'
	mukáága	'six'	mukaaga-mukáága	'six by six'
	músáanzu	'seven'	musaanzu-músáanzu	'seven by seven'
	munáána	'eight'	munaana-munáána	'eight by eight'
	ikúmi	'ten'	ikum-iikúmi	'ten by ten'

The lack of tone in the leftmost element supports the assumption that the reduplicant is a prefix. A reduplicant is under different compulsions to be faithful to the base than the base itself is — see McCarthy & Prince 1994, 1995 and Odden & Odden 1996 for discussion of the emergence of unmarked structures in reduplication. There is an intrinsic tension between the markedness constraint *H which penalizes any occurrence of a H tone, and the faithfulness constraint Ident-IO(H), which requires all underlying tones to be realized on the surface. Since underlying H tones are generally preserved in Kikerewe, it is apparent that Max-IO(H) dominates *H. However, the form of the reduplicant is not determined by Max-IO(H), but rather by the separate constraint Max-BR(H) which requires base and reduplicant to have identical tones. The fact that the reduplicant appears as toneless then indicates that the markedness constraint *H dominates Max-BR(H).

(11)

	RED-bá-bili	Max-IO(H)	*H	Max-BR(H)
	babili-babili	*!	*	
	bábíli-bábíli		*!*[6]	
☞	babili-bábíli		*	*

The lack of tone in the reduplicant also distinguishes between truly reduplicated numbers and two-word numbers such as *ikúmi n' óó-mw' íkúmí n' óó-mó* 'eleven by eleven (Cl. 2)', where no reduction in tone is found.

If the number has no H tone, a H tone appears on the final vowel of the reduplicant, as well as on the initial vowel of the base.

(12)	mweendá-mwéenda	'nine by nine'
	kihuumbí-kíhuumbi	'1,000 by 1,000'

These H tones have an independent explanation. At the phrasal level, when a noun is followed by a toneless modifier, a H tone is assigned to the final vowel of the noun. This H then spreads to the following syllable by bounded rightward spreading — singly-linked H tones are generally prohibited in the language.

[6] A sequence of two adjacent H tones represents a single H, linked to multiple syllables, as dictated by a high-ranking constraint banning singly-linked H tones. Therefore, only two multiply linked H tones are present in this candidate, not four.

(13)	oluguhyo	'broken pot'
	luukizaano	'green (Cl. 11)'
	oluguhyó lúúkizaano	'green broken pot'
	omugeni	'stranger'
	mukokolo	'old (Cl. 1)'
	omugení múkokolo	'old stranger'
	ebikweema	'cudgels'
	mweenda	'nine'
	ebikweemá mwéenda	'nine cudgels'

While one might have expected **mweenda-mweenda* and **kihuumbi-kihuumbi*, the appearance of final H in the reduplicant can be explained by independent factors. Without going deeply into the details, when a stem precedes a toneless stem or word in certain 'close' morphosyntactic contexts, a H tone is assigned to the end of the first stem, due to a constraint referred to here as *Tone-Lapse. Any combination of word plus word at the phrasal level necessarily involves the combination of a stem plus word or stem; by assumption, the reduplicant has the status of 'stem', and is therefore also subject to this juncturally-defined tone insertion.

The problematic tonal data involve tone alternations in the reduplicated form of monosyllabic numbers. As the data below show, the numbers '1' and '4' have an underlying H in the stem, and the prepausal forms also have a H on the vowel of the prefix. The stem-final H spreads leftward to the noun class prefix when the numeral is prepausal: the phrase medial form shows that the H is underlyingly on the final vowel of the stem. Such pre-pausal leftward spreading is exceptionless: no prepausal H is ever preceded by a toneless syllable in the language. The phrase-medial form further illustrates bounded rightward spreading from the stem of the number (*-na, -mo*) to the underlyingly toneless subject prefix of the verb (*-ba-, li-*).

(14)	bá-ná	'four (Cl. 2)'	ba-ná bá-kabúla	'four got lost'
	lí-mó	'one (Cl. 5)'	li-mó lí-kalimwa	'one was cultivated'

However, in the reduplicated form, the rightmost token of the base lacks its lexical tone. On the surface, the final vowel of the reduplicant surfaces with a H tone due to the tone-lapse constraint.

(15)	gú-mó	'one (Cl. 3)'	gumóó-gúmo	'one by one (Cl. 3)'
	lí-mó	'one (Cl. 5)'	limóó-límo	'one by one (Cl. 5)'
	bá-ná	'four (Cl. 2)'	banáá-bána	'four by four (Cl. 2)'
	bí-ná	'four (Cl. 8)'	bináá-bína	'four by four (Cl. 8)'

Given that the reduplicant is a prefix, these structures exhibit the anomaly that the lexical H tone of the base must delete when preceded by a reduplicant. This raises the question of what motivates this deletion. No doubt, the presence of a single H is due to a tendency in the language that there should only be one H per word. The problem is that, as can be seen in polysyllabic numbers, the tone of the base is retained at the expense of that of the reduplicant. One might stipulate a constraint which bans H in a stem just in case the stem is monosyllabic and is preceded by a reduplicant within the word, but the motivation for such a constraint is very unclear. The question of why the base is modified in this manner will therefore be left as a problem for future research. However, it should also be pointed out that this problem is not isolated to Kikerewe. Javanese has a pattern of vocalic replacement associated with reduplication (Dudas 1975, Kenstowicz 1985) where vowels of both the base and reduplicant are subject to vocalic replacement, somewhat in an attempt to make the vocalism of base and reduplicant non-identical. When the second vowel of the base is *a*, *a* is replaced by *ɛ* when reduplicated (assuming that the reduplicant is a prefix); when the first vowel is *a*, it is replaced by *o* in the reduplicant.

(16)	udan	udan-udɛn	'rain'
	kumat	kumat-kumɛt	'have a relapse'
	lali	lola-lali	'forget'
	adʉs	odas-adʉs	'bathe'
	salah	solah-sɛlɛh	'make a mistake'
	jaran	joran-rɛrɛn	'horse'

To summarise, the following generalizations hold regarding the pattern of reduplication in numbers.

(17) a. The class-agreement prefix is obligatorily copied: the base is defined as the whole word.
b. The (prefix) reduplicant is toneless.
c. The final vowel in the reduplicant of a monosyllabic stem is lengthened.
d. The stem tone of a monosyllabic base is deleted when part of a reduplicated structure.

3. Adjectives

Reduplication of adjectives attenuates the semantic interpretation of the adjective, viz. 'kind of big'. Unlike number reduplication, adjective reduplication does not systematically include the noun class agreement prefix.

(18)	mu-háángo	'big (Cl. 1)'	mu-haango-háángo	'kind of big'
	mu-gága	'rich (Cl. 1)'	mu-gaga-gága	'kind of rich'
	mu-gází	'wide (Cl. 3)'	mu-gazi-gází	'kind of wide'
	i-bísi	'raw (Cl. 5)'	i-bisi-bísi	'kind of raw'

However, like number reduplication, the reduplicant in an adjective is toneless.

Another property common to adjective and number reduplication is that if the adjective stem is toneless, a H tone appears at the end of the reduplicant, and spreads rightwards into the base.[7]

(19)	mu-kokolo	'old (Cl. 1)'	mu-kokoló-kókolo	'kind of old'
	ba-zito	'heavy (Cl. 2)'	ba-zitó-zíto	'kind of heavy'
	ki-leehi	'tall (Cl. 7)'	ki-leehí-léehi	'kind of tall'

This results from Tone-Lapse, which forces insertion of H at the end of a stem which precedes a toneless stem, as noted above.

Although noun class agreement prefixes are generally excluded from the reduplicant in adjective reduplication, in case the adjective stem is monosyllabic, the class prefix must be copied as well. In addition, the stem vowel is lengthened.

(20)	bá-bí	'bad (Cl. 2)'	ba-bíí-bá-bi	'kind of bad'
	bí-hyá	'new (Cl. 8)	bi-hyáá-bí-hya	'kind of new'
	tú-ké	'few (Cl. 13)'	tu-kéé-tú-ke	'kind of few'
	mú-tó	'young (Cl. 1)'	mu-tóó-mú-to	'kind of young'

This again raises the question whether lengthening reflects retention of underlying length lost in word-final position, or length generated to satisfy a minimality condition. The diagnostic of pre-clitic length indicates that these adjectives have an underlying short vowel, hence vowel length in (20) is in satisfaction of a minimality condition.

(21)	ba-bíꜜ-kí	'which bad (Cl. 2)?'
	tu-kéꜜ-kí	'which few (Cl. 13)?'
	mu-tóꜜ-kí	'which young (Cl. 1)?'

It is true that when an adjective of the form CGV is followed by a clitic, as in *muhyááꜜ-ki* 'which new (Cl. 1)?' the final vowel of the adjective is long. However, this is a result of the general principle that vowels are long after consonant+glide sequences, and thus such an example is irrelevant to the question of the basic length of monosyllabic stems. The data in (21) indicate that these stems do not have underlying long vowels, since one would expect a long vowel to be retained before a clitic. Therefore the lengthening seen in (20) is the result of 'bulking up' to satisfy the stem-minimality constraint on the reduplicant. This contrasts with prefixal overcopy, which is in response to a different minimality requirement, namely a bisyllabic minimum for the reduplicant as a whole.

So far, the only difference between adjective reduplication and number reduplication has been that the class agreement prefix is not generally copied under adjective reduplication, but is systematically copied under number reduplication, in order to satisfy the bisyllabic minimality requirement of the reduplicant. Copying of the class prefix is

[7] One might alternatively see this as inserting H at the left edge of the base, which spreads to the left. However, there independently exists principles — the Tone Lapse constraints — which would assign H to a stem before a toneless stem.

required in another context: just in case there is phonological fusion between stem and prefix, the prefix must be copied. In this respect, reduplication of adjectives (and nouns, to be discussed in the following section) in Kikerewe operates like reduplication in Kihehe (Odden & Odden 1985, 1996), where there is also exceptional overcopying of prefixal material under conditions of phonological fusion between prefix and stem.

Two contexts yield phonological fusion between prefix and adjective stem. The first is when the adjective stem is vowel initial; in that case, the V+V sequence arising at the juncture between prefix and stem is resolved into a single syllable in conformity with the general principles of syllable structure in the language, and when the adjective is reduplicated, the segmental material of the prefix is copied along with the stem syllable.

(22)	mw-iila	'hospitable (Cl.1)'	mw-iilá-mw-íila	'kind of hospitable'
	mw-aangu	'quick (Cl. 1)'	mw-aangú-mw-áangu	'kind of quick'
	ly-aangu	'quick (Cl. 5)'	ly-aangú-ly-áangu	'kind of quick'
	k-íingi	'a lot (Cl. 7)'	k-iingi-k-íingi	'kind of a lot'
	b-ééngi	'a lot (Cl. 2)'	b-eengi-b-ééngi	'kind of a lot'
	n-iingi	'a lot (Cl. 10)'	n-iingi-n-íingi	'kind of a lot'
	mw-éélu	'white (Cl. 3)'	mw-eelu-mw-éélu	'kind of white'
	nn-élu	'white (Cl. 9)'	nn-eluu-n-élu	'kind of white'[8]

The second context involves the class 9-10 agreement prefix *n-*, which assimilates in place of articulation to the following consonant (additionally causing the change of *h* to *p*, and *l* to *d*).

(23)	mú-hyá	'new (Cl. 1)'	m-pyá	'new (Cl. 9)'
	m-pyáá-m-pya		'kind of new (Cl. 9)'	
	mu-háángo	'big (Cl. 1)'	m-páángo	'new (Cl. 9)'
	m-paangoo-m-páángo[9]		'kind of big (Cl. 9)'	
	mu-bísi	'raw (Cl. 3)'	m-bísi	'raw (Cl. 9)'
	m-bisii-m-bísi		'kind of raw (Cl. 9)'	
	mu-leehi	'long (Cl. 1)'	n-deehi	'long (Cl. 9)'
	n-deehíí-n-déehi		'kind of long (Cl. 9)'	
	mu-gúfu	'short (Cl. 1)'	n-gúfu ([ŋ-gúfu])	'short (Cl. 9)'
	n-gufuu-n-gúfu ([ŋgufuuŋgúfu])		'kind of short (Cl. 9)'	

These data raise important questions about the notion of 'base' and its relation to 'stem' in reduplication. Much work in reduplication — for example McCarthy & Prince 1993, 1995 — tends to downplay the notion of 'base' as independent from the strictly morphological notion 'stem'. Downing 1996, however, has correctly pointed to the need

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[8] Geminate nasals are allowed only in utterance-initial position; cf. then *endaláá' nélu* 'white leopard', where the nasal degeminates (but transfers its mora to the preceding vowel). Thus in the reduplicated form, the base only has a simple nasal on the surface.

[9] Except when a vowel is onsetless, a vowel is always long before a sequence of nasal plus consonant in Kikerewe. See Odden 1995a for further discussion.

for an independent structure Base, which is largely but not strictly coterminous with the stem. Such a notion of Base is necessary for characterising reduplication in Kikerewe. Consider the shape of the reduplicant in words such as *ba-bíi-bá-bi*, where the agreement prefix is exceptionally copied in order to satisfy the constraint Red>σ. Under a conception of reduplicative base where the 'base' is simply the immutable morphological structure 'stem', it is difficult to predict the correct form of the reduplicant. The candidate which best matches the reduplicant to the base defined in this way would be **ba-bi-**bi***, where the stem and reduplicant are exactly identical. The fatal flaw with this candidate is that the reduplicant is monosyllabic. A better candidate would be **ba-CVbi-**bi*** or **ba-biCV-**bi***, where CV represents some constant phonetic sequence, most likely *yi* given the phonology of the language. This candidate satisfies the reduplicant bisyllabicity condition, at the expense of violating Dep-BR, i.e. introducing material which is not found in the stem.

This incorrect pattern of reduplication-with-epenthesis should be compared to the actual form *ba-bíi-bá-bi*, where the reduplicant also contains material not found in the stem. Parallel examples like *mu-bíi-mú-bi* 'bad (Cl. 1)' demonstrate that the extra material in the reduplicant is systematic: it is the syllable of the preceding prefix. The problem is that the shape of the reduplicant is assumed to be governed by constraints governing the relation of the reduplicant and the stem. Apart from a fixed-material augment such as *yi*, there would appear to be no other way to satisfy reduplicant minimality, short of recycling material from the stem as in **ba-bibi-bi*.[10]

A solution to this problem emerges once it is assumed that the Base is a phonological constituent whose edges are not necessarily identical with those of the morphological stem (see Odden & Odden 1996 for further discussion). Whether or not this constituent is constructed apart from reduplicated constructions remains an open question: see Downing 1996, who argues for such a structure independent of reduplication. For the purposes of this paper, the Base is called on only for reduplication. Generally, the base and stem are identical, per the following constraints.

(24) **Base-to-Stem Alignment**
Align(Base,R,Stem,R)
Align(Base,L,Stem,L)

Following Downing 1996, it is also assumed that the positioning of the reduplicant relative to the base is governed by a prosodic alignment constraint, rather than as the result of morpheme ordering in the input.

(25) **Reduplicant-to-Base Alignment**
Align(Redup,R,Base,L)

When the stem is monosyllabic, the left edge of the base must be adjusted leftward to include the agreement prefix, in order that the reduplicant — which copies the

[10] Such a pattern of subminimal reduplication is found in Kinande (see Downing 1996, Mutaka & Hyman 1990).

base — be minimally bisyllabic. In the following tableau, the reduplicant is underlined and the base is indicated in boldface.

(26)

ba-RED-bi	Red>σ	Dep-BR	Integrity-BR[11]	RB-Align	Min Stem$_{redup}$	BS-Align
ba-bi-**bi**	*!					
ba-bi-bi-**bi**			*!			
ba-ba-bi-**bi**		b!a				
ba-bi-**ba-bi**		b!a		ba		
ba-bi-**ba-bi**					*!	*
☞ ba-bii-**ba-bi**						*

Another constraint governing the left edge of the reduplicant is Syllable-alignment which requires the reduplicant to be aligned with the left edge of a syllable. This constraint is crucial in accounting for the reduplicative pattern of vowel-initial stems such as *mw-iila*.

(27) **Syllable-Alignment**: Align(Red,L,σ,L)

Given that the base and reduplicant must be identical, any constraint which dictates the shape of the reduplicant in effect holds of the base as well. Since the reduplicant must be aligned on the left with a syllable, and since /mu+i/ inevitably forms a single syllable, then the reduplicant necessarily is *mwiila*. Since the reduplicant and stem are identical, this means that *mw* must also appear in the base, even though including that material in the base entails violation of the constraint requiring the base to be aligned with the left edge of the stem.

(28)

mu-RED-ila	Ons	Syl-Align	Dep-BR	BS-Align
mw-iila-**ila**	*!	mw		
mw-iil-**iila**		m!w		
mw-iila-**w-iila**		m!		w
mw-iila-**w-iila**			m!	w
☞ mw-iila-**mw-iila**				mw

In the examples of adjective reduplication considered so far, the reduplicant has been toneless, just as the reduplicant in number reduplication is toneless. However, reduplicated adjectives have an alternative pronunciation where the lexical tone of the stem is retained.

(29) ma-bísi　ma-bísiꜜ-bísi　'raw (Cl. 6)'
mu-fúla　mu-fúláꜜ-fúla　'kind (Cl. 1)'
mu-gága　mu-gágá-gága　'rich (Cl. 1)'
mi-gúfu　mi-gúfúꜜ-gúfu　'short (Cl. 4)'

---

[11] This constraint requires that every segment in the base have a unique correspondent in the reduplicant.

lu-háángo	lu-háángóꜜ-háángo	'big (Cl. 11)'
lu-lééngа	lu-lééngáꜜ-léénga	'weak (Cl. 11)'
bi-gází	bi-gazíꜜ-gází	'wide (Cl. 8)'
mu-gúmé	mu-guméꜜ-gúmé	'strong (Cl. 1)'
mu-zímá	mu-zimáꜜ-zímá	'good (Cl. 1)'

Recall that H spreads rightward to a non-prepausal syllable, hence the alternation between *ma-bisi* and *ma-bisiꜜ-bisi* from *ma-bisi-bisi*; furthermore, prepausal H spreads leftward so that /bi-gazí/ becomes *bi-gází* and /bi-gazí-gazí/ becomes *bi-gazíꜜ-gází*. To derive the variant where lexical H tone is deleted in the reduplicant (*mufulafúla*), the constraint *H must dominate Ident-BR(H) which would otherwise force the reduplicant to mirror any H tone found in the base. Therefore, for the variant where H tones of the base are mirrored in the reduplicant (*mufúláꜜfúla*), the opposite ranking of these constraints is necessary.

Although both tonal variants exist, they are not attested with equal frequency. Further research is needed to establish solidly which of the two tonal variants is most frequent, but it appears that tone-deletion is more frequent than tone-retention if the adjective has a lexical stem-initial H (thus, forms like *luhaangoháángo* are the forms most frequently encountered), and tone-retention is weakly more frequent than tone-retention if the stem has an underlying H on the final syllable (hence, *bi-gazíꜜ-gází* is somewhat more common than *bi-gazi-gází*). In contrast, tone deletion in the reduplicant of numbers is exceptionless. Finally, it should be noted that reduplicated monosyllabic adjectives exhibit an anomalous tone pattern, a pattern also found in reduplicated monosyllabic numerals. As can be seen in (20), e.g. *babii-bábi*, the H tone in the base is missing, although otherwise the tone of the base is not affected by reduplication.

In summary, reduplication in adjectives exhibits the following traits.

(30)
a. The class agreement prefix is copied when the stem is monosyllabic.
b. The class agreement prefix is copied when it fuses phonologically with the stem.
c. A monosyllabic stem is lengthened in the reduplicant.
d. H tone of the base optionally deletes in the reduplicant, especially if the H tone is stem-initial.
e. The stem tone of a monosyllabic base deletes after a reduplicant.

4. Nouns

Reduplication in nouns operates according to principles which are nearly identical to those found in adjectives. Since the set of nouns in the language is open, one has the opportunity of inspecting a very wide range of phonological structures to see how they operate under reduplication. Nominal reduplication gives a noun the sense 'a real N'. As the examples of (31) show, the class prefix of the noun is not generally copied in a reduplicated noun.

(31)	o-mu-gólé	'queen'	o-mu-goléꜜ-gólé	'real queen'
	o-mu-fúmu	'medicine man'	o-mu-fúmú-ꜜfúmu	'real medicine man'
	e-ki-swéélá	'biting ant'	e-ki-sweeláꜜ-swéélá	'real biting ant'
	e-ki-kóómbe	'cup'	e-ki-kóómbéꜜ-kóómbe	'real cup'
	e-bi-mííná	'scorpion'	e-bi-miiná-ꜜmííná	'real scorpion'
	o-lu-bále	'fishing pole'	o-lu-bálé-ꜜbále	'real fishing pole'
	o-lu-taaga	'cassava'	o-lu-taagá-táaga	'real cassava'
	o-lu-paapúlá	'paper'	o-lu-paapulá-pááꜜpúlá	'real paper'

However, copying of the noun class prefix is sometimes allowed; such a variant occurs rarely, and is always optional (except under phonologically well-defined circumstances).

(32)	e-ki-sweelá-ki-ꜜswéélá	'real biting ant'
	o-lu-taagá-lú-taaga	'real cassava'
	e-ki-gaambó-kí-gaambo	'real word'

Copying of the noun class prefix is required under three circumstances — exactly the circumstances where prefix copying is required in adjectives. First, if the noun stem is monosyllabic, the noun class prefix must be copied.

(33)	**Noun**	**Reduplicated noun**		**Gloss**
	e-ki-sa	e-ki-sá-kí-sa	*e-ki-sá-sa	mercy
	e-ki-me	e-ki-mé-kí-me	*e-ki-mé-me	dew
	e-ki-la	e-ki-lá-kí-la	*e-ki-lá-la	yam
	e-kí-ná	e-ki-náꜜ-kí-ná	*e-ki-ná-ná	fungal ringworm
	o-bú-ló	o-bu-lóꜜ-bú-ló	*o-bu-ló-ló	millet
	o-mú-tí	o-mu-tíꜜ-mú-tí	*o-mu-tí-tí	medicine
	a-má-tí	a-ma-tí-ꜜmá-tí	*a-ma-tí-tí	trees
	o-mú-bú	o-mu-bú-ꜜmú-bú	*o-mu-bú-bú	mosquito

Exceptional overcopying of the noun class prefix is required in nouns (as in adjectives), in order to satisfy the bisyllabic minimality requirement on the reduplicant.

The second context for obligatory prefix copy is when the noun stem is vowel initial: in that case, the class prefix fuses syllabically with the noun stem, so prefixal material is reduplicated along with the other segments of the stem. This is illustrated in (34) with combinations of nonidentical vocoid where the first vowel in the sequence is a high vowel: on the surface, such sequences are resolved by glide formation.

(34)	**Noun**	**Underlying**	**Reduplicated**	**Gloss**
	o-mw-óózó	/o-mu-ózó/	o-mw-oozóꜜ-mw-óózó	fellow
	o-mw-áágázi	/o-mu-ágázi/	o-mw-áágázi-mw-áágázi	virgin goat
	o-mw-áána	/o-mu-ána/	o-mw-áánáꜜ-mw-áána	child
	o-lw-éémbo	/o-lu-émbo/	o-lw-éémbo-ꜜlw-éémbo	song
	e-ly-eeyo	/e-li-eyo/	e-ly-eeyó-ly-éeyo	broom
	o-mw-iika	/o-mu-íka/	o-mw-iiká-ꜜmw-íika	smoke

	o-bw-íími	/o-bu-ími/	o-bw-íímíꜜ-bw-íími	stinginess
	o-bw-óóngó	/o-bu-óngó/	o-bw-oongóꜜ-bw-óóngó	brain

The class 7 prefix *eki-* is subject to a further modification, since *ky* becomes *ch*.

(35)	**Noun**	**Underlying**	**Reduplicated**	**Gloss**
	e-ch-aalamo	/e-ki-alamo/	e-ch-aalamó-ch-áálamo	funeral
	e-ch-áála	/e-ki-ála/	e-ch-áálꜜá-ch-áála	finger
	e-ch-áámba	/e-ki-ámba/	e-ch-áámbáꜜ-ch-áámba	animal blood
	e-ch-ááya	/e-ki-áya/	e-ch-ááyáꜜ-ch-ááya	anger

Copying of prefixal material as result of vowel fusion can be further illustrated with sequences of *a*+V, where the sequence of vowels is merged into a single non-high vowel.

(36)	**Noun**	**Underlying**	**Reduplicated**	**Gloss**
	a-m-óóyá	/a-ma-óyá/	a-m-óóyáꜜ-m-óóyá	feathers
	a-m-ééno	/a-ma-ínó/	a-m-éénóꜜ-m-ééno	teeth

Finally, sequences of identical vowels merge into a single long vowel, and prefixal copying is also found here.

(37)	**Noun**	**Underlying**	**Reduplicated**	**Gloss**
	a-b-áána	/a-ba-ána/	a-b-áánáꜜ-b-áána	children
	e-k-iibo	/e-ki-íbo/	e-k-iibo-k-iíbo	basket
	e-b-iibo	/e-bi-íbo/	e-b-iibo-b-iibo	baskets
	e-l-ííno	/e-li-íno/	e-l-íínóꜜ-l-ííno	tooth
	a-m-áálwá	/a-ma-álwá/	a-m-aalwáꜜ-m-áálwá	beer
	a-m-ááni	/a-ma-áni/	a-m-ááníꜜ-m-ááni	strength

The third context where there is prefix copying is when the noun appears in classes 9 or 10, which are characterized by the class prefix *-n-*. Monosyllabic noun stems in class 9-10 systematically require the noun class prefix *n-* to be copied.

(38)	**Noun**	**Reduplication with copy**	**Reduplication without copy**	**Gloss**
	é-n-zwi	e-n-zwiíꜜ-n-zwi	*e-n-zwiíꜜ-zwí	knee
	é-n-dá	e-n-dááꜜ-n-dá	*e-n-dááꜜ-dá	louse

There is a strong tendency for there to be overcopy of the noun class prefix with longer stems in classes 9 and 10.

(39)	**Noun**	**Reduplicated noun**	**Gloss**
	e-n-zóka	e-n-zókááꜜ-n-zóka	snake
	e-n-dálá	e-n-daláꜜá-n-dálá	leopard
	e-m-bozu	e-m-bozúú-m-bózu	catfish
	e-m-pílyá	e-m-pilyááꜜ-m-pílyá	money

e-n-gábe	e-n-gábéé'-n-gábe	sitatunga
e-n-chúpa	e-n-chúpáá'-n-chúpa	bottle

Unlike the situation with sub-minimal monosyllabic stems or vowel initial stems where copying of the prefix is obligatory, copying of an assimilated nasal prefix in nouns of classes 9 and 10 is optional. This optionality can be distinguished from the existing option inherent in all noun reduplication that the prefix may be copied. Whereas copying of the class prefix with VCV- prefixes added to CVX nouns is a rarely exercized option, *failure* to copy the prefix *n* is a rarely exercized option.

(40)	**Marked Reduplication without prefix copy**	**Reduplication with prefix copy**	**Gloss**
	e-m-bebá-béba	e-m-bebáá-m-béba	rat
	e-m-buunjá'-búúnjá	e-m-buunjáá'-m-búúnjá	jigger
	e-m-bozú-bózu	e-m-bozúú-m-bózu	catfish

The tonology of reduplicated nouns is at least partially similar to that of reduplicated adjectives and numbers. If the noun stem is underlyingly toneless, a H tone appears on the final vowel of the reduplicant, and it spreads to the right by one syllable, a pattern previously seen with adjectives and numbers.

(41)	**Noun**	**Reduplicated noun**	**Gloss**
	a-ka-hooliimo	a-ka-hooliimó-hóóliimo	chorus
	e-kaluumbeeta	e-kaluumbeetá-káluumbeeta	trumpet
	e-ki-gaambo	e-ki-gaambó-gáambo	word
	e-bi-susano	e-bi-susanó-súsano	photos
	i-biingo	i-biingó-bíingo	elephant grass
	i-bogomelo	i-bogomeló-bógomelo	waterfall
	i-huna	i-huná-húna	owl
	kanamuunsaambwa	kanamuunsaambwá-kánamuunsaambwa	skunk
	o-bu-lagalika	o-bu-lagaliká-lágalika	type of dance
	o-bu-lemo	o-bu-lemó-lémo	war
	o-lu-gela	o-lu-gelá-géla	basket tool
	o-mu-buuki	o-mu-buuki-búuki	fisherman

Another tonal similarity between nouns and adjectives (but not numbers) is that nouns optionally retain the tones of the base in the reduplicant, as many of the previous examples have shown, and as illustrated in (42).

(42)	**Noun**	**Underlying form**	**Reduplicated noun**	**Gloss**
	o-mu-gólé	o-mu-golé	o-mu-golé'-gólé	queen
	o-mu-fúmu	o-mu-fúmu	o-mu-fúmú'-fúmu	doctor
	o-lu-paapúlá	o-lu-paapulá	o-lu-paapulá-páá'púlá	paper
	o-mw-íika	o-mu-íka	o-mw-iika-mw-íika	smoke
	a-m-óóyá	a-ma-óyá	a-m-óóyá'-m-óóyá	feathers
	e-n-chúpa	e-n-chúpa	e-n-chúpáá'-n-chúpa	bottle

The examples in (42) are to be contrasted with those below, where the reduplicant may surface as toneless.

(43)	Noun	Reduplicated noun	Gloss
	e-n-zóka	e-n-zokaa-n-zóka	snake
	e-ki-lááto	e-ki-laato-lááto	shoe
	e-ki-kóómbe	e-ki-koombe-kóómbe	cup
	e-ki-súsi	e-ki-susi-súsi	calabash
	o-lu-bále	o-lu-bale-bále	fishning pole
	o-lu-lábyo	o-lu-labyo-lábyo	lightening
	o-mu-fúmu	o-mu-fumu-fúmu	medicine man
	o-lw-éémbo	o-lw-eembo-lw-éémbo	song
	e-ki-nálánazyo	e-ki-nalanazyo-nálánazyo	punishment
	o-mw-áágázi	o-mw-aagazi-mw-áágázi	virgin goat
	e-ki-túúngúlu	e-ki-tuungulu-túúngúlu	onion
	e-ki-biliíti	e-ki-biliiti-biliíti	matches
	e-n-gúlúbe	e-n-gulube-n-gúlúbe	pig

Thus, tone deletion in the reduplicant of nouns is optional as it is with adjectives. Also similar to the pattern of adjectives, a lexical H is more likely to be deleted if the H is stem initial.

