North East Linguistics Society

Volume 29 *Proceedings of the North East Linguistic Society 29 -- Volume One: Papers from the Main Sessions*

Article 19

1999

Reduplication in Ju|'hoansi: Tone Determines Weight

Amanda Miller-Ockhuizen
The Ohio State University

Reduplication in Ju|'hoansi: Tone Determines Weight*

Amanda Miller-Ockhuizen

The Ohio State University

1. Introduction

The Northern Khoisan language Ju|'hoansi displays interesting phonological behavior in verbal reduplication. The reduplication discussed in this paper is partial, which prefixes a syllable to the full root. The weight of the prefixed syllable is dependent on the tonal shape of the root word. If the root is bitonal, then the reduplicant is bimoraic. However, if the root is monotonal, then the reduplicant is monomoraic. This gives strong evidence for phonetic contour tones in Ju|'hoansi being composed of two separate level tones as argued by Miller-Ockhuizen (1998), and not contour units as has been claimed for !Xóõ (Traill, 1985), a related Khoisan language. It also crucially shows that there is a constraint requiring no more than one tone per mora. Ju|'hoansi reduplication exemplifies a case where tonal faithfulness interacts with tonal well-formedness in order to overcome constraints on segmental faithfulness, and faithfulness to other prosodic categories, such as syllable membership. Since tones in the base do not always appear on the same mora in the reduplicant, the requirement on tonal faithfulness cannot be analyzed as a more general faithfulness condition which encompasses both segmental and prosodic faithfulness on the base and the reduplicant. While the separateness of tones and segmental material has been known for many years, this is the first evidence that this separation also holds for Khoisan languages as well, since tones generally are maintained within single morphemes. There is no tone spread or tone reassociation.

*The research resulting in this paper was supported by a National Science Foundation Dissertation Grant to the author (David Odden, Project Director) entitled "Phonetics and Phonology of Ju|'hoan", SBR 9705334. I would also like to acknowledge the help of my consultants at |Xoan n!huru, Namibia. Additionally, thanks to Beth Hume and David Odden for helpful comments and suggestions on an earlier draft of this paper, as well as the OSU *Phonies* (Phonetics and Phonology Reading Group) at OSU for their helpful comments.

Pius Tamanji, Masako Hirotani, and Nancy Hall (eds.), NELS 29: 261-276

2. Overview of Ju|'hoansi Prosody

Since the shape of the reduplicant in partial reduplication depends on both the shape of the base (root), and the tonal pattern of the base, it is necessary to first gain an understanding of the different types of verb root shapes and tonal patterns which are attested in the language.

The shape of verb roots in Ju|'hoansi is highly constrained. The majority of roots are either monosyllabic, usually containing a long vowel or a diphthong, or bisyllabic with two short vowels, leading to the generalization that the majority of roots are bimoraic. Some roots have a final nasal consonant, [m], which is assumed to be moraic, since it bears tone. Additionally, [m] never occurs in words that already contain two other vowels, such as CVV words where the vowel is a diphthong, or in bisyllabic words. However, there are a few exceptional cases of CVVCV, most of which are actually CV'VCV, the first vowel being an interrupted vowel. There are also trimoraic roots with diphthongs in the first syllable. The attested root shapes are shown schematically in (1), along with examples of each type.

(1) Attested Root Shapes[1]

CVV	tshìì	'to laugh'	g‖àá	'to lend'
CVm	n!ầʰm	'to look for'	n|ầm̀	'to dance'
CVCV	ǂʰáró	'to peel'	gǂxàβá	'to trip'
CV'VCV	!ò'òβà	'to be neat'	g!ù̃'úní	'to tighten'
CV_1V_2CV	kòàrà	'to not have'	nǂə̀ùcé	'to be slow'

Each type of root can have either one or two tones, but roots with interrupted vowels have an affinity towards being bitonal. There are four tone levels, but only six of the predicted tonal patterns are attested on verb roots. Verbs bear all four level tones, plus two of the three possible combinations of rising tones. The third possible rising tone, H SH, occurs only very rarely on nouns. This is expected, since SH tones are in general very rare. All of the attested tone patterns, and example words exhibiting each pattern, are given in (2) below:

[1]Note that superscripted n indicates nasalization of the preceding vowel, superscripted h indicates breathiness of all vowels preceding the h, ' indicates an interrupted vowel (Snyman,1977), and superscripted q indicates an epiglottal quality on the preceding vowel. The interrupted vowels are monosyllabic with glottalization on the vowel. Data throughout this paper are also marked for syllabification with a period separating syllables.

