On Tonal Transfer

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What happens to tone when a form is reduplicated in a tone language? In the classic models of Marantz (1982) and McCarthy and Prince (1986), it is only segmental melody that is copied from the base. The prediction is thus that no tones of the base will appear on the reduplicant. In other models, on the other hand, the whole base is copied, including prosody (Steriade 1988, McCarthy and Prince 1988, McCarthy and Prince 1993a). Such models make the prediction that the tone of the base will always appear on the reduplicant.

The facts turn out to be more complicated than either of these extreme scenarios. In Chichewa, a Bantu language spoken mainly in Malawi, there are two reduplicative constructions, each of which poses problems for a tonal analysis. In verbs, as in (1), the stem is reduplicated to form a repetitive expression.[2]

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2 All Chichewa data were gathered at Chancellor College, Zomba, Malawi, and represent a relatively standard Central form of the language. We would like to thank Janet Banda, John Mchilikidzo and especially Al Mtenje for teaching us about Chichewa.

In these and all other Chichewa forms, we abstract away from postlexical modifications. These include (1) spread of a high tone one syllable rightward if two syllables follow the target syllable in the phonological phrase, (2) lengthening of the phrase-penultimate vowel, (3) shifting of a phrase-final high tone onto the phrase-penultimate mora. Thus the actual surface transcription of the reduplicated form in (2e) would be [mwamúnámúuna], and that of (2a) would be [mnyamatámaáta]. See Kanerva (1989) for detailed discussion of these processes and the domain of their application.

We have chosen to factor out these effects because they are phrasal and obscure the lexical patterns we are discussing here. But it is also not clear that the spread and shift are phonological. They struck our ears as gradient, variable and tempo-dependent, suggesting they might best be treated as phonetic implementation. We plan to deal with this question in forthcoming instrumental studies.

(1) a.	nda-ona "I have seen"	nda-ona-ona "I have seen repeatedly"
b.	ndina-óna "I saw"	ndina-óna-ona "I saw repeatedly"
c.	ndíma-óna "I see"	ndíma-óna-óna "I see repeatedly"
d.	nda-pezá "I have found"	nda-pezá-pezá "I have found repeatedly"

Here the problem is that when a high tone is realized on the stem, there sometimes is a corresponding high tone on the reduplicant, as in (1c) and (1d), and sometimes there is not, as in (1b). We could say that in the former case the tone is copied along with the segments, and that the tone is not copied in the latter case. The question is why tone is sometimes copied and sometimes not.

In the nouns, the final two syllables (i.e. the final foot) of a noun X can be reduplicated to form a word meaning "a real X", as in (2).

(2) a.	mnyamatá "boy"	mnyamatá-matá "a real boy"
b.	chibwaná "childishness"	chibwaná-bwaná "real childishness"
c.	bambo "father"	bambo-bámbo "a real father"
d.	chikhulupiriro "faith"	chikhulupiriro-ríro "real faith"
e.	mwamúna "man"	mwamúna-muná "a real man"
f.	chigawénga "terrorist"	chigawénga-wengá "a real terrorist"

In (2a) and (2b), the tones in the reduplicant correspond to those in the base, suggesting that the tones have been copied along with the segments. But in (2c) and (2d), a high tone appears on the reduplicant that does not occur in the base, and in (2e) and (2f) a high tone on the reduplicant corresponds to one on the base, but the tones are not on corresponding syllables. The question in this construction, then, is whether the tones are copied from the base, and how one should account for the tonal discrepancies between base and reduplicant.

In this paper we argue that tone is always included in reduplication, and that apparent non-copy of tone is due to purely phonological neutralization processes. We begin in Section 1 by reviewing the predictions that various models of reduplication make with respect to tone. We then give in Section 2 a brief introduction to the model we assume, a version of Optimality Theory (Prince and Smolensky 1993, McCarthy and Prince 1993a, 1993b). The body of the paper is in Section 3, where we give an OT account of tone in reduplicative constructions in Chichewa. We follow this in Section 4 with a comparison to the pattern in another Malawian language, Chiyao.

1. Tonal Transfer in Reduplication

Tone is a feature associated with the prosodic units mora and syllable. It is not part of the segmental melody. In Lithuanian, for example, a long vowel and a diphthong each counts as two tone bearers because each represents two moras (Blevins 1993). There is no language, on the other hand, in which a diphthong counts as two tone-bearers by virtue of its two feature specifications, while a long vowel counts as only one. Likewise, a consonant never counts as a tone-bearer except if it is syllabic or moraic.

The prosodic nature of tone is relevant to its behavior in reduplication. Reduplication, according to Marantz (1982) or McCarthy and Prince (1986), consists of (1) affixation of a morpheme consisting only of prosodic specifications, (2) copy of the complete segmental melody of the base, (3) mapping of the copied melody onto the prosodic template provided by the affix. Such a model makes the incorrect prediction that the only aspects of the reduplicant determined by the base will be those in the segmental melody. Prosodic information such as quantity and tone, on the other hand, should be determined entirely by the reduplicative morpheme.