There is one striking difference between the treatment of nominal reduplicants and the treatment of adjectival reduplicants. Whereas the final vowel of a monosyllabic reduplicant lengthens to satisfy stem-minimality (cf. *omu-bii-mú-bi* 'kind of bad (Cl. 1)', there is no such lengthening in monosyllabic noun stems.

(44)			
	a-má-tá	a-má-táꜜ-má-tá	'milk'
	e-kí-bá	e-kí-báꜜ-kí-bá	'bundle'
	e-kí-ná	e-kí-náꜜ-kí-ná	'fungal ringworm'
	e-kí-lá	e-kí-láꜜ-kí-lá	'yam'
	e-ki-me	e-ki-mé-kí-me	'dew'
	a-má-tí	a-má-tíꜜ-má-tí	'trees'
	a-ma-ni	a-ma-ni-má-ni	'liver'
	o-bú-tá	o-bú-táꜜ-bú-tá	'bow'

The lack of a final long vowel in a monosyllabic reduplicated noun stem might seem to indicate that the minimality constraint on stems in reduplicants only holds for numbers and adjectives. Further evidence argues that the lack of final long vowels in nouns is due to an independent factor, namely that the reduplicant in nouns must define a phonological word (and therefore a long vowel cannot appear at the end of the reduplicant). We have previously noted that vowels are always long within the phonological word when preceded by a sequence of consonant plus glide. When followed by a clitic, a vowel at the end of the morphological word will always be long when preceded by a C+G sequence, as observed in (8); further confirmation of this fact is seen in (45).

(45)	o-mu-hyóó-ꜜkí	'which knife?'
	o-ku-twíí-ꜜkí	'which ear?'
	a-ma-hwáá-kí	'which thorns?'
	e-ki-swáá-kí	'which anthill?'
	olu-láꜜbyóó-kí	'which lightning?'
	i-gúꜜfwáá-kí	'which bone?'
	i-huuswáꜜ-kí	'which feather headdress?'

As the data of (46) show, the reduplicant of these same stems nevertheless has a surface short vowel.

(46)	o-mu-hyóꜜ-mú-hyó	'knife'
	o-ku-twíꜜ-kú-twí	'ear'
	a-ma-hwá-má-hwa	'thorns'
	e-ki-swá-kí-swa	'anthill'
	olu-lábyóꜜ-lábyo	'lightning'
	i-gúfwáꜜ-gúfwa	'bone'
	i-huuswáꜜ-húúswá	'feather headdress'

Since a short vowel after a C+G sequence is otherwise found only in word-final position (where long vowels are systematically prohibited), the short vowel at the end of a noun reduplicant can be handled by postulating that the reduplicant in a noun must be aligned at its right edge with a phonological word.

(47) **Red-Word Alignment**: Align(Red(noun),R,Pword-R)

Consequently, reduplicated nouns and adjectives have different prosodic structures. Since (47) is undominated, noun reduplicants behave as though they are word-final and therefore cannot have a long vowel,[12] whereas the reduplicant in an adjective behaves as though it is word-medial and therefore may have a long vowel.

(48)

Reduplicated nouns have thus been seen to observe the following principles.

[12] Word final long vowels are actually permitted. Vowels are always long before a sequence of a nasal plus a consonant, and since this lengthening is found at the phrasal level, one encounters word-final long vowels for example in *endaláá ndéehi* 'tall leopard'. Lengthening before NC is also found in reduplication, hence there is a long vowel at the end of the reduplicant in *enchúpááꜜ-nchúpa* 'bottle'.

(49) a. Prefixes are copied to satisfy the bisyllabic reduplicant minimality condition.
b. Prefixes are copied when phonologically fused with the stem.
c. The reduplicant ends a phonological word.
d. Underlying H is optionally retained in the reduplicant.

5. Verbs

The fourth category of reduplication in Kikerewe is productive verbal reduplication. Such reduplication gives the verb the added connotation of action being done here and there, often without appropriate care. The following data from the infinitive illustrate basic examples of such reduplication.

(50)	ku-lima	'to cultivate'
	ku-lima-lima	'to cultivate haphazardly'
	ku-bíba	'to plant'
	ku-bíbá-biba	'to plant here and there'
	ku-káláanga	'to fry'
	ku-kálááanga-kalaanga	'to fry any old way'

In fact, there are two freely-varying strategies for reduplicating verbs, the full-copy variant and the asymmetrical-copy variant. We will begin with consideration of the full-copy variant.

5.1. Full Copy

In adjectives and nouns, reduplication preferentially excludes prefixal material, but copying of a prefix can be forced if there is phonological fusion between the prefix and stem, or when the stem is monosyllabic. In contrast to the situation with adjectives and nouns, verbal reduplication never allows copying of prefixal material. For example, the 1 sg. verbal subject prefix is *n*-, which assimilates to the following consonant just as the class 9-10 nominal prefix *n*- does. Unlike the nominal prefix, the subject and object prefixes *n*- do not overcopy under reduplication.

(51)	n-teeka-tééká	'I cook a bit'
	n-dima-límá	'I cultivate a bit'
	m-pabuula-habúúlá	'I advise here and there'
	n-dimile-limílé	'I cultivated a bit (yest.)'
	n-kalaangile-kalaangílé	'I fried off and on (yest.)'
	kuu-n-téékéla-teekela	'to fry for me a bit'

No verb stems are underlyingly vowel initial; however, stems with initial *y* optionally delete that *y* after a vowel.[13] The surface outcome is that the initial stem vowel

[13] Another possibility for analysing this alternation is that these stems are underlyingly vowel-initial, and *y* is optionally epenthesized in order to avoid violation of the Onset constraint. There is no contrast in

and the vowel of the preceding prefix merge into a single syllable. Despite this syllable fusion, there is no copying of the prefix.

(52)	ku-yáta-yata	kw-ááta-yata	'to cut sloppily'
	tu-yaangile-yaangílé	tw-aangile-yaangílé	'we disagreed somewhat'
	ba-yeta-yétá	b-eeta-yétá	'they call here and there'
	tu-yeenda-yéénda	tw-eenda-yéénda	'we kind of like'
	tu-ka-yiníka-yinika	tu-k-ééníka-yinika	'we soaked a bit'
	wa-yilúkile-yilukile	w-éélúkile-yilukile	'you sg. chased about'
	wa-tú-yilukile-yilukile	wa-tw-iilúkile-yilukile	'you sg. chased us about'

The third context where one might expect prefix copying, based on non-verbal patterns of reduplication, would be when the verb stem is monosyllabic. The following examples show that although the vowel of the reduplicant is long (presumably in satisfaction of a minimality requirement), the preceding prefix is not copied.

(53)	ku-gwa	'to fall'	ku-gwaa-gwa	'to fall about'
	ku-sya	'to grind'	ku-syaa-sya	'to grind here and there'
	ku-gu-sya	'to grind it'	ku-gu-syaa-sya	'to grind it here and there'
	a-ka-za	'he went'	a-ka-zaa-za	'he went about'
	ba-láá-há	'they will give'	ba-laa-háá-ha	'they will give some'
	a-ka-tú-há	'he gave us'	a-ka-tú-háa-ha	'he gave us a bit'

Lack of prefixal overcopy when there is phonological fusion between stem and prefix indicates that respect for morphological alignment of the base and the stem is of highest priority in verbs, whereas in nouns and adjectives, the structure of the base is adjusted so that the base and reduplicant are both identical and left-aligned with a syllable. The failure to overcopy prefixal material where the stem is subminimal can also be explained by appeal to a strict exclusion of prefixal material from the base in verb reduplication, though it may also be that there simply is no bisyllabicity requirement for reduplicated verbs: at any rate, there is at this point no overt evidence for such a condition in verbs (but see the discussion of asymmetrical reduplication where such evidence will be considered).

As before, it is necessary to consider the question of identifying the base versus the reduplicant. Previously, two considerations have been called on to distinguish base and reduplicant — reduplicants are or may be rendered toneless, and the vowel of a monosyllabic stem is lengthened in the reduplicant. The data in (53) would appear to support the claim that the reduplicant is a prefix, since the lefthand token of the stem has a long vowel. However, counterbalancing this consideration is the fact that monosyllabic verb roots are generally associated with special length properties. The suffixes for the applied, causative and reciprocal forms of the verb begin with underlyingly short vowels, as indicated in (54).

Kikerewe between *y*-initial stems and vowel-initial stems, so the analysis of these alternation could go either way.

(54)	ku-bon-a	'to see'
	ku-bon-el-a	'to see for'
	ku-bon-esy-a	'to cause to see'
	ku-bon-an-a	'to see each other'

When preceded by a verb root of the form C(G), these suffixes have long vowels.

(55)	ku-mwa	'to shave'
	ku-mw-aan-a	'to shave each other'
	ku-mw-eel-a	'to shave for'
	ku-mw-eesy-a	'to cause to chave'
	kú-h-á	'to give'
	hu-h-éésya	'to cause to give'
	ku-h-aan-a	'to give each other'
	kú-t-á	'to release'
	ku-t-áán-a	'to release each other'

Hence the lengthening found in the reduplicant of a monosyllabic verb may reflect this special property of this class of roots, rather than reflecting a minimality constraint on the reduplicant. Other evidence will be considered later which gives stronger support to the existence of a bisyllabic minimality condition as well as a bimoraic stem minimality condition.

Still, the distribution of long vowels at the end of the reduplicant does provide some information bearing on the minimality issue. Given that a monosyllabic reduplicant ends in a long vowel, this would suggest that the reduplicant is not at the edge of a phonological word. However, consider the following examples of reduplication in verbs which end in a consonant-plus-glide sequence.

(56)	ku-bal-w-a-bal-w-a	'to be counted'
	ku-básy-á-basy-a	'to catch'
	ku-chéélélelw-a-cheelelelw-a	'to be late'
	ku-gelezy-a-gelezy-a	'to sprinkle'
	ku-yébw-á-yebw-a	'to forget'

Although the reduplicant ends in a sequence of consonant plus glide — a context where vowels always surface as long — the reduplicant ends in a short vowel. It cannot simply be the case that these verb stems are exceptions to this otherwise exceptionless generalization regarding vowel length; as (57) shows, the final vowel is in fact long when it is followed by a clitic.

(57)	ku-bal-w-áá-yő	'to be counted there'
	ku-bá'sy-áá-gá	'to catch who?'
	ku-chéélélelw-áá-hó	'to be late a bit'
	ku-gelezy-áá-ki	'to sprinkle what?'

Such data argue that the reduplicant in verbs must end a phonological word; yet the data from monosyllabic stems argues, on the contrary, that the last vowel of a reduplicant cannot be at the end of a phonological word.

These contradictions can be understood if a bisyllabic minimality condition is assumed for the reduplicant. Two constraints are relevant in implementing the minimality condition for verbal reduplication.

(58) **Red=Pword** (Align(Red,R,Pword,R);Align(Red,L,Pword,L))
Pword > σ

When the reduplicant is bisyllabic or longer, these constraints force the reduplicant to end a phonological word, which thus precludes long vowels at the end of the reduplicant (phonological words are enclosed in brackets).

(59)

	ku-RED-balwa	Pword > σ	Red=Pword	*VV]$_{pword}$	*CGV
☞	ku-[balwa]-[balwa]				**
	ku-[balwa-balwa]		*!		**
	ku-[balwaa-balwa]		*!		*
	ku-[balwaa]-[balwa]			*!	*

On the other hand, with a monosyllabic root, the reduplicant cannot form a phonological word, hence no constraint prohibits a long vowel at the end of the reduplicant.

(60)

	ku-RED-gwa	Pword > σ	Red=Pword	*VV]$_{pword}$	*CGV
	ku-[gwaa]-[gwa]	*!		*	*
	ku-[gwa]-[gwa]	*!			**
☞	ku-[gwaa-gwa]		*		*
	ku-[gwa-gwa]		*		*!*

It was noted above in connection with examples like *omuhyóˈmúhyó* 'a real knife' that the nominal reduplicant ends a phonological word — this same conclusion has just been argued for in the case of verbs. However, there is a substantial empirical difference between nouns and verbs with respect to final vowel length, and that is that the reduplicant of a noun never exhibits final vowel length, even when monosyllabic. This difference between nouns and verbs is actually a side-effect of a more basic difference between nouns and verbs. Whereas the reduplicant of a noun can include a prefixal syllable in order to satisfy the reduplicant minimality condition, this is disallowed in verbs. From this fact, it follows that nouns actually can satisfy the minimality condition on reduplicants, which is mediated through phonological word constituency, and therefore a noun reduplicant always forms a phonological word. Since verbs cannot recruit prefixal material to satisfy the minimality condition, the alternative selected is that the reduplicant cannot define a phonological word just in case it is monosyllabic.

Tonal data does nothing to clarify whether reduplication is prefixing or suffixing. Consider the data in (61), drawn from the infinitive, hodiernal perfective, and remote past tense. It will be noticed that lexically H toned verbs manifest the H tone on the left-most token of the stem, which has been identified as the reduplicant.

(61) a. Toneless verbs

ku-bala	ku-bala-bala	'to count'
twaa-bazile	twaa-bazile-bazile	'we counted (today)'
aka-bala	aka-bala-bala	'he counted (rem.)'

b. H toned verbs

ku-bála	ku-bálá-bala	'to kick'
twaa-bázile	twaa-bázile-bazile	'we kicked (today)'
aka-bála	aka-bálá-bala	'he kicked (rem.)'

Such examples might be taken to indicate that reduplication is suffixal in verbs. However, further investigation into verbal tonology indicates that the location of tone in the verb does not distinguish between the hypothesis of prefixing versus suffixing reduplication.

There are no significant restrictions on the location of H tone in nouns and adjectives, apart from the fact that there is at most a single H. In verbs, on the other hand, the location of tone is highly constrained. Tense-aspect categories can be divided into four groups, with respect to where tones appear within the stem — see Odden (1995b) for further discussion. The simplest and most common group has the so-called base tone pattern; in the base pattern, toneless verbs remain toneless and H toned verbs have a H on the first syllable of the stem. Further illustrations of the base tone pattern, as seen in (61), drawn from the infinitive, are seen below.

(62)

ku-bíbika	'to border on'	ku-bónékana	'to appear'
ku-bííhililwa	'to be angry'	ku-bóóbóota	'to babble'
ku-búgáángana	'to meet'	ku-chéélélelwa	'to be late'
ku-góóngóbola	'to peel banana stem'	ku-hééndágula	'to break'
ku-hólóóloka	'to be in low spirits'	ku-nááláámbula	'to scatter'

No verb stem in the base pattern has H associated with any syllable other than the initial syllable (from which position it spreads one syllable to the right); thus tones in verbs are subject to a high-ranking constraint requiring H to be aligned with the left edge of the stem. It has been assumed here that the stem and reduplicant are joined into a single structure referred to as the extended stem: the extended stem is the domain within which verbal tone is assigned. Therefore the appearance of H in the reduplicant and its lack in the base is of no consequence for identifying the base versus the reduplicant. The high-ranking constraints governing the position of tone in verbs simply override the constraint *H which otherwise would result in a toneless reduplicant.

In other tenses, a melodic H tone is added to all stems. In tenses such as the remote past relative and the hesternal past, this H is assigned to the final syllable (where it spreads to the preceding syllable if the verb is prepausal, due to general prepausal leftward H spread). When the verb is reduplicated, H appears on the absolute word-final syllable, i.e. at the end of the extended stem.[14]

(63)	ku-bala	ku-bala-bala	'to count'
	m-bazilé	m-bazile-bazilé	'I counted (yest)'
	abaa-bazilé	abaa-bazile-bazilé	'they who counted (rem.)'
	ku-bíba	ku-bíbá-biba	'to plant'
	m-bibílé	m-bibile-bibílé	'I planted (yest)'
	abaa-bibílé	abaa-bibile-bibílé	'they who planted (rem.)'

In the near future tense, where a melodic H is assigned to the penultimate syllable, that H appears on the penult of the entire verb.

(64)	balaa-baliláana	balaa-balilana-baliláana	'they will count for each other'
	balaa-bibiláana	balaa-bibilana-bibiláana	'they will plant for each other'

Thus H tone in verbs is not systematically excluded from the rightmost stem-like portion of the verb; again, this is due to the fact that the positioning of H tone in verbs is governed by high-ranking constraints, which override the tendency of reduplicants to be toneless. Consequently, the position of tone cannot be called on to decide whether reduplication in verbs is prefixing or suffixing.

One further phonological matter must be attended to before the analysis of full-copy reduplication is complete. It was noted in (52) that stem initial *y* optionally deletes when it is intervocalic. While initial *y* in the reduplicant may delete in this position, *y* in the base cannot delete.

(65)	ku-yááŋgá-yaanga	kw-ááŋgá-yaanga	'deny'
	*ku-yááng-áanga	*kw-ááng-áanga	
	ku-yátá-yata	kw-áátá-yata	'cut'
	*ku-yát-áata	*kw-áát-áata	
	ku-yéémbá-yeemba	kw-éémbá-yeemba	'sing'
	*ku-yéémb-éemba	*kw-éémb-éemba	
	ku-yeleela-yeleela	kw-eeleela-yeleela	'float'
	*ku-yeleel-eeleela	*kw-eeleel-eeleela	
	ku-yilúka-yiluka	kw-iilúka-yiluka	'run away'
	*ku-yilúk-eeluka	*kw-iilúk-eeluka	
	ku-yómá-yoma	kw-óómá-yoma	'be dry'
	*ku-yóm-óoma	*kw-óóm-óoma	

[14] In prepausal position, this final H must spread to the preceding syllable, as noted above.

This restriction follows from the assumed morphological structure of the verb, in particular the assumption that the reduplicant and stem join together in forming the extended stem, in conjunction with independently motivated principles regarding deletion of *y*. Deletion of *y* is not freely available in all positions. While *y* has a rather restricted distribution, appearing most frequently at the beginning of the stem, *y* also appears in stem-medial position. In that position, *y* never deletes.[15]

(66)	ku-bóya	*kú-bw-á	'fight'
	ku-gaya	*kú-g-á	'despise'
	ku-gay-an-a	*ku-g-aan-a	'despise each other'
	ku-geya	*ku-gy-a	'speak ill'
	kw-oya	*kw-a	'take a break'
	ku-saaya	*ku-s-a	'get angry'

Deletion of *y* must therefore be restricted to 'initial' position — specifically, initial position within the extended stem, which is the constituent containing both the base and reduplicant. Since only the initial *y* of the reduplicant is in that position, it alone is in the proper position for deletion.

5.2. Asymmetrical Copy

Consideration of the asymmetric pattern of reduplication does yield clear evidence that the reduplicant is a prefix in verbs. In previous examples of verb reduplication, every element present in the base appears in the reduplicant. Additionally, there is a freely available phonological variant of reduplication which is realized by partially copying elements from the base into the reduplicant. One of these optional variations in the pattern of reduplication selects all elements from the base except for the final tense-aspect morpheme. The data in (67) exemplify this pattern, and are drawn from the subjunctive, which has the structure derivational stem+*e*, where *-e* marks the subjunctive. In the asymmetrical reduplication pattern, the subjunctive tense-aspect morpheme *-e* is not copied, and the default final suffix *-a* is used instead (at least for these examples).

(67)	**Base form**	**Asymmetrical reduplicant**	**Symmetrical reduplicant**	
	ni-tu-lím-é	ni-tu-lim-a-lím-é	ni-tu-lim-e-lím-é	'we should cultivate'
	noo-hahúúl-é	noo-habuul-a-habúúl-é	noo-habuul-e-habúúl-é	'you should advise'
	ni-ba-tafún-é	ni-ba-tafun-a-tafún-é	ni-ba-tafun-e-tafún-é	'they should chew'

Whereas the leftmost token of the stem, the reduplicant, may manifest this less marked morphological structure, the rightmost token, the base, must be inflected with the subjunctive suffix. If the reduplicant is a prefix, the conditions for non-occurrence of the

[15] Deletion of *y* in non-stem initial position would result in quite radical reduction of the verb stem. Simple deletion for example *ku-bóy-a* → *ku-bó-a* would be impossible, since the language allows no vowel sequences. Instead, the vocalic elements merge into a single long syllable. However, long vowels are prohibited word-finally, so deletion of *y* in *-bóya* would inevitably lead to *-*bwá*.

subjunctive affix can be stated locally, as a property of the reduplicant. If the reduplicant were a suffix, it would be more difficult to state the conditions under which *-e* may be excluded from the base, namely when the base is followed by a reduplicant.

(68) *ni-tu-lim-e-lím-á
*noo-habuul-e-habúúl-á
*ni-ba-tafun-e-tafún-á

Another manifestation of asymmetric reduplication is that derivational extensions such as the applicative suffix *-il-*, the causative *-isy-*[16] and the reciprocal suffix *-an-* may be ignored in copying. Thus, the asymmetrical reduplicants in (69) reflect only the verb root.

(69)	ku-bón-án-a-bon-an-a	ku-bón-á-bon-an-a
	'to see each other'	
	ku-yéémb-él-a-yeemb-el-a	ku-yéémb-á-yeemb-el-a
	'to sing for'	
	ku-kám-ísya-kam-isy-a	ku-kám-á-kam-isy-a
	'to cause to milk'	
	ku-hákúl-il-an-a-hakul-il-an-a	ku-hákúl-a-hakul-il-an-a
	'to take out for each other'	
	ku-lim-il-an-a-lim-il-an-a	ku-lim-a-lim-il-an-a
	'to cultivate for each other'	

Interestingly, partial reduplication of a stem which contains two or more derivational suffixes may copy a contiguous sequence of such suffixes which follow the root. Discontinuous copying from the derivational stem is disallowed.

(70) ku-lim-il-a-lim-il-an-a 'to cultivate for each other'
*ku-lim-an-a-lim-il-an-a

It can be shown that the contiguity constraint must be stated in terms of the derivational stem, not the entire inflectional stem. The relevant evidence involves verbs in the subjunctive tense, where the stem contains derivational affixes. As (71) shows, an asymmetrical reduplicant may select a subset of the derivational affixes of the base followed by the final affix *-a*, or the reduplicant can be composed of the bare root plus the subjunctive affix *-e*.

(71)	nee-kam-a-kám-w-é	'they should be milked'
	nee-kam-w-a-kám-w-é	=
	nee-kam-e-kám-w-é	=

[16] These suffixes have the vowel-harmonic variants *-el-* and *-esy-* after mid vowels.

ni-ba-kam-a-kam-isy-é	'they should cause to milk'
ni-ba-kam-isy-a-kam-isy-é	=
ni-ba-kam-e-kam-isy-é	=
ni-ba-lim-a-lim-il-án-é	'they should cultivate for each other'
ni-ba-lim-il-a-lim-il-án-é	=
ni-ba-lim-il-an-a-lim-il-án-é	=
ni-ba-lim-e-lim-il-án-é	=
ni-ba-lim-il-e-lim-il-án-é	=

It should be pointed out that the three most common patterns are either total reduplication, reduplication of just the root followed by *-a*, and reduplication of the root followed by *-e*; forms such as *ni-ba-lim-il-e-lim-il-án-é* are not as strongly accepted. Nevertheless, such forms are ultimately acceptable, in contrast to completely ill-formed examples such as **ku-limana-limilana* with discontinuous copying within the derivational stem.

The requirement that the reduplicant be a contiguous subpart of the derivational stem will be enforced by the following constraint.

(72) **Redup-Contig**: The reduplicant must correspond to a contiguous substring of the derivational stem.

Another restriction on partial copying of the base is that entire morphemes must be copied. Thus the following patterns where only parts of a stem or affix are reduplicated are excluded.

(73)	*ku-kala-kalaanga	'to fry'
	*ku-bibi-bibika	'to border'
	*ku-héézú-heezula	'blow off (of roof)'
	*ku-héléélu-heleeluka	'be last'
	*ku-hélée-heleeluka	'be last'
	*ku-bali-bal-il-a	'to count for'
	*ku-balis-a-bal-isy-a	'to cause to count'

The Morpheme Integrity constraint guarantees that partial copying of morphemes is blocked (see Mutaka & Hyman 1990).

(74) **Morpheme Integrity**: the segment at the edge of the d-stem in the reduplicant must have a correspondent at the edge of the morpheme in the base

Constraints (72) and (74) thus account for the ability to select a subset of the derivational stem, but so far we have no account of the fact that the final tense aspect morpheme may vary between *-a* and *-e*, the latter being expected on morphological grounds. The fact that the reduplicant terminates with the vowel *-a* is consistent with the fact that Kikerewe tolerates no coda consonants. The precise selection of *-a* over all other vowels reflects a constraint requiring the reduplicant to have the appearance of a 'canonical stem' — see Downing 1994 for discussion. Except in marked circumstances, namely in the subjunctive and perfective, all verb stems end in the vowel *-a*, a morpheme which has no semantic contribution and which simply indicates that the form in question is a verb. There is no independent evidence that *a* is a phonological 'default vowel'. Consideration of the pattern of epenthesis in loanwords suggests that *i* is actually the vowel inserted to repair illicit consonant sequences. Loanword evidence must be used with caution, since it is not always clear what the immediate source of loanwords in Kikerewe is. In particular, it is probable that all apparently current loanwords from English actually derive via Swahili (which also resolves codas and onset clusters by vocalic epenthesis). However, there are loanwords, especially ones introduces by French-speaking missionaries, which did not enter Kikerewe via Swahili. Particularly indicative are personal names such as *Sumáálidi* 'Sumard', *Malisééli* 'Marcel', *Maliko* 'Marc',[17] where the epenthetic vowel is *i*.

A complete analysis of this variation in the selection of the final inflectional affix will not be undertaken here, since it would involved many issues which are tangential to the present paper. It will simply be assumed that there are competing requirements for the inflectional suffix within the reduplicant — either that it be *-a-*, or that it be the tense-aspect appropriate suffix *-e* — and that by allowing either strategy to be followed, the existing range of variation in forms is accounted for.

Another example of asymmetrical reduplication involves the perfective form of the stem. The perfective stem involves a morpheme which may be abstractly represented as *-ile*, and which has a number of surface variants. Since the interaction between perfective stem-formation and reduplication depends crucially on the principles of stem-formation for the perfective, a brief digression is necessary to establish those principles.

The primary variant of the perfective is the suffix *-ile*, which appears with the widest variety of stem types.

(75)	ku-bik-a	a-bik-ílé	'he announced a death'
	ku-bís-a	a-bis-ílé	'he concealed a fact'
	ku-bánik-a	a-banik-ílé	'he roasted'
	ku-gololok-a	a-gololok-ílé	'he was straigthened out'
	ku-hágám-a	a-hagam-ílé	'he was too big'

The perfective suffix is associated with a morphophonemic change in final oral coronals, whereby $t \rightarrow s$, and $d,l \rightarrow z$.

(76)	ku-ful-a	a-fuz-ílé	'he cleaned'
	ku-lol-a	a-loz-ílé	'he saw'
	ku-buut-a	a-buus-ílé	'he choked'
	ku-biind-a	a-biinz-ílé	'he tucked in a loincloth'
	ku-geend-a	a-geenz-ílé	'he went'

[17] Especially in names with a clear biblical origin, names tend to retain the gender-appropriate theme vowel from Greek, *-o* for masculine and *-a* for feminine names: cf. *Maafíta* 'Martha', *Peetélo* 'Peter'.

Note that this spirantizing effect is not a general property of all *ti, li* and *di* sequences: cf. *kufulila* 'to lean for', *kubuutila* 'to choke for' and *kubiindila* 'to tuck in a loincloth for'. This spirantization takes place only before the perfective suffix *ile*, the causative suffix *y*, and the nominalization suffix *-i*.

The second variant of the perfective is the so-called imbrication variant (Bastin 1983, Hyman 1995). In the imbrication variant, the vowel *i* is infixed before the stem-final consonant and the suffix *-e* is added. The would-be vowel sequence is resolved so that *oi* → *wee, ui* → *wii, ii, ei* → *ee* and *ai* → *ee*. The imbrication variant is selected by any stem which contains at least two moras, where the final consonant is *l*.

(77)	ku-lwáál-a	a-lw-éé-l-é	'he is ill'
	ku-láál-a	a-l-éé-l-é	'he lied down'
	ku-bágál-a	a-bag-éé-l-é	'he weeded'
	ku-nyegel-a	a-nyeg-éé-l-é	'he itched'
	ku-limil-a	a-lim-íí-l-é	'he cultivated for'
	ku-goongobol-a	a-goongobw-éé-l-é	'he debark'
	ku-hálúl-a	a-halw-íí-l-é	'he scraped the pot'
	ku-luguul-a	a-lugw-íí-l-é	'he was surprised'

Monosyllabic verbs stems select a variant of the perfective with a long vowel.[18]

(78)	ku-gw-a	a-gw-íílé	'he fell'
	ku-z-a	a-z-íílé	'he went'
	ku-mw-a	a-mw-éélé	'he shaved'
	kú-ly-á	a-l-iilé	'he ate'
	kú-nw-á	a-nw-éélé	'he drank'
	kú-h-á	a-h-éélé	'he gave'
	kú-t-á	a-t-éélé	'he released'

As noted earlier, lengthening is a general property of these stems, cf. *ku-mw-aan-a* 'to shave each other' vs. *ku-bal-an-a* 'to count each other'.

Longer stems which end in a glide introduce a further complication. In a stem of the form *CVCw*, the basic perfective suffix *-ile* is selected: note, however, that the glide *w* is infixed within the perfective suffix *-ile*.

(79)	ku-bóhw-a	a-boh-íl-w-é	'he was tied'
	ku-lihw-a	a-lih-íl-w-é	'he was paid'
	ku-kúgw-a	a-kug-íl-w-é	'he was found'
	ku-manyw-a	a-many-íl-w-é	'he was known'

[18] Certain stems are associated with phonetically unpredictable lowering of the vowel of the perfective suffix. A full analysis of this problem is outside the scope of this paper, but could be handled by postulating a floating partial specification for vowel height following the stem final consonant.

If the perfective suffix then comes to stand after *l*, *t* or *d*, spirantization affects the final consonant.