(2) Tonal Patterns on Ju|'hoansi Verb Roots

Monotonal Verbs

SL	SL	kȁȕʰ	'to light a fire'	kə̏rȅʰ	'to praise'
L	L	|xə̀ì	'to spit'	ǂhànà	'to be scraped'
H	H	n|óá	'to cook'	g!úβú	'to bubble up'
SH	SH	!ə̋ű	'to move house'		

Bitonal Verbs

SL	L	n|hȕì	'to take'	!ə̏bì	'to color in'
L	H	g|kùí	'to twist'	n|òβá	'to walk fast'

There is also one falling tone pattern (HL) which only occurs on loanwords. Since most loanwords are nouns, there are no verbs exhibiting this pattern. Additionally, the SH SH pattern only occurs on monosyllabic roots. There are no bisyllabic verbs which have this pattern, although I have uncovered some bisyllabic nouns which exhibit this pattern. Miller-Ockhuizen (1998) discusses the constraints responsible for the severe restrictions on tonal patterns within single morphemes.

3. Reduplication in Monotonal Verb Roots

First I will examine the basic reduplication patterns which arise depending on the root shape, keeping the tonal patterns consistently monotonal. First in (3) we see that when the root is monosyllabic, the entire root is copied.

(3) Reduplicated Forms of Monotonal Monosyllabic Roots

n|ȕȕ^{n}	'to be grumpy'	n|ȕȕ^{n}.n|ȕȕ^{n}	'to cause to be grumpy'
t̏ȉʰ	'to be heavy'	t̏ȉʰ.t̏ȉʰ	'to cause to be heavy'
cə̀ò	'to be wide'	cə̀ò.cə̀ò	'to widen'
tòà^{n}	'to be finished'	tòà^{n}.tòà^{n}	'to cause to be finished'
!əú^{n}	'to be sick'	!əú^{n}.!əú^{n}	'to make ill'
!kə̋ű	'to be dry'	!kə̋ű.!kə̋ű	'to dry off'

However, as shown in (4), if the root is bisyllabic and monotonal, then the prefixed syllable will be an exact copy of the first syllable of the root. Since the first syllable is almost always light in bisyllabic roots, the reduplicant will also be light.

(4) Reduplicated Forms of Monotonal Bisyllabic Roots

Reduplicant is Causative Morpheme

ǂʔʰù.βì	'to be crowded'	ǂʔʰù.ǂʔʰù.βì	'to cause to crowd together'
gkʰù.rì	'to become visible'	gkʰù.gkʰù.rì	'to cause to be visible'
ǂʰà.mà	'to take'	ǂʰà^{n}.ǂʰà.mà	'to cause to take'
xə́.βə́	'to sting (of skin)'	xə́.xə́.βə́	'to cause to sting'

Reduplicated Form Expresses Continuous Motion or Action

gǂkò.ɾò	'to pour'	gǂkò.gǂkò.ɾò	'to empty out'
xò.ɾè	'to scrape out '	xò.xò.ɾè	'to scrape continuously'
!ò.ɾò	'to knock on s.t.'	!ò.!ò.ɾò	'to knock continuously'
xə̀^{n}.mə̀	'to scrape together'	xə̀^{n}.xə̀.mə̀	'to scrape all together'
ǂkò.βò	'to boil a long time'	ǂkò.ǂkò.βò	'to boil all of the water out'
tcò.βò	'to give off steam'	tcò.tcò.βò	'to steam continuously'
tsxɔ̃̀.ɾʊ̃̀	'to spill'	tsxɔ̃̀.tsxɔ̃̀.ɾʊ̃̀	'to spill all over'

The reduplicant is always one syllable in monotonal forms. It is heavy when the root is a heavy monosyllable, but light when the root is bimoraic and bisyllabic. One generalization which can be drawn from the data for monotonal roots is that the reduplicant in partial reduplication in Ju|'hoansi always corresponds to the first syllable of the base. Another generalization is that reduplication only copies vowels, and doesn't skip intermediate consonants in order to maintain a consistent weight in the reduplicant. However, as will be discussed in section 3, the facts are different when the root is bitonal. The generalization that the reduplicant always corresponds to the first syllable of the base is not upheld. In the next section, I will present an Optimality Theoretic analysis of the monotonal verb facts, before turning to a discussion of bitonal verb roots in section 4.

3.1. OT Analysis of Reduplication in Monotonal Verbs

In order to account for these facts, I propose the constraints in (5) below:

(5)	RED = σ:	The Reduplicant is a syllable.
	CONTIGUITY B-R:	All Elements which are Contiguous in the Base are contiguous in the Reduplicant.
	NO CODA:	Syllables do not have codas.
	MAX B-R:	All segmental material in the base has corresponding material in the reduplicant.