That this prediction is wrong as far as it concerns quantity has been amply demonstrated by Levin (1985), Clements (1985), and McCarthy and Prince (1988). Generally speaking, the quantity of a segment in the reduplicant corresponds to that in the base, unless the reduplicative template imposes conditions that are inconsistent with such correspondence. Clements (1985) refers to such copying of prosodic information as "transfer". With regard to tone, the examples in (1) show that tone is at least sometimes transferred in reduplication, a point that has been made for Chichewa by Mtenje (1988) and for Kinande by Mutaka and Hyman (1990).

Various models of reduplication have been proposed that allow for prosodic transfer: Clements (1985), McCarthy and Prince (1988), Steriade (1988) and McCarthy and Prince (1993a). What they predict about the transfer of tone depends on what they propose is copied.

In the model of Clements (1985), what is copied depends on the nature of the reduplicative affix. If the affix consists of skeletal units, then anything that is associated with the corresponding skeletal units of the base will be copied. If the reduplicative template consists of syllable nodes, then anything that is associated with the corresponding syllables of the base will be copied. The prediction, then, is that tone will be copied if and only if the reduplicative affix consists of the tone-bearing units of the language (or higher categories that contain those units).

McCarthy and Prince (1988) propose an alternative account of transfer effects. They argue that all and only underlying information gets transferred. Phonemic quantity is thus transferred, but not predictible aspects of syllable structure.This model predicts that underlying tone will always get transferred.

Mutaka and Hyman (1990) directly address the issue of tone in reduplication. Their proposal is that copying applies to the skeletal tier of the base "and all of the tiers that link to it (melodic, tonal)". This predicts that tone will be copied in reduplication if its location is unpredictible (i.e. it requires underlying association). This differs from the prediction of McCarthy and Prince (1988) in that underlyingly floating tones will not be copied.

Another model that allows for prosodic transfer is that of Steriade (1988). According to this approach, the first step of reduplication is always total reduplication: copying of the base in its entirety including prosody. Partial reduplication results when the result of total reduplication is then submitted to a process of truncation to fit a prosodic template. All information from the base is preserved, unless it is lost in this truncation process. It follows that tone is always copied in reduplication, whether the tone is underlying or derived.

In the model of McCarthy and Prince (1993a), there is no copying operation in reduplication. Rather, correspondence between the base and the reduplicant is expressed through constraints that require base and reduplicant to be identical in all elements, segmental and prosodic. This model is like Steriade's in predicting that tone will always be transferred, regardless of whether it was underlying.

2. Tone and Reduplication in Optimality Theory

In this study we assume the basic prinicples of Optimality Theory (henceforth OT: Prince and Smolensky 1993, McCarthy and Prince 1993a,b, 1994). To account for tone alternations in OT, we need to allow underlying associations and tone specifications, but these must be considered tentative and subject to evaluation against the constraints. We adopt the convention of distinguishing an input representation for tone from an output notation (Myers 1994):

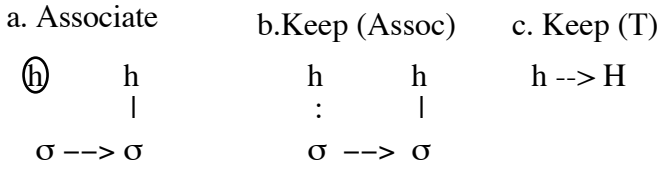
(3) a. Input Representations b. Parsed (realizable) representations

Association	**:**	(dotted line)	Association	|	(solid line)
Tone	**h**	(lower-case)	Tone	**H**	(upper-case)

Underlying representations have the tonal notation in (4a). A tone is phonetically interpreted only if it is parsed, and a tone-bearer is only realized with a particular tone if it is associated with it by a parsed association. Notation for parsed representational elements is given in (4b).

The set of operations mapping input to output representations is called GEN. The part of GEN relevant to tone is given in (4). The operation in (5a) consists of associating an unassociated tone. Other operations, as in (5b) and (5c), add the property of being parsed (i.e. they map from the elements of (4a) to those of (4b)).

(4) GEN for Tone (All operations are optional and unordered).



Since these operations are optional and unordered, they will generate every conceivable linking between the tonal and tone-bearing tiers. The only thing they will not do is actually delete a tone or association from the representation. This is because the operations of GEN must be structure-building, not structure-changing ("Containment": McCarthy and Prince 1993a: 20).

In derivational phonology, the default is to do nothing to the input representation. This is reflected in the convention that a rule applies only if its structural description is satisfied. In OT, this result is guaranteed by the Faithfulness Conditions, which favor conservation of underlying structure. The Faithfulness Constraints that will be relevant to our analysis are given in (5):

(5) Faithfulness Conditions

a. PARSE (T) : A tone must be parsed.

b. *FLOAT: A tone must be associated by at least one parsed association to at least one tone bearer.

c. *STRUCTURE (T): There must be no tones.

PARSE (T) assesses a violation for each unparsed (i.e. lower-case) tone. It thus insures that, all else being equal, underlying tones will be realized. *FLOAT penalizes floating tones. It thus favors the realization of underlyingly unassociated tones. *STRUCTURE (T) assesses a violation for each tone. Underlying tones are maintained in each output, by virtue of Containment, so all outputs of a given input tie with respect to the cost of underlying tones.This constraint is therefore only decisive for nonunderlying tones and association, giving them a cost that must be weighed against other constraints.