(80)	ku-búlw-a	a-buz-íl-w-é	'he failed to get'
	ku-lolw-a	a-loz-íl-w-é	'he was seen'
	ku-liindw-a	a-liinz-íl-w-é	'he was guarded'
	ku-bátw-a	a-bas-íl-w-é	'he was snared'

When the stem ends in the sequence *Cy*, the suffix *-iizye* is employed. The *y* in this variant of the suffix presumably represents the stem-final *y*, infixed within the perfective suffix.

(81)	ku-koby-a	a-kob-íiz-y-é	'he picked up'
	ku-hiingy-a	a-hiing-íiz-y-é	'he exchanged'
	ku-lóby-a	a-lob-íiz-y-é	'he wetted'

A number of stems end with *-zy-*, which derives from underlying /ly/. In the perfective of such stems, the glide *y* which ordinarily conditions the change $ly \rightarrow zy$ is infixed within the perfective suffix, and therefore *l* does not spirantize in the perfective of such verbs.

(82)	ku-guzy-a	a-gul-íiz-y-é	'he sold'
	ku-kizy-a	a-kil-íiz-y-é	'he rescued'
	ku-lozy-a	a-lol-íiz-y-é	'he tried'
	ku-boonzy-a	a-boond-íiz-y-é	'he had a foretaste'

For example, [kuguzya] derives from /kugulya/ via this spirantization process. In accord with the constraints of the language regarding seletion of perfective allomorphs and the positioning of glides within the stem, the perfective stem of this verb might be expected to be *-guliilye*; but because of the spirantizing effect of *y*, the surface form is *-guliizye*.

Returning to the main theme of asymmetrical reduplication in the perfective, the examples of (83) show that in the asymetrical variant, the suffix *-ile* does not appear in the reduplicant, and the final suffix *-a* appears in its place.

(83)	ku-bís-a	a-bis-ílé	a-bis-a-bis-ílé	'he concealed a fact'
	ku-bánik-a	a-banik-ílé	a-banik-a-banik-ílé	'he roasted'
	ku-hágám-a	a-hagam-ílé	a-hagam-a-hagam-ílé	'he was too big'

These examples are analogous to the subjunctive examples in (67), where the tense-aspect suffix *-e* is excluded from the reduplicant, and therefore *-a* appears in its place.

Also analogous to the subjunctive, the base must manifest the perfective affix, which excludes the following patterns where the reduplicant but not the base is marked with the perfective.

(84) *a-bis-ile-bis-á
*a-banik-ile-baník-á
*a-hagam-ile-hagám-á

This further supports the claim that reduplication is prefixing in verbs. Under the hypothesis that reduplication were suffixing, there would be no reason for the supposed base *bisa* in *a-bisa-bisile* to lack the perfective suffix when the reduplicant manifests the suffix; there would also be no reason why forms such as (84) are impossible, where the supposed base, the leftmost token of the stem, contains all of the morphemes which it would be expected to contain, while the reduplicant only contains a portion of the base morphemes. Under the assumption that reduplication is prefixing, these patterns are explainable. The reduplicant may be less marked than the base — it may lack elements found in the base — but it cannot be more marked — it cannot contain elements not found in the base.[19]

The first significant complication in the phonological pattern of asymmetric reduplication is seen with stems which end in an oral coronal, which spirantizes before the perfective suffix *-ile*. As the data below demonstrate, there is no spirantization of the final consonant in the reduplicant, even though its correspondent in the base spirantizes.

(85)	ku-lol-a	n-doz-ílé	n-dol-a-loz-ílé	'I saw'
	ku-ful-a	a-fuz-ílé	a-ful-a-fuz-ílé	'he cleaned'
	ku-kuut-a	a-kuus-ílé	a-kuut-a-kuus-ílé	'he threshed seeds'
	ku-biind-a	a-biinz-ílé	a-biind-a-biinz-ílé	'he tucked in a loincloth'
	ku-geend-a	a-geenz-ílé	a-geend-a-geenz-ílé	'he went'

The example *ndolalozile* particularly underscores the nature of the problem. While the number and identity of the segments in the base and reduplicant should be the same, it is evident that the consonants of the reduplicant, *dola*, do not match the base, *lozile*. This is because the content of the reduplicant in Kikerewe does not depend on matching the reduplicant with the surface nature of the base, but rather depends on matching the reduplicant with the underlying shape of the base. The underlying form of *ndolalozile* is *n*-RED-*lol-ile*, and it is obviously identity with the underying form that the reduplicant is striving towards.

A perfect match between the reduplicant and the underlying form of the base would be achieved in **nlolalozile*. However, such perfection could only be achieved at the expense of violating the constraint against *nl*, and this constraint is unviolated in the language. Thus it is inevitable that identity constraints must be violated. If the initial *l* in the reduplicant alone is changed, then the surface identity of the base and reduplicant segments will be destroyed. The correct form for both the base and the reduplicant results from subordinating all of the faithfulness constraints to the (unviolable) phonological

[19] Of course, the reduplicant may be more faithful to the phonologically underlying form of the base due to IR faithfulness constraints and the base may be made less faithful to its underlying form due to high ranking phonological constraints. However that is not the situation here: the differences between which morphemes are present in the base and reduplicant are not due to any general phonological constraints.

constraints, and subordinating the requirement of surface base-reduplicant identity to the constraints requiring identity between the surface forms of the reduplicant or base and the input. (See Poletto, this volume, for discussion of a similar problem in Runyankore).

(86)

	n-RED-lol-ile	*nl	*l+$i_{perfective}$	Ident-IO	Ident-IR	Ident-BR
	nlolalozílé	*!		z		l≠z
	ndoladozílé			z,d!	d	l≠z
	ndoladolílé		*!		d	
	ndozalozílé			z	d,z!	d≠l
☞	ndolalozílé			z	d	d≠l, l≠z

As long as the underlying form of the base does not end in a sequence of consonant plus glide, the segments of the reduplicant correspond to a contiguous substring of the surface form of the base, and thus there is a contiguous correspondence between the reduplicant *dol* and the base *loz*. However, when the underlying form of the stem ends in a glide, the reduplicable segments will not be contiguous in the base at the surface level. Recall that a stem-final glide is repositioned so that it appears in the last syllable of the verb, in this case appearing infixed within the perfective affix, so the stem *boh-w-* has the perfective form *boh-il-w-e*. As can be seen in (87), the reduplicant selects the segments found in the underlying form of the base, save for the perfective morpheme itself: but this substring is not contiguous in the surface form of the base.

(87)	ku-bóh-w-a	a-boh-íl-w-é	a-boh-a-boh-íl-w-é	'he was tied'
	ku-lih-w-a	a-lih-íl-w-é	a-lih-a-lih-íl-w-é	'he was paid'
	ku-kúg-w-a	a-kug-íl-w-é	a-kug-a-kug-íl-w-é	'he was found'

In the example *abohabohílwé*, the best possible match between the underlying form of the base and the reduplicant would occur if the reduplicant were *bohilwe*. This is not possible, since the reduplicant is explicitly barred from containing the perfective suffix (assuming the assymetrical reduplication option); therefore, a substring of the base which excludes the offending perfective morpheme is selected. That substring, *bohw*, must be augmented with the default final suffix *-a*, to give a stem with the canonical shape of a verb stem, as required in this particular construction.[20]

Further examples of asymmetrical reduplication involving the imbricated variant of the perfective can be seen below.

(88)	ku-lwáál-a	a-lw-éé-l-é	a-lwaal-a-lw-éé-l-é	'he is ill'
	ku-bágál-a	a-bag-éé-l-é	a-bagal-a-bag-éé-l-é	'he weeded'
	ku-hálúl-a	a-halw-íí-l-é	a-halul-a-halw-íí-l-é	'he scraped the pot'
	ku-fútán-a	a-fut-éé-n-é	a-futan-a-fut-éé-n-é	'he chewed'

[20] Another form of asymmetrical reduplication for this verb is *a-boha-bohílwé*, where the passive suffix *w* is not copied; this is consistent with the generalization that any continuous subset of the morphemes found in the derivational stem are reduplicated.

It is unclear exactly what should be the underlying phonological form in the case of imbricated perfectives. Assuming the standard notion of an underlying representation, the underlying form of *abagéélé* would combine the underlying form of the root *bagal* with some representation of the perfective suffix, perhaps *-ie* or *-ile*. Some set of constraints forces the initial vowel of the suffix to be infixed within the root, in which case it would be subject to constraints against V+V sequences. The important point is that the reduplicant is the base without the perfective, whether the perfective is realised on the surface as a discretely identifiable suffix following the stem, or as an infix blended with the segments of the stem.

In the examples considered so far, the reduplicant has been more faithful to the underlying form of the base than the base itself is: this is because divergence between underlying and surface forms in the base is compelled by factors specific to the perfective affix, an affix which is excluded from the reduplicant in asymmetrical reduplications. However, in one type of case, the base is more faithful to the underlying form of the stem than the reduplicant is, for the reason that the causal factor behind the phonological alternation is lacking in the base but is present in the reduplicant. It has been noted above that surface *zy* generally derives from /ly/ via spirantization, so *kuguzya* derives from /kugulya/. Because the underlying stem-final glide is moved from its underlying position and is infixed into the perfective suffix, the underlying /l/ actually surfaces in the perfective of such a verb stem. Consequently, the perfective of such a stem — e.g. *gulíizyé* 'he sold' — is more faithful to the underlying representation than the non-perfective is; the *y* which might trigger spirantization is not adjacent to the stem-final *l* in the perfective. The tradeoff, in this case, is that faithfulness to the underlying order of segments results in unfaithfulness with respect to the quality of these segments, and vice versa. Because asymmetrical reduplications exclude the perfective suffix from the reduplicant, there is no factor which triggers separation of /l/ and /y/. Therefore, spirantization takes place in the reduplicant, even though there is no spirantization in the base.

(89)	ku-guzy-a	a-gul-íiz-y-é	a-guzy-a-gul-íiz-y-é	'he sold'
	ku-kizy-a	a-kil-íiz-y-é	a-kizy-a-kil-íiz-y-é	'he rescued'
	ku-lozy-a	a-lol-íiz-y-é	a-lozy-a-lol-íiz-y-é	'he tried'
	ku-boonzy-a	a-boond-íiz-y-é	a-boonzy-a-boond-íiz-y-é	'he had a foretaste'

There is an important limitation on asymmetric reduplication regarding stem size, which argues for a minimal size constraint on the reduplicant even in verbs. Monosyllabic stems reduplicate, and when they do, they appear with a long vowel. Asymmetric reduplication is possible with such stems in the subjunctive, as the following data ilustrate. The vowel of the reduplicant, whether *-e* by strict copy or *-a* in the asymmetrical variant, always appears as long.

(90)	ni-tú-gwé	ni-tu-gwéé-gwé	ni-tu-gwáá-gwé	'we should fall'
	ni-tú-zé	ni-tu-zéé-zé	ni-tu-záá-zé	'we should go'
	ni-tú-nwé	ni-tu-nwéé-nwé	ni-tu-nwáá-nwé	'we should drink'
	ni-tú-hé	ni-tu-héé-hé	ni-tu-háá-hé	'we should give'
	ni-tú-té	ni-tu-téé-té	ni-tu-táá-té	'we should release'

It has been shown above that this vowel length is due to independent factors.

However, asymmetrical reduplication is not possible in the perfective of monosyllabic stems.

(91)	ku-gwa	a-gwiile-gwíílé	*a-gwaa-gwíílé	'he fell'
	ku-za	a-ziile-zíílé	*a-zaa-zíílé	'he went'
	ku-mwa	a-mweele-mwéélé	*a-mwaa-mwéélé	'he shaved'
	kú-lyá	a-liile-líílé	*a-lyaa-líílé	'he ate'
	kú-nwá	a-nweele-nwéélé	*a-nwaa-nwéélé	'he drank'
	kú-há	a-heele-héélé	*a-haa-héélé	'he gave'
	kú-tá	a-teele-téélé	*a-taa-téélé	'he released'

The question is why there should be a difference between the perfective and subjunctive in terms of the possibility of asymmetric reduplication. The reduplicant prefers to be bisyllabic, but material is never epenthesized to achieve bisyllabicity; verbal reduplicants also cannot contain prefixal material. In light of these facts, reduplicated monosyllabic roots are under a considerable and apparently unrelievable pressure to satisfy the bisyllabicity condition. All else being equal, reduplication may freely include or exclude the final tense-aspect affix. The crucial observation is that all is not equal between symmetrical and asymmetrical reduplication in the perfective.

In the subjunctive, the reduplicant is fated to be monosyllabic, and selection of symmetric versus asymmetric reduplication is no better or worse with respect to the minimality requirement of the reduplicant.

(92)

	ni-tu-RED-he	Redup-Min	*infl	Max-BR
☞	ni-tu-háá-hé	*		*
☞	ni-tu-héé-hé	*	*	

In contrast, the asymmetric-copy variant in the perfective violates the bisyllabicity condition on reduplication; therefore, the full-copy option is the only viable option.

(93)

	tu-RED-h-ile	Redup-Min	*infl	Max-BR
	tu-haa-héélé	*!		*
☞	tu-heele-héélé		*	

In this section, the productive pattern of reduplication in verbs has been shown to exhibit the following characteristics.

(94) a. The reduplicant only contains material found in the stem.
b. Reduplication may be partial or complete: the root and optionally any contiguous sequence of derivational affixes may be copied.
c. The final inflectional morphemes for the subjunctive and the perfective are optionally copied.

d. Asymmetrical reduplication of monosyllabic stems in the perfective is disallowed (due to the bisyllabic minimality constraint on the reduplicant).
e. If the reduplicant is at least bisyllabic, it forms a phonological word, and therefore long vowels are shortened at the end of the reduplicant. Long vowels are retained in the reduplicant of a monosyllabic stem.

6. Lexical reduplication

There are a number of stems which are lexically reduplicated, for which there exists no related unreduplicated stem.

(95)	ku-bóhá-boha	'to babble'
	ku-huuna-huuna	'to wander aimlessly'
	ku-káánzá-kaanza	'to patch'
	ku-tééká-teeka	'to think'
	ku-túúmá-tuuma	'to grope aimlessly'
	ku-húgá-huga	'to not have a good upbringing'

These stems cannot be further reduplicated via the otherwise productive process of reduplication.

(96) *ku-bóhá-boha-boha-boha
*ku-huuna-huuna-huuna-huuna
*ku-kaanza-kaanza-kaanza-kaanza
*ku-tééká-teeka-teeka-teeka
*ku-túúmá-tuuma-tuuma-tuuma
*ku-húgá-huga-huga-huga

These stems generally require asymmetrical reduplication. In the perfective, the reduplicant ends ins *-a*, not the perfective suffix *-ile*.

(97)	a-boha-bohílé	*a-bohile-bohílé	'he babbled'
	a-huuna-huunílé	*a-huunile-huunílé	'he wandered aimlessly'
	a-teeka-teekílé	*a-teekile-teekílé	'he thought'
	a-tuuma-tuumílé	*a-tuumile-tuumílé	'he groped aimlessly'
	a-huga-hugílé	*a-hugile-hugílé	'he didn't have a good upbringing'
	a-kaanza-kaazílé	*a-kaanzile-kaanzílé	'he patched'

For the last verb in (97), there exist two forms of the perfective: besides *akaanzakaanzílé*, one also finds the form *akaanzakéénzé*, illustrating the imbrication variant of the perfective. Monosyllabic verb stems ending in *-aand-* do not otherwise allow imbrication — cf. *tu-laand-ílé* 'we interlaced sticks', *a-taand-ílé* 'he spread', *n-saand-ílé* 'I wooed'. Although there are no other polysyllabic verb stems which end in *-VVnd-*, the pattern where imbrication affects polysyllabic stems but not monosyllabic stems is well established — see the discussion of perfective formation above. This points to another difference between lexical versus productive patterns of reduplication. With productive reduplication, the reduplicant is not included in the domain whose size determines the possibility of imbrication, thus we find *abazílé* 'he counted' and *abalabazílé* 'he counted here and there', never **abalabéélé* with imbrication. The reduplicant in a lexical reduplication, on the other hand, is at least optionally contained in the domain considered when choosing between the suffixing and imbricating variants of the perfective.

When lexically reduplicated stems are followed by derivational suffixes, those suffixes also cannot appear in the reduplicant.

(98)	ku-bóhá-boh-el-a	*ku-bóhéla-boh-el-a
	'to babble for'	
	ku-káánzá-kaanz-il-an-a	*ku-káánz-il-an-a-kaanz-il-an-a
	'to patch for each other'	
	ku-téèká-teek-el-an-a	*ku-téék-él-án-a-teek-el-an-a
	'to think about each other'	

However, lexically reduplicated stems do not form a totally impermeable morphological unit, since the subjunctive affix may appear in the reduplicant.

(99)	naa-boha-bóhé	naa-bohe-bóhé	'let him babble'
	naa-huuna-húúné	naa-huune-húúné	'let him wander aimlessly'
	ni-tu-kaanza-káánzé	ni-tu-kaanze-káánzé	'we should patch'
	nii-n-teeka-téèké	nii-n-teeke-téèké	'let me think'

Thus,

(100) a. Lexical reduplication precludes productive reduplication.

b. A lexical reduplicant is opaque to derivational affixation and perfective formation, but not subjunctive-affixation

c. The base optionally joins with a lexical reduplicant to form a single domain for perfective formation.

7. Conclusions

In this paper, a number of strategies for reduplication in Kikerewe have been discussed. While certain principles hold across reduplication constructions, certain properties hold only in specific types of reduplication. It has been argued that the base for reduplication is not necessarily an immutable morphological structure such as the stem, but is rather a more fluid quasi-phonological constituent whose boundaries are subject to adjustment in order to satisfy other phonological constraints. Reduplication is prefixing in all constructions, and the reduplicant typically shows special properties such as the optional or obligatory loss of tone, or failure to copy morphemes from the base. In nouns and verbs, the two open lexical classes with reduplication, the reduplicant preferentially defines a phonological word. Finally, all forms of reduplication are subject to a bisyllabic minimality requirement, but constructions differ as to whether prefixal material can be copied.

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The Incremental Constriction Model for the Description of Vowel Height*

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1 Introduction

This paper explores the description of vowel height, arguing for a new model for its representation. The current proposal, the incremental constriction model, describes vowel height with multiple occurrences of the feature [closed]. This model is used to analyze height harmony in a number of languages, from which a previously undocumented generalization emerges; all cases of partial height harmony involve one-step raising. The discussion in this paper demonstrates that this generalization is true for all known cases of partial height harmony, and further, that this generalization is uniquely captured by the incremental constriction model.

The description of vowel height has posed a problem for generative phonology since Chomsky and Halle (1968) proposed the binary features [high] and [low] for the characterization of vowel height contrasts. While these features are widely used to describe vowel height, there have been numerous proposals to the contrary. In the year following the publication of *The Sound Pattern of English* (Chomsky and Halle 1968), Contreras (1969) argued that [high] and [low] should be replaced by a multivalued height feature in order to properly account for a hypothetical language in which all non-high vowels raise a single step. Contreras was the first of many authors to express dissatisfaction with the features [high] and [low]. Some authors have sought to modify [high] and [low] by positing these features to be monovalent (e.g., Selkirk 1991, Dyck 1995), while others have argued, as did Contreras, that [high] and [low] be abandoned altogether and replaced by multivalued features (e.g., Lindau 1975), or by scalar[1] features (Schane 1984, 1990, Clements 1989, 1991), still others have argued for a distinct set of unrelated features (e.g., Goad 1993).

Thus, Chomsky and Halle's (1968) proposal has never enjoyed a non-controversial status. A cross-linguistic examination of partial height harmony reveals that many of the

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[1] Multivalued and scalar approaches differ in that the former employs a single feature that has multiple values so that one vowel is [1high] and another [3high], while the latter uses more than one instance of the same feature.

proposals mentioned above cannot account for the robustly attested phenomenon of one-step raising in which vowels of several heights raise one degree. In addition, all of these proposals miss important generalizations concerning partial height harmony. This paper will demonstrate that all cases of partial height harmony involve a *one-step* change in height, and that all such harmonies *raise* their target vowels. Only the incremental constriction model, proposed here, captures these generalizations.

2 The Incremental Constriction Model

In this section, the incremental constriction model is introduced, the properties of this model are discussed, predictions of this model are delineated, and the incremental constriction model is implemented to account for partial height harmony in Llogoori. The analysis of Llogoori, and all other languages discussed in this paper, is framed within the constraint-based approach of optimality theory (Prince and Smolensky 1993). Within optimality theory, assimilation is generally accounted for by the ranking of 'alignment' constraints (Kirchner 1993, Pulleyblank 1993 and others). The alignment constraints required to handle the wide range of languages that exhibit partial height harmony are quite similar cross-linguistically, varying only with respect to three parameters. The form of alignment constraints involved in partial height harmony is discussed in this section.

2.1 The model

In the incremental constriction model, vowel height distinctions are treated as steps along a single phonetic scale, characterized by occurrences of the feature [closed] so that eahc heigh in a language corresponds to an additional instance of [closed]. In this model, the lowest vowels of any language are specified for no occurrences of [closed], but all non-low vowels are specified for at least one instance of [closed] and each higher vowel has an additional occurrence of this feature.

(1) The Incremental Constriction Model.

Height
|
[closed]
|
[closed]
|
[closed]

In a language containing three vowel heights, two occurrences of [closed] are required to characterize the inventory. In such a language (2), the lowest vowels are specified for no occurrences of [closed], the mid vowels are specified for a single occurrence of [closed], and the high vowels are specified for the maximum number of occurrences of [closed] active in the language, in this case, two instances of [closed].

(2) Three vowel heights.

	high	mid	low
[closed]	•	•	
[closed]	•		

(3) Four vowel heights.

	high	mid-hi	mid-lo	low
[closed]	•	•	•	
[closed]	•	•		
[closed]	•			

In a language containing four vowel heights, three occurrences of [closed] are required to characterize the inventory. In such a language (3), the low vowel is specified for no occurrences of [closed], the next lowest vowels are specified for one occurrence of [closed], the next lowest are specified for two occurrences of [closed], and the highest vowels are specified for the maximum number of occurrences of [closed] active in the language, three. Thus, the number of occurrences of [closed] that are active in a language is determined by the number of heights in that language.

Occurrences of [closed] correspond to increased constriction in the vocal tract, and thereby increasing vowel height. The feature [closed] raises a vowel when this feature is inserted, spread, etc. The feature [closed] is defined in terms of first formant frequency (F_1), the acoustic property most reliably correlated to vowel height (Ladefoged 1971, Lindau 1975, Tranmüller 1981, inter alia). The relationship between F_1 and vowel height are inversely related so that low vowels have a relatively higher F_1 while high vowels have a lower F_1. The feature [closed], therefore, is defined in terms of decreased F_1.

The feature [closed] is *incremental* since multiple occurrences of this feature may characterize a single vowel. Characterizing vowel height with incremental features allows vowel height to be treated as a single phonetic scale. Other authors have suggested that vowel height be characterized with multiple occurrences of a single feature (Clements 1991, Schane 1984, 1990), though these models differ from the incremental constriction model where vowel height is exclusively characterized in terms of a feature that corresponds to increased height.

The feature [closed] is monovalent so that languages may only insert, spread, or delink the presence of this feature. In contrast, binary models posit that each feature in the system has two values; positive [+] and negative [–], such that both values are expected to spread, delink, etc. cross-linguistically. It has been argued that reference to both values of a feature is unnecessary, and that where possible, only one value of a feature is recognized. Monovalent features have been argued for with respect to many features. The feature [labial], for example, is widely accepted as monovalent since the phonology of no language makes reference to the negative value, [–labial] (Selkirk 1993). Characterizing vowel height contrasts in terms of monovalent elements has been argued for by many authors, including Schane (1984 1990), Anderson and Ewen (1987), Kaye et. al. (1985), Selkirk (1991), and Goad (1993).

2.2 Predictions of the incremental constriction model

In the incremental constriction model (1), all occurrences of [closed] are organized into a single constituent, Height,[2] in recognition of the fact that many languages refer to this set of features as a group (Odden 1991, Clements 1991, Wiswall 1991, Goad 1993, Parkinson 1994). Such an organization correctly predicts that languages may exhibit assimilations in which one vowel assimilates to another for height such that both vowels surface with identical heights (Odden 1991, Clements 1991). An assimilation of this type is called a *complete height harmony* (Parkinson 1994) and is expressed as the simultaneous assimilation for all height features (Clements 1991, Odden 1991, Wiswall 1991, Goad 1993). Complete height harmony is discussed and contrasted with partial height harmony in §4.

Some height assimilations are not complete, rather a vowel may move toward the height of another vowel, but not attain the height of that vowel. Such an assimilation is called a *partial height harmony* (Parkinson 1994). In partial height harmony, a vowel surfaces with a height between its own (original) height and that of a trigger. It is argued here that partial height harmony is expressed as an assimilation for just one height feature[3] since, on the surface, the trigger and target do not share all height features.

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[2] Schane (1990, Clements (1991), and Clements and Hume (1994) use the term "Aperture" to characterize this constituent in recognition of the fact that tongue height is not directly correlated to phonemic height (Ladefoged. 1971, Lindau. 1975). Here, the familiar term Height is used in reference to phonemic height.

[3] The "all or one" option described here follows Clements (1985) and others who argue that phonology operates on only *single* elements — a node or feature. For a different view, see Halle. 1995, Padget. 1994.

In the incremental constriction model, vowel height is characterized exclusively by the feature [closed] so that a partial height assimilation constitutes an assimilation for one occurrence of this feature. As [closed] is monovalent and corresponds to increased vowel height, the incremental constriction model predicts that all partial height harmonies necessarily involve raising. Because the feature [closed] is incremental with occurrences of [closed] distinguishing steps along the vowel height continuum, the incremental constriction model predicts that all partial height assimilations involve a single-step change.

(4) Prediction of the Incremental Constriction Model.
All cases of partial height harmony involve one-step raising.

The incremental constriction model holds that all height distinctins are characterized by [closed], but recognizes that some language require the features [ATR] or [tense]. It is argued here that [ATR] and [tense] not be used as an ersatz device to characterize a langauge with more than three heights (the maximum contrasted with [high] and [low]). Instead, [ATR] is reserved for languages that exhibit true cross-height harmony, e.g., Akan (Stewart 1969, Lindau 1975) and that [tense] is used only for languages such as German.

2.3 Llogoori

Llogoori (Leung 1986) is Bantu (E41) language spoken in Kenya, and is a member of the Luhya group. Llogoori contrasts the vowels in (5.a),[4] and requires three occurrences of [closed] to characterize its inventory. The Llogoori vowels are characterized in the incremental constriction model as in (5.b).

(5) Llogoori vowels.

a.

i		u
ɪ		ʊ
ɛ		ɔ
	a	

b.

	i u	ɪ ʊ	ɛ ɔ	a
[closed]	•	•	•	
[closed]	•	•		
[closed]	•			

The examples of Llogoori verbs in (6) consist of a pronominal prefix, a verb stem, and a final vowel marking the subjunctive mood. The final vowel for many tenses is *a*, but in the examples from the subjunctive below, the final vowel surfaces as *ɛ* or *ɪ*.

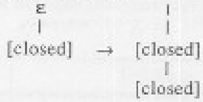
(6) Llogoori partial height harmony.

a.		b.	
kɛ-vɛg-ɛ	'shave it'	kɪ-guut-ɪ	'defeat it'
kɛ-rɛɛt-ɛ	'bring it'	kɪ-vis-ɪ	'hide it'
kɛ-ŋoor-ɛ	'obtain it'	kɪ-guriz-ɪ	'sell it'
kɪ-karag-ɛ	'cut it'	kɪ-vis-ɪ	'hide it'
kɪ-saamb-ɛ	'burn it'	kɪ-dʊɣ-ɪr-ɪ	'hit for it'
		kɪ-kɪn-ɪr-ɪ	'play for it'
		kɪ-rʊm-ɪ	'bite it'

The final vowel is always a front vowel in the subjunctive, and surfaces as *ɛ* when preceded by a vowel of the same or lower height (6.a). The final vowel raises to *ɪ* when preceded by a higher vowel (6.b).

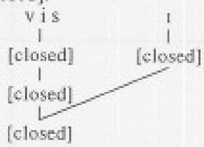
[4] Llogoori, like many Bantu languages (e.g., Kikuyu, Kimatuumbi) contrasts three heights where the upper "mid" vowels are pronounced as *ɪ ʊ* and the low mid vowels are *ɛ ɔ*. Leung (1986) uses the symbols *e o* for the lower mid vowels while *ɛ ɔ* are used here for consistency with the vowels represented by these symbols.

(7) Effect of partial height harmony in Llogoori.



Since Llogoori raising (6) is assimilatory, the surface form of *visɪ* should have some structure shared between the triggering *i* and the harmonizing *ɪ*. The assimilation in (6) is not a complete height harmony, so the shared element cannot be the Height node. Instead, a single instance of [closed] should be multiply linked between the trigger and target such that the harmonizing vowel is specified for one more occurrence of [closed] in the output than in the input.

(8) Spreading one instance of [closed].



McCarthy and Prince (1995:264-5) propose a family of constraints that require feature specifications to be identical between corresponding input and output segments. Identity constraints are feature specific, as posited by McCarthy and Prince, so that for every feature there is an identity constraint that requires that correspondent segments be featurally identical to one another. The identity constraint relevant to the representation in (8) is that requiring identity between input and output correspondents with respect to the feature [closed]. IDENT[cl] is defined in (9).

(9) Identity of [closed].

IDENT[cl] = an output segment must be specified for an identical number of occurrences of [closed] as its input correspondent.

IDENT[cl] is violated whenever corresponding segments are specified for a distinct number of occurrences of [closed]. Thus, IDENT[cl] prohibits the insertion, deletion, spreading, and delinking of [closed]. Consider the form *vis-ɪ* 'hide it,' here, the final vowel of the input is spcified for just one occurrence of [closed]. In its output form, depicted in (8), the final vowel is specified for two occurrences of [closed], thus incurring a violation of IDENT[cl].

Since multiple linkings in general are dispreferred by IDENT[CL], a higher ranked constraint must prefer the specific structure in (8) in order to allow this form to be optimal. This constraint is from the alignment family, specifically ALIGN[closed] as defined in (10). (See §2.4 for discussion of formulation of alignment constraints that make reference to [closed].)

(10) ALIGN([closed], R, root, R) — Llogoori.

ALIGN[cl] = if a vowel is specified for [closed], then the right edge of an occurrence of [closed] must be aligned to the right edge of the stem.