The first constraint is the templatic constraint which requires the reduplicant to be a syllable. Contiguity rules out skipping segmental material when copying, and NO CODA accounts for the fact that there are no coda consonants. MAX B-R requires segmental identity between the base and the reduplicant.

The bisyllabic verbs motivate the ranking of the constraints, so I will discuss these first. As shown in (6), the (a) candidate, which copies both vowels in the base, is ruled out by CONTIGUITY B-R, since this candidate has adjacent vowels in the reduplicant, which are not adjacent in the base. The (b) candidate is ruled out by NO CODA. The (c) candidate is ruled out by the templatic constraint, RED = σ, since the reduplicant is two syllables. The (d) candidate is the best, since it satisfies all of the higher ranked constraints, at the expense of low ranked MAX B-R.

(6) Monotonal CVCV Base

RED - ǂʔʰùbì	RED = σ	CONTIGUITY B-R	NO CODA	MAX B-R
a. ǂʔʰùì.ǂʔʰù.βì		*!		*
b. ǂʔʰùβ.ǂʔù.βì			*!	*
c. ǂʔʰù.βì.ǂʔʰù.βì	*!			
d.⇒ ǂʔʰù.ǂʔʰù.βì				**

In the case of monosyllabic verbs, the candidate which best satisfies the constraints is the (a) candidate, since it copies all material without violating any of the other constraints.

(7) Monotonal CVV Base

RED - còà	RED = σ	CONTIGUITY B-R	NO CODA	MAX B-R
a. ⇒ còà. còà				
b. cò.còà				*!

Copying all material does not violate CONTIGUITY since there is no medial consonant to skip. The crucial rankings established by monotonal reduplicated forms is given in (8):

(8) Constraint Ranking

RED = σ, CONTIGUITY B-R, NO CODA >> MAX B-R

This constraint ranking accounts for all of the monotonal verbs. As will be shown in the next section, the patterns differ with bitonal verbs, which motivates the addition of a separate constraint on tonal faithfulness.

4. Bitonal Verb Roots

The generalization that the reduplicant corresponds to the first syllable of the root breaks down when the root is bitonal. If the root is monosyllabic and bitonal, the pattern is the same as above, as shown in (9a). That is, the reduplicant corresponds exactly to the first syllable of the base. However, as shown in (9b), if the root is bisyllabic and bitonal, the reduplicated prefix also copies both vowels in the root deriving a heavy syllable, even though this requires skipping an intermediate consonant. This is the opposite of what we saw in section 3.1, where monotonal bisyllabic roots had light reduplicants, which I argued was due to the ranking of CONTIGUITY B-R over MAX B-R.

(9) (a) Reduplicated Forms of Bitonal Monosyllabic Roots

g!ʰə̃ĩⁿ	'to move from sideways'	g!ʰə̃ĩⁿ.g!ʰə̃ĩⁿ	'to move from side to side'
n|ù ̏ĭ	'to be shiny'	n|ù̏ĭ.n|ù̏ĭ	'to cause to be shiny'

(b) Reduplicated Formsʃ of Bitonal Bisyllabic Roots

tsxə̀.βí	'to grab'	tsxə̀í.tsxə̀.βí	'to grab forcefully'
|xə̃̀.m̀	'to poke a hole'	|xə̃̀ĩⁿ.|xə̃̀m̀	'to drill a hole'
n‡àˤ.ró	'to find s.t.'	n‡àˤó.n‡àˤ.ró	'to find a lost object'
‖xə̀.rí	'to fry'	‖xə̀í.‖xə̀.rí	'to cause to fry'

These data falsify the generalization that the reduplicant always corresponds to the first syllable of the base. However, it leads to a new generalization: that the full tone pattern is always preserved in reduplication. If the base is bitonal, then both vowels will be copied so that there will be two moras that can bear the two tonemes.

Since none of the constraints proposed thus far require tonal faithfulness, or tonal well-formedness, the constraint ranking given thus far will not predict the difference between bitonal and monotonal verbs. The constraint ranking in (8) will incorrectly predict that the reduplicant in bitonal bisyllabic verbs should be a light syllable. This incorrect result is shown in (10) below:

(10) Incorrect Prediction in Bitonal Bisyllabic Roots

RED - tsxə̀βí	RED = σ	CONTIGUITY B-R	NO CODA	MAX B-R
a. tsxə̀í. tsxə̀.βí		*!		*
b. tsxə̀β. tsxə̀.βí			*!	*
c. tsxə̀.βí. tsxə̀.βí	*!			
d.☒ tsxə̀.tsxə̀.βí				**

The (d) candidate wins over the (a) candidate, because it satisfies CONTIGUITY B-R.