The output representation that minimally violates the Faithfulness Conditions differs from its input only in having parsed tones and associations, and no floating tones. The Faithfulness Constraints can, however, be overridden by higher constraints such as the Obligatory Contour Principle, and it is this that results in alternations (Myers 1994, Carleton 1993).

McCarthy and Prince (1993a,b, 1994) provide an OT approach to reduplication. They propose that a reduplicant R is constrained by three constraints referring to its base B (McCarthy and Prince 1993a: 62-63):

(6) CONTIGUITY: R corresponds to a contiguous substring of B.
(7) ANCHORING: In R + B, the initial element in R is identical to the initial element in B.
In B + R, the final element in R is identical to the final element in B.
(8) MAX: R=B.

According to MAX, R must be identical to its base. It registers a violation for each element of B not present in R, including any prosodic element (op.cit., p.64). CONTIGUITY corresponds to the prohibition in Marantz's (1982) association conventions against skipping of elements in the copying process. ANCHORING corresponds to the unmarked left-to-right association for reduplicative prefixes, and right-to-left for suffixes.

There is no copying operation in this model. Rather, GEN is assumed to include operations inserting all possible phonological elements, generating therefore all possible phonological representations. For morphemes with lexical content, these insertions will be strongly constrained by the Faithfulness Constraints, allowing insertion only when motivated by higher constraints. But reduplicative morphemes lack any lexical content to respect in this way, with the result that their whole content is inserted. Out of the vast array of strings generable by random insertion, these constraints will select as optimal that string with the closest correspondence to the base. Reduplication, then, does not result from the operation generating the reduplicant, but from the matching enforced by MAX.

MAX is satisfied only by total reduplication. Partial reduplication results when MAX is dominated by a templatic constraint on the relation between R and prosodic categories (e.g. R = σ). MAX requires identity in both prosody and segments, so it enforces prosodic transfer. However, this transfer, like segmental transfer, can be overridden by prosodic constraints on the form of R.

3. Tone and Reduplication in Chichewa

As mentioned above, Chichewa has two major reduplicative constructions. In verbs, a stem X can be reduplicated to form a new stem denoting "repeated Xing". In nouns, the final two syllables of the noun X can be reduplicated to form a new noun denoting "a real X". To understand the behavior of tone in these constructions, we must first understand something about nonreduplicative tone patterns in Chichewa. We therefore begin by discussing the tone patterns of

the verb stem in Section 3.1. We then present an analysis of verbal reduplication (in Section 3.2) and nominal reduplication (in Section 3.3).

3.1. Tone in Verb Stems

The verb stem in Chichewa consists of the root, followed by any number of suffixes called "extensions", and an obligatory inflectional or nominalizing suffix called the "final vowel". This whole sequence is reduplicated together in stem reduplication.

Chichewa has two tones - high and low. We mark high tone with acute accent in transcriptions, and low tone with the absence of accent . In representations, high tone is h (unparsed) or H (parsed), while low-toned syllables simply lack tone. Chichewa tonology has been discussed by Moto (1983), Mtenje (1987, 1988), Peterson (1987), and Kanerva (1986, 1989). Our analysis draws heavily on the insights of Kanerva (1986, 1989).

If one of the morphemes in a Chichewa verb stem is high-toned, this high tone is realized on one of the two last syllables of the stem. A high tone is realized on the final syllable of the stem if the tone belongs to the root, an extension, or the subjunctive mood marker, as in (9).The stem is delimited here and henceforth by square braces. The morpheme that contributes the high tone is underlined.[3]

(9) a. [pez-á]
find-fv
"find!"

b. [tambalal-á]
stretch legs - fv
"stretch your legs!"

c. [phik-its-á]
cook-intens-fv
"really cook!"

d. ti-[sangalats-é]
we-please-subj
"let's please"

(10) a. [on-a]
see-fv
"see!"

b. [sangalal-a]
enjoy-fv
"enjoy yourself!"

c. [phik-a]
cook-fv
"cook!"

d. [sangalats-a]
please-fv
"please!"

The forms in (9a-c) and (10a-c) are all imperatives. In (9a) and (9b) the high tone on the final syllable comes from the root, as can be seen by comparing the imperative of the low-toned roots in (10a) and (10b). In (9c) the high tone originates from the high-toned intensive suffix /-its-/, and in

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[3] Abbreviations:
fv: final vowel habit: habitual intens: intensive inf: infinitive
subj: subjunctive fut: future neg: negative

(9d) the high tone belongs to the subjunctive marking. The corresponding forms in (10) lack the high-toned morpheme and so lack a high tone in the stem.

A high tone is realized on the penult, as in (11), if it is a marker of certain tenses, including the present habitual and the negative future.

(11) a. ndí-ma-[sangalál-a]
I-habit-be happy-fv
"I am happy (pres. hab.)" (cf. (10b))

b. s-aa-dza-[sangaláts-a]
neg-he/she-fut-please-fv
"he/she will not please (neg. fut.)" (cf.(10d))

c. a-zí-[fotokóz-a]
he/she-subj-explain-fv
"he must explain (strong subj)" (cf. [fotokoz-a] "explain!")