ALIGN[cl] is satisfied by candidates, produced by GEN, where a single occurrence of [closed] is shared between the root and the suffix. In Tableau 1, ALIGN[cl] is satisfied by the first candidate, (a), but is violated in (b) where no sharing takes place. Candidate (a) is preferred, in spite of violating IDENT[cl], establishing the relative ranking of these constraints in Llogoori. In fact, the ranking ALIGN[cl] » IDENT[cl], is found in all of the languages exhibiting partial height harmony discussed in this paper.

Tableau 1

vis-ɛ → vis-ɪ	ALIGN[cl]	IDENT[cl]
a. vis ɪ ☞ [closed] [closed] [closed] [closed]		*
b. vis ɛ [closed] [closed] [closed] [closed]	*!	
c. vis i [closed] [closed] [closed] [closed]		**!

Candidate (c) violates IDENT[cl] twice since it satisfies ALIGN[cl] by multiply linking a non-terminal occurrence of [closed], thereby sharing that occurrence of [closed] and its dependent. In this way, the final vowel is specified for two more occurrences of [closed] in the output than is its input correspondent. Multiple linking of non-terminal [closed] is always dispreferred since ALIGN[cl] can be satisfied by aligning a terminal occurrence of [closed].

GEN only produces candidates that obey universal, inviolable well-formedness conditions, among which is a prohibition that rules out structures in which a higher vowel assimilates to a lower vowel for the feature [closed]. This prohibition falls out from well-established notions of dominance and precedence, declaring ill-formed all tree structures in which two elements are simultaneously in both a precedence relation and a dominance relation.

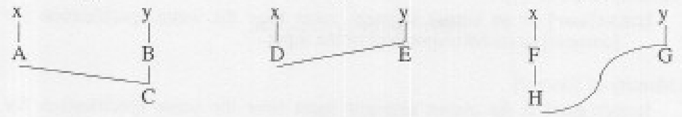
Two standard assumptions in non-linear phonology are that elements on a single tier are ordered, i.e., in a precedence relation (Sagey 1990, Kornai 1995:7), and that elements connected by an association line are in a dominance relation. Following Partee et. al. (1990:442), these relations are understood to be exclusive such that no two elements may be in both relations.

(11) Dominance/Precedence prohibition.

> If two elements are in the dominance relation, then those elements are not in the precedence relation. If two elements are in the precedence relation, then they are not in the dominance relation.

In (12.a), *A* is in a precedence relation with *B*, and *A* is in a dominance relation with *C*. This structure is permitted by (11). The structure in (12.b) violates (11) because *D* precedes *E* and *D* dominates *E*. Likewise in (12.c), because *F* precedes *G*, and *F* dominates *H*. Due to the new (dashed) association line, *H* also dominates *G*, so that (via transitivity) *F* dominates *G*. Thus, *F* both dominates and precedes *G*.

(12) a. * b. * c.



ε → e / _ i ε → e / _ ε e → i / _ ε

If the alphabetic nodes in (12) are replaced by occurrences of [closed], then the only permissible sharing of [closed] is one in which a higher vowel (i.e., a vowel specified for relatively more occurrences of [closed]) shares an occurrence of this feature with a lower vowel. Vowels of the same height cannot share an occurrence of [closed] so that one vowel surfaces higher than its original height, nor can a lower vowel share one of its occurrences of [closed] with a higher vowel so that the latter may surface even higher. This prohibition is understood to be universal and inviolable such that no candidate produced by GEN violates (11).

For this reason, Llogoori roots with the vowels *ε ɔ a* cannot share a specification of [closed] with a following affix containing *ε* because such candidates would be in violation of the universal prohibition, and therefore never generated.

Another constraint that plays a role in Llogoori is defined in (13). This constraint disfavors vowels that simultaneously are non-low and central. The central vowel *a* does not violate HEIGHTPL since it is low, but *ɔ i* do violate HEIGHTPL since these vowels are non-low and lack a peripheral place specification.

(13) Height→Place.

HEIGHTPL = if a vowel is specified for an occurrence of [closed], it must also be specified for a place feature so that it is either a front or back vowel.

In Llogoori, HEIGHTPL is ranked higher than ALIGN[cl] as illustrated in Tableau 2. The relative high ranking of HEIGHTPL ensures that *a* does not raise in Llogoori.

Tableau 2

vis-a → vis-a	HEIGHTPL	ALIGN[cl]
a. ☞ vis a [closed] [closed] [closed]		*
b. vis ɔ [closed] [closed] [closed]	*!	

HEIGHTPL could be satisfied by inserting a place feature on the non-low central vowel. This option is less attractive than violating ALIGN[cl] due to the more highly ranked identity constraints in (14) and (15). A place feature inserted to satisfy HEIGHTPL would violate the highly-ranked IDENT[cor] or IDENT[dor], and thus be ruled out.

(14) Identity of [coronal].

IDENT[cor] = an output segment must bear the same specification for [coronal] as its correspondent in the input.

(15) Identity of [dorsal].

IDENT[dor] = An output segment must bear the same specification for [dorsal] as its correspondent in the input.

The identity family of constraints requires that the feature specifications of output segments be identical to those of the corresponding input segmentents. The feature-specific constraints in (14) and (15) above (as well as IDENT[cl]) state that a segment in the output be specified for a feature if and only if its correspondent is secified for that feature in the input.

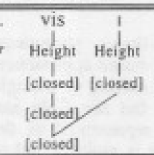
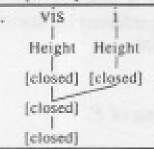
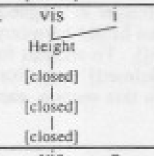
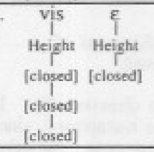
Tableau 3 demonstrates that the identity constraints in (14) and (15) as well as HEIGHTPL are ranked above ALIGN[cl], but the relative ranking among IDENT[dor], IDENT[cor], and HEIGHTPL is not crucial. The best candidate is one that violates ALIGN[cl] but satisfies the identity constraints and HEIGHTPL.

Tableau 3

vis-a → vis-a	IDENT[dor]	IDENT[cor]	HEIGHTPL	ALIGN[cl]
a. ☞ vis a [closed] [closed] [closed]				*
b. vis ə [closed] [closed] [closed]			*!	
c. vis ɛ [closed] [closed] [closed] [cor]		*!		
d. vis ɔ [closed] [closed] [closed] [dor]	*!			

The identity constraint in (9) restricts sharing to a single occurrence of [closed]. Multiply linking the Height node effects complete harmony, in which the entire set of height features is shared. Such a structure, candidate (c) in Tableau 4, incurs two violations of IDENT[cl]. As discussed earlier, multiply linking a non-terminal occurrence of [closed] is also ruled-out by IDENT[cl] (b).

Tableau 4

vis-ε → vis-ɪ	ALIGN[cl]	IDENT[cl]
a. ☞ 		*
b. 		**!
c. 		**!
d. 	*!	

The universal prohibition against lower vowels raising higher vowels (11) and the highly HEIGHTPL constraint allow only the suffix *ε* to undergo raising,[5] and only when preceded by a higher vowel. Thus, the optimal candidate generated from an input of the form *kɪ-vis-ε* is one in which the suffix is raised, as in *kɪ-vis-ɪ* 'hide it.'

Llogoori raising (6) constitutes a partial height harmony since *ε* does not raise to the same height as the high vowel trigger in *kɪvisɪ* 'hide it.' Examples such as *kɪrumɪ* 'bite it' indicate that the suffix assimilates in height to a preceding high vowel, but does not assimilate to the place of that vowel.

2.4 Alignment Constraints and the feature [closed]

Assimilation in optimality theory is most often described in terms of alignment, a constraint that favors linked structures, or sharing (Pulleyblank 1993, Kirchner 1993, among others but see Cole and Kisseberth 1994). The linked structures that result from assimilation provide a structural account for phenomena like gemminate integrity and inalterability (Schein and Steriade 1986, Hayes 1986), and restrict the set of possible assimilations to those in which the trigger and surface form of the target share some property. In the absence of evidence to abandon this view, it is adopted here.

As mentioned above, partial height harmony and complete height harmony differ both in effect and the manner in which each is expressed. In complete height harmony, both the trigger and the target surface with identical height, formalized as sharing a single Height node. In partial height harmony, the target moves toward the height of the trigger, but does

[5] The final vowel in Llogoori has only two qualities underlyingly, *a* and *ε*.

not attain that height so that the two vowels surface with distinct heights. Thus, a vowel that partially assimilates in height surfaces with a height intermediate to its original height and that of the trigger.

Assimilation is formalized as spreading in derivational non-linear phonology (Goldsmith 1979, Hayes 1986 inter alia). In non-derivational constraint-based approaches, assimilation is expressed as sharing of some element, i.e., the multiple linking of a single element to two or more prosodic elements (e.g., Pulleyblank 1993, but see Cole and Kisseberth 1994). It is assumed here that assimilation is formally represented as the sharing of an element between a trigger and a target whereby an element is multiply linked to the trigger and target. In optimality theory, this multiple linking dispreferred by IDENT, defined in (9), and violated only to satisfy a more highly ranked constraint.

(16) Assimilation in non-derivational phonology.

Assimilation for an element, *F*, is expressed as the multiple linking of *F*.

An alignment constraint that refers to a feature is satisfied when that feature is "aligned" to both edges of a domain.[6] As this paper is concerned only with partial height harmony, all assimilations discussed here are expressed as an alignment of [closed]. To account for the languages discussed here, constraints referring to the alignment of [closed] vary, from language to language, with respect to a limited number of parameters. In this section, each of these parameters is explained.

(17) Alignment and directionality.

ALIGN ([closed], L/R) = candidates are evaluated for their alignment of some occurrence of [closed] to the left or right edge of the word.

Constraints may evaluate the alignment of [closed] with respect to directionality. In many cases, the direction of alignment is predictable, e.g., in Romance metaphony, since only suffixes trigger raising, alignment is evaluated to the left in this case. In other languages, however, the direction in which ALIGN[closed] is evaluated plays a more critical role. In languages such as Setswana, in which alignment is evaluated for all occurrences of [closed] whether affiliated with stem or affix and for vowels of all heights, directionality plays a greater role. In Setswana, [closed] is aligned leftward from any vowel to another (so long as the vowel on the right is higher than that on the right) so that the constraint takes the form of ALIGN[closed](L).

(18) Alignment and morphological affiliation.

ALIGN ([closed], Stem/Affix) = alignment is evaluated only for occurrences of [closed] affiliated with vowels in a stem or a particular affix.

Constraints may refer to whether an occurrence of [closed] is affiliated with a vowel in some particular morphological domain, e.g., stem, prefix, or suffix. For example, in Romance metaphony, only high vowels in suffixes trigger raising. In Setswana, however, any following vowel may trigger raising. Thus, the alignment constraint active in languages that exhibit metaphony take the form of ALIGN([closed]$_{max}$, Suffix), where *max* allows this constraint to be violated only with respect to high vowels, and *Suffix* allows this constraint to be violated only with respect to occurrences of [closed] affiliated with suffix vowels.

[6] For the languages discussed here, the relevant domain is defined as having two edges, one of which is the segment with which the feature [closed] is affiliated, and the other is the begining or end of the word.

(19) Alignment and height of the trigger.

ALIGN ([closed]$_{max}$) = alignment evaluated only for occurrences of [closed] affiliated with high vowels, i.e., the vowels specified for the maximum number of occurrences of [closed] active in the language.

Constraints (and thus languages) refer only to [closed]$_{max}$ or to a general occurrence of [closed]. For example, in Nzεbi and in Basque, only high vowels, i.e., vowels specified for the maximum number of occurrences of [closed] active in that language (denoted as [closed]$_{max}$), trigger raising while in Llogoori and in Setswana, raising is triggered by any higher vowel. Of course only higher vowels are permitted to trigger raising in lower vowels due to the dominance/precedence constraint (11). Thus, in Nzεbi, the alignment constraint will take the form of ALIGN[closed] (*max*) and is violated only for the misalignment of [closed] affiliated with a high vowel while in Setswana, the alignment constraint makes no mention of *max* and is violated by any misalignment of [closed].

For consistency with the recieved form of alignment constraints, the alignment constraints used in this paper will make reference to the left or right edge of the feature [closed], though the particular edge is always predictable from the direction of the sharing.

(20) Template for constraints referring to the alignment of [closed].

$$\text{Align[closed]}\left(\begin{matrix}\text{ø}\\ \text{max}\end{matrix}, \begin{matrix}\text{prefix}\\ \text{root}\\ \text{suffix}\end{matrix}, \begin{matrix}\text{L}\\ \text{R}\end{matrix}\right)$$

The parameters discussed above allow for the logical possibilities in (20); a constraint may refer to an occurrence of [closed] that is affiliated with a high vowel or any vowel (ø, or *max*), a vowel in the prefix, root, or suffix, and may require that feature to be aligned leftward or rightward. Each of these possibilities is attested in the languages discussed in this paper, with one exception. No language has been uncovered in which a prefix to vowel triggers partial height harmony.

3 Partial Height Harmony

As partial height harmony is expressed as an assimilation for a single height feature, the incremental constriction model predicts that all partial height harmonies involve one-step raising (cf. §2.2). In each of the languages discussed below, and as was true of Llogoori, partial height assimilation is expressed as the sharing of a single occurrence of [closed] to satisfy a form of the constraint ALIGN[closed]. Each of these languages, as was true for Llogoori, bears our the predictions of the incremental constriction model (4).

3.1 Lena Spanish

The Lena dialect of Spanish (Hualde 1989a, 1989b, Kaze 1989, Dyck 1995, Martínez-Gil 1996) is spoken in Austurias, Spain. Lena Spanish contrasts three heights among the vowels *i e a o u*. In this dialect, *a* is the unique low vowel, and is specified for no occurrences of [closed]. The mid vowels *e o* are specified for one occurrence of [closed] and the high vowels *i u* are specified for two occurrences of [closed].

(21) Vowels in the Lena dialect of Spanish.

	i u	e o	a
[closed]	•	•	
[closed]	•		

Like many dialects in the Romance family, Lena exhibits metaphony, i.e., vowel alternations triggered by the suffixation of a high vowel. Metaphony in Lena affects all stressed vowels, raising them one step before a high vowel suffix as in (22). The root *gat*, for example, surfaces with a low vowel before a non-high suffix (cf. *gata* 'cat (fem. sg.)') but the root vowel raises to *e* when followed by a high vowel, *getu* 'cat (mas. sg.).'

(22) Incremental raising in Lena Spanish.

fem. sg.	mas. sg.	gloss
gát-a	gét-u	'cat'
sánt-a	sént-u	'saint'
nén-a	nín-u	'child'
bwén-a	bwín-u	'good'
kóš-a	kúš-u	'cripple'
bón-a	bún-u	'good'

These examples illustrate that all non-high vowels raise one step in metaphony so that *a* surfaces as *e*, *e* surfaces as *i*, and *o* surfaces as *u*. In the incremental constriction model, these changes involve increasing the number of [closed] specifications of the root vowel by one in assimilation to a following high vowel. Metaphony is a partial height assimilation since *a* does not surfaces as a high vowel before the high vowel *u*.

(23)


H-EVAL prefers candidates that exhibit metaphony effects, i.e., the sharing of an occurrence of [closed] between a suffixal high vowel and a root vowel, since these candidates satisfy the constraint ALIGN[cl].

(24) ALIGN([closed]$_{max}$, L, suffix, L)— Lena.

ALIGN[cl] = if a suffix vowel is specified for [closed]$_{max}$, then the left edge of some occurrence of [closed] must be aligned to with the stressed vowel to its left.

This constraint favors candidates in which a high vowel suffix shares an occurrence of [closed] with the preceding root vowel. Candidate (a) in Tableau 5 violates IDEN[cl], but is optimal anyway because it satisfies ALIGN[cl]. Candidate (b) fails because it violates the highly ranked ALIGN[cl].

Tableau 5

nen-u → ninu	ALIGN[cl]	IDEN[cl]
a. ☞ nen u [cl] [cl] [cl]		*
b. nen u [cl] [cl] [cl]	*!	

The MAX family of constraints 'maximizes inputs,' or prohibits deletion by requiring all underlying segments be present on the surface. McCarthy and Prince (1995) define MAX in terms of segments. Following Lombardi (1995), it is assumed here that MAX can be extended to refer to specific features. In this way, the constraint defined in (25) rules against candidates in which the feature [closed] is deleted.

(25) Maximize [closed].

MAX[cl] = an occurrence of [closed] in the input must have a correspondent in the output.

MAX[cl] is violated by structures such as (c) in Tableau 6 where ALIGN[cl] is vacuously satisfied by deleting an occurrence of [closed] from the suffix vowel. Note that candidates (a) and (c) are equivalent with respect to IDEN[cl], each incurring a single violation, and that MAX[cl] must be active in Lena to rule out (c).

Tableau 6

bón-u → bún-u	MAX[cl]	ALIGN[cl]	IDENT[cl]
a. ☞ bún u [cl] [cl] [cl]			*
b. bón u [cl] [cl] [cl]		*!	
c. bón o [cl] [cl]	*!		*

In Lena, STICPL is active, but ranked above IDENT[cor] so that *a* may undergo raising, but must surface with the default peripheral place, [coronal].[7] IDENT[dor] is ranked above IDENT[cor] since candidate (d) is not optimal in Tableau 7. In this way, *a* raises and fronts to satisfy ALIGN[closed] without violating HEIGHTPL. The relative ranking of ALIGN[closed], Ident[dor], and HEIGHTPL is not crucial.

[7] The fact that *a* fronts, i.e., the fact that [coronal] is the 'default' place for vowels, is attributed to universal markedness constraints (Prince and Smolensky. 1993).

Tableau 7

gatu → getu	MAX[cl]	ALIGN[cl]	HEIGHTPL	IDENT[dor]	IDENT[cor]	IDENT[cl]
a. ☞ get u [cl] [cor] [cl] [dor]					*	*
b. gat u [cl] [cl] [dor]		*!				
c. gət u [cl] [cl] [dor]			*!			*
d. got u [cl] [cl] [dor]				*!		*
e. gat o [cl] [dor]	*!					*
f. gæt u [cl] [cor] [cl] [dor]		*!			*	

3.2 Servigliano Italian

The Servigliano dialect of Italian (Camilli 1929, Kaze 1989, 1991) is spoken in the Marche region of Italy. Servigliano Italian contrasts four heights among the vowels specified in (26).

(26) Vowels in the Servigliano dialect of Italian.

	i u	e o	ɛ ɔ	a
[closed]	•	•	•	
[closed]	•	•		
[closed]	•			

Servigliano Italian exhibits metaphony similar to that of Lena Spanish. In Servigliano, a non-low stressed vowel raises one step before a high vowel suffix. The examples in (27), from Camilli (1929), illustrate this alternation. Post tonic vowels (right of stressed) are identical to the ultima (Camilli 1929:224-5).

(27) Metaphony in Servigliano Italian.

modɛ́st-a	'modest' (fem. sing.)	modést-u	'modest' (mas. sing.)
sgwɛ́z-a	'sinister (fem. sing.)	sgwéz-u	'sinister' (mas. sing.)
pétten-e	'comb'	péttin-i	'combs'
sprɔ́t-a	'pedantic' (fem. sing.)	sprót-u	'pedantic (mas. sing.)
mɔ́r-e	'he dies'	mór-i	'you die'
métt-o	'I put'	mítt-i	'you put'
kréd-o	'I believe'	kríd-i	'you believe'
fjór-e	'flower'	fjúr-i	'flowers'
spós-a	'wife'	spú-su	'husband'
métt-a-la	'put it (fem.)'	mítt-i-li	'put them (mas.)'
métt-o-lo	'put it (mas)'	mítt-u-lu	'put it (mas. mass)'

The examples above illustrate that *ɛ* raises to *e*, *ɔ* raises to *o*, *e* raises to *i*, and *o* raises to *u* when followed by a suffix containing a high vowel. These changes represent a partial height harmony in which non-low vowels gain a single occurrence of [closed].

(28) Effects of Servigliano metaphony.

```
  ɛ ɔ              e o               e o              i u
   |                |                 |                |
[closed]   →    [closed]          [closed]    →    [closed]
                    |                 |                |
                [closed]          [closed]         [closed]
                                                       |
                                                   [closed]
```

Servigliano metaphony can be accounted for as the result of an alignment constraint, similar to that posited for Lena Spanish above, preferring candidates in which an occurrence of [closed] is multiply linked between suffixal high vowels and the stressed vowel of the root.

(29) ALIGN([closed]$_{max}$, L, suffix, L) — Servigliano.

ALIGN[cl] = if a suffix is specified for [closed]$_{max}$, then the left edge of some occurrence of [closed] must be aligned leftward to the stressed vowel.

Tableau 8

mɔ́r-i → mór-i	MAX[cl]	ALIGN[cl]	IDENT[cl]
a. ☞ mór [cl] — i [cl] [cl] [cl]			*
b. mɔ́r [cl] — i [cl] [cl] [cl]		*!	
c. múr [cl] — i [cl] [cl] [cl]			**!
d. mór [cl] — e [cl] [cl]	*!		*

As seen by examples such as bárcu 'ship (mas. sg.),' the low vowel *a* does not undergo metaphony due to the high ranking of IDENT[dor], IDENT[cor] and HEIGHTPL, so that while not multiply linking an occurrence of [closed] affiliated with a high vowel suffix to *a* incurs a violation of ALIGN[closed], a candidate with only this one violation is preferred to a candidate that violates IDENT[dor], IDENT[cor], or HEIGHTPL. The relative ranking of the identity place constraints and HEIGHTPL is not crucial.

Tableau 9

bárc-u → bárc-u	IDENT[dor]	IDENT[cor]	HEIGHTPL	ALIGN[cl]
a. ☞ bárc u [cl] [dor] [cl] [cl]				*
b. bə́rc u [cl] [dor] [cl] [cl]	*!		*!	*
c. bɔ́rc u [cl] [dor] [cl] [cl]			*!	
d. bérc u [cl] [dor] [cl] [cor] [cl]		*!		

3.3 Nzɛbi

Nzɛbi (Guthrie 1968) is Bantu language spoken in Gabon. Nzɛbi contrasts four vowel heights among the vowels below. There is a complementary distribution between most vowels in Nzɛbi and ə. The vowel ə does not occur as the first stem vowel (V1), occurring only as the second stem vowel (V2), while *e ɛ a ɔ o* never appear in V2. The vowel *i* appears in V2 only certain morphological conditions discussed below. The vowel *u* appears in V2 only when V1 is also *u* (Guthrie 1968).

(30) Nzɛbi vowels.

	i u	e ə o	ɛ ɔ	a
[closed]	•	•	•	
[closed]	•	•		
[closed]	•			

Guthrie (1968) documents two speech rates, *normal* and *deliberate* (slow), which affect the appearance of V2. In normal speech, V2 does not surface word finally, DELIBERATESPEECH *salə* ~ NORMALSPEECH *sal* 'work'. The examples in (31) are transcribed in deliberate speech.

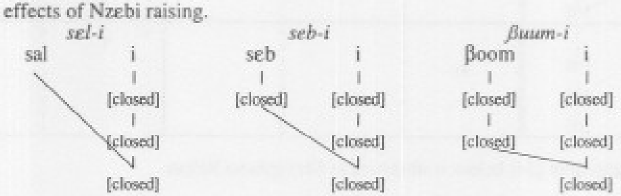
In Nzɛbi, all verbs have two forms, which Guthrie calls *simple* and *yotized*. In the simple form, V2 appears as ə, e.g., *dibəx* 'shut,' whereas the in yotized form, V2 appears as *i*, e.g. *dibix*. Examples of verbs in their simple and yotized form are provided in (31).

(31) Nzɛbi.

	simple	yotized	
e → i	betə	biti	'carry'
	bexə	bixi	'foretell'
o → u	βoomə	βuumi	'breathe'
	kolən	kulin	'go down'
ɛ → e	sɛbə	sebi	'laugh'
	βɛɛdə	beedi	'give'
ɔ → o	tɔɔdə	toodi	'arrive'
	mɔnə	moni	'see'
a → ɛ	salə	sɛli	'work'
	baadə	bɛɛdi	'be'

In the yotized forms, the high vowel in V2 triggers raising of the first stem vowel. The first vowel of the stem raises one step: *a* → *ɛ*, *ɛ ɔ* → *e o*, *e o* → *i u*. Nzɛbi raising is a partial height harmony since the first stem vowel does not always surface as the same height as the trigger *i*.

(32) The effects of Nzɛbi raising.



The multiply linked structures in (32) satisfy an alignment constraint that their non-raised counterparts violate. This constraint, ALIGN[cl] is defined below.

(33) ALIGN([closed]max, L, word, L) — Nzɛbi.

ALIGN[cl] = if a vowel is specified for $[\text{closed}]_{max}$, then the left edge of some occurrence of [closed] affiliated with that vowel must be aligned with the left edge of the word.

In Nzɛbi, as in Lena, ALIGN[cl] and HEIGHTPL are not crucially ranked with respect to each other, but both are ranked higher than the identity constraints IDENT[dor], IDENT[cor], and IDENT[CL]. This ranking, HEIGHTPL, IDENT[dor] » IDENT[cor], allows *a* to raise, but requires that it surface as a front vowel.

Tableau 10

sal-i → sɛl-i	ALIGN[cl]	HEIGHTPL	IDENT[dor]	IDENT[cor]	IDENT[cl]
a. ☞ sɛl i [cl] [cl] [cor] [cl]				*	*
b. sɜl i [cl] [cl] [cl]		*!			*
c. sɛl i [cl] [cl] [dor] [cl]			*!		
d. sal i [cl] [cl] [cl]	*!				

The ranking in (34) below is observed in Servigliano Italian.

(34) Constraint ranking in Nzɛbi.

ALIGN[cl], HEIGHTPL, IDENT[dor] » IDENT[cor], IDENT[cl]

For vowels that have a peripheral place feature underlyingly, the identity constraints and HEIGHTPL play no role in selecting the optimal candidate. For these forms, ALIGN[cl] determines the surface form.

Tableau 11

sɛb-i→seb-i	MAX[cl]	ALIGN[cl]	IDENT[cl]
a. ☞ seb i [cl] [cl] [cl] [cl]			*
b. sɛb i [cl] [cl] [cl] [cl]		*!	
c. sɛb e [cl] [cl] [cl]	*!		*

Tableau 12

ßoom-i → ßuum-i	MAX[cl]	ALIGN[cl]	IDENT[cl]
a. ☞ ßuum i [cl] [cl] [cl] [cl] [cl]			*
b. ßoom i [cl] [cl] [cl] [cl] [cl]		*!	
c. ßoom e [cl] [cl] [cl] [cl]	*!		*

Note that Nzæbi is confirmation that the hypothetical language to which Contreras (1969) refers, truly exists (cf. §1). In Nzæbi, all non-high vowels raise one step. If vowel height were characterized in terms of the features [high], [low], and [ATR], then Nzɛbi raising would defy a unified treatment, since each vowel that undergoes raising requires reference to a different feature (35, see also Clements 1991, Parkinson 1994).

(35) Nzɛbi raising with [high], [low], and [ATR].

a	→	ɛ	[+low]	→	[−low]
ɛ ɔ	→	e o	[−ATR]	→	[+ATR]
e o	→	i u	[−high]	→	[+high]

Because vowel height is characterized in terms of multiple occurrences of the same feature in the incremental constriction model, Nzɛbi raising is described with reference to only one feature, [closed].

3.4 Setswana

Setswana (Cole 1955) is a Bantu language (S21) spoken in Botswana, and is related to the other Sotho languages SeSotho and Northern Sotho. Setswana requires five occurrences of [closed] to characterize the vowels in (36). The vowels *e o* appear in underlying forms, though their distribution is extremely limited. The vowels *i u* are strictly derived from *ɪ ʊ*.

(36) Setswana vowels.

	į ų	i u	ɪ ʊ	e o	ɛ ɔ	a
[closed]	•	•	•	•	•	
[closed]	•	•	•	•		
[closed]	•	•	•			
[closed]	•	•				
[closed]	•					

Setswana exhibits partial height harmony in which vowels of two different heights each raise one step before a higher vowel (Cole 1955, Parkinson 1994). In the examples in (37), the mid vowels *ɛ ɔ* raise to *e o* when followed by a superclosed vowel (37.a) or when followed by *ɪ ʊ* (37.b). Raised vowels are underlined for clarity.

(37) Mid vowel raising in Setswana.

rɛk-a	'buy'	mʊ-re̱k-j̹	'buyer'
lɔ-a	'bewitch'	mʊ-lo̱-j̹	'witch'
bɔl-a	'rot'	sɪ-bo̱l-ɥ̹	'rotten thing'
ɛm-a	'stand'	k'ɪ-e̱m-ɪ	'I am standing'
ɛp'-a	'dig'	e̱p'-ʊlʊl-a	'dig out'
bɔɸ-a	'tie'	bo̱ɸ-ʊlʊl-a	'untie'
bɔn-a	'see'	xa-kɪ-bo̱n-ɪ	'I do not see'

In (37), the vowel *ɪ* appears in the negative suffix, and *ʊ* appears in the reversive suffix. The superclosed vowels *j̹ ɥ̹* appear as suffixes in certain noun classes. The vowels *ɪ ʊ* not only trigger the raising of *ɛ ɔ*, but also undergo raising themselves when followed by *j̹ ɥ̹* as seen in the examples in (38).

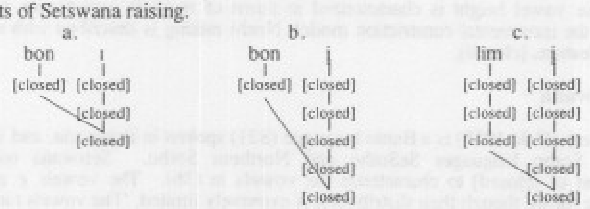
(38) High vowel raising in Setswana.

lɪm-a	'plow'	mu-li̱m-j̹	'farmer'
lɪɸ-a	'pay'	mu-li̱ɸ-j̹	'one who pays'
rʊk-a	'sew'	mu-ru̱k-j̹	'tailor'
tʃʊm-a	'hunt'	mu-tʃu̱m-j̹	'hunter'

The raising of the mid vowels *ɛ ɔ* and of the high vowels *ɪ ʊ* is a one-step change. Both assimilations are partial since in neither case does the target surface with the same height as the trigger. Setswana raising is described as a vowel acquiring a single occurrence of [closed] from a vowel to its right.