The key to predicting the different behavior of bitonal and monotonal bisyllabic verbs is in recognizing the differences in their tonal specifications, and in positing a constraint governing tonal faithfulness, separate from segmental faithfulness. I will offer different tonal representations for the two types of verbs in the next section, and then I will return to the Optimality Theoretic analysis of these data, in section 6.

5. Implications of Partial Reduplication for the Tonal System

Traill (1985) argues that tonemes in !Xóõ, a Southern Khoisan language, are phonological contour tones, and the tone bearing unit in the language is the word. Contrary to his analysis, Haacke (1992) has argued that phonetic contour tones in Khoekhoe, a central Khoisan language, can be decomposed into sequences of single level tones which each dock to a mora. Miller-Ockhuizen (1998) has also argued in a similar fashion for Ju|'hoansi. Reduplication in Ju|'hoansi gives further evidence for a decompositional analysis of tonal patterns in the language. If word tones were tone units, and the tone bearing unit were the word (which he argues can be monomoaric or bimoraic), as Traill has argued they are for !Xóõ, we would expect similar behavior in reduplication for monotonal and bitonal words. However, I have already shown in the previous section that monotonal and bitonal forms of bisyllabic roots behave differently with regards to reduplication. Monotonal roots have monomoraic reduplicants, while bitonal roots have bimoraic reduplicants. I argue that this disparity arises because the tone bearing unit is the mora. The second vowel in bisyllabic bases is only copied in order to get another mora to bear a second tone when the base is bitonal. In this section, I will review the structures I assume for Ju|'hoansi tones in order to explicate this point.

I argue that there is a disparity between tones on bisyllabic words such that monotonal words have single multiply linked specifications, while bitonal words contain two separate tone specifications as shown in (11):

(11) Ju|'hoansi Tonal Specifications

Monotonal Roots	Bitonal Roots
L	L H
/\	| |
μ μ	μ μ
!òrò	tsxə̀ βí

This disparity accounts for the difference in these types of words with regards to reduplication. In monotonal structures, there is only one toneme, so assuming that there is a constraint requiring only one tone per mora, only one mora is necessary to bear the tone. In the bitonal roots, however, there are two tones, so both moras are copied in order to bear each of the separate tones.

The alternative analysis is that tones are tonal contour units linked to the word in Ju|'hoansi following Traill's (1985) analysis of !Xóõ. This would result in structures as in (12), with no difference in the linking between monotonal and bitonal roots.

(12) Incorrect Contour Tone Specifications linked to the Word

Monotonal Roots	Bitonal Roots
L	LH
|	|
Σ	Σ
!òrò	tsxə̀ βí

One of Traill's arguments for word tones is that contour tones occur on monomoraic words in !Xóõ. However, Miller-Ockhuizen (1998) showed that the only monomoraic words that contain contour tones in !Xóõ are a very small set of grammatical items. Regardless, his arguments make it clear that he does not assume the mora as a tone bearing unit. Without the additional requirement that every tone must be assigned to a mora, these structures would not explain why there is a disparity between the behavior of monotonal and bitonal bisyllabic roots in partial reduplication. Under this analysis, both types of words have one tonal specification, and there should be no correlation between tone patterns and the weight of the reduplicant, as found in Ju|'hoansi.

Partial reduplication in Ju|'hoansi is of some significance, since it gives additional evidence for the underlying structure of tones in the language. The evidence from reduplication shows that contour tones in Ju|'hoansi can be decomposed into two level tones which are each linked to a mora, while monotonal bisyllabic words bear only one single tonal specification which is multiply linked to two moras. Additionally, these data shows that tones are on a separate tier from segmental structure in the language. While this is accepted as the norm for most tonal systems, it is a novel finding for Khoisan languages, where tones always surface on the mora they originate on, and there is little interaction between adjacent tones. The only kind of phrasal tonal phenomena unearthed in these languages thus far is the evidence of Downstep in reduplication, which is shown in Miller-Ockhuizen (to appear).

6. Optimality Theoretic Analysis of Bisyllabic Bitonal Verb Roots

Given the different tonal specifications of monotonal roots and bitonal roots above in (10), the analysis of the difference between monotonal and bitonal verb roots is straightforward. The disparity in the behavior of the two types of roots in reduplication follows from the fact that there is only one tonal specification in monotonal roots, but two tonal specifications in bitonal roots. I propose an additional constraint, which requires faithfulness to tone features in the base, on the part of the reduplicant. This constraint, along with a constraint requiring no more than one tone per mora, ranked above CONTIGUITY B-R, will force the copy of both vowels, skipping intermediate consonants.

The constraint on tonal faithfulness is a MAX constraint, which I give in (13) below:

(13) MAX B-R [TONE]: Every tone in the base must have a correspondent in the reduplicant.