In (11), all the roots are low-toned, so that the high tone on the penult must be attributed to the tense marker.

To summarize, some morphemes of the stem contribute a high tone to the stem, while others do not. But any high tone present is realized on the stem-final or stem-penult syllable, depending on the tense. We assume, then, that morphemes that contribute a high tone to the stem have an unassociated high tone in their underlying representation. Some of these morphemes are purely tonal, consisting only of the floating high tone.

The operation "Associate Tone" in GEN yields outputs with every conceivable association for a given input. To account for the fact that a high tone within the stem is realized at the end of the stem, we posit two constraints:

(12) ALIGN (H, R, Stem, R)

(13) NONFINALITY: * H
|
σ x]

(x = present habitual, negative future, strong subjunctive...)

The constraint in (12) belongs to a family of ALIGN constraints that require that an edge of one category be aligned with an edge of another category (McCarthy and Prince 1993b). This particular constraint requires that the right edge of every high tone (located at the right edge of its rightmost tone-bearer) be aligned with the right edge of a stem. The constraint is satisfied if a high tone is associated with the final syllable of the stem, and a violation is assessed for each tone-bearer that separates the two edges.

NONFINALITY is a tonal counterpart to the metrical constraint of the same name in Prince and Smolensky (1993: 40). It is violated if there is a high tone on the final syllable of a stem bearing one of the inflections that condition penultimate placement of high tone. It is similar in effect to an extratonality rule.

The ranking of the constraints must be: *FLOAT, PARSE (T) >> NONFINALITY >> ALIGN (STEM). A form with an underlying high tone, such as that in (9b), is evaluated as in (14).

(14) tambalalá ("stretch out your legs!", (9b))

Input: / h / / /
[/tambalal/ / a /]

Candidates	*FLOAT	PARSE (T)	NONFINAL	ALIGN (STEM)
a. H ☞ | tambalala				
b. H | tambalala				*!
c. H | tambalala				**!
d. h tambalala	*!	*!		

None of the outputs in (14) violates NONFINALITY because that constraint applies only to a morphologically restricted set of stems, such as those in present habitual. In (14d), the input has been left unchanged. This violates PARSE (T) and *FLOAT, and so is less optimal than the representations (14a-c), which do not violate these high-ranked constraints. Of representations (14a-c), (15a) is the optimal one, since it has the fewest violations of ALIGN (STEM). The optimal output representation for the input in (14) is thus the one with the high tone associated with the stem-final syllable.

The stem evaluated in (15) has the tonal present habitual marker and therefore is subject to NONFINALITY.

(15) ndíma[sangalála] ("I am happy (habitual)", (11a)

Input: /h/ / / / /
[/sangalal/ / a /]

Candidates	NONFINAL	ALIGN (STEM)
a. H | sangalala	*!	
b. ☞ H | sangalala		*
c. H | sangalala		**!

In (15a), the tone is associated with the stem-final syllable, which satisfies ALIGN (STEM), but violates NONFINALITY because the stem is present habitual. This form is therefore less optimal than that in (15b), which violates ALIGN (STEM) but not the higher-ranked NONFINALITY. Representation (15c) also avoids violation of NONFINALITY, but it is less optimal than (15b) because it has a worse violation of ALIGN (STEM). The optimal output is thus (15b) with the penultimate high tone.

If the stem includes more than one high-toned morpheme, only one high tone is realized. In (16a) the stem includes the high-toned root /tambalal/, cf. (9b), and the high-toned intensive suffix /its/, cf. (9c). Yet only one tone is realized, on the final syllable. In (16b), the stem includes the same high-toned root /tambalal/ and the high-toned stem inflection for the present habitual, cf. (11a).

(16) A. [tambalal-its-á]
stretch legs-intens-fv
"really stretch out your legs!"

b. ndí-ma-[tambalál-a]
I-habit-stretch legs-fv
"I stretch my legs"

To account for this neutralization, Kanerva (1986: 5) posits a rule of tone deletion, which he suggests might be " a version of the Obligatory Contour Principle".

(17) T_a T_a --> ø Applies iteratively.

This rule is to be interpreted as deleting the second of two identical tones. Since only high tones are actually represented with a tone, the effect is to delete the second of two high tones. Deletion of a high tone next to a high tone is wide-spread in the Bantu languages (e.g. Meeussen 1963, Goldsmith 1984). Goldsmith (1984) refers to it as "Meeussen's Rule" in honor of the version of the rule formulated by A.E. Meeussen for Tonga.

In OT, we can derive this dissimilation from an extended version of the OCP, formulated in (18) (Myers 1994).

(18) OCP!: There must not be two identical parsed feature specifications in the same minimal domain.

The OCP forbids two identical parsed feature specifications that are adjacent. OCP! is stronger in that it drops the adjacency requirement and forbids any two identical parsed feature specifications within the same minimal domain. The stem is the smallest domain that includes the stem, so if OCP! dominates PARSE (T), it will guarantee that only one high tone in the stem can be parsed and so realized.