Due to the universal dominance/precedence prohibition (11), GEN can only produce multiply linked candidates in which the trigger is higher than the target, similar to those in (39) below. The only candidates that need to be ruled out are those in which no sharing occurs or those where the sharing is rightward rather than leftward.

(39) Effects of Setswana raising.



The alignment constraint that is active in Setswana is defined in (40). This constraint is observed throughout the root (i.e., morpheme internally) and its affixes so that no reference to the morphological affiliation of the trigger is required.

(40) ALIGN([closed], L, word, L) — Setswana.

ALIGN[cl] = if a vowel is specified for an occurrence of [closed], then some occurrence of [closed] must be aligned to the left edge of the word.

In Setswana, HEIGHTPL and IDENT[dor], IDENT[cor] are ranked above ALIGN[cl] since the low vowel *a* does not undergo raising, as seen in the form *xa-kɪ-bal-ɪ* 'I do not count.'

Tableau 13

xʊ-bal-ɪ → xʊ-bal-ɪ	IDEN[cor]	HEIGHTPL	ALIGN[cl]
a. ☞ a ɪ [cl] [cl] [cl]			*
b. ə ɪ [cl] [cl] [cl]		*!	
c. e ɪ [cl] [cl] [cor] [cl]	*!		

For examples containing non-low vowels, only the constraint ALIGN[closed] is relevant.

Tableau 14

bɔn-ɪ → bon-ɪ	ALIGN[cl]	IDENT[cl]
a. ☞ bon [cl] ɪ [cl] [cl] [cl]		*
b. bɔn [cl] ɪ [cl] [cl] [cl]	*!	
c. bɔn [cl] ɛ [cl]		**!

Tableau 15

xʊ-lɪm-i̧ → xu-lim-i̧	ALIGN[cl]	IDENT[cl]
a. ☞ lim: [cl] [cl] [cl] i̧: [cl] [cl] [cl] [cl] [cl]		*
b. lɪm: [cl] [cl] [cl] i̧: [cl] [cl] [cl] [cl] [cl]	*!	

Strings of vowels may also undergo raising, though as expected, low vowels and lower vowels block the process. In the examples below, a string of vowels of the same height, *ɪ ʊ* or *ɛ ɔ*, all raise when followed by a higher vowel. The examples in (41.b) illustrate that *ɪ ʊ* do nor raise when followed by a lower vowel, even if that lower vowel is raised. The example in (41.c) illustrates that [closed] may not be aligned across *a*. The vowels that do not undergo raising are boxed.

(41) Raising strings of vowels.

a.	mʊ-lɪφ-i̧	→	mu̱-li̱φ-i̧	'one who pays'
	mʊ-rʊk-i̧	→	mu̱-ru̱k-i̧	'one who sews'
	-ɔmɛlɛl-ɪ	→	-o̱me̱le̱l-ɪ	'dry out completely (neg.)'
b.	mʊ-ɛmɛl-i̧	→	m$\boxed{ʊ}$-e̱me̱l-i̧	'one who represents'
	mʊ-bɔn-i̧	→	m$\boxed{ʊ}$-bo̱n-i̧	'one who sees'
c.	mʊ-xak'ʊlʊl-i̧	→	m$\boxed{ʊ}$-xak'u̱lu̱l-i̧	'one who advises'

GEN does not produce candidates in which a higher vowel assimilates to a lower for [closed], as discussed above. The highly ranked constraints of IDEN[dor], IDEN[cor], and HEIGHTPL prevent *a* from undergoing raising.

Tableau 16

mʊ-xak'ulul-i̧	IDEN[cor]	IDEN[dor]	HEIGHTPL	ALIGN[cl]
a. ☞ ʊ a ʉ ʉ i̧				* *
b. ʊ ə u u i̧			*!	*
c. ʊ e u u i̧ [cor]		*!		*

Each candidate in Tableau 16 incurs at least one violation of ALIGN[closed] since in all forms, [closed] is not aligned to the prefix vowel. The winning candidate violates ALIGN[closed] twice since neither the prefix vowel nor *a* is linked to [closed] affiliated with the *j* in the suffix.

(42) No Gapped Configurations.

NOGAP = multiple linking across an eligible anchor is prohibited.

To rule out a fourth candidate, the constraint NOGAP (42) is posited to be ranked higher than ALIGN[closed]. NOGAP (adapted from McCarthy 1995, Padgett 1995) is a violable constraint that prefers structures in which no element is skipped in a multiple linking.

Tableau 17

mʊ-xak'ulul-i̧	NOGAP	ALIGN[closed]
a. ☞ ʊ a ʉ ʉ i̧		**
b. ʉ a ʉ ʉ i̧	*!	*

While the Setswana facts may resemble a cross-height harmony of the type found in Akan (Stewart 1967, Lindau 1975), an analysis based on [ATR] is not tenable, however.

An [ATR] analysis fails because it requires a contradictory specification for the vowels *ɪ ʊ*, and must make crucial reference to the height of trigger–target combinations.

In an [ATR] analysis, the vowel *ɪ* must be specified as [−ATR] and become [+ATR] before the vowels *i̧ u̧* (43.a). But, since *ɪ* also triggers raising of [−ATR] *ɛ ɔ* to [+ATR] *e o* , this vowel must also be specified at [+ATR] (43.b).

(43) a.

ɪ	→	i
[−ATR]		[+ATR]

b.

bɔn a	→	bon	ɪ
[−ATR]		[−ATR]	[+ATR]

If Setswana were a cross-height harmony, then raising would be expected to apply between any [−ATR] target and [+ATR] trigger combination, so that *ʊ* raises to *u* before *ɛ*, since [ATR] spreads independently of height (Stewart 1967). The examples in (41.b) illustrate that this is not the case in Setswana. Vowels only raise before higher vowels, independent of whether the trigger is raised or not.

3.5 Basque

Basque (Hualde 1991) is a language isolate spoken in northeastern Spain and southern France. Basque contrasts three vowels heights among the vowels in (44).

(44) Basque vowels.

	i u	e o	a
[closed]	•	•	
[closed]	•		

Basque exhibits one-step raising in the examples in (45). Here, the vowel *a* surfaces as *e* when it appears in a suffix following a high vowel. Basque raising is a partial height harmony since *a* does not assimilate to the place of a preceding vowel, nor to the complete height of that vowel, as seen in *laɣun-e* 'the friend,'

(45) Ondarroa

gišon-a	'the man'	laɣun-e	'the friend'
pelota-ka	'throwing a ball'	ar̄i-ke	'throwing stones'
ba-na	'one by one'	biɲ-e	'two by two'

Gernika

etše-ra	'to the house'	mendi-re	'to the mountain'
bašo-an	'in the forest'	lekû-en	'in the place'
bašo-tan	'in forests'	lekû-ten	'in forests'
neška-tšat	'for/as a girl'	mutil-tšet	'for/as a boy'

Mid vowels in Basque, do not raise in this position. This is due to a constraint that disprefers high vowels. This constraint is not violated when *a* raises to *e*, but is violated if *e* becomes *i*, or if *o* becomes *u*.

(46) *[closed]$_{max}$.

***[closed]$_{max}$** = a vowel specified for the maximum number of occurrences of [closed] active in a language should not be parsed.

As high vowel do occur in the language, the constraint MAX is ranked higher than *[closed]MAX in Basque. This ranking effectively tolerates high vowels only if underlying. Candidate (e) below is ruled out because a vowel present in the input is absent in the output, thus violating Max even while satisfying *[closed]MAX.

Tableau 18

laɣuna→laɣune	MAX	*[cl]$_{max}$	ALIGN[cl]	HEIGHTPL	IDEN[cor]
a. ☞ u [cl] [cl] e [cor]		*			
b. u [cl] [cl] ə		*		*!	
c. u [cl] [cl] a		*	*!		
d. u [cl] [cl] ə [cl]		*	*!	*	*!
e. o [cl] a	*!				

Since the low vowel *a* fronts when it undergoes raising in Basque, ALIGN[cl] ranked higher than the identity constraints and HEIGHTPL.

Tableau 19

u - e → u - e	MAX[cl]	*[cl]*max*	ALIGN[cl]
a. ☞ u [cl] [cl] e [cl]		*	*
b. u [cl] [cl] e [cl]		**!	
c. o [cl] e [cl]	*!		

The fact that mid vowels do not raise before high vowels is attributed to the fact that MAX is ranked above *[cl]MAX. Candidate (a) in Tableau 19 is forced to violate ALIGN[cl] in order to satisfy MAX[cl] and *[cl]MAX.

3.6 Gitonga

Gitonga (Odden pc) is a Bantu language (T32) spoken in Mozambique. Three occurrences of [cl] are required to characterize vowels.

(47) Gitonga vowels.

	i u	e o	ɛ ɔ	a
[cl]	•	•	•	
[cl]	•	•		
[cl]	•			

In Gitonga, the vowels ɛ ɔ raise one step when followed by a high vowel, as seen in the examples in (48). Here, the two forms of the locative, one marked by *ni*, the other by *tunu*, each contains a high vowel. The vowels ɛ ɔ raise to *e o* when they appear before *i u*.

(48) Raising in Gitonga.

root	*gloss*	*locative$_a$*	*locative$_b$*
sɔmbɔ	'clothes'	sombo-ni	sombo-tunu
gilatɔ	'shoe'	gilato-ni	gilato-tunu
gipɛtɔ	'circle'	gipeto-ni	gipeto-tunu
ndzɛvɛ	'ear'	ndzeve-ni	ndzeve-tunu

Gitonga raising is accounted for by positing a constraint that prefers candidates in which a high vowel shares one occurrence of closed with a preceding vowel.

(49) ALIGN($[cl]_{max}$, L, word, L) — Gitonga.

ALIGN[cl] = if a vowel is specified for $[cl]_{max}$, then the left edge of some occurrence of [cl] affiliated with that vowel must be aligned with the left edge of the word.

Tableau 20

sɔmbɔni → somboni	ALIGN[cl]	IDENT[cl]
a. ☞ o o i [cl] [cl] [cl] [cl] [cl]		**
b. ɔ o i [cl] [cl] [cl] [cl] [cl]	*!	*
c. ɔ ɔ i [cl] [cl] [cl] [cl] [cl]	*!*	

4 Contrasting Partial and Complete Height Harmonies

All the harmonies discussed so far have been partial height harmonies in which the trigger assimilates to the target in height, but does not attain that height. Partial height harmonies are distinct from complete height harmony in that the latter results in the trigger and target surfacing with vowels of identical height. An example of complete height harmony is found in Kimatuumbi (Odden 1991), where the height of suffix vowels is identical to that of the nearest (non-low) stem vowel.

(50) Kimatuumbi vowels.

	i u	ɪ ʊ	ɛ ɔ	a
[closed]	•	•	•	
[closed]	•	•		
[closed]	•			

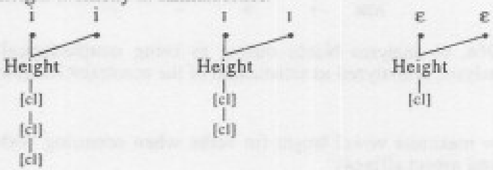
Kimatuumbi (Odden 1991,) is a Bantu language spoken in Tanzania that contrasts four vowel heights among the vowels in (50). While all the vowels in (50) are contrastive, the height of all non-stem-initial vowels is predictable. The height of the stem-initial vowel is realized on all subsequent non-low vowels. All vowels following the low vowel *a* are either high, *i u*, or low, *a*. While these generalizations hold morpheme-internally, alternations found in suffixes indicates that there is an active process of harmony in the language. For example, the first vowel of the passive suffix always surfaces as a front vowel, but its height is determined by the preceding root vowel, as seen in (51).

(51) Kimatuumbi height harmony.

passive — *ilw*		causative — *iy*	
asim-ilw-a	'borow'	ut-iy-a	'to make pull'
kun-ilw-a	'dance'	yib-iy-a	'to make steal'
twɪɪk-ɪlw-a	'lift a load'	yʊyʊʊt-ɪy-a	'to make whisper'
ʊʊg-ɪlw-a	'bathe'	bɪɪk-ɪy-a	'to make put'
kɛɛŋgɛɛmb-ɛlw-a	'uproot tubers'	gɔɔnj-ɛy-a	'to make sleep'
bɔɔl-ɛlw-a	'tear bark off a tree'	čɛɛŋg-ɛy-a	'to make build'
kɪŋgam-ilw-a	'follow'	kɪŋgam-iy-a	'to make follow'
		kaat-iy-a	'to make cut'

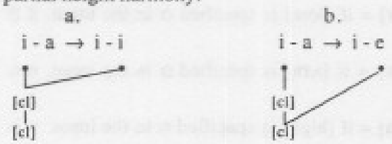
The assimilation in (51) is a complete height harmony since the assimilating vowel always surfaces as the same height as the preceding vowel. Odden (1991, see also Clements 1991, Parkinson 1994) argues that the result of complete height harmony is an assimilation for all vowel height features, expressed as sharing the Height node.

(52) Complete height harmony in Kimatuumbi.



The fact that the trigger and target surface with identical heights is reflected in the structures in (52), which share all height features. Complete height harmony is distinct from partial height harmony, then, in both its effect and its formalization. In partial height harmony, the target does not surface with the same height as the trigger, and the two vowels share only a single occurrence of [closed].

(53) Complete versus partial height harmony.



A comparison of the effects of these two types of height harmony reveals another, more important difference between them. Complete height harmony reduces the potential for contrasts. In Kimatuumbi, for example, on only possible height contrast must be realized on the stem-initial vowel, since all subsequent vowels have predictable height. In contrast, partial height harmony tends to preserve contrasts. In Nzɛbi raising, height contrasts are maintained in the yotized forms for all vowels except for *e* and *o*, which neutralize with *i u*.

(54) Height harmony and height contrasts.

Kimatuumbi		Nzɛbi	
i → i	/ i	i → i	/ i
ɪ → i	/ i	e → i	/ i
ɛ → i	/ i	ɛ → e	/ i
		a → ɛ	/ i

Recall that an assimilation for the Height node entails a MAX[cl] violation, since a shared node requires the "deletion" of the original node. On the other hand, partial height harmony does not incur a MAX[cl] violation since all underlying features are faithfully present in the output. At least with respect to height harmony, MAX acts as a constraint that favors that maintenance of contrasts.

5 Other Accounts of One-Step Raising

Kirchner (1996a, b) provides an analysis of the Nzɛbi facts within the framework of optimality theory. In his analysis, the Nzɛbi vowels are specified for the binary features [high], [low], and [ATR] as in).

(55) Nzɛbi vowels in Kirchner 1(996a, b).

	i u	e ə o	ɛ ɔ	a
high	+	−	−	−
low	−	−	−	+
ATR	+	+	−	−

Kirchner (1996a, b) analyzes Nzɛbi raising as being morphologically conditioned. Raising, in this analysis, is analyzed as satisfaction of the constraint RAISING (56).

(56) Raising.

Raising = maximize vowel height (in verbs when occurring with certain tense and aspect affixes).

To mitigate against the complete satisfaction of RAISING, Kircher (1996a) posits constraints (57) that are satisfied when an output vowel "preserves" the feature specification of the input vowel (i.e., these are functional equivalents of "identity constraints" and are replaced by PARSE in Kirchner 1996b).

(57) Preserve constraints.

PRESERVE[low] = if [low] is specified α in the input, it is specified α in the output.

PRESERVE[ATR] = if [ATR] is specified α in the input, it is specified α in the output.

PRESERVE[high] = if [high] is specified α in the input, it is specified α in the output.

Kirchner (1996) then establishes a disjunction realtion for pairs of the PRESERVE constraints, so that the disjoined constraints are satisfied as long as one of the two is satisfied. Thus (58.a) is satisfied if a vowel preserves its specification of [low] but changes its [ATR] specification, or if a vowels changes its specification for [low] but preserves its [ATR] specification.

(58) Disjoined PRESERVE constraints.

a. **PRESERVE[low] ∨ PRESERVE[ATR]** = the output must have an identical specification as its input correspondent for either [low] or [ATR].

b. **PRESERVE[high] ∨ PRESERVE[ATR]** = the output must have an identical specification as its input correspondent for either [high] or [ATR].

If these two constraints are not ranked with respect to each other, but both are ranked above RAISING as the tableaux from Kirchner (1996) demonstrate. In Tableau 21.a, the first two candidates satisfy both PRESERVE constraints, but the second candidate incurs fewer violations of RAISING, and is therefore optimal.

Tableau 21

	[low] or [ATR]	[high] or [ATR]	RAISING
a. a → a			***!
☞ a → ɛ	– → + [low]		**
a → e	*!	– → + [ATR]	*
a → i	*!	*	
b. ɛ → a	– → + [low]		**!*
ɛ → E			**!
☞ ɛ → e	– → + [ATR]	– → + [ATR]	*
ɛ → i	– → + [ATR]	*!	
c. e → a	*!	+ → – [ATR]	***
e → ɛ	+ → – [ATR]	+ → – [ATR]	**
e → e			*!
☞ e → i		– → + [high]	
i → a	*!	*	***
i → ɛ	+ → – [ATR]	*!	**
i → e		+ → – [high]	*!
☞ i → i			

Problematic to Kirchner's approach is that it does not properly rule out two-step raisings, while such raisings (outside of complete height harmony) are unattested. Two-step raisings in Tableau 21 are ruled out because of the inventory of Nzɛbi, and the constraints that Kirchner (1996a) allows to be in the disjunction relation. He states that "A pair of faithfulness constraints may be disjunctively combined iff they refer to features which define contiguous refions on some phonetic scale." Oddly, the among the features [high], [low], and [ATR], the two features most clearly defining contiguous regions on the height scale are [high] and [low], both of which refer (acoustically) to F_1 and (articulatorily) to height of tongue body, yet these two features are not disjoined. Instead, [ATR], which refers to pharyngeal volumne or tongue root advancement, is disjunctively combined with height features. That is, the disjunctions in (58) do not follow Kirchner's (1996a) guidelines.

More problematic for Kirchner's analysis is that it makes the wrong predictions for Sesotho. As shown in Tableau 22, the same ranking that Kirchner (1996) posits for Nzɛbi fails to select the correct candidate in Sesotho. Notice that the candidate selected in Tableau 22 is *two* steps higher in the output than in the input.

Tableau 22

ɛ → e		[low] or [ATR]	[high] or [ATR]	RAISING
a.	ɛ → a	– → + [low]		*!***
b.	ɛ → ɛ			*!**
c. ?	ɛ → e	– → + [ATR]	– → + [ATR]	*!*
d. ☛	ɛ → ɪ		– → + [ATR]	*
e.	ɛ → i	*!	*	

Another problem with Kirchner's (1996) analysis is that it fails to rule out lowerings. Candidate (a) is ruled out in Tableau 22 on the basis of RAISING. Intervening constraints could allow the disjoined PRESERVE constraints of Kirchner's (1996) analysis to pick candidates that lower one step.

6 Conclusion

In this paper, a new model for the description of vowel height was proposed. This new approach, the incremental constriction model, characterizes vowel height contrasts as increments along a single phonetic scale, where each height is correlated with an (additional) occurrence of [cl]. The representation of vowel height in the incremental constriction model as a continuum is consistent with the view of many phoneticians that vowel height should be characterized in terms of F1 (e.g., Lindau 1975, Tranmüller 1981). In addition, this approach allows for a straightforward account of languages like Nzɛbi, Lena Spanish, Servigliano Italian, and the Sotho languages including Setswana in which vowels of several heights raise one-step. One-step raising in these languages is elegantly described in terms of a single feature, [cl].

The discussion of partial height harmony in this paper has revealed a generalization concerning this phenomenon, which is unmentioned previously. All partial height harmonies involve one-step changes, and all such harmonies involve raising. That is, if a vowel assimilates to another for height and does not attain the height of that vowel, then the harmonizing vowel raises one step.

This generalization is missed in all other accounts of vowel height (Parkinson 1994, 1995), but falls-out naturally from the description of vowel height in the incremental constriction model. The number of languages that exhibit partial height harmony (listed in Table 1) and bear out the predictions of the incremental constriction model demonstrate that this generalization is both robust, and important for an approach to the phenomenon to capture.

There is evidence that the generalizations that hold of partial height harmonies are also true of morphological raisings as well (Bradshaw 1995, Parkinson 1996). Languages such as Gbanu (Bradshaw 1995), Basaá (Schmidt 1994), and Imonda (Seiler 1985) exhibit one-step raising in certain morphological contexts. Raising in these languages is easily handled incremental constriction model as the insertion of the feature [cl], but more problematic for other approachs. If all morphological shifts are indeed one-step raisings, then this can be viewed as additional support for the incremental constriction model.

	language	input		output	trigger
a.	Basque, Woleaian	a	→	e	high vowels
b.	Uyghur	a ä	→	e	higher vowels
c.	Loniu	a	→	ɛ	i
d.	Nzɛbi	a ɛ ɔ e ə o	→	ɛ e o i u	high vowels
e.	Basaá	a ɛ ɔ e o	→	e e o i u	morphological conditioning
f.	Lena Spanish	a e o	→	e i u	high vowels
g.	Imonda	a e ə o	→	ɛ i u	morphological conditioning
h.	Ejagham, Kikuria, Gitonga, Zulu	ɛ ɔ	→	e o	high vowels
i.	Gbanu	ɛ ɔ e o	→	e o i u	morphological conditioning
j.	Servigliano Italian	ɛ ɔ e o	→	e o i u	high vowels
k.	Sesotho, Tswana, Northern Sotho, Konzo, Kinande	ɛ ɔ ɪ ʊ	→	e o i u	higher vowels

Table 1 Languages exhibiting partial height harmony

The discussion of alignment constraints in this paper revealed that with respect to height harmony, such constraints vary with respect to only three parameters. The implication of this limited range of variation allows for all height harmony to be accounted for with a small number of constraints. Such economy is important in a theory such as optimality theory (Prince and Smolensky 1993) in which all constraints are posited to be universal. In addition, restricting variation among alignment constraints referring to [cl] suggests that the economy found for height harmony may be found in other segmental assimilations as well.

Finally, the differences between partial height harmony and complete height harmony was shown to include both the loss–preservation of height contrasts and a different ranking of MAX. This poses the question as to whether MAX plays the role of preserver of contrasts with respect to other phenomena as well. This, and the questions posed above, remain for future research.

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Base-Identity Effects in Runyankore Reduplication[*]

Robert Poletto

1 Introduction

The complicated verbal morphology of the Bantu verb has provided rich soil for investigation into the behavior of morphological and prosodic elements in phonology. During the past fifteen years, study into the nature of reduplication has included much work within the realm of Bantu verbal reduplication (Marantz 1982, Odden & Odden 1983, Mutaka & Hyman 1990, Downing 1994a, b). Much of the more recent work has been inspired by developments in the theory of phonology, including Optimality Theory (Prince & Smolensky 1993, McCarthy & Prince 1993) and Correspondence Theory (McCarthy & Prince 1995). This paper is an examination of the reduplication system of the Bantu language Runyankore[1], which is spoken in the Ankole district of southern Uganda. It is closely related to Rukiga as well as to Runyoro, Rutoro, Haya and Kikerewe (see Odden 1996).

The focus of this discussion is the set of constraints on reduplication in Runyankore and how they interact to result in an incomplete copy of the verb stem. Of special interest is an asymmetry between the location of the causative morpheme [y] in the reduplicant (the copied or matching segments) and the underlying base (the source for the copying). As seen in (1), the causative lies in the pre-final position of the verb. Reduplication of a non-causative form in (2) illustrates the copying of segments from base into the reduplicant (underlined). The copying involves adjacent segments, [reeb], and the vowel [-a], which is required by the grammar. However, in the reduplicated form of a causative, the copying skips the segments [-ir-] in the reduplicant, as in (3).

(1)	oku-reeb-a	'to see'
	oku-reeb-y-a	'to betray'[2]

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[1] All the data herein were elicited by me from Patrick Bamwine, a native speaker of Runyankore. I would like to thank him as well as David Odden and Beth Hume for their advice on this research. Thanks also to Frederick Parkinson for his feedback on this manuscript.

[2] While most causative/transitive forms are transparently related to the non-causative form, some are less obviously related.

(2)	a-reeb-ire	's/he saw'
	a-reeba-reeb-ire	's/he saw over and over'
(3)	a-reeb-ize ← /a-reeb-ir-y-e/	's/he betrayed' (hesternal[3])
	a-reebya-reeb-ize ← /a-RED-reeb-ir-y-e/	's/he betrayed over and over'

The morpheme [y], located in pre-final position, interacts with the [r] of [-ire] to produce [z]. Thus, it is adjacent to the [r] in the surface base. However, the [y] appears next to the [b] of [reeb] in the reduplicant even though it is not adjacent to this segment in the surface base.

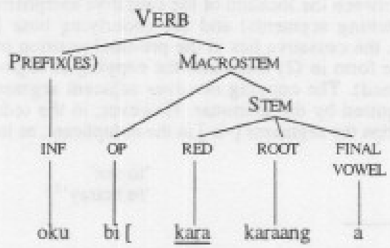
In this paper, I will provide an account of the main features of Runyankore reduplication in order to demonstrate the relationship that exists between the reduplicant (the copied segments) and the base (the segments that are copied from). I will demonstrate that a set of constraints on well-formedness (Prince & Smolensky 1993, McCarthy & Prince 1993, 1995) can predict the unusual copying of the causative morpheme into the reduplicant, despite surface discontinuities. As I will show, this analysis depends on the ordering of the causative morpheme with respect to the other morphemes of the verb in the input to the phonology. This ordering allows us to account for the asymmetry between the surface reduplicant and the base and the failure of the morpheme to appear in the reduplicant in some verbs.

This discussion is organized as follows: in Section 2, I provide a short description of reduplication in Runyankore. Section 3 examines how a set of ranked constraints might account for the properties of reduplication in this language. In Section 4, I review the segmental mutations that occur, and their interaction with reduplication in Section 5.

1.1 Theoretical Assumptions

In my discussion of the verb in Runyankore, I will use the following terms: root, stem, macrostem, base, and reduplicant. The verb in Bantu languages is classically analyzed in a hierarchical fashion. Of particular importance is the verb stem, which comprises the root, derivational morpheme (like the causative), the final vowel, and the reduplicant (see especially Hyman 1990 and Downing 1994a,b regarding reduplication). This structure is shown in (4). Another structure that plays a role in reduplication is the macrostem, which subsumes the stem and the object prefixes.

(4) The hierarchical structure of the Bantu verb
oku-bi[kara-karaanga, 'to dry roast them$_7$ over and over'[4]



[3] The hesternal refers to actions that took place yesterday.
[4] Subscripted numbers after pronouns indicate the noun class to which the object pronoun refers.

The root is the core of the verb. Most roots are either CVC or CVVC/CVNC, though there are other forms, such as CV, or CVCVVC. The final vowel is a morpheme that varies according to the tense and mood of the verb. It is [-a] in most indicative moods. In the subjunctive and hypothetical, it is [-e] and in a number of past tenses it corresponds to the morpheme [-ire], traditionally referred to as the perfective. The reduplicant is the copied portion of the verb. The base refers to the segments that are used as the source for copying. I will assume that the reduplicant is located within the stem. The evidence for this will be discussed in Section 2.1.

Tone in Runyankore is lexically marked. The verb [oku-šara] 'to go crazy' is toneless while [oku-šára] 'to cut' is high toned. The high tone normally falls on the left edge of the stem. There is no tone spreading. In addition to the lexically underlying tone, certain verb tenses require a high tone. For example, the hesternal tense, puts a high tone on the syllable containing the second mora of the verb (the V2 pattern) if the verb is toneless, [a-bazíírire] 'he sewed' and on the final (with penult retraction) if the verb is high toned [a-karaanjíre] 'he dry roasted'. The V2 pattern is helpful in determining where the left edge of the stem lies.

The theoretical framework I will be using is that of Optimality Theory (Prince & Smolensky 1993, McCarthy and Prince 1993, 1995). In this framework, the grammatical form of an input is selected from a candidate set of parses. The grammatical parse best satisfies the requirements of a set of ranked constraints on well-formedness. According to Prince & Smolensky (1993) the set of constraints is universal and individual differences between languages result from different rankings of the constraints. The task is to discover which ranking will result in grammatical forms being selected (out of a theoretically infinite set of possibilities). McCarthy & Prince (1995) describe sets of constraints that require faithfulness between input and output forms and between input/output and reduplicated forms. The ranking of these constraints along with other constraints on the form of Runyankore verbs will be shown to predict the patterns found below.

2 A Description of Reduplication in Runyankore

Verbal reduplication in Runyankore has the meaning of repetition, usually expressed as "over and over". It also has a sense of an action done poorly, offhandedly, or incompletely. For brevity, I will use ellipsis (...) after the verb to indicate this additional meaning.

Reduplication involves infixing the reduplicant at the beginning of the verb stem—so that the reduplicant is also part of the stem. The reduplicant is formed by copying a [CVC], [CVVC], or [CVNC] sequence from a base (either the stem or the macrostem if the stem is insufficiently long) and attaching the vowel [-a]—the final segment of the reduplicant is always [a] (for example, see (5e)). In the infinitive, the copying of the CVC elements is exact—all the features are copied obeying constraints on faithfulness of identity between the base and the reduplicant (McCarthy and Prince 1995). I underline the reduplicant and use the left bracket, [, to indicate the left boundary of the stem.

(5)	a. oku[reeb-a	'to see'
	oku[reeba-reeb-a	'to see ...'
	b. oku[šek-a	'to laugh'
	oku[šeka-šek-a	'to laugh ...'
	c. oku[kwaat-a	'to touch'
	oku[kwaata-kwaat-a	'to grope'

d. oku[bagar-a 'to weed'
oku[baga-bagar-a 'to weed …'

e. oku[šohor-a 'to go out'
oku[šoha-šohor-a 'to go out …'

In forms of the verb with the perfective suffix [-ire][5] (required by some past tenses and some moods, such as the hortative), the last consonant of the stem mutates before the vowel [i] of [-ire]. However, this effect is not copied to the reduplicant, where the last consonant remains faithful to the input. These are seen in (6), where an infinitive is contrasted with a verb form having the perfect suffix.