Note that an analogous IDENT constraint would not work here, since IDENT only requires corresponding tones to be identical. The data above require MAX, which requires all tones in the base to be actually present in the reduplicant. Further, MAX does not require the tones to be on corresponding moras in the base and in the reduplicant. This will be crucial in getting the correct result for trimoraic bitonal roots in section 7.

It is also necessary to have a constraint requiring only one tone per mora, in order to account for the fact that both tones are not copied onto a single mora, as in (14):

(14) MORA = T.B.U.: Only one tone is associated to a mora.

This constraint is upheld throughout the language. As shown by Miller-Ockhuizen (1998), there are no contour tones on monomoraic words in the language as a whole. It is important to note that this constraint does not rule out doubly linked structures which I proposed in (11) above, where a single tone is mapped onto two different moras.

Assuming the above tonal specifications, ranking MAX B-R[TONE] and MORA=T.B.U. above CONTIGUITY B-R yields the correct result in bitonal forms, as shown in (15):

(15) Bitonal Roots: MAX B-R [TONE], MORA = T.B.U. >> CONTIGUITY B-R

L H RED-tsxə.βı	MAX B-R [TONE]	MORA = T.B.U.	CONTIGUITY B-R
a.⇒ tsxə̀í. tsxə̀.βí			*
b. tsxə̀.tsxə̀.βí	*!		
c. tsxə̌.tsxə̀.βí		*!	

An additional candidate, tsxə̀ə́.tsxə̀.βí, lengthens the initial vowel either through insertion of a mora, or reassignment of the second mora in the base to the first mora of the reduplicant. These candidates motivate two additional constraints given in (16) below:

(16) DEP B-R μ: Every mora in the reduplicant must have a corresponding mora in the base.

IDENT μ-V: Every mora in the reduplicant should be assigned to the same vowel in the reduplicant and in the base.

The ranking of these constraints over CONTIGUITY B-R rules out these candidates:

(17) DEP B-R μ, IDENT μ-V >> CONTIGUITY B-R

μ_1 μ_2 RED - tsxə.βi	DEP B-R μ	IDENT μ-V	CONTIGUITY B-R
$\mu_1\mu_3$ μ_1 μ_2 a. tsxəə.tsxə.βi	*!		
$\mu_1\mu_2$ μ_1 μ_2 b. tsxəə.tsxə.βi		*!	
$\mu_1\mu_2$ μ_1 μ_2 c. ⇒tsxəi.tsxə.βi			*

I give the revised constraint ranking incorporating these constraints in (18) below:

(18) Revised Constraint Ranking

RED = μ, NO CODA, MAX B-R [TONE], MORA=T.B.U., DEP B-R. μ, IDENT μ-V >> CONTIGUITY B-R >> MAX B-R

In the case of monotonal roots, there is only one tone, so MAX B-R [TONE] and MORA=T.B.U. are both satisfied by just copying one vowel, which also allows low-ranked CONTIGUITY B-R to be satisfied.[2]

(19) Monotonal Roots

L RED - ǂʔʰuβɪ	MAX B-R [TONE]	MORA = T.B.U.	CONTIGUITY B-R
a. ǂʔʰù̀ɪ.ǂʔʰù.βɪ			*!
b.⇒ ǂʔʰù.ǂʔʰù.βɪ			

The (a) candidate is ruled out by its unnecessary violation of CONTIGUITY B-R. Note that a possible third candidate, analogous to the (c) candidate in (15) above, has two low tones linked to a single vowel. It would be impossible to distinguish such a candidate from the winning candidate, since it would be no different phonetically than the winning candidate. There is no reason to presume such a candidate might win, since the analogous contour tone candidate in (15) doesn't win.

In this section, I have shown that the tonal constraint MORA=T.B.U. and a reduplication specific constraint governing tone, MAX B-R [TONE], must both crucially outrank CONTIGUITY B-R in order to account for the disparity of monotonal and bitonal bisyllabic roots with regards to reduplication. The difference in their tonal specifications which was shown in section 5 above, along with these constraints, straightforwardly accounts for this disparity. Additionally, the ranking of DEP B-R μ and IDENTμ-V over CONTIGUITY B-R accounts for the fact that initial vowels aren't lengthened in order to yield another mora for the docking of a contour tone in the reduplicant. In the next section I will discuss the behavior of trimoraic stems in reduplication.

7. Trimoraic Verb Stems

As was noted in Section 2 above, there are two types of trimoraic stems in Ju|'hoansi. One type of trimoraic stem has a simple diphthong in the first syllable. The other type has an interrupted vowel in the first syllable. The contour toned trimoraic stems are very interesting for two reasons. First, there is a difference in tone assignment in the two types of trimoraic stems. Second, the tones of the base in trimoraic stems do not always occur on the same mora in the base and in the reduplicant.