The evaluation of the form in (16a), with two high tones in the stem, is shown in (19).

(19) tambalalitsá ("really stretch your legs!" (intensive), (16a))

Input: / h / / h / / /
[/tambalal/ + /its/ + /a/]

Candidates	OCP!	PARSE (T)	NONFINAL	ALIGN (H/STEM)
a. H H | | tambalalitsa	*!			*
b. H H | | tambalalitsa	*!			**
c. h H ☞ | tambalalitsa		*		

If both tones are parsed, as in (19a) or (19b), this violates the constraint OCP!, regardless of where in the stem the two tones are associated. The optimal representation must thus have only one of the high tones parsed, as in (19c), and to obey ALIGN (H/STEM) that one high tone must be associated with the stem-final syllable.

A high tone can also occur on the stem from an inflectional prefix immediately preceding it. Such a prefix is not itself realized as high-toned, but the syllable following it is always high-toned. The prefixes with this behavior are the past habitual -ma- in (20a), the recent past -na- in (20b), and the infinitival ku- in (20c).

(20) a. ndi-ma-[sángalats-a]
I-habit-please-fv
"I used to please" (past habitual)

b. ndi-na-[sángalats-a]
I-past-please-fv
"I pleased" (recent past)

c. ku-[sángalats-a]
inf-please-fv
"to please" (infinitive)

Kanerva (1986) proposes that these "postaccenting" prefixes have a high tone but are extraprosodic, so that they cannot bear that tone. He assumes that association on the word level (as opposed to the stem) is left-to-right, so the H of the inflection in these cases docks on the leftmost intraprosodic tone bearer, which is the first syllable of the following stem.

Our OT account is quite similar. Left-to-right association is expressed by another ALIGN constraint, as in (21).[4]

(21) ALIGN (H, L, Domain, L)

This constraint is satisfied if a parsed high tone is associated with the leftmost tone bearer in the smallest domain that contains that tone. We assume that the verb stem is a domain, but we also posit a domain consisting of the inflectional prefixes (Myers 1987). Accordingly, the morphemes preceding the stem in (20) belong to an AUX constituent, and the constraint in (21) insists that any high tone belonging to those morphemes must be realized on the first syllable of that constituent.

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4 This constraint has a limited effect, since most morphemes at the word level have underlyingly associated tones that do not vary in position. ALIGN (DOMAIN) is thus dominated by PARSE (T) and PARSE (A). It only has crucial effects for the few floating inflectional tones outside the verb stem, and the nominal reduplicant discussed in Section 3.3.

ALIGN (DOMAIN) is dominated by ALIGN (STEM) in (12), which requires that a tone within the verb stem be associated with the rightmost tone-bearer in the stem. The result of these two constraints - H/STEM >> H/DOMAIN - is that a tone is associated with the left edge of its minimal domain except within the verb stem.

In the cases in (20), H/DOMAIN conflicts with another, morphologically governed constraint, given in (22):[5]

(22) *DOMAIN: A tone belonging to a morpheme of category X must not be associated with a tone-bearer in its minimal domain (X = past habitual, recent past, infinitive).

Tones belonging to these particular morphological categories cannot be realized within the AUX constituent that contains them. According to ALIGN (DOMAIN), however, such tones must still be as close to the left as they can get. The optimal association will therefore be with the syllable immediately following the AUX constituent. Example (20a) is evaluated as in (23).

(23) ndimasángalatsa ("I used to please" (past habitual) (20a))

/ / / h / / // /
[Aux / ndi / / ma /][Verb /sangalats//a/]

Candidates	*DOMAIN	ALIGN (DOMAIN)
a. [H][ ] | [ndima][sangalatsa]	*!	*
b. ☞ [H][ ] \ [ndima][sangalatsa]		**
c. [H][ ] \ [ndima][sangalatsa]		***!

5 Such a constraint is relevant in any case where a morpheme contributes a feature that is not realized on that morpheme, e.g. palatalizing suffixes that don't include palatalizing vowels.

Representation (23a), with H associated within the inflectional constituent, is less optimal than (23b), since the former violates *DOMAIN and the latter doesn't. Output (23b) is more optimal than (23c), on the other hand, because it has less severe violation of ALIGN (DOMAIN).[6]

The constraints required for the verbal tone alternations are summarized in (24):

(24) OCP! >> PARSE (T), *FLOAT >> NONFINALITY >> ALIGN (STEM), *DOMAIN >> ALIGN (DOMAIN)

Placement of tones in verbs is controlled by the two ALIGN constraints. *DOMAIN and NONFINALITY represent lexically governed exceptions to the general placement. OCP! reflects the generalization that at most one tone belonging morphologically to the verb stem is ever actually realized. PARSE (T) and *FLOAT, the Faithfulness Constraints, reflect the fact that underlying tones are generally realized, subject to OCP!.

3.2 Tone in Verbal Reduplication

Having accounted for the basic tone patterns in unreduplicated verbs, we can now consider the tones of reduplicated stems. Some of the high tones that appear on the stem appear also on the reduplicant, while others do not. Instances of tonal transfer are given in (25), while failure of transfer is illustrated in (26).