(6) a. oku[heek-a 'to carry'
a-káá[heeč-ire 'he should carry' (hortative)
a-káá[heeka-heeč-ire 'he should carry …'

b. oku[bar-a 'to count'
a[baz-íre 's/he counted'
a[bará-baz-ire 's/he counted …'

c. oku[huut-a 'to drink from a bowl'
a[húúts-ire 's/he drank from a bowl'
a[huutá-huuts-ire 's/he drank from a bowl …'

d. oku[jeend-a 'to go'
a[jeenz-íre 's/he went'
a[jeendá-jeenz-íre 's/he went …'

e. oku[kwaat-a 'to catch'
a[kwaats-íre 's/he caught'
a[kwaatá-kwaats-ire 's/he caught …'

There is a further complication involving the affix [y], which marks the causative or the facultative (to VERB with). In general, the causative morpheme [y] occurs on the stem-final consonant, as shown in (7).

(7) a. oku[gab-a 'to divide'
oku[gab-y-a 'to divide with'

b. oku[kam-a 'to milk'
oku[kam-y-a 'to enable to give milk'

c. oku[rim-a 'to cultivate'
oku[rim-y-a 'to cause to cultivate'

d. oku[šutam-a 'to sit'
oku[šutam-y-a 'to cause to sit'

[5] The suffix [-ire] is one of three verbal affixes that causes a palatalization/spirantization effect in consonants (the other two are the causative [y] and the nominalizing suffix [i]). Historically, these all derive from the proto-Bantu superhigh vowel [į]. Not all occurrences of the vowel [i] in Runyankore result in palatalization/spirantization, however. Because of this, these morphemes probably have to be specially marked in the lexicon as invoking a particular constraint.

However, if the final consonant is a coronal or dorsal the morpheme [y] causes some type of consonant mutation: coronalization of dorsals, depalatalization of alveo-palatals, and spirantization of coronal stops, as shown in (8).

(8)	a. oku[gur-a	'to buy'
	oku[guz-a	'to sell'
	b. oku[taah-a	'to enter'
	oku[taas-y-a	'to bring in'
	c. oku[hik-a	'to arrive'
	oku[hič-a (~ [-hitsya])	'to cause to arrive'
	d. okw[óog-a	'to wash'
	okw[óoz-y-a	'to wash (tr.)'

As noted above, this morpheme always appears just before the last vowel of the verb. Thus, we find that in the perfective, it mutates not the last consonant of the root (as in (8)), but the consonant [r] of the perfective suffix [-ire]. Hence, the causative morpheme appears on the last consonant of the verb stem. The causatives forms in (9) contrast an infinitive, with the final vowel [-a], and a perfective (the hesternal tense), with the final morpheme [-ire].

(9)	a. oku[róob-y-a	'to wet down'
	a[roob-íze	's/he wet down'
	b. oku[hunam-y-a	'to quiet'
	a[hunám-ize	's/he quieted'
	c. oku[reeb-y-a	'to betray'
	a[rééb-ize	's/he betrayed'

The behavior of the reduplicant with respect to the causative morpheme is of particular interest because the causative morpheme or its effects appear in the reduplicant, as well as in the base, as illustrated in (10).

(10)	a. oku[hika	'to arrive'
	oku[hiča	'to cause to arrive'
	oku[hiča-hiča	'to cause to arrive …'
	b. oku[taaha	'to enter'
	oku[taas-y-a	'to bring in'
	oku[taasya-taas-y-a	'to bring in …'
	c. okw[óoga	'to wash'
	okw[óoz-y-a	'to wash (tr.)'
	okw[óózya-yooz-y-a	'to wash … (tr.)'

However, as shown in (11), the spirantizing/palatalizing effects of the affix [-ire] are not copied to the reduplicant.

(11)	a. okw[óoga	'to bathe'
	a[yoǰ-íre	's/he bathed'
	a[yoga-yoǰ-íre	's/he bathed …'

b. oku[čúunda — 'to churn'
a[čuunz-íre — 's/he churned'
a[čuunda-čuunz-íre — 's/he churned …'

c. oku[mera — 'to germinate'
bi[mez-íre — 'they$_8$ germinated'
bi[merá-mez-ire — 'they$_8$ germinated …'

Recall from (9), that the causative [y] always appears just after the last consonant of the word. Because this effectively shifts the causative [y] away from the edge of the first CVC of the base, one expects no palatalization or spirantization in the reduplicant. However, as the following reduplicated forms demonstrate, even if the causative [y] is no longer adjacent to the copied CVC from the base (because it has shifted to pre-final position), its presence or effects as still found in the reduplicant.

(12) a. oku[bara — 'to count'
oku[baza — 'to cause to count'
a[bazá-bar-ize ← bar-ir-y-e — 's/he caused to count'

b. a[hič-íre — 's/he arrived'
a[hiká-hič-íre — 's/he arrived …'
a[hičá-hič-ize — 's/he caused to arrive …'

c. oku[guza ← gur+y+a — 'to sell' ('cause to buy')
a[gur-íze — 's/he sold'
a[guzá-gur-ize — 's/he sold …'

The reduplicant copies the [y] of the causative morpheme, even though it is no longer contiguous with the other copied segments in the base.

The main problems to be accounted for in this discussion relate to the reduplication pattern and the asymmetry between the perfective and the causative and their respective effects on the reduplicant and base. Once the principles governing reduplication have been introduced, an account of the interaction of reduplication and segmental phonology will be undertaken. The copying of segmental features into the reduplicant from the base will be shown to be a consequence of the hierarchy of constraints responsible for copying of segments and features.

2.1 Reduplication and the Stem

The data presented thus far suggest that the reduplicated material is taken from the left edge of the stem and is prefixed to the base. However, I have assumed thus far that the reduplicant is infixed into the stem—it is in the stem. In other words, the left edge of the reduplicant and the left edge of the stem coincide (see McCarthy & Prince 1993 for a further discussion of alignment). Below I provide independent evidence from the placement of tones in the language that argues for an analysis that includes the reduplicant in the stem.

2.1.1 The Stem as a Tonal Domain

The data in (13) show reduplication of high-toned verbs. The lexical high tone stays at the left edge of the stem. A morphological constraint on tonal association compels a lexical high tone to align to the left edge of the stem.

(13) a. oku[šára — 'to cut'
oku[šára-šara — 'to cut over and over'

b. oku[rúma 'to bite'
oku[rúma-ruma 'to bite over and over'

c. oku[káraanga 'to dry roast'
oku[kára-karaanga 'to dry roast over and over'

Another principle of tone assignment (one that is morphologically conditioned) requires toneless verbs to have a high tone on the syllable that contains the second mora of the stem[6] in certain verb tenses: the V2 pattern. As the habitual forms in (14) demonstrate, the high tone of the habitual stays on the V2 syllable in both plain and reduplicated forms of the verb.[7]

(14)	a[bazíira	's/he sews'	a[bazá-baziira	's/he sews …'
	a[šohóra	's/he goes out'	a[šohá-šohora	's/he goes out …'
	a[haandíika	's/he writes'	a[haandá-haandiika	's/he writes …'
	a[gurúka	's/he jumps'	a[gurá-guruka	's/he jumps …'
	a[ramútsya	's/he greets'	a[ramá-ramutsya	's/he greets …'
	a[ǰéénda	's/he goes'	a[ǰeendá-ǰeenda	's/he goes …'

The domain of these tonal principles is the stem as defined in (4) above (see also Poletto 1996). In order to consistently predict the location of this high tone, the reduplicant must be counted as part of the stem. Therefore, as shown by the tonal evidence in (13) and (14), the reduplicant forms part of the morphological stem.

2.1.2 *Monosyllabic Roots and the Stem*

The reduplicant is not simply a copy of segments from the stem but must also satisfy a requirement of minimal size. The reduplicant must be two syllables long, adhering to a binarity constraint. If the stem is at least two syllables in length, then the reduplicant will be disyllabic. However, if the base for reduplication, the input stem, is too short, there may not be sufficient segmental material to create a binary reduplicant. If the base contains a glide, as in (15), then reduplication may take place. The glide is moraic in the input and can contribute a mora to the reduplicant, allowing it to be binary (two morae). However, if the base does not contain a glide, then a binary reduplication cannot be created, as seen in (16).

(15) a. oku[mwa 'to shave'
oku[mwaa-mwa 'to shave …'

b. nibá[rya 'they are eating'
niba[ryáá-rya 'they are eating …'

(16) a. okú[fa 'to die'
*oku[fá-fa, *oku[fáa-fa 'to die …'

b. oku[za 'to go to'
*oku[za-za, *oku[zaa-za 'to go out …'

c. oku[sa 'to grind'
*oku[sa-sa, *oku[saa-sa 'to grind …'

---

[6] If this mora is in either position of a long penult, the result is a falling tone.
[7] Two details must be noted: (1) coda nasal consonants are not counted in calculating V2, even though they lengthen a preceding vowel and (2) a high tone retracts from a final syllable, owing to phrase-final position.

Note that in these example, we might expect the final vowel of the verb to be long, because of glide formation and compensatory lengthening, illustrated in (17). However, long vowels never appear at the edge of the word (see Odden, this volume, for discussion of a similar phenomenon in Kikerewe). This appears to be a high ranked constraint in the language. But, because the reduplicant is word-internal, glide formation and compensatory lengthening will produce a long vowel and thus satisfy the binarity requirement.

(17) Glide Formation and Compensatory Lengthening

```
 μ μ             μ  μ
 | |              \/
m u a     ⇒     m w a
```

One strategy that the language uses to satisfy the binarity requirement on reduplicants is to recruit the object prefix into the reduplicant, as in (18).

(18)	a. oku[sa	'to grind'
	oku-bú[sa	'to grind it$_{14}$'
	náá-bú[sa-busa	'to grind it$_{14}$ ...'
	b. okú-rya	'to eat'
	oku-bú[rya	'to eat it$_{14}$'
	oku-bú[rya-burya	'to eat it$_{14}$ ...'
	c. okú[ɲwa	'to drink'
	oku-gá[ɲwa	'to drink it$_{6}$'
	oku-gá[ɲwa-gaɲwa	'to drink it$_{6}$ ...'

Here, the base is defined in terms of the macrostem, which includes the object prefix. The fact that the object prefix segments appear on the right as well suggests that the reduplicant is suffixed in these cases. However, this fact can be analyzed as a means to satisfy the requirements on reduplicant and verb well-formedness.

3 A Ranked Constraints Approach to Reduplication

This account of the reduplication of Runyankore verbs will use a set of ranked constraints to evaluate the well-formedness of surface forms (Prince & Smolensky 1993). Following McCarthy & Prince (1995), I will also assume that there is a set of constraints on faithfulness between input and output. A family of surface-to-surface faithfulness constraints is crucial for an analysis of reduplication as well. These constraints ensure that the reduplicant, which is phonologically empty in the input, contains segments that are phonologically similar to (subject to other constraints on well-formedness) the base on the surface or the input to the base (reduplicant-base faithfulness and input-reduplicant faithfulness, respectively).

As we saw in section 2, the reduplicant is always binary at some level of analysis—disyllabic or bimoraic. Following Downing (1993), the constraints on the length of the reduplicant are that it must be a foot and that feet are binary.

(19) The reduplicant must be a foot RED=FT

(20) Feet must be binary (at some level of analysis) FTBIN

Along with the constraint on binarity of feet, FTBIN (Prince & Smolensky, 1993), RED=FOOT requires only binary reduplicants to surface. The location of the reduplicant is specified by constraints that require it to prefix to the stem-base and to be anchored to the left edge of the stem-base. Specifically, the reduplicant must be anchored to the left edge of the stem.

(21) ALIGN(RED, LEFT, STEM, LEFT) ALIGN-L
Align the left edge of any reduplicant with the left edge of some stem.

(22) LEFT-ANCHOR(RED, BASE) ANCH-L
The reduplicant should be anchored to the left edge of the base.

ALIGN-L requires the left edge of the reduplicant to align with the left edge of the stem. The result is that the reduplicant is always included in the stem (as shown by tonal assignment). The anchoring constraint ANCH-L requires the reduplicant to anchor to the left edge of the base. Since the reduplicant is also part of the stem, the reduplicant will be anchored not with the stem on the surface but with the base, which is defined in terms of the input stem or macrostem. Because the reduplicant is phonologically empty, there is no segmental material to be copied. Thus, the segmental material at the left edge of the base coincides with the segments at the left edge of the verb root, which is the leftmost morpheme in the stem. This ensures that the reduplicant can be included in the stem on the surface. The fact that the segments copied are also part of the stem supports the correspondence relationship between the input stem and the output reduplicant. The reference to the input base in the ANCH-L constraint avoids the problem of a circular reference to segments in the reduplicative morpheme when evaluating its anchoring—the result if anchoring also referred to the left edge of the stem on the surface.

The constraints on reduplicant well-formedness must outrank the constraints that would require total copying of all elements in the base to the reduplicant:

(23) MAX-BASE REDUPLICANT MAX-BR

The MAX-BR (McCarthy and Prince 1995) constraint requires every segment in the base to also appear in the reduplicant. However, if the base is longer than a foot the entire base cannot be copied into the reduplicant. In such a case, only the segments necessary to satisfy FTBIN and RED=FT are copied in the reduplicant. Thus, the following ranking must hold.

(24) RED=FT, FTBIN, ALIGN-L, ANCH-L >>MAX-BR

This ranking is demonstrated in the following tableau. The curly braces "{ }" represent the boundaries of a foot (which I will mark when necessary for clarity). I will be assuming that the word is not exhaustively footed and the lack of curly braces indicates that the reduplicant is not footed (violating RED=FT, but not FTBIN).

Tableau 1 oku + káraang + a + RED 'to dry roast …'

			RED=FT	FTBIN	ALIGN-L	ANCH-L	MAX-BR
☞	a.	oku[{kára}-karaanga					aanga
	b.	oku[ká-karaanga	*!				raanga
	c.	oku[{káraanga}-karaanga		*!			
	d.	oku[ká-{kara}-raanga			*!		aanga
	e.	oku[{ráánga}-karaanga				*!	ka

Candidate (a) succeeds because it satisfies all the constraints on reduplicant well-formedness. Runyankore is very strict regarding the formation of reduplicants and will only admit a few exceptions. Candidate (b) fails because the reduplicant is not a foot.

Candidate (c) fails because the foot constructed over the reduplicant is not binary. Candidate (d) fails because the reduplicant is misaligned with respect to the left edge of the stem. Finally, candidate (e) fails because the reduplicant is not anchored with the left edge of the base, [karaanga].

Consider, the following reduplications where the base is longer than two syllables. Reduplication fails to copy the vowel of the second syllable of the base. The sound [a] is substituted in its place.

(25)	oku[rama-ramutsya	'to greet …'
	oku[reemba-reembesereza	'to comfort …'
	oku[šoha-šohora	'to go out …'

The last vowel of the reduplicant is not copied from the base (as is suggested in Tableau 1—only the first CVC or CVVC is copied from the base. A separate constraint requires the reduplicant to end in the vowel [a], regardless of the vowel in the input base. What would compel this requirement? Downing (1993) argues that reduplicants in Kikuyu and KiNande also end in the vowel [a] because the reduplicant must be a "Canonical Stem" (cf. Peng 1992) defined by Downing as follows:

1. Prosodic constraint: Must be a syllabic trochee.

2. Morphological constraint: Must look like a verb stem by ending with Final Vowel /-a/.

One potential difficulty with this understanding of reduplication lies in identifying what a canonical stem is. Generally, the stem is considered to be the verb root, derivational affixes (such as [-ir-] 'for' and [-an-] 'each other') and a final vowel which contributes information about the mood and tense of the verb. For example, in most indicative present tenses, the final vowel is [a]. However, in the subjunctive, the final vowel is [-e]. In fact, the terminology "final vowel" might be an unfortunate misnomer because the perfective morpheme, [-ire], occupies the same space as the final vowels [-a] and [-e]. Perhaps "final morpheme" would be a better choice. But, "final vowel" is accepted in the literature on Bantu morphology and phonology and I will retain it for tradition, if not for perspicacity.

(26)	akáá[heeka-heeč-ire	'he should carry …'
	a[bará-baz-ire	's/he counted …'
	a[huutá-huuts-ire	's/he drank from a bowl …'
	a[jeendá-jeenz-ire	's/he went …'

As the words in (26) show, the final vowel of the reduplicant is invariably [a] and cannot have its origins linked to the surface final vowel (final morpheme).

When Downing was writing these analyses of Bantu reduplication, OT did not have at its disposal the families of faithfulness constraints collectively referred to as *Correspondence Theory* (CP, McCarthy & Prince, 1995). In a way, Downing's account requires a relationship between the surface reduplicant and some other idealized stem, the canonical stem. Constraints in the correspondence family might provide a means to evaluate the similarity between the reduplicant and a canonical stem. However, the correspondence constraints refer to specific elements in the language (both on the surface and underlying). Using correspondence constraints to compel the insertion of the vowel [a] at the end of a reduplicant requires the introduction of another notion into the grammar—the canonical stem. Of course, there are many stems in the realm of grammatical verb forms that correspond to a grammatical stem. But, referring to them as a class would still require positing a canonical stem first.

The notion of canonical stem seems to be derived from the statistical preponderance of verb stems that have the form [CVCa]. However, the only purpose a constraint requiring the reduplicant to be a canonical stem serves is to ensure that it ends in the vowel [a]. The constraints RED=FT and FTBIN enforce size requirements that are also true of canonical stems. Thus far, analyses of Runyankore verbal system do not require any other reference to the canonical stem. Is the canonical stem a necessary concept? At this point, rather than appealing to the notion of canonical stem, I will simply use a constraint that requires the last vowel of the reduplicant to be [a]:

(27) ALIGN(RED, RIGHT; [a], RIGHT) REDFV
Align the right edge of a reduplicant with the right edge of the vowel [a].

Because the vowel [a] appears in the reduplicant without a correspondent in the input or in the base, we know that the REDFV constraint must outrank a constraint penalizing the insertion of a segment into the reduplicant that is not in the base: DEP-BR.

(28) A segment in the reduplicant
must have a corresponding segment in the base: DEP-BR

Tableau 2 oku[šohora + RED 'to go out ...'

	REDFV	FTBIN	ALIGN-L	ANCH-L	MAX-BR	DEP-BR
☞ a. oku[{šoha}-šohora					-ora	-a
b. oku[{šoho}-šohora	*!				-ra	
c. oku[{hora}-šohora				*!	šo-	

Candidate (b) fails because the reduplicant does not end in the vowel [a], violating REDFV. Candidate (a) succeeds despite a DEP-BR violation—the insertion of the vowel [a] into the reduplicant. This is necessary to satisfy the REDFV constraint. This approach sees the segment [a] as not corresponding to any segment in the base—it is inserted by GEN. Because it is inserted and not licensed by a base-reduplicant identity relationship, it violates DEP-BR. Recall that there is no segmental content to the reduplicant morpheme RED. So, any candidate has some number of DEP-IR violations (perhaps analogous to a *STRUC violation under pre-CT Optimality). One could alternatively view this as a violation of IDENT-FEATURE-BR. Under this interpretation, the faithfulness coindexing between the reduplicant and the base would include a reference between the last vowel of the reduplicant and the fourth (in this case) segment of the base, [o]. However, we will reject this approach because the last vowel of the reduplicant is clearly not supplied by the base—it is invariably [a], regardless of the "corresponding" (i.e., positionally equivalent) vowel in the base. Recalling Downing's analysis of reduplication, the [a] is present because of the requirement that the reduplicant be a canonical stem. Under this account there is further support for the argument that the vowel [a] is independently inserted. Thus, we could imagine a tableau like the following.

Tableau 3 oku[šohora + RED 'to go out ...'

	REDFV	DEP-BR
☞ a. oku[šoha-šohora		*
b. oku[šoho-šohora	*!	
c. oku[šohe-šohora	*!	*
d. oku[šohi-šohora	*!	*
e. oku[šohu-šohora	*!	*

Candidate (b) does not violate DEP-BR because every segment in the reduplicant has a correspondent in the base (assuming at this point that the base is the remainder of the stem). Candidates (c)–(e) all incur violations of DEP-BR, just as candidate (a) does. However, like candidate (b), they fatally violate REDFV.

In the case of a long verb, such as [oku-reembesereza], 'to comfort', several segments from the base are not copied in the reduplicant. This results in some number of MAX-BR violations. However, the constraints on reduplicant form outrank MAX-BR.

Tableau 4 oku[reembesereza + RED 'to comfort …'

	FTBIN	RED=FT	MAX-BR
☞ a. oku[{reemba}-reembesereza			esereza
b. oku[{reembe}sa-reembesereza		*!	ereza
c. oku[{reembesa}-reembesereza	*!		ereza

The more that a candidate satisfies MAX-BR the worse it does with respect to RED=FT and/or FTBIN. This is further evidence for ranking the reduplicant form constraints above MAX-BR.

Because the constraints on reduplicant form appear not to be ranked with respect to one another, I will collapse them into more general statement for the purposes of simplicity.

(29) RED=FT, FTBIN, REDFV, ALIGN-L, ANCHOR-L ⇔ *REDFORM*[8]

REDFORM is not a constraint in itself, but a shorthand for a group of related constraints that rank together in this language, and define the well-formed, properly anchored and aligned reduplicant. With this shorthand, Tableau 2 appears as follows:

Tableau 2′ oku[šohora + RED 'to go out …'

	REDFORM	MAX-BR	DEP-BR
☞ a. oku[{šoha}-šohora		-ora	-a
b. oku[{šoho}-šohora	*!	-ra	
c. oku[{hora}-šohora	*!	šo-	

3.1 Vowel-Initial Stems

Vowel-initial stems also undergo reduplication. The form of the reduplicant is dependent upon the length of the base. If the base is VCV, as in (30), then there is copying with the insertion of a [y] to avoid hiatus between the reduplicant and the base and/or between vowels, as in (30).

(30) okw[éége-yega 'to learn …'
okw[aara-yara 'to spread out …'
okw[ootsya-yootsya 'to burn …'
oku[íiba-yiba 'to steal …'

[8] I will indicate an abbreviation of a number of constraints by italicizing it.

(31) a[yega-yejíre 's/he learned …'
a[yeta-yetsíre 's/he called …'
a[yita-yitsíre 's/he killed …'

In (30), the glide [y] separates the final [a] of the reduplicant from the initial [e] of the base. Observe that the epenthetic [y] is not copied into the reduplicant: *[oku[yéga-yega]]. In (31), a glide appears both between the reduplicant and the base and between the reduplicant and the subject prefix [a-]. This is evidence that the ONSET constraint is ranked above the constraint against inserting segments, DEP. Furthermore, MAX-BR would tend to enforce copying of the epenthetic segment from the base into the reduplicant. However, this is not the case. I suggest that input-reduplicant faithfulness is more highly ranked and, therefore, preserves the similarity between the input and reduplicant over the need to make the reduplicant resemble the surface form of the base, as required by MAX-BR.

To satisfy the *REDFORM* constraints, anchoring must be violated. This is evidence that ANCH-L lies below *REDFORM* in the constraint hierarchy. The words in (30) have two ANCH-L violations. Recall from above that the anchoring constraint here applies between the input base and the surface form. The [y] is inserted between the reduplicant and the rest of the base in the output in order to avoid an ONSET violation.

(32) Input: oku - { RED - ég - a } $_{\text{Base}}$
⇓
Output: okw [ééga - yega

Here the segments marked as 'base' are what the anchoring constraint refers to—they are not thus marked in the input. Because RED is phonologically empty, the segment at the very left edge of the input is the vowel [e]. Thus, even though there is a [y] present on the surface at the left edge of the remainder of the base (minus the reduplicant) its epenthetic nature prevents it from being copied into the reduplicant to satisfy ANCH-L. The words in (31) have the glide present at the left edge of both the reduplicant and the base. In this instance, this glide appears in both locations to satisfy ONSET. The satisfaction of ANCH-L as well as base-reduplicant identity constraints is serendipitous.

Tableau 5 illustrates the evaluation of a vowel-initial stem. Because REDFORM does not outrank the ANCH-L constraint, candidate (a) will be superior to candidate (b), which has a prosodically well-formed but a misanchored reduplicant. Finally, candidate (c) fails because it incurs an ONS violation between the reduplicant and the base.

Tableau 5 oku - RED - ég - a 'to learn …'

	ONS	*REDFORM*	IR-FAITH	MAX-BR	DEP-BR
☞ a. okw[ééga-yega					
b. o[kwééga-yéega		**!	*		
c. okw[ééga-ega	*!	*			

In most cases, if the base is long, the initial vowel continues to be considered part of the stem, as in (33).

(33) a. okw[iiga-yigura 'to open …'
a[yigá-yigura 's/he opens …'

b. okw[oora-yoreka 'to show …'
a-[yora-yorečíre 's/he showed …'

However, in some cases, the initial vowel is excluded, as in (34).

(34)	ay-ee[yama-yamwiire	's/he yawned …'
	ay-ee[šerá-šerečire	's/he hid …'
	okw-éé[šonga-šongora	'to sing …'
	a-ye[šonga-šongoíre	's/he sang …'

In all of these cases, the vowel in question is [e]. These forms can be analyzed as involving the reflexive prefix [e]. This would explain why the vowel is not included in reduplication.

3.2 Monosyllabic Roots

Consider again the monosyllabic roots that have no reduplicated form, repeated from (16) in (35). They have no means to satisfy the binarity requirement.

(35)	a. okú[fa	'to die'
	*oku[fá-fa, *oku[fáa-fa	'to die …'
	b. oku[za	'to go to'
	*oku[za-za, *oku[zaa-za	'to go out …'
	c. oku[sa	'to grind'
	*oku[sa-sa, *oku[saa-sa	'to grind …'

Thus, no parse of the forms in (35) can be considered grammatical—there just is no reduplicated form of this verb. In order to account for this, the grammatical model must have a means to rule out a particular parse. This problem remains an area for further research.

On the other hand, the monosyllabic roots in (36) are able to satisfy the minimality constraint because the resulting reduplicant is dimoraic owing to the underlying presence of a vowel in the root, which contributes a mora, along with the inserted vowel [a].

(36)	a. oku[mwa	'to shave'
	oku[mwaa-mwa	'to shave …'
	b. nibá[rya	'they are eating'
	niba[ryáá-rya	'they are eating …'

There is another means by which the minimality constraint FtBin can be satisfied in monosyllabic roots lacking an underlying vowel—an object prefix can be 'recruited' into the reduplicant, as in (37) (repeated from (18)). If an object prefix is present, it appears twice—in the reduplicant and before the base. The words in (37b–c) also suggest that object prefix incorporation is the preferred strategy, even if the verb root is bimoraic.

(37)	a. oku-[sa	'to grind'
	oku-bú[sa	'to grind it$_{14}$'
	oku-bú[sa-busa	'to grind it$_{14}$ …'
	b. okú[rya	'to eat'
	oku-bú[rya	'to eat it$_{14}$'
	oku-bú[rya-burya	'to eat it$_{14}$ …'
	c. okú[ɲwa	'to drink'
	oku-gá[ɲwa	'to drink it$_{6}$'
	oku-gá[ɲwa-gaɲwa	'to drink it$_{6}$ …'

Notice also that the prefixal segments of [oku-] cannot be recruited to satisfy the requirement of binarity (compare (37) and (35)). Only the object prefixes can be included in the reduplicant. Why should this be? Unlike the prefix [oku-], the object prefixes (including the reflexive object prefix [-e-]) are part of a larger constituent in the verb—the macrostem, which comprises the stem proper as well as the object prefixes and the reflexive prefix. The failure of certain monosyllabic roots to reduplicate and the complexities of prefix incorporation are necessary for a full account of reduplication in Runyankore. However, they are currently beyond the scope of this paper and are the focus of ongoing research.

4 Consonantal Phonology and Reduplication

In this section, I will present three types of segmental interaction in Runyankore—coronalization, spirantization and dissimilation, all caused by the causative morpheme, [y], and the perfective suffix, [-ire]. The consonants of Runyankore are provided in (38).

(38) Runyankore Consonants

Labial	Coronal	Alveo-palatal	Dorsal	Glottal
p b	t d*		k g	h
f v	s z	š ž		
		č ǰ*		
m	n	ɲ	ŋ*	

*These sounds appear to be present only on the surface.

The sounds [r], [d] and [z] are surface variants of one another. The glide [r] appears in intervocalic position: [oku-rima] 'to cultivate'. The voiced stop [d] appears in post-nasal position: [okuu-n-dim-ir-a] 'to cultivate for me'. The sounds [d] and [r] alternate with [z] before the vowel [i] in certain affixes, shown below. The sound [ǰ] appears to be an allophone of [g], appearing before front vowels. There are five vowels [a e i o u] with [e] and [i] being closer to [ɛ] and [ɪ].

4.1.1 Consonant Mutations in the Causative and Perfective

A number of consonantal alternations take place in Runyankore. Most of these are a species of coronalization (see e.g., Hume 1994) or spirantization. Generally they occur before the high front vowel [i] and result in palatalization, or before the causative morpheme [y] and result in coronalization (with [−anterior]) of the consonant. However, in some cases, the consonant undergoing the change is already a coronal. In those cases, the result is usually a type of frication/affrication.

(39) Consonant mutations induced by the vowel [i] in the morpheme [-ire]

a.	t → ts[9]	a[huut	+	ire	→	a[húúts-ire	'he slurped (yest.)'
b.	r → z	a[bar	+	ire	→	a[baz-íre	'he counted'
c.	š → s	a[héeš	+	ire	→	a[hees-íre	'he forged (metal)'
d.	ž → z	a[beiž	+	ire	→	a[béíz-ire	'he carved'
e.	k → č	a[heek	+	ire	→	a[hééč-ire	'he carried'
f.	g → ǰ	a[hiing	+	ire	→	a[hiinǰ-íre	'he cultivated'
		3S[ROOT	+	PERFECTIVE			

[9] This segment frequently is also pronounced as [s]. This alternation is probably socio-linguistically influenced. The closely related language Rukiga is recorded to make use of this sound before [i].

In fact, the data in (39) represent three different consonant mutations. The first is a morpho-phonologically conditioned spirantization of a coronal sound ([ts] and [z]). The second involves the loss of a [−anterior] feature because of an OCP violation involving the vowel [i] ([s] and [z]). Finally, we see an example of coronalization in which a dorsal sound becomes alveo-palatal before [i]. The first two sounds in questions may seem to be less like a natural class until one considers the fact that [r] and [d] are positional variants of each other ([d] only appears after a stop and alternates with [z] in the same way that [r] does).

The causative morpheme [y] causes slightly different effects. As the forms in (40) show, the coronals [t] and [z] spirantize. However, the glide [y] of the causative is lost. On the other hand, the dorsals [k] and [g] become [−anterior] coronals, with the preservation of the glide.