[2]There is another analysis that does not assume there is only one tone underlyingly in monotonal verbs, which would also predict the disparate behaviors of monotonal and bitonal roots. In both analyses, it is absolutely crucial that the disparity in the weight of the reduplicant arises from the difference in the tones - e.g. the light syllable bears a single tone, but the heavy syllable bears two tones. However, it is possible that the varying amounts of tonal copy in monotonal and bitonal verbs is a function of a higher ranked OCP constraint, which disallows adjacent like tones in the reduplicant. Under this account, only one tone would be copied in monotonal verbs in order to avoid violations of the OCP. Conversely, in bitonal forms both would be copied, since this would not violate the OCP. The difference between the two analyses then is that in the one I offered above, MAX B-R [TONE] is undominated, while in this alternative analysis, MAX B-R [TONE] is violated only to satisfy the OCP, so the ranking would be MAX I-R [TONE] >> OCP >> MAX B-R [TONE].

7.1. Tone Assignment in Trimoraic Verbs

There are two different types of bitonal patterns in trimoraic verb stems. All trimoraic stems have two moras in the first syllable, with a short vowel in the last syllable. Words with diphthongs in the initial syllable and words with long interrupted vowels in the first syllable have different tonal associations of two tones. In the case of initial diphthongs, the first syllable bears the first tone on both moras, and the second tone is borne on the second syllable, as shown in (20a) below. In words with initial interrupted vowels however, the entire tonal contour is borne on the first long syllable, with the final syllable bearing the same tone as the second half of the contour tone, as in (20b).

(20) (a) Bitonal Trimoraic Verbs with Initial Diphthongs

!ə̏ȕrù	'to cut a carrying strip'	‖əùrú	'to run (through)'
k^{h}əùrú	'to load off, climb'		

(b) Bitonal Trimoraic Verbs with Initial Interrupted Vowels

dȁ'àbà	'to get a fright'	nǂȁ'àrà	'to leak'
nȁ'àrù	'to sway'	ǂȁ'àbà	'to be flat'
dù'úrí	'to slough (skin), peel'	g!ù'úbú	'to swell, rise'
bȁ^{q}'àrì	'to sprout'	ja^{q}'àrà	'to quench thirst'

I assume that the tonal specifications of these verbs both have only two tones. However, the linking of the tones is different in the two cases. That is, as shown in (21), the diphthongs have the first tone doubly linked to the diphthong, while the interrupted vowels have both tones associated to the interrupted vowel.

(21) Different Tonal Representations for Trimoraic Verb Roots

Initial Diphthongs — Initial Interrupted Vowel

It is entirely predictable which words have one structure, and which the other. I attribute the distinction to the vowel phonation quality of interrupted vowels, which occur almost exclusively with rising tone. Since the interrupted vowels are made by closing the glottis momentarily, which shows up in laryngographic tracings (Traill, personal communication), this closure causes the pitch to also be interrupted at this place. It is this interruption which causes the pitch contour to rise.[3] This overrules the normal propensity to avoid contour tones within a syllable by assigning a single tone to a diphthong in the

[3] I have only found a couple of examples in my 5000 word corpus of monotonal words which contain interrupted vowels. Traill (personal communication) also founds Fo adjustments in all of the tokens of this type of vowel in his extensive corpus of !Xóõ data.

other kind of trimoraic verbs. Thus, with the addition of the articulatory constraint on tone assignment, tone assignment is predictable even in these forms. The constraints posited in (22) will account for these data:

(22) *σ=TT: Contour tones do not occur on a single syllable.
μ'μ=TT: Interrupted vowels rise in pitch.

The tableaux in (23) shows that ranking of the articulatory constraint over the constraint against contour tones within a single syllable, will account for the disparity in tone assignment in the two types of trimoraic verbs.

(23) Contour Tones on Interrupted Vowels

L H gǁo'obo	μ'μ=TT	*σ=TT
a. ⇒ gǁò'óbó		*
b. gǁò'òbó	*!	

Thus, all trimoraic words with contour tones are also bitonal. They never have more than one change in pitch. This will be important in understanding their behavior in reduplication, which will be discussed in the next section.

7.2. Reduplication in Trimoraic Verbs

The data in (24) show that both moras in the first syllable of trimoraic words are copied in reduplication, regardless of whether the base is a bitonal or monotonal verb.