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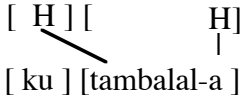
6 The high tone of these inflectional prefixes appears on the stem also when there is a stem-internal high tone. This leads to forms in which there are two distinct realized high tones on the stem, in apparent violation of OCP!:

(a) ku-támbalal-á
inf-stretch legs-fv
"to stretch one's legs"

We assume that the inflectional tone in such a case is not completely in the minimal stem domain, since the representation of (a) would be as in (b).

(b)



This does not count as a violation of OCP! because the smallest domain that includes both high tones is the phonological word, which is not the smallest domain that includes each tone individually.

(25) a.	[tambalal-á] stretch legs-fv "stretch your legs!"	[tambalalá][tambalalá] "stretch your legs repeatedly!"
b.	[phik-its-á] cook-intens-fv "really cook!"	[phikitsá][phikitsá] "really cook repeatedly!"
c.	ndí-ma-[sangaláts-a] I-habit-please-fv "I please"	ndí-ma-[sangalátsa][sangalátsa] "I please repeatedly"
d.	ti-[sangalats-é] we-please-subj "let's please"	ti-[sangalatsé][sangalatsé] "let's please repeatedly"
(26) a.	ndi-ma-[sángalats-a] I-past habit- please-fv "I used to please"	ndi-ma-[sángalatsa][sangalatsa] "I used to please repeatedly"
b.	ndi-na-[sángalats-a] I-past-please-fv "I pleased"	ndi-na-[sángalatsa][sangalatsa] "I pleased repeatedly"
c.	ku-[sángalats-a] inf-please-fv "to please"	ku-[sángalatsa][sangalatsa] "to please repeatedly"

Mtenje (1988) notes this distinction and proposes an analysis exploiting rule ordering. One lexically-governed tone association rule ("Tone Shift") puts the last high tone on the penult, while another ("Association") associates other tones left to right, and is responsible for putting tones on the stem-initial syllable. Tone Shift precedes reduplication and Association follows it. Therefore, tones associated by Tone Shift will get copied, while those associated by Association will not.

One problem with this analysis is that it is incomplete. Mtenje does not consider final high tones, as in (25a,c,d), and so does not capture that they are copied as well as the penultimate high tones. Another problem is that the analysis requires reduplication to be ordered in the cycle among phonological rules. Such an ordering has not been motivated in other languages.

The tones that get copied are those that are systematically placed on the penult or the final syllable of the stem; those tones that are placed on the stem-initial syllable are not copied. This reflects the morphological constituency of the tones: the tones that are placed on the penult or final syllables belong morphologically to the stem, while the tones that are placed on the syllable immediately following AUX belong morphologically to AUX. The tones that are transferred are those of the root (e.g. 25a), the extensions (e.g. 25b), and the stem inflections (e.g. 25c,d). The tones that fail to get transferred are those of the pre-stem inflections in AUX (e.g. 26).

In a derivational account, one could capture this generalization with level ordering. Reduplication of the stem would occur at the stem level, before the tones of the inflectional prefixes are associated onto the stem. It would be crucial, of course, that such reduplication copy tone as well as segments.

The pattern can also be handled straightforwardly in an OT analysis. The reduplicative morpheme RED is subject to the following constraints.

(27) a. RED^{Verb} is a stem.
b. ALIGN (RED^{Verb}, L, Stem, R)

Constraint (27a) insures that the reduplicant behaves like a separate stem with respect to such constraints as ALIGN (STEM). Constraint (27b) insures that the reduplicant follows its base, the verb stem.

The prosodic base is the base that is relevant to the reduplicative constraints. We define the prosodic base as follows:

(28) a. The prosodic base of a <u>suffixed</u> morpheme is the part of the phonological representation preceding the exponent of that morpheme, beginning with the left edge of its morphological base.

b. The prosodic base of a <u>prefixed</u> morpheme is the part of the phonological representation following the exponent of that morpheme, up to the right edge of its morphological base.

This definition is based on that of McCarthy and Prince (1993a: 106). It differs from theirs only in how the edge of the base that is away from the affix is defined. The base in their definition ends with the nearest edge of a prosodic word, while in our definition it ends with the edge of the morphological base. We make this change in order to capture the kind of cyclic effects that are typical of stem reduplication.

The extent of copying is determined by the interplay of two general constraints. MAX, repeated here from (8), requires that the reduplicant be identical to the base. *STRUCTURE, repeated here from (5c):

(29) a. MAX: R = B
b. *STRUCTURE (T): There must be no tone.

MAX penalizes any difference between the base and the reduplicant, including differences in tone. It is crucial to note here, though, that the prosodic base in this case is coextensive with the morphological category "Stem". Thus, MAX will only be sensitive to those elements that belong morphologically to the stem, and will ignore material from other morphological domains that happen to be realized on the stem.