(40) Consonant mutations induced by the causative

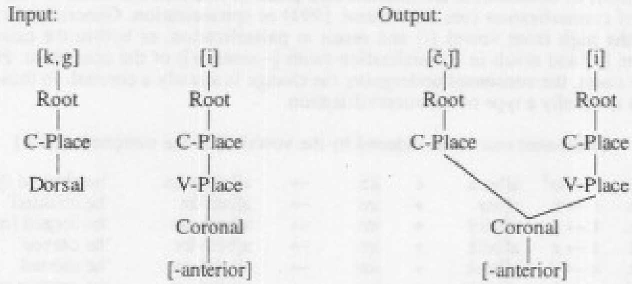
a.	t → ts	oku[haata	+	y	→	oku[haatsa	'to cause to peel'
b.	r → z	oku[bara	+	y	→	oku[baza	'to cause to count'
c.	k → tsy	oku[hika	+	y	→	oku[hitsya	'to cause to arrive'
d.	g → zy	okw[ooga	+	y	→	o[kwoozya	'to wash (tr.)'
		INFINITIVE	+	CAUSATIVE			

The coronals [t] and [r] spirantize as with [-ire]. However, the dorsal sounds [k] and [g] become palatalized coronals. The sounds [š], [ž],and [č] do not participate in this process because of suppletive principles that substitute the alternative causative affix [-is-].

(41) oku[beiž-is-a 'to cause to carve'
oku[raaš-is-a 'to cause to shout'
oku[čač-is-a 'to cause to mince'

When a dorsal sound, [k] or [g], is followed by [-ire], the [−anterior] value of the vowel [i] must be shared by the consonant. This is accomplished via the linking of the vocalic [Coronal, −anterior] features to the place node of the velar, replacing it. The resulting sound is an alveo-palatal [č] or [ǰ].

(42) Coronalization of Dorsals



The constraint that requires this output configuration (the shared V-Place Coronal node) will be referred to as CORONALIZE.

(43) CORONALIZE A dorsal sound in the input that is adjacent to a front vowel must share the Coronal place with the vowel on the surface.

Unlike coronalization, which is widespread and regular throughout Runyankore, the spirantization of [r] and [t] is conditioned only by a small set of morphemes. These morphemes are the causative [y], the perfective suffix [-ire], and the nominalizing suffix [-i] (e.g., √kor 'work', [omu-koz-i] 'worker'). Historically, all three had the superhigh vowel *į. Runyankore no longer contrasts the superhigh vowels, *į and *ų from the high vowels (i.e., they have merged to [i] and [u], respectively). However, the spirantizing effects of the superhigh vowels persist in Runyankore. Because the high front vowel [i] in these three spirantizing affixes is the same as a nonspirantizing [i], we must resort to a morpho-phonological constraint that requires these sounds to surface as affricates or fricatives when followed by the vowel [i] in one of these morphemes. The constraint responsible for this is given in (44).

(44) SPIRANTIZE — An Coronal, [+anterior] sound in the input should be pronounced as an affricate or fricative when followed by [y] causative, [-ire] perfective, or [-i] agentive.[10]

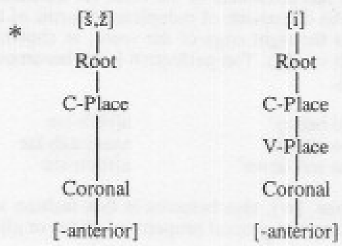
The coronal sounds [t] and [r] both spirantize. The alveopalatal fricatives [š] and [ž] become [s] and [z], which will be analyzed as a form of the OCP applying to the feature [−anterior]. The dorsal sounds [k] and [g] become alveopalatal fricatives—a process analyzed as a sharing (or spreading) of the vocalic place of the vowel [i]. In order for the effect of this constraint to appear, the SPIRANTIZE constraint must outrank the constraint requiring input-output identity, IO-IDENT. Furthermore, because the glide [y] is lost when the causative is the conditioning morpheme, the SPIRANTIZE constraint must be understood to force the deletion of a glide in this context, violating MAX.

Tableau 6 oku [bar - y - a 'to cause to count'

	SPIRANTIZE	MAX
☞ a. oku[baza		*
b. oku[bazya	*	
c. oku[barya	*	

Finally, let us consider the alternation of [š] with [s] and [ž] with [z]. When followed by the perfective morpheme [-ire] they surface as [s] and [z], respectively. This is dissimilation—the loss of the feature [−anterior] because of the [−anterior] vowel.

(45) [−anterior] dissimilation



[10] With further research into the consonantal phonology of Runyankore, I hope to be able to "unpack" the notion of spirantization.

The prohibition against the structure in (45) is resolved by delinking or eliminating the [−anterior] specification on the [š] or [ž]. The constraint that enforced this is a member of the OCP family and I will refer to it as OCP[−ANT].

(46) OCP[−ANT] A [−anterior] sound may not be followed by a [−anterior] sound.

In Runyankore the constraint MAX-[ANT], which requires [−anterior] specifications to survive on the surface, must be ranked below OCP[−ANT], as shown in Tableau 7.

Tableau 7 a [beiž - ire 's/he carved'

	OCP[−ANT]	MAX-[ANT]
☞ a. a[beiz-ire		*
b. a[beiž-ire	*!	

Even though coronalization, spirantization, and anterior-dissimilation are distinct, for the sake of elucidating the issue at hand, I will use an abbreviation to subsume both of them: *CORONAL*. Failure to mutate before this vowel (the vowel [i] of this affix in particular) will result in a violation of *CORONAL*.

(47) CORONALIZE, SPIRANTIZE, OCP[−ANT] ⇔ *CORONAL*

The important phonological alternation relevant to reduplication involves palatalization/spirantization. In the non-reduplicating environment, we can deduce that the constraint requiring input-output faithfulness is ranked below the constraint requiring palatalization as shown in Tableau 8.

Tableau 8 a[bar + ire 'he counted'

	CORONAL	IO-IDENT
☞ a. a[baz-íre		*
b. a[bar-íre	*!	

4.1.2 The Position of Glides within the Verb

The causative [y] has another property that is relevant to reduplicative identity—the glide always appears just after the last consonant of the verb. As we shall see below, in Section 5.1, this will be relevant to the discussion of reduplicated forms of these words. The affix [y] always tries to stay near the right edge of the word, as shown by the infinitive and perfective forms of the verb in (48). The perfective [-ire] becomes [-ize] because of the causative—[-ir-y-e] → [-ize].

(48)	oku[reeb-y-a	'to betray'	a[rééb-ize	's/he betrayed'
	okw-éé[taas-y-a	'to intrude'	ayee[tááh-ize	's/he intruded'
	oku[roob-y-a	'to wet down'	a[róób-ize	's/he wet down'

The passive morpheme, [w], also behaves in this fashion as shown in (49). This suggests that rightward shifting is a general property of glides or glide morphemes.

(49) a. oku[reeb-w-a 'to be seen'
a[rééb-ir-w-e 's/he was seen'

b. oku[káraang-w-a 'to be dry roasted'
bi[karaanj-ir-w-e 'they$_8$ were dry roasted'

c. oku[biingwa 'to be driven away'
e[biinj-ír-w-e 'it$_9$ was driven away'

Hyman (1995) reports a similar phenomenon in Cibemba, a Bantu language spoken in Zambia. In Cibemba, the causative and passive morphemes also appear at the edge of the word, as shown in the data from Hyman in (50). The first column represents the passive form of the stem and the third column, the passive perfective ([-ile]).

(50)	cít-w-a	'be done'	cít-il-w-e
	fúl-w-a	'be forged'	fúl-il-w-e
	tém-w-a	'be cut'	tém-el-w-e

The causative morpheme [y] behaves the same way. The forms in parentheses in (51) are the phonetic form—the combination of the causative with the perfective results in [š].

(51)	kúm-y-a	'touch'	kum-is-y-e	(kum-iš-e)
	luf-y-a	'lose'	luf-is-y-e	(luf-iš-e)
	lis-y-a	'make cry'	lis-is-y-e	(liš-iš-e)
	saam-y-a	'make sparkle'	saam-is-y-e	(saam-iš-e)

The fact that this effect is found in other Bantu languages supports the notion that there is a specific constraint responsible for the shifting of glides to edge position. Given this, I will employ a constraint aligning a glide with the left edge of the verb.

(52) ALIGN(GLIDE, RIGHT; WORD, RIGHT) ALIGN(GL,R)

Of course, as we have seen, this edge-alignment is not absolute. The glide never ends up at the very end of the verb. In general there are no long vocoids at the edge of a word in Runyankore (as well as in other Bantu languages, for evidence of this effect in Kikirewe, see Odden, 1996). For example, a word-internal glide in an onset of a syllable results in a long vowel on the surface, but not if the vowel is final. The first set of words in (53) show the long vowel after a glide. However, if the glide-vowel sequence is word-final, the vowel is never long.

(53)	a. oku[byaama	'to sleep'
	oku[čweera	'to spit'
	oku[myoora	'to twist'
	oku[rwaana	'to fight'
	b. oku[rya	'to eat'
	oku[gwa	'to fall'
	oku[čebwa	'to be mashed'
	oku[reebya	'to betray'

It is for this reason that no words in Runyankore end in long vowels, glides or diphthongs (which are phonologically long). The prohibition against long vocoids at the edge of the word in Runyankore will assign marks to any of these structures. The constraint is shown in (54).

(54) *VV] No long vocoids (vowels or vowel+glide sequences) at the edge of the word.

The appearance of the glide in the penultimate position on the surface is the result of this constraint being ranked above the constraint requiring the glide to align to the right edge of the word. A vowel-glide sequence within a syllable nucleus is long, violating *VV]. Moreover, a consonant-glide-vowel sequence should result in a long vowel. Such a vowel would not surface according to *VV].

(55) *VV] >> ALIGN(GL, R)

The ranking in (55) is illustrated, along with the constraints SPIRANTIZE and MAX in Tableau 9.

Tableau 9 a [roob - y - ire 's/he wet (something) down'

	*VV-EDGE	AL(GL.R)	CORONAL	MAX
☞ a. a[róób-ize		*		y
b. a[rrobý-ire		**!*		
c. a[róób-irey	*!			
d. a[róób-izye		*	*!	
e. a[róób-irye		*	*!	

The optimal form in Tableau 9 has the spirantized version of the consonant [r] of the perfective. Because the glide is not visible on the surface in candidate (a), I will assume that the grammar evaluates the ALIGN(GL, R) constraint based also on the effect of the glide (the spirantization of [r]). Candidate (b) fails because the glide is too far from the edge of the verb—it could be closer. Candidate (c) fails because the glide cannot be at the absolute right edge of the word. Finally, candidates (d) and (e) fail because they do not show the spirantization effects, which include deletion of the glide.

Next, I will examine further the role of these constraints in the perfective and a further problem involving sequences of spirantized segments.

4.1.3 Consonant Alternation in the Causative Perfective

As we saw above, the last consonant of a CVC root alternates between the basic and palatalized/spirantized form in the non-perfective, and the perfective form of the stem (from adding [-ire]). The causative shifts from [CVC-y-a] to [CVC-ir-y-e], which surfaces as [CVC-ize] owing to spirantization of [r].

(56) a. oku[baza ← bar+y̲+a 'to make count'
a[bar-íze ← a+bar+ir-y̲-e 's/he made count'

b. oku[šáza ← šar+y̲+a 'to slice with'
a[šar-íze ← a+šar+ir-y̲-e 's/he sliced with'

c. oku[ramutsya ← ramuk+y̲+a 'to greet'
a[ramúč-ize ← ramuk+ir-y̲-e 's/he greeted'

d. oku[heza ← her+y̲+a 'to finish (tr.)'
a[her-íze ← a+her+ir-y̲-e 's/he finished (tr.)'

e. okw[iimutsya (like b.) 'to raise up (tr.)'
a[yimúč-ize 's/he raised up'

f. okw-éé[taas-y-a 'to intrude'
ayee[tááh-ize 's/he intruded'

However, the final [r] of the root [bar] fails to surface as [z] despite SPIRANTIZATION. This is also true of the final [s] in the root √taah, in (56f). The sound [r] never appears as [z] before the perfective plus causative morpheme combination, [-ize]. The sequences [ziz] and [siz] violate a species of the OCP. I will account for this using a constraint against these sequences: OCP-z. For example, the word in Tableau 10 could undergo spirantization in both [r]s. However, only the last [r] of the word spirantizes. Compare this with a form exemplified in Tableau 11 in which palatalization and spirantization both take effect (in the optimal parse). Finally, to avoid absolute final placement of the glide we again invoke the constraint that prohibits long vocoids (long vowels and diphthongs) at the edge of a word: *VV].

Tableau 10 a [bar - y - ire '<s/he made count' (3s + √count + CAUS + PERF)

	*VV]	AL(GL,R)	OCP-z	*Coronal*	IO-IDENT
☞ a. a[bar-íze		*		*	*
b. a[baz-íze		*	*!		**
c. a[baz-íre		**!*		*	*
d. a[baz-íre-y	*!				

In Tableau 10, we see the ranking of constraints relating to the consonant mutation and glide effects. Candidate (a) is optimal because it satisfies the constraints the best. Candidate (b) fails because the inner [r] is spirantized (satisfying *Coronal*, but violating OCP-z). Candidate (c) misaligns the glide—the glide is not aligned closely enough to the right edge of the word. Candidate (d) fails because the glide is too close to the edge of the word. Notice that candidate (a) also has a *Coronal* violation. This violation occurs because the [r] of the root, √*bar*, is not spirantized. However, this is necessary to avoid violating OCP-z, as does candidate (b). Compare Tableau 10 with Tableau 11 below.

Tableau 11 a [ramuk- y - ire 's/he greeted'

	*VV]	AL(GL,R)	OCP-z	*Coronal*	IO-IDENT
☞ a. a[ramúč-ize		*			*
b. a[ramúk-ize		*		*!	
c. a[ramúč-ire		**!*		*	
d. a[ramúč-irey	*!				

In this case, the OCP-z constraint is irrelevant. Candidate (b) fails because the [k] of the root is not coronalized (to obey *Coronal*). Candidate (c) fails because the glide is misaligned. Candidate (d) fails because the glide is too far to the right, violating *VV].

5 Base-Identity and Input-Identity

Now, we can consider the issue of interest here—the relationship between the base and the reduplicant in instances when there is a causative morpheme [y] present. The important issue under consideration here revolves around the question of reduplicant and base identity. What is the relationship of identity that holds between the reduplicant, the input and the base?

What we find in Runyankore is that the reduplicant tends to resemble the input more closely than the surface form of the base. The data presented thus far tend to obscure this fact owing to the similarity between the input and the base. However, if we consider verb forms exhibiting a large divergence between the input and the base, we will discover that the reduplicant tends to conform more closely to the input while the base diverges from the input. In the reduplicated words in (57) the reduplicant (underlined) resembles more closely the stem of the infinitive—palatalization is not copied from the base.

(57) a. oku[heeka 'to carry'
akáá[heeč-ire 'he should carry'
akáá[heeka-heeč-ire 'he should carry …'

b. oku[bara 'to count'
a[baz-íre 's/he counted (yesterday)'
a[bará-baz-ire 's/he counted …'

c. oku[huuta 'to drink from a bowl'
a[húúts-ire 's/he drank from a bowl (yesterday)'
a[huutá-huuts-ire 's/he drank from a bowl …'

d. oku[jeenda 'to go'
a[jeenz-íre 's/he went (yesterday)'
a[jeendá-jeenz-ire 's/he went …'

e. oku[kwaata 'to catch'
a[kwaats-íre 's/he caught (yesterday)'
a[kwaatá-kwaats-ire 's/he caught …'

This basically suggests that the constraint ranking here is such that the phonotactic constraint responsible for selecting palatalized/spirantized forms of consonants (*CORONAL*) must rank above the constraint requiring base-reduplicant identity. Because of this ranking, the base will undergo consonant mutation and need not be completely identical to the reduplicant. The constraint requiring faithfulness of the reduplicant to a base form must rank above the base-reduplicant identity constraints. Because we must compare the reduplicant with the input base, the relevant constraint is a member of the I(nput)-R(eduplicant)-Faithfulness family.

(58) INPUTREDUPLICANT-FAITHFULNESS >> BASEREDUPLICANT-IDENTITY

In other words, it is more important for the reduplicant to resemble the input than it is for the reduplicant to be like the base. This is illustrated in Tableau 12.

Tableau 12 a - RED - jeend - ire 'he went …'

	IR-FAITH	BR-ID
☞ a. a[jeendá-jeenz-ire		*
b. a[jeenzá-jeenz-ire	*!	

The optimal candidate in Tableau 12 is the one which most closely resembles the input, [jeend]. The spirantizing effects of the perfective morpheme cannot be copied into the reduplicant because of this fact.

Similarly, the constraint requiring the spirantization of the [d] in this word must rank above the constraint requiring base-reduplicant identity. This is illustrated below in Tableau 13, where *CORONAL* ranks above BR-ID.

Tableau 13 a - RED - heek - ire

	CORONAL	BR-ID
☞ a. a[hééka-heeč-ire		*
b. a[hééka-heek-ire	*!	

The reduplicant in the optimal candidate in Tableau 13 must obey the constraint *CORONAL* despite the fact that the result is a violation of base-reduplicant identity.

The constraints input-reduplicant faithfulness and *CORONAL* must both outrank base reduplicant identity. However, they cannot be ranked with respect to each other as shown by Tableau 14 where the optimal form violates neither.

Tableau 14 a - RED - heek - ire

		IR-FAITH	*CORONAL*
☞ a.	a[hééka-heeč-ire		
b.	a[hééka-heek-ire		*!
c.	a[hééča-heeč-ire	*!	

These rankings total up to the following.

(59) RED-FORM ≫ ALIGN-L, ANCH-L, CORONAL, IR-FAITH ≫ BR-IDENT, BR-MAX

The constraints on reduplicant form and location along with the constraint requiring palatalization (before the appropriate morphemes beginning with the vowel [i]) both outrank the constraints on base-reduplicant faithfulness.

Tableau 15 a[ɟeend + íre + RED 's/he went …'

		REDF	*CORORAL*	IR-FAITH	BR-ID	BR-MAX
☞ a.	a[ɟeendá-ɟeenz-ire				*	-ire
b.	a[ɟeenzá-ɟeenz-ire			*!		-ire
c.	a[ɟeendá-ɟeend-ire		*!			-ire
d.	a[ɟeendí-ɟeenz-ire	*!	*			-re
e.	a[ɟeenzíre-ɟeenz-íre	*!				

Although candidate (a) violates the constraints on base-reduplicant identity, it satisfies the higher ranked constraints of the reduplicant form, the constraint *CORONAL* and the constraint on input-reduplicant faithfulness. Candidate (b) copies the coronalization features of the base in the reduplicant—satisfying BR-ID. However, IR-FAITH outranks BR-ID. Because the reduplicant has a segment with a feature value different from the input, it incurs a violation here and fails to pass muster. Candidate (c) satisfies both IR-FAITH and BR-ID but fatally fails to show spirantization of the segment [d], failing *CORONAL*. Candidates (d)–(e) all fail immediately owing to their ill-formed reduplicants.

What Tableau 15 tells us is that reduplicant must resist the copying of features that appear in the base caused by the consonant-mutating effects of the vowel [i]. For this reason, the constraint requiring input-reduplicant faithfulness ranked higher than the constraints requiring faithfulness between the reduplicant and the surface form of the base. In a theory of ordered derivational rules, the reduplication would precede any phonological interaction between the high vowel and preceding consonants.

5.1 Causative Complexities

The addition of the causative morpheme to the verb creates an additional level of complexity to the relationship between the input and the reduplicant. We would expect, given the result seen above (especially in Tableau 15) to find that the causative morpheme simply appears at the right edge of the word and that there is no copying of it in the reduplicant. However, this is not the case. Consider the following reduplicated verbs that also involve the causative morpheme [y] in (60).

(60)	a. oku[taaha	'to enter'
	oku[taas-y-a	'to bring in'
	oku[taasya-taas-y-a	'to bring in …'
	b. oku[hika	'to arrive'
	a[hič-íre	's/he arrived'
	a[hiká-hič-ire	's/he arrived …'
	c. oku[[hič-a	'to cause to arrive'
	a[hičá-hič-ize	's/he caused to arrive …'
	d. oku[guza ← gur+y+a	'to sell' ('cause to buy')
	a[gur-íze	's/he sold'
	a[guzá-gur-ize	's/he sold …'
	e. okw[óoga	'to wash'
	okw[óoz-y-a	'to wash (tr.)'
	okw[óózya-yooz-y-a	'to wash … (tr.)'
	f. okw[ootsya ← (ok + y + a)	'to roast, burn'
	okw[ootsya-yootysa	'to roast …'
	a[yoč-íze	's/he roasted'
	a[yotsyá-yoč-ize	's/he roasted …'

What is striking about the words in (60) is that the reduplicant appears to copy some features of the surface base that were not copied when the agent of coronalization was the perfective, [-ire]. The behavior of the reduplicant (what features it must copy) is different when the causative is present. In (60a), the glide also appears in the reduplicant. The lack of consonant-glide interaction makes this easier to see. In (60c), the causative causes coronalization of the stem-final consonant. Notice that when the meaning is only 'he arrived …' the coronalization is not copied to the reduplicant. However, if the meaning is causative, then the reduplicant ends in [č], a coronalized [k]. However, this cannot simply be a case of copying from the base—consider (60b, d, & f). In this case, the reduplicant and the base are different. What can explain this array of differing relationships between the reduplicant and the base?

It is important to note the common element in all of these cases: the causative morpheme /y/. It appears in the reduplicant and in the base. For example, in [a[hičá-hič-ize]] "he caused to arrive …' the first [č] is a result of the causative (or some correspondent of it), while the second is a result of the high from vowel at the left edge of the perfective. This must be the case because the causative has induced spirantization of the [r] to [z] in the perfective.

Yet, we know that the reduplicant is not merely a copy of the base (i.e., the surface form of the input) because of the disparity between the reduplicant and the base in the perfective, as in (60d). It appears that there is at least one morpheme, the causative, whose corresponding segment and influence (i.e., spirantization) appears in both the base and the reduplicant, obeying base-reduplicant identity. But, such words as [a[guzá-gurize]] 'he sold …' demonstrate that the copying cannot be just on the surface.

In fact, what we observe from the very first set of data in (60), repeated here as (61) is that what appears in both the reduplicant and the base is the causative morpheme.

(61) a. oku[taaha 'to enter'
oku[taas-y-a 'to bring in'
oku[<u>taasya</u>-taas-y-a 'to bring in …'

This accounts for [a[<u>guzá</u>-gur-ize]] 'he sold …'. The [z] of the reduplicant is the product of the [r+y] combination of the last consonant of the stem and the correspondent of the causative morpheme.

How does a correspondent of this morpheme appear in two locations that do not correspond positionally? By examining the input to the surface form, it is possible to see how the causative morpheme can be copied into the reduplicant. Assume that the input looks something like (62)

(62) a + RED + hik + y + ire 3s+RED+√arrive+CAUSATIVE+PERFECTIVE

To best satisfy the MAX-BR constraints, the grammar will try to copy as much out of the base as it can. If this is the case, then it will try to copy [hiky]. In the case of a simple perfective reduplication, the string that is copied from is [hik-ire]. However, the grammar will not copy the moraic element [i] from the perfective affix because that would involved copying an unneeded mora into a slot to be filled with [a]—the final vowel as required by the constraints on REDFORM. But, copying of the glide [y] can be accomplished because the resultant reduplicant, with the addition of the vowel [a] as required by *REDFORM*, will still satisfy the constraints on reduplicant length.

Consider the inputs in (63). In the perfective, the segments copied into the reduplicant are [hik]. However, when the causative [y] is included the segments that are copied are [hiky].

(63)	Perfective	Perfective & Causative
Input	a + RED + hik + ire	a + RED + hik + y + ire
'Intermediate'	a + <u>hik</u>-⟨a⟩ + hik + ire	a + <u>hiky</u>-⟨a⟩ + hik + ir-y-e
Final	a[<u>hiká</u>-hičire	a[<u>hičá</u>-hičire

The intermediate line is not a stage in the derivation—it is simply expository. As one can see, the causative is copied into the reduplicant because it is adjacent to the right edge of the base. This is the case even though the causative 'migrates' to the right edge of the word (i.e., GEN moves it there and this satisfies the constraint ranking). At this point, one might argue that the morphemes in the input are not ordered with respect to one another. Consider what happens if you try this with a verb root that is longer than one syllable.

(64) a. oku[reenǰez-a 'to wink at, hint'
oku[<u>reenga</u>-reenǰez-a 'to wink at, hint …'
a[reenǰ-éize 's/he hinted'
a[<u>reengá</u>-reenǰ-eize 's/he hinted …'

b. oku[ramutsy-a 'to greet'
oku[<u>rama</u>-ramutsya 'to greet …'
a[ramúč-ize 's/he greeted'
a[<u>ramá</u>-ramuč-ize 's/he greeted …'

In the words in (64) there is a causative morpheme. The evidence for this can clearly be seen in the simple perfective, where the perfective is [-ize], showing the spirantizing effect of [y]. Observe, however, that the reduplicant shows no trace of the causative affix. Notice also that the reduplicant is shorter than the base. The glide is not adjacent to the last consonant copied into the reduplicant, as it was above, in (63).

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Kikamba Verb Stem Tonology*

R. Ruth Roberts-Kohno

0. Introduction

Verb stems in the Bantu language Kikamba have a number of different tone patterns on the surface, depending on the tense, aspect and clause type that the verb appears in. In fact, there are 15 verbal tone patterns in Kikamba. However, far from being a random collection of unrelated patterns, this range of melodies emerges from the interaction of a small set of independent and interacting tone assignment parameters.

In (1) we find a few examples of verb stems and the different melodies which can occur.

(1)	a. to-kaa-[	kon-a	we will hit
		$[_{stem}$ root-final vowel	
	b. to-kaa-[	kon-an-a	we will hit each other
		$[_{stem}$ root-extension-final vowel	
	c. ne-to-[	kon-an-í-ɛ̂	we hit each other yesterday
		$[_{stem}$ root-extension-t/a-final vowel	

In Kikamba, as in many Bantu languages, tense-aspect distinctions are marked not only by selection of appropriate prefixes and suffixes, but also by the stem tone pattern.

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Kikamba has a large number of tone patterns available to it partially because, unlike other Bantu languages, Kikamba is a four-level tone language; these tones are seen in (2).

(2)	SH = super high (̋)	kota̋la̋	L = low	(unmarked, or as ̄ in derivations for clarity)	kokonà
	H = high (́)	kosáno.à	SL= super low	(̀)	koβálokà

The verbs in (3) demonstrate the 15 surface tone melodies, using the lexically H-tone verb /tál/, meaning 'count.' The analysis of these patterns into a system of independent parameters will be the focus of this paper.

(3)	1. moond' óól' ɔ̋ɔkaa[tála	man who will count (future)
	2. nétónáa[tálilɛ̀	we counted (recent past)
	3. moond' óóla̋ twaa[tálílɛ́	man we counted (remote past)
	4. nétwáa[tálílɛ̂	we counted (remote past)
	5. ko[tálanelà	to count for each other (infinitive)
	6. toíkaa[tálanelá	we will not count for each other (future)
	7. nétó[tála.â	we always count (habitual)
	8. toí[tálá.â	we don't always count (habitual)
	9. [tálána	count each other! (imperative)
	10. nóo[táléilɛ́	he counted for (today past)
	11. moond' óól' ɔ̋ɔ[tálááŋgéetɛ	man who has counted (pres. perf. cont.)
	12. nóo[tálááŋgɛ̂ɛ̀tɛ̀	he has counted a little (pres. perf. cont.)
	13. toí[tálááŋgéetɛ̂	we have not counted a little (present perfect)
	14. moond' óóla̋ tó[tálááŋgilɛ́	man who we counted a little (today past)
	15. nétó[tálááŋgéetɛ̂	we have counted a little (pres. perf. cont.)

We first demonstrate that Kikamba has a lexical distinction between H-tone verbs and toneless verbs, a distinction found in all tenses. Then we show that there is a phrasal SL tone which appears in conjunction with affirmative main clause verbs. We next motivate a set of rules pertaining to how a SL tone interacts with adjacent tones, and provide examples of how these tones are manifested phonetically. With that general background to Kikamba tonology, we turn to the system of morphologically-induced tone melodies. We show that the 15 tone melodies of Kikamba can be accounted for by these general principles interacting with three principles of grammatical tone assignment, which are outlined below.

(4) Grammatical Tone Assignment Principles

1. Melodic V_2-High (henceforth, V_2H) tone assignment:
   Assign a H tone to the second μ of the verb stem.
2. Final tone assignment:
   Assign a H, L, SL, or Falling tone to the final μ of the verb stem.
3. Penultimate L tone assignment:
   Assign a L tone to the penultimate μ of the verb stem.

As we will see, some tenses make use of only one of these parameters, while others combine parameters.

1. General tone facts

1.1 Base pattern: Lexical tone

The simplest pattern involves just the lexical tone without grammatical tones. We will refer to this as the base tone pattern. An example of the base pattern is seen in (5), where we find the affirmative, relative clause form of the future tense. (5a) gives a toneless verb, which has only L tones in the stem, and (5b) is a H-tone verb with H on the first stem mora.

(5)	/kon/	toneless verb	hit
	/tál/	H-tone verb	count

Future, relative clause form: Base pattern

a. moond' óól' ɔ̃okaa[kona — man who will hit

b. moond' óól' ɔ̃okaa[tála — man who will count

Other tenses which have the base tone pattern are seen in (6).

(6) Future, negative relative clause form

a. moond' óól' ɔ̃otákaa[kona — man who will not hit

b. moond' óól' ɔ̃otákaa[tála — man who will not count

Immediate past, relative clause form

c. moond' óólá̃ wáá[kona — man who just hit

d. moond' óólá̃ wáá[tála — man who just counted

Habitual, relative clause form

e. moond' óól' ɔ̃ɔ[kona.a — man who always hits

f. moond' óól' ɔ̃ɔ[tála.a — man who always counts

1.2 Phrasal SL Tone

Now we turn to a general phrasal SL tone. In addition to the lexical tone, main clause affirmative verbs are marked by the presence of a phrase-level SL tone. We will refer to this morphosyntactic class of verbs as assertive. This is demonstrated in (7a,b), where the verb surfaces with a final SL tone. We can verify that this SL is a phrase-level tone by placing an object after the verb. As seen in (7c), the noun 'bananas' ends in a L tone in isolation. However, as seen in (7d,e), when placed after an assertive verb, a SL tone surfaces on the noun. Note also that the verb itself surfaces with a regular L tone, not a SL.