(24) (a) Monotonal Trimoraic Roots with Initial Interrupted Vowels
!ò'ò.bà 'to be neat' !ò'ò.!ò'ò.bà 'to cause to be neat'

(b) Monotonal Trimoraic Roots with Initial Diphthongs
ǂxə́ú.nú 'to slip' ǂxə́ú^{n} .ǂxə́.nú 'to cause to slip'

(c) Bitonal Trimoraic Roots with Initial Interrupted Vowels
gǁò'ó.bó 'to make noise' gǁò'ó.gǁò'ó.bó 'to make a lot of noise'
ǂà'à.bà 'to be flat' ǂà'à.ǂà'à.bà 'to cause to be flat'

(d) Bitonal Trimoraic Roots with Initial Diphthongs
ǂʔə̀ù.cé 'to be slow' ǂʔə̀ú.ǂʔə̀ù.cé 'to be very slow'

Since there are two moras in the first syllable that act as tone bearers of two distinct tones, there is no discrepancy in the reduplicated forms of monotonal and bitonal trimoraic roots. Both moras of the initial vowel in trimoraic monotonal forms are copied because copying both best satisfies MAX B-R [TONE] without violating CONTIGUITY B-R.

When the base has two tones, the reduplicant still only copies both moras of the first syllable, since two moras are available for tone assignment of both tones in the base, without violating Contiguity B-R, as shown in (25) below:

(25) Bitonal Trimoraic words with Initial Diphthongs

L H RED - ǂʔəuce	MAX B-R [TONE]	MORA = T.B.U.	CONTIGUITY B-R
a. ǂʔəé.ǂʔəù.cé			*!*
b. ǂʔə̀.ǂʔəù.cé	*!		
c. ǂʔə̆.ǂʔəù.cé		*!	
d. ǂʔəù.ǂʔəù.cé	*!		
e. ⇒ǂʔəú.ǂʔəù.cé			

It is interesting to note that in the case of bitonal trimoraic roots with initial diphthongs, the tones of the base do not occur on the same moras in the base and in the reduplicant. This rules out an alternative analysis where it is the identity of the tone, and the vowel the mora of that tone is linked to which is important. It doesn't matter which moras the tones are linked to in the reduplicant, as long as they appear somewhere in the reduplicant.

8. Theoretical Implications of Ju|'hoansi Reduplication

In this section, I will discuss some implications of this data for linguistic theory. First, this type of reduplication has been hitherto unattested. It represents a true case of reduplication where the reduplicant is a syllable of varying weight. Secondly, this paper gives further evidence for Carleton and Myers' (1995) claim that tonal and segmental copy are separate and must be governed by separate MAX constraints. These data cannot be handled easily by derivational approaches to tonal transfer such as offered by Steriade (1988). It does, however, support Mutaka and Hyman's (1990) claim that all aspects of prosody which are unpredictable, must be copied in reduplication.

McCarthy and Prince (1986) in their discussion of the types of reduplicative templates which are possible in natural languages, suggest the possibility of a template of varying weight, exemplified by the language Kaingang. Steriade (1988) argues that this is the case only because Kaingang doesn't have any vowel length distinction. It is not clear whether Ju|'hoansi has a vowel length distinction or not. It is similar to Chinese, in that monosyllabic words are always heavy- either long vowels or diphthongs. Dickens (1994) marks a small number of words with a single vowel, implying that these are monomoraic. However, there are no minimal pairs in the language which are distinguished by length alone. Most minimal pairs of this type contrast in length and tone, with the shorter vowels being monotonal, and the longer vowels being contour toned, as shown in (26) below:

(26) Minimal Pairs Distinguished by Length and Tone

tshì	'to laugh'	tshȉì	'terrapin'
zà	'to pour'	zȁà	'to try'
tȍ^h	'thread'	tȍò^h	'tin, motor car'

It is clear that tone and weight are inseparable in this language. All contour toned words are long. However, diphthongs act as two moras, as they can bear contour tones as well. So, Steriade's point that only languages without vowel length can have a template of varying weight is also applicable to this language. However, the fact that when the two vowels are different, both vowels are only copied when there are two tones leads to real evidence that the weight of the reduplicant is inconsistent. Steriade (1988) claims that languages which only copy a light syllable, foot the reduplicant as part of one foot with the base. Similarly, languages with heavy syllable templates require the reduplicant to be footed separately from the base. Perhaps footing is not relevant in this language, since it is a tonal language, and there is little evidence for the presence of feet. Regardless, this is a language which, under a templatic view of reduplication, would be seen as having a syllable template of varying weight. The variation in weight is predictable, as is captured in the Optimality Theoretic analysis given herein.