MAX maximizes the number of phonological elements in the reduplicant by demanding that the reduplicant have every element that is in the base. *STRUCTURE (T), on the other hand, penalizes each tone in the representation, so it has the effect of minimizing the number of elements in the reduplicant. If there is to be any copying at all, MAX must dominate *STRUCTURE (T). But if MAX is maximally satisfied, the lower ranked *STRUCTURE (T) insures that no extra tones are added to the reduplicant that are not motivated by MAX.

Consider first the tableau for (25c), in which the stem lexically includes a high tone. The reduplicant is underlined.

(30) ndímasangalátsasangalátsa ("I am happy repeatedly" (present habitual) (25c))

Input: [/ h / / /][/h// // /]
[/ndi/ /ma/][/sangalats//a/][RED]

Candidates	MAX	*STRUCT (T)
a. [H][H][ ] | | [ndi-ma][sangalatsa][sangalatsa]	*! (H)	**
b [H][H][H] ☞ | | | [ndi-ma][sangalatsa][sangalatsa]		***

The output (31b) is more optimal than (31a), because the reduplicant in (31a) is missing an element of the base, namely the high tone. Output (31b) satisfies MAX, which renders its extra violations of *STRUCTURE (T) irrelevant.

The form evaluated in (31), on the other hand, has no lexical high tone within the stem. The only high tone in this example, repeated from (26b), belongs morphologically to the past habitual marker -ma- in AUX. It does not associate with any syllable within AUX due to *DOMAIN, which requires it to appear immediately following AUX.

(31) ndimasángalatsasangalatsa ("I used to be happy repeatedly" (past habitual) (27b))

Input: [/ / / h /][/ // /]
[/ndi/ /ma/][/sangalats//a/][RED

Candidates	MAX	*STRUCT (T)
a. [H][ ][ ] ☞ [ndi-ma][sangalatsa][sangalatsa]		*
b. [H][ ][H] [ndi-ma][sangalatsa][sangalatsa]		**!

Candidate (31a) satisfies MAX. There is a high tone on the first syllable of the stem which does not have a counterpart in the reduplicant, but that high tone lies beyond the left edge of the verb stem which is the morphological base of the reduplicant. It is therefore not included in the prosodic base of the reduplicant and does not count for MAX. Candidate (31a) is more optimal than (31b), despite the latter's apparently more complete correspondence, since (31b) has more violations of *STRUCTURE (T).

To get this result, the reduplicative correspondence must include tones as well as segments, which is accomplished here simply by not restricting MAX to segmental identity. Beyond this theoretical assumption, we need only specify that the base of the reduplicant is the verb stem.

3.3 Tone in Nominal Reduplication

Nouns differ from verbs in Chichewa (as in most Bantu languages) in that association of tone is not predictible in nouns. No underlying associations are required in the verbs, since they are all predictible, but in the nouns, tones must often be underlyingly associated. Two syllable noun stems, for example, can be HL, LH, or LL, while three syllable stems can be HLL, LHL, LLH, or LLL (Kanerva 1989).[7]

Nominal reduplication differs from verbal reduplication in that it is only the last two syllables of a noun that get copied. As far as tone, all that matters are the tones of the final two syllables of the base. Since there are no underlying sequences of high tones in Chichewa, (e.g.

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7 Stems with more than one high tone underlyingly are rare, and are usually recognizable as loanwords (Kanerva 1989: 14).

*/...HH/), there are only three possibilities: (a)...LH, (b)...LL, and (c)...HL. Examples of each are given in (32)-(34), with the reduplicant underlined.

(32) ...LH	...LH-LH	
a. iwó	iwó-<u>iwó</u>	"them"
b. masaná	masaná-<u>saná</u>	"afternoon"
c. chibwaná	chibwaná-<u>bwaná</u>	"childishness"
d. mnyamatá	mnyamatá-<u>matá</u>	"boy"
e. chémwalí	chémwalí-<u>mwalí</u>	"brother, friend"
f. nkhúlulú	nkhúlulú-<u>lulú</u>	"cricket"
g. kamvúlumvulú	kamvúlumvulú-<u>mvulú</u>	"whirlwind"

(33) ...LL	...LL-HL	
a. manja	manja-<u>mánja</u>	"hands"
b. chino	chino-<u>chíno</u>	"this (Class 7)"
c. lero	lero-<u>léro</u>	"today"
d. mtsíkana	mtsíkana-<u>kána</u>	"girl"
e. munthu	munthu-<u>múnthu</u>	"person"
f. chímanga	chímanga-<u>mánga</u>	"maize"
g. dókotala	dókotala-<u>tála</u>	"doctor"
h. chibolíboli	chibolíboli-<u>bóli</u>	"wood carving"
i. chikhulupiriro	chikhulupiriro-<u>ríro</u>	"hope"

(34) ...HL	...HL-LH	
a. tókha	tókha-<u>tokhá</u>	"just us"
b. máwa	máwa-<u>mawá</u>	"tomorrow"
c. wámfúpi	wámfúpi-<u>fupí</u>	"short"
d. yánga	yánga-<u>yangá</u>	"my (Class 9)"
e. chilómbo	chilómbo-<u>lombó</u>	"beast of prey"
f. chigawénga	chigawénga-<u>wengá</u>	"terrorist"
g. mwamúna	mwamúna-<u>muná</u>	"man"

The cases in (32), ending in ...LH, present no obvious tonal problems, since the tone of the reduplicant corresponds perfectly to that of the base. The cases in (33), in which the base ends in ...LL, do present a problem in that a high tone appears on the first syllable of the reduplicant which

does not correspond to any tone of the base. The cases in (34), with bases in ...HL, will also require some explanation, since the reduplicant has the pattern LH instead of HL.