(7) Recent past, assertive form: Base pattern and Phrasal SL tone

a. nétónáa[koni.ɛ̀ — we hit
b. nétónáa[tálilɛ̀ — we counted
c. ma.i.o — bananas
d. nétónáa[koni.ɛ ma.i.ò — we hit bananas
e. nétónáa[tálilɛ ma.i.ò — we counted bananas

Habitual, relative clause form: Base pattern
f. moond' óól' ɔ́ɔ[kona.a — man who always hits
g. moond' óól' ɔ́ɔ[tála.a — man who always counts
h. moond' óól' ɔ́ɔ[kona.a maio — man who always hits bananas
i. moond' óól' ɔ́ɔ[tála.a maio — man who always counts bananas

The syntactic distribution of this SL tone is complex, but the basic fact is that a SL tone is inserted at the end of any VP beginning with an assertive verb. We can show that the SL on the object in (7d,e) is due to the assertive verb by comparing these examples to ones where a non-assertive verb has an object, as in the habitual relative clause forms of (7f-i). The non-assertive verb does not have a SL prepausally, and an object following such a verb lacks the SL. Thus the final SL in (7a,b) is due to a general phrasal rule. In (8), we see other assertive verb forms that are also characterized by the base pattern and a phrasal SL.

(8) Present progressive, assertive form
a. nétó.o[konà — we are hitting
b. nétó.o[kona maiò — we are hitting bananas

Habitual, assertive form
c. nóo[tála.à — he always counts
d. nóo[tála.a maiò — he always counts bananas

1.3 Tone Rules

We now turn to tone rules that apply generally throughout the grammar.

1.3.1 Word-level Tone Rules

There are three word-level tone rules which interact with a SL tone. To illustrate these rules, we will use the assertive form of the immediate past tense. In (9), we have a bimoraic toneless verb. In (9a) we get the form we expect: the phrasal SL surfaces on the final mora of the verb. And in (9b), the SL surfaces on the final mora of the object, not on the verb, just as seen in the examples in (8).

(9) Toneless, bimoraic verb
a. néwáá[konà — he just hit
b. néwáá[kona maiò — he just hit bananas

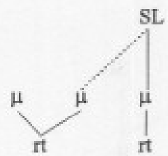
However, with a bimoraic H-tone stem, or in a verb with a long penultimate syllable, there are different surface patterns. In (10), we have a toneless verb with a long penult. In (10a), an object follows the verb, and the phrasal SL surfaces on the object as expected. However, in (10b), there is a SL tone not only on the final, but also on the penultimate mora.

(10) Toneless verb with a long penultimate syllable

a. néwáá[suuŋga maiò	he just guarded bananas
b. néwáá[suùŋgà	he just guarded
*néwáá[suuŋgà	

In fact, a long syllable with a regular L tone is virtually never followed by a SL tone. Instead, the SL surfaces on the long penult. This can be explained by the rule of SL-Spread, seen in (11). When a final SL is preceded by a long penultimate syllable, the SL tone spreads leftward to the second mora of the penult.

(11) SL-Spread



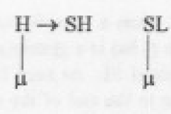
In (12), we have a H-tone verb with a long penultimate syllable. In (12a), we find the expected phrasal SL on the object. In (12b), when the verb is phrase-final, the SL surfaces on the verb, and we notice that the SL spreads leftward to the long penult.

(12) H-tone verb with a long penultimate syllable

a. néwáá[léɛŋga maiò	he just aimed at bananas
b. néwáá- léɛŋgà → néwáá[léɛ̀ŋgà	he just aimed at

However, the H tone of the verb has also become a SH tone. This is due to the rule of Raising, which is seen in (13). This rule raises a H to a SH just in case the following mora bears a SL tone. SL-Spread creates the environment for Raising in (12), and therefore, SL-Spread feeds Raising.

(13) Raising[1]



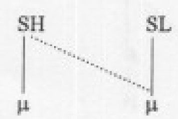
[1] Note that raising in this context appears to be a dissimilation of pitch level and is not predicted by any current theory of tone features, in which tone interaction is assimilatory. Thus, Kikamba may be evidence that a feature such as [peripheral] is needed in the theory of tone features. (See Ao 1993 for a proposal for 4- and 5-tone languages using the feature [extra].)

Finally, (14) demonstrates the behavior of a bimoraic H-tone verb. In (14a), the phrasal SL shows up on the object. When the verb is phrase-final in (14b), we find SH on both stem moras.

(14) H-tone, bimoraic verb
a. néwáá[tála maiò — he just counted bananas
b. néwáá- tálà → néwáá[tálá̋ — he just counted

First the lexical H raises to SH by Raising, since it is followed by a final SL, though not a SL on the surface. Subsequently, we apply the rule SH-Doubling, seen in (15a). SH-Doubling spreads a SH tone to a following SL syllable just in case the SL tone is singly-linked. Thus, SH-Doubling occurs in (15b) where the final SL is linked to only one vowel, but does not apply in (15c) where the SL is doubly-linked. This rule explains the surface generalization that SH can never immediately precede a word-final SL tone.

(15) a. SH-Doubling



b. néwáá[tálá̋ — he just counted (14a)
c. néwáá[lɛ́ɛ̀ŋgà — he just aimed at (12a)
*néwáá[lɛ́ɛ́ŋgà

1.3.2 Phrase-level Tone Rules

In addition to the phrasal SL discussed in 1.2, there is a word-level grammatical SL tone which is assigned to the end of a verb in certain tenses.[2] We now turn to two phrase-level rules, which will be crucial in distinguishing this word-level SL from the phrasal SL. The first rule deletes a SL tone on a head if it is followed by a complement. The crucial fact is that this rule does not apply if the SL tone is a phrasal SL tone, but only if it is a word-level grammatical SL tone.

(16) a. ko[konà — to hit
b. ko[kona maio — to hit bananas

The verb in (16a) ends in a SL tone, but when a complement is added in (16b), the SL disappears. This is because the SL tone in (16a) is a grammatical SL tone. Compare this behavior to that of a verb ending in a phrasal SL. As seen before, the phrasal SL at the end of the assertive verb in (17a) migrates to the end of the complement in (17b), rather than deleting. To summarize, we can identify the SL tone in (16) as grammatical, while the SL in (17) is phrasal.

[2] This will be explained further in section 2.

(17) a. nétóɔ́náa[koni.ɛ̀ we hit
b. nétóɔ́náa[koni.ɛ ma.i.ɔ̀ we hit bananas

A second rule applies just in case a Falling tone is in phrase-medial position. As we will see later, one of the possible grammatical tones that can be assigned to the end of the verb stem is a Falling tone, seen in (18a).

(18) a. toí[konéetɛ̂ we have not hit
b. toí[konéetɛ́ maio we have not hit bananas

However when a complement is added, we no longer have a Falling tone at the end of the verb, but instead we have a SH tone, as seen in (18b). This is due to a phrase-level rule that changes a Falling tone to a SH tone in phrase-medial position. We can compare the behavior of grammatical Falling tone in (18) with that of a surface Falling tone in (19), which arises by combining a final H with the phrasal SL. In (18), prepausal grammatical Fall corresponds to SH medially, whereas in (19), prepausal Fall due to phrasal SL corresponds to plain H plus SL on the following object.

(19) a. tokáa[konâ we will hit
b. tokáa[koná maiɔ̀ we will hit bananas

Thus, we see that there is evidence for a distinction between word-level grammatical SL and Falling tones, versus phrase-level SL that surfaces as either a SL or a Falling tone. (20) summarizes the behavior of grammatical versus phrasal tones.

(20) a. Grammatical tones
SL tone → ∅ when followed by complement
Falling tone → SH in phrase-medial position
b. Phrasal SL tone
SL tone moves to end of first complement following an assertive verb

What we have seen so far about tone can be summarized as in (21).

(21) Summary of Tone Facts
1. The base tone pattern is for verbs to bear a H or L on the first stem mora.
2. There is a SL inserted at the end of the phrase when the verb is assertive.
3. The considerable range of surface tone patterns can be accounted for by low-level rules pertaining to the presence of a SL at the end of a word, (i.e. SL-Spread, Raising, and SH-Doubling).

2. Grammatical Tone Assignment in Verbs

We will now turn to the principles of grammatical tone assignment, and show that the system of grammatical tone reduces to three independent parameters interacting with the general tone rules of the language.

2.1 Tone Assignment Principle 1: Melodic V_2H tone assignment

The first grammatical tone principle is V_2H assignment, which assigns a H to the second mora of the verb stem. The tenses given in (22) illustrate this pattern, and we notice that the second stem vowel bears a H tone. Moreover, all subsequent vowels of the stem also have H.

(22) Tenses exhibiting the Base pattern and V_2H tone:

Remote past, relative clause form

a. moond' óólá twaa[koníɛ́	man we hit
b. moond' óólá twaa[tálílɛ́	man we counted

Habitual, negative relative clause form

c. moond' óólá tota[koná.á	man we don't always hit
d. moond' óólá tota[tálá.á	man we don't always count

Remote past perfect, negative main clause form

e. toyáa[konááŋgɛ́ɛ́tɛ́	we hadn't hit a little
f. toyáa[tálááŋgɛ́ɛ́tɛ́	we hadn't counted a little

These forms can be accounted for by two rules. First, as seen in (23a), a H tone is assigned to the second mora of the verb stem: this rule applies only in specified grammatical contexts. This V_2H spreads rightward by (23b). These two rules alone suffice to account for (22): there is no phrasal SL here, because these are non-assertive verb tenses.

(23) a. V_2H tone assignment b. V_2H tone spread (iterative)

H H

[stem μ μ μ μ

It should be noted that this V_2H tone is the only tone which is allowed to spread, which raises the question of why other tones do not spread. One possibility is that other tones, such as lexical tones, must remain linked only to those vowels which they are underlyingly associated with. Thus, since this V_2H tone is a melodic tone not underlyingly associated with any vowels, it is allowed to spread. In Correspondence theory terms, one could postulate a constraint requiring tones to be aligned both on the left and right to the vowels which sponsor them. And since a melodic tone is not sponsored by any particular vowel, it is allowed to spread.[3]

In (24) we see that the assertive future and remote past tenses follow a similar pattern: they have the lexical tone and the V_2H. In addition, there is a phrase-final SL tone due to the fact that these are assertive verbs, as seen in (24). Since these verbs end in a H tone, the phrasal SL tone combines with the final H to give a surface Falling tone.

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3 This Correspondence theory account was suggested by David Odden (pc).

(24b,d) verify that this is a phrasal SL because SL surfaces on the following object, rather than as a SH tone on the verb (see 1.3.2).

(24) Tenses exhibiting the Base pattern, V_2H tone, and Phrasal SL tone:

Future, assertive form

a. tokáa[konâ	we will hit
b. tokáa[koná maiò	we will hit bananas
c. tokáa[tálâ	we will count
d. tokáa[tálá maiò	we will count bananas

Remote past, assertive form

e. nétwáa[koníɛ̂	we hit
f. nétwáa[tálílɛ̂	we counted

2.2 Tone Assignment Principle 2: Final tone assignment

2.2.1 Tenses with a final SL tone[4]

The second grammatical principle assigns a tone to the final vowel of the verb: the possible final tones are SL, H, L, and Fall.[5] (25) provides examples of one of the Progressive tenses, in which the tone assigned to the final mora of the verb is a SL tone.

(25) Present Perfect Progressive, negative: Base pattern and Final SL tone

a. totɛ́.o[kona.à	we haven't been hitting
b. totɛ́.o[tála.à	we haven't been counting
c. totɛ́.o[kona.a maio	we haven't been hitting bananas
d. totɛ́.o[tála.a maio	we haven't been counting bananas

Since this tense is not assertive, the final SL in (25a,b) must be grammatical, not phrasal. This is confirmed in (25c,d), where an object follows the verb. If the SL were phrasal, it would have surfaced on the object. Instead, this grammatical SL deletes before a complement, as explained in 1.3.2. Other tenses following this pattern are seen in (26).

(26) Other tenses exhibiting the Base pattern and Final SL tone:

Infinitive form

a. ko[konà	to hit
b. ko[kona maio	to hit bananas
c. ko[tálanelà	to count for each other
d. ko[tálanela maio	to count bananas for each other

Remote past, negative form

e. tóyáá[konanà	we didn't hit each other
f. tóyáá[tálanà	we didn't count each other

[4] Note that we are now discussing the word-level grammatical SL tone, not the phrasal SL tone.

[5] In this section, we only discuss tenses with a final SL and a final H tone, since final Fall and final L only occur in conjunction with one of the other two principles, and will be discussed in 2.3.

Today past, negative relative clause form

g. moond' óólá̋ toinaa[koneðyà — man who we didn't cause to hit

h. moond' óólá̋ toinaa[táleðyà — man who we didn't cause to count

Although this SL is a grammatical tone assigned to specific tenses, a look at other verb stem types in (27) demonstrates that the rules of SL-Spread, Raising, and SH-Doubling are applicable, indicating that they are general rules in the grammar. They apply when the SL is in the appropriate environment, regardless of the nature of the SL tone.

(27) Infinitive form

toneless verbs with a long penultimate vowel (SL-Spread applies)

a. ko[maàndà — to search

b. ko[liìndà — to cover

H-tone verbs with a long penultimate vowel (SL-Spread and Raising apply)

c. ko[sɛ̋ɛ̀mbà — to run

d. ko[kőònzà — to fold

H-tone verbs with a short penultimate vowel (Raising and SH-Doubling apply)

e. ko[tá̋lá̋ — to count

f. ko[tú̋βá̋ — to pay wages

In (27a,b), SL spreads left to the long penult. In (27c,d), there is SL-Spread, and since these verbs have a H tone, Raising also applies giving a surface SH tone. (27e,f) provide examples of Raising as well. In addition, the derived SH spreads rightward since the final SL is singly-linked. We provide the examples in (28) to demonstrate that by placing an object after the verb in these tenses, the grammatical SL deletes as expected.

(28) Remote past, negative form

a. toyá̋á̋ꜜ- tál-à → toyá̋á̋ꜜ[tá̋lá̋ — we didn't count

b. toyá̋á̋ꜜ[tála maio — we didn't count bananas

Infinitive form

c. ko-tál-à → ko[tá̋lá̋ — to count

d. ko[tá̋la maio — to count bananas

2.2.2 Tenses with a final H tone

Another tone that can be assigned to the final mora of the verb is a H tone. The negative future tense in (29) is assigned a final H.

(29) Future, negative: Base pattern and Final H tone

a. toìkaa[konaná — we will not hit each other

b. toìkaa[tálanelá — we will not count for each other

Other tenses which follow the same pattern are seen in (30).

(30)	Immediate past, relative clause form	
	a. moond' óólá twáa[koná	man we just hit
	b. moond' óólá twáa[tálá	man we just counted
	Habitual, relative clause form	
	c. moond' óólá to[kona.á	man who we always hit
	d. moond' óólá to[tála.á	man who we always count

In (31) we see other tenses which have the final H as well. Since these are assertive verbs, they also have a phrasal SL tone. The phrasal nature of the SL is confirmed by placing an object after the verb: as expected, the phrasal SL surfaces on the object, rather than surfacing as a SH tone on the verb (see 1.3.2).

(31)	Tenses exhibiting the Base pattern, Final H tone, and Phrasal SL tone:	
	Immediate past, assertive form	
	a. nétwáa[konâ	we just hit
	b. nétwáa[koná maiò	we just hit bananas
	c. nétwáa[tálâ	we just counted
	d. nétwáa[tálá maiò	we just counted bananas
	Habitual, assertive form	
	e. nétó[kona.â	we always hit
	f. nétó[kona.á maiò	we always hit bananas
	g. nétó[tála.â	we always count
	h. nétó[tála.á maiò	we always count bananas

2.3 Combinations of parameters

We now turn to melodies involving combinations of parameters. This section explains the tone patterns of the tenses which are characterized by some combination of V_2H tone, Final tone, and Penultimate L tone assignment, as well as a phrasal SL in the relevant clause types. We will see that the third principle, Penultimate L tone assignment, only occurs in conjunction with one of the other tone assignment principles.

2.3.1 Combinations with V_2H tone assignment and Final tone assignment

In (32), the negative habitual and negative subjunctive tenses are characterized by the addition of a V_2H and a final SL to the basic lexical contrast. V_2H then spreads right, and a SL is assigned to the final mora, where it surfaces as a Falling tone because of its combination with a final H.

(32)	Tenses exhibiting Base pattern, V_2H tone, and Final SL tone:	
	Habitual, negative forms	
	a. toí[koná.â	we don't always hit
	b. toí[tálá.â	we don't always count

Subjunctive, negative forms

c. toikaa[konánɛ̂	let's not hit each other
d. toikaa[tálánɛ̂	let's not count each other
e. toikaa[tálɛ̂	let's not count
f. toikaa[tálɛ́ maio	let's not count bananas

This SL tone is not the phrasal SL, since this verb tense is nonassertive, a context not characterized by the phrasal SL. (32f) directly demonstrates that the final SL is grammatical, and not phrasal, since it does not surface on a following object. Instead, the Falling tone changes to a SH before a complement.

In (33), we see examples of the imperative and the affirmative relative clause form of the today past. These tenses are characterized by the addition of a V_2H and a final L. What should be noted about these forms is that the V_2H does not spread all the way to the final syllable. First, the V_2H is assigned to the second mora, and the L is assigned to the final mora. After these tones have been assigned, the V_2H spreads rightward; spreading stops at the penult, since the final mora already bears a L tone. Thus, grammatical final L behaves differently from grammatical final SL. When there is a grammatical SL, V_2H spreads to the final. After spreading, the SL tone is added, resulting in a Falling tone created by the H-SL combination, as seen in (32).

(33) Tenses exhibiting Base pattern, V_2H tone, and Final L tone:

Imperative, affirmative form

a. [konána	hit each other!
b. [tálána	count each other!

Today past, relative clause form

c. moond' óól' ɔ̃ɔ[konéíε	man who hit for
d. moond' óól' ɔ̃ɔ[táléílε	man who counted for

However, it should be noted that if the imperative verb stem is bimoraic, the addition of the final L occurs on the final mora, even though the final mora already bears a H tone. We therefore have a case of a Falling tone created from a H-L sequence: [konâ 'hit!' This fact demonstrates that the second half of a Falling tone is not always a SL tone, since in the imperative it is a regular L tone. Thus, we conclude that a Falling tone alone does not constitute evidence of the presence of a SL tone. Where possible, we must look to longer forms to determine if a tense is characterized by a L tone or a SL tone.

Moreover, H-tone bimoraic imperative forms pose another problem. The imperative form of 'count!' is [tálà. We might expect a Falling tone to surface on the second mora, resulting from V_2H assignment and final L assignment, as observed in the verb 'hit!' However, only a L surfaces on the second mora. A likely explanation for this fact has to do with the OCP, and will be addressed in the last section of the paper.

In (34), we see the 3rd singular, assertive form of the today past. This tense employs V_2H and a final L tone, and in addition has the phrasal SL tone. In (34a,b), the SL surfaces on the final mora of the object, confirming that this is a phrasal SL.

However, (34c,d) have a different surface tone pattern, with two final SH tones. As seen in (34e-k), this is simply the result of the general tone rules discussed earlier, which apply when a SL tone is present. After the assignment of lexical tone in (34e), H is assigned to the second stem mora in (34f), and a L is assigned to the final mora in (34g). Then in (34h), the V_2H spreads rightward until it reaches a mora already bearing a tone. Thus, H stops spreading at the penult. (34i) shows that the phrasal SL tone is assigned to the final mora, deleting the final L tone. This results in H and SL on adjacent moras, which is the relevant environment for rules creating and spreading SH. First, Raising occurs as in (34j). This triggers SH-Doubling in (34k), resulting in the surface form.

(34) Today past, 3rd singular, assertive form:
Base pattern, V_2H tone, Final L tone, and Phrasal SL tone

a. nóo[konéiɛ maiò	he hit for bananas
b. nóo[táléilɛ maiò	he counted for bananas
c. nóo[konéi̋ɛ̋	he hit for
d. nóo[táléi̋lɛ̋	he counted for

Derivation of (34c)

e. Lexical tone assignment	nóo[táleilɛ
f. V_2H tone assignment	nóo[táléilɛ
g. Final L tone assignment	nóo[táléilɛ̀
h. V_2H spread	nóo[táléílɛ̀
i. Phrasal SL assignment	nóo[táléílɛ̏
j. Raising	nóo[táléi̋lɛ̏
k. SH-Doubling	nóo[táléi̋lɛ̋

2.3.2 Combinations with Tone Assignment Principle 3: Penultimate L tone assignment

The third parameter of tono-grammatical inflection is the addition of a penultimate L. This tone is always added in conjunction with either a V_2H or a Final tone. The penultimate L pattern is seen in (35) with the 3rd person, affirmative relative clause form of the present perfect continuous. This form has a V_2H and a penultimate L tone. The H is assigned to the second mora of the verb stem, and the L is assigned to the penultimate mora. The spreading of the V_2H stops with the antepenult, since the penultimate mora already bears a L tone.

(35) Present perfect continuous, 3rd singular, relative clause form:
Base pattern, V_2H tone, and Penultimate L tone

a. moond' óól' ɔ́ɔ[konááŋgéetɛ	man who has hit a little
b. moond' óól' ɔ́ɔ[tálááŋgéetɛ	man who has counted a little

Another pattern is seen in (36). These assertive forms are constructed by combining the basic lexical contrast with a V_2H, a penultimate L, and the phrasal SL tone of assertive verb forms. This phrasal SL is clearly seen in (36a,b), where it surfaces on the object.

(36) Present perfect continuous, 3rd singular, assertive form:
Base pattern, V_2H tone, Penultimate L tone, and Phrasal SL tone
a. nóo[konááŋgéetɛ maiò he has hit bananas a little
b. nóo[táláá ŋgéetɛ maiò he has counted bananas a little
c. nóo[konááŋgé̄ètɛ̄ he has hit a little
d. nóo[táláá ŋgé̄ètɛ̄ he has counted a little

In (36c,d), however, the phrase-final form of the verb has a different surface tone pattern. As seen in (37), this follows automatically from the rules that we have already posited.

(37) Derivation of (36c)
a. Lexical tone assignment nóo[tálaaŋgeetɛ
b. V_2H tone assignment nóo[táláaŋgeetɛ
c. Penultimate L tone assignment nóo[táláaŋgeētɛ
d. V_2H spread nóo[tálááŋgéētɛ
e. Phrasal SL assignment nóo[tálááŋgéētɛ̄
f. SL-Spread nóo[tálááŋgé̄ètɛ̄
g. Raising nóo[tálááŋgé̄ètɛ̄

We begin with the lexical tone in (37a). In (37b,c), we assign the V_2H and the penult L. After these tones have been assigned, V_2H spreads rightward, as in (37d), until the L-tone penult, where it stops. In (37e) the phrasal SL links to the final mora. In (37f), the SL spreads left by SL-Spread. We now have a H tone adjacent to a SL tone, so Raising occurs, as seen in (37g).

In (38), we see another combination of parameters, as well as examples of a final Falling tone. The present perfect tense is characterized by a V_2H, a penultimate L, and a final Fall. All tones are assigned and then V_2H spreads up until it reaches a mora already bearing a tone, which in this case is the penult.

(38) Present perfect, negative form:
Base pattern, V_2H tone, Penultimate L tone, and Final Falling tone
a. toí[konááŋgéetɛ̂ we have not hit a little
b. toí[tálááŋgéetɛ̂ we have not counted a little

Another combination of parameters is found in (39). These tenses have a V_2H, a penult L, and a final H. As expected, the grammatical tones are assigned to the appropriate position and the V_2H spreads.

(39) Tenses exhibiting Base pattern, V_2H tone, Penultimate L tone, and Final H tone:
Today past, relative clause form
a. moond' óólá tó[konááŋgi.ɛ́ man who we hit a little
b. moond' óólá tó[tálááŋgilɛ́ man who we counted a little

Present perfect continuous, relative clause form
c. moond' óólá tó[konááŋgéetɛ́ man who we hit a little
d. moond' óólá tó[tálááŋgéetɛ́ man who we counted a little

Present perfect continuous, negative relative clause form
e. moond' óólá tótá[konéetɛ́ man who we haven't hit yet
f. moond' óólá tótá[táléetɛ́ man who we haven't counted yet

We now turn to (40), where we find more examples of the today past, affirmative relative clause tense. The examples here are monosyllabic verb roots, in contrast to those given in (39a,b). These examples are interesting because the entire stem consists of only three moras: these verb stems are too short to accomodate all the grammatical tones. In such a case, we would expect there to be a strategy for determining which tones surface in the verb. As seen in (40), H-tone verbs and toneless verb verbs actually choose different strategies for determining the surface tone pattern.

(40) Trimoraic verb stems (from Monosyllabic verb roots)
Today past, relative clause form
toneless verbs → choose the V_2H tone
a. moond' óólá tó[koníɛ́ man who we hit
b. moond' óólá tó[eβíɛ́ man who we paid

H-tone verbs → choose the penultimate L tone
c. moond' óólá tó[tálilɛ́ man who we counted
d. moond' óólá tó[tómi.ɛ́ man who we sent

(41) demonstrates the final combination of parameters. Like the examples in (39) and (40), these tenses select V_2H, a penult L, and a final H. In addition, they take a phrasal SL since they are assertive verbs.

(41) Today past, assertive form
a. nétó[konááŋgi.ɛ̂ we hit a little
b. nétó[tálááŋgilɛ̂ we counted a little

Present perfect continuous, assertive form
c. nétó[konááŋgéetɛ̂ we hit a little
d. nétó[tálááŋgéetɛ̂ we counted a little

We see that the same problem which we encountered in (40) arises in these forms as well. When we look at the trimoraic verb stems in (42), which arise with monosyllabic roots, we again find that there are not enough moras to accomodate all the tones that are assigned. As in the relative clause forms, the toneless verbs and H-tone verbs choose different strategies for determining which tones surface. The toneless verbs choose the V_2H tone, and the H-tone verbs choose the penultimate L.

(42) Trimoraic verb stems (from Monosyllabic verb roots)
Today past, assertive form
toneless verbs → choose the V_2H tone

a. nétó[koní.ɛ̂	we hit
b. nétó[eβíɛ̂	we paid

H-tone verbs → choose the penultimate L tone

c. nétó[tálilɛ̂	we counted
d. nétó[tómi.ɛ̂	we sent

One possible explanation for these different strategies has to do with avoiding an OCP violation: the initial and penultimate mora of the stem may not both bear a H tone if they are adjacent. This is demonstrated in (43a), with a derivation of (42a,c) in (43b).

(43) a.

```
*      H           H
       |           |
  [stem μ          μ        μ]
```

b. Derivation of (42a,c)

Lexical tone assignment	nétó[koni.ɛ	nétó[tálilɛ
V_2H tone assignment	nétó[koní.ɛ	N/A, OCP-violation
Penultimate L tone assignment	N/A, penultimate μ already bears a tone	nétó[tál īlɛ
Final H tone assignment	nétó[koní.ɛ́	nétó[tál īlɛ́
V_2H Spread	N/A	N/A
Phrasal SL assignment	nétó[koní.ɛ̂	nétó[tálilɛ̂

Recall that there is one other case seen where the OCP appears to play a role. In the imperative of bimoraic verb stems, H-tone verbs and toneless verbs also behave differently. The forms are repeated in (44):

(44)

a. [konâ	hit!
b. [tálā	count!

This tense is characterized by a V_2H and a final L tone. But in the H-tone verb /tál/, only the final L appears. Thus, placing a H tone on the final mora when it is adjacent to a H-tone stem-initial mora is also a violation of the OCP. We could modify our constraint against adjacent H tones as follows:

(45)

```
*      H         H
       |         |
  [stem μ        μ      (μ)]
```

Appealing to the OCP explains why H-tone and toneless bimoraic verbs behave differently in the imperative as well as in the today past tense. However, if the OCP is the explanation for H-tone and toneless monosyllabic verbs behaving differently in these two tenses, it is interesting that it is only found in this specific context, whereas H tones are otherwise free to occur on adjacent moras. The revised constraint in (45) may also indicate that we need to appeal to foot structure or final extrametricality to explain the behavior of bimoraic and trimoraic verb stems in Kikamba. At any rate, this result indicates that further investigation is required to determine what role OCP-type phenomena play in Kikamba tonology.

3. Conclusion

In conclusion, we have demonstrated that the complex system of verb stem tone patterns in Kikamba can be accounted for by the interaction of a small set of general tone parameters. Lexically, the initial mora of the verb stem may be H or L. Assertive verbs are assigned a phrasal SL. This phrasal SL is affected by general tone rules in the language, resulting in a variety of surface tone patterns. And finally, we have shown that Kikamba employs three principles of grammatical tone assignment: V_2H tone assignment, Penultimate L tone assignment, and Final tone assignment. Together, these relatively few parameters can explain the wide variety of tonal patterns found in Kikamba verb stems.

Reference

Ao, Benjamin. 1993. The Phonetics and Phonology of Nantong Chinese. Columbus: The Ohio State University dissertation.

factors, it is interesting that it is only found in this specific context, whereas H tones are otherwise free to occur on adjacent moras. The second constraint in (xx) may also indicate that we need to appeal to foot structure or local autosegmentality to explain the behavior of [illegible] and [illegible] each mora in Kikamba. At any rate, this result indicates that further investigation is required to determine what role OCP-type phonotactics play in Kikamba tonology.

5 Conclusion

In conclusion, we have demonstrated that the seemingly chaos of verb stem tone patterns in Kikamba can be accounted for by the interaction of a small set of general tone parameters. Lexically, the initial mora of the verb stem may be H or L. Aspectual verbs are assigned a phrasal H. This phrasal H is affected by general tone rules in the language, resulting in a variety of surface tone patterns. And finally, we have shown that Kikamba employs three principles of grammatical tone assignment: TAM tone assignment, Penultimate L tone assignment, and Final tone assignment. Together these relatively few parameters can explain the wide variety of tonal patterns found in Kikamba verb stems.

References

Xu, Benjamin. 1993. The Phonetics and Phonology of Mandarin Chinese. [illegible] The Ohio State University dissertation.