It is important to determine what these data tell us about the transfer of prosody in reduplication. There have been several theories proposed in the literature. Steriade (1988) claims that all reduplication is total reduplication, and partial reduplication results from truncation or other phonological processes applying to the reduplicant. Her account of Sanskrit reduplication required an extra step of resyllabification. A similar extra step of tone assignment would be necessary in order to account for the Ju|'hoansi trimoraic forms, where the tones in the base occur on different moras in the reduplicant.

Mutaka and Hyman's (1990) proposal was that only prosody which is not predictable is copied in reduplication. Since Ju|'hoansi tone assignment is predictable, the only thing which would need to be copied is the bare tones: one tone for monotonal roots, and two tones for bitonal roots. Tone assignment in parallel in the base and the reduplicant would then assign the tones to each mora. The problem with their model would be determining how much segmental material would be copied in any particular case. We have seen above that the amount of segmental material copied in bisyllabic roots is driven by the number of tonemes present in the base. Only a completely parallel phonological framework such as Optimality Theory can handle the conflicting demands found in Ju|'hoansi, that (1) tones are not linked during copy, thus allowing tones to link to different moras in the base and in the reduplicant; and (2) there be a correspondence between the number of tones in the base and the number of moras in the reduplicant to bear these tones. These data further support Carleton and Myers'(1995) claim that copy of tone and segmental structure must be regulated by different MAX constraints, and that Optimality Theory allows for the crucial interaction of constraints governing tone and segmental material in reduplication.

9. Conclusion

Ju|'hoansi reduplication is unique among the languages of the world, in that the weight of the reduplicant varies. The weight of the reduplicant is, however, predictable in any given word from the tonal pattern of the base. In bisyllabic words, only the first vowel is copied in order to avoid skipping intermediate consonants, and to maintain the reduplicant as one syllable. If, however, the base is bitonal, both vowels will be copied, and intermediate consonants will be skipped. It is this requirement to copy all tonal material, and the tonal constraint which rules out contour tones on single moras which causes intermediate consonants to be skipped. Trimoraic forms are interesting in that in these words, the tones which are copied are not always present on the same moras in the base as in the reduplicant. This data is unique. This is the only language other than Kaingang which has been claimed to have a reduplicant of varying weight. It also gives further support for the necessity of parallel evaluation found in Optimality Theory.

References

Carleton, Troi and Scott Myers. (1995). "Tonal Transfer in Chichewa". *Phonology 13.1.* pp. 39-72.

Dickens, Patrick. (1994). *English – Ju| 'hoan - Ju| 'hoan-English Dictionary.* Quellen zur Khoisan Forschung 8. Köln: Rudiger Köppe Verlag.

McCarthy , J. and A. Prince. (1995). "Faithfulness and Reduplicative Identity." In J. Beckman, L. Dickey, and S. Urbanczyk (eds.), *Papers in Optimality Theory.* Amherst: GLAS, pp. 249-384.

McCarthy, John J. and Alan S. Prince. (1995). "Prosodic Morphology." In John A. Goldsmith, Ed., *The Handbook of Phonological Theory.* Cambridge: Blackwell.

Miller-Ockhuizen, Amanda. (1998). "Towards a unified decompositional analysis of Khoisan lexical tone." in Schladt, Mathias (ed.) *Language, Identity and Conceptualization among the Khoisan.* Quellen zur Khoisan Forschung 15. Köln: Rudiger Köppe Verlag.

Miller-Ockhuizen, Amanda. (To appear). "Two Kinds of Reduplication in Ju|'hoansi." Proceedings of LASU 5. *Khoisan Forum.* Cologne: University of Cologne.

Mutaka, Ngessimo, and Larry Hyman. (1990). "Syllables and Morpheme Integrity in Kinande Reduplication." *Phonology 7.* pp. 73-120.

Prince, Alan and Paul Smolensky. (1993). "Optimality Theory: Constraint Interaction in Generative grammar." MS. Rutgers University and University of Colorado.

Snyman, J.W. (1975). *Zu| 'hoasi Fonologie & Woordeboek.* (Communication of the University of Cape Town School African Studies, 37.). Cape Town / Rotterdam: A. A. Balkema.

Snyman, J.W. (1977). "The interrupted juxtaposed vowels of Zu|'hoasi." in A. Traill (ed.) *Khoisan Linguistic Studies 3. A.S. I. Communication 6.*

Steriade, Donca. (1988). "Reduplication and Syllable Transfer in Sanskrit and Elsewhere." *Phonology* 5. pp. 73-155.

Traill, A. (1985). *Phonetic and Phonological Studies of !Xóõ Bushman.* Hamburg: Helmut Buske Verlag.

Department of Linguistics
222 Oxley Hall
1712 Neil Avenue
Columbus, Ohio 43210

amiller@ling.ohio-state.edu