In all examples, the reduplicant consists of exactly two syllables, regardless of the length of the base. We thus require a templatic constraint:

(36) LX≈PR: RED^{Noun} = Foot

This is a member of the family of constraints requiring correspondence between lexical categories such as morphemes and prosodic categories such as feet or prosodic words (Prince and Smolensky 1993: 101).[8] The template dominates MAX, insuring that reduplication in nouns is partial.

The foot in Chichewa is a disyllabic trochee. Kanerva (1989:38-54) gives several arguments for such a foot in Chichewa. First, two syllables is the minimum prosodic word in Chichewa; any form that is not disyllabic by virtue of its morphemic content is augmented by an epenthetic vowel. Second, the phrase-penultimate vowel is lengthened and is resistant to reduction processes. Kanerva accounts for this by positing a final disyllabic foot, so that the penult vowel is in a metrically strong position. Following Kanerva, we assume that each word ends in such a foot, so that in the reduplication construction the foot of the reduplicant is preceded by a foot at the end of the base.

Furthermore, we assume that RED is a clitic, and therefore is subject to the phonology of the phonological word domain. RED is subject to ALIGN (DOMAIN), which places H on the leftmost available tone-bearer, rather than ALIGN (STEM), which pushes H to the right. It is also subject to the OCP (McCarthy 1986, Myers 1993):

(36) OCP: Two parsed feature specifications must not be adjacent.

With respect to tone, the OCP forbids a sequence of two high tones associated with successive syllables. This will have consequences for where a high tone may be realized in the reduplicant. The OCP!, on the other hand, does not play a crucial role in this construction since there is more than one minimal domain in the construction.

To account for the high tone that occurs with LL-final bases, we propose that RED includes in its lexical specification a floating H tone. This accounts for an invariant property of the reduplicant - namely, that it always includes a high tone regardless of whether the base does. It is a

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8 Such constraints can be seen as instances of ALIGN: ALIGN (RED, L, Foot, L) and ALIGN (RED, R, Foot, R).

kind of prespecification, analogous to prespecification of the template for invariant vowel or consonant features (Marantz 1982).

Let us begin with a simple example with a base in LH. Tableau (37) shows the evaluation of (32d). Parentheses demarcate feet: the final foot of the base and the foot that constitutes the reduplicant. The heads of these feet are indicated by asterixes.

(37) mnyamatá-matá ("a real boy" (32d))

Input: [/ // h /][/h /]
[/ // : /][ ]
[/m//nyamata/][/RED/]

Candidates	OCP	PARSE (T)	ALIGN (DOMAIN)	MAX
a. H H | | mnya(mata)(mata) * *	*!		*	* (H)
b. H h | | mnya(mata)(mata) * *		*!		* (H)
c. ☞ H H | | mnya(mata)(mata) * *			**	

In (37a), the floating H of the reduplicant is associated with the first syllable of the reduplicant, leading to a fatal OCP violation. Candidates (37b) and (37c) are more optimal than (37a) because neither of them violate the OCP. Candidate (37c) is more optimal than (37b), on the other hand, because (37b) violates PARSE (T), rendering irrelevant the fact that (37c) has a worse violation of the low-ranked ALIGN (DOMAIN).

The placement of the H in candidate (37c) is also optimal from the perspective of the reduplicative constraints. MAX, CONTIGUITY and ANCHORING would all be violated if there was no high tone on the last syllable of the reduplicant corresponding to the final high of the base. It is of no concern to these constraints that the H in this form is a lexical property of the reduplicative morpheme; the constraints are only evaluating correspondence. It is thus irrelevant that this H has not arisen through the usual means through the random insertion of elements.

The tableau for (33i), with LL-final base, is given in in (38).

(38) chikhulupiriroríro ("a real hope" (33i))

Input: [ ][/h /]
[/chi//khulupirir//o/][/RED /]

Candidates	OCP	*FLOAT	ALIGN (DOMAIN)	MAX
a. H ☞ | chikhulupi(riro)(riro) * *				* (H)
b. H chikhulupi(riro)(riro) * *		*!		* (H)
c. H | chikhulupi(riro)(riro) * *			*!	* (H)

The optimal candidate in this case is (38a), with the floating H of the reduplicant associated with the first syllable of the reduplicant. This satisfies *FLOAT and ALIGN (DOMAIN). Candidate (38b) is worse because it violates *FLOAT, and (38c) is worse because it violates ALIGN (DOMAIN). All candidates violate MAX, in that the floating H of the reduplicant does not correspond to any element of the base, but satisfying MAX by leaving that tone unparsed or unassociated would violate higher Faithfulness Constraints.

With bases ending in HL, the reduplicant has LH instead of HL. The high tone is shifted from its expected position to the right in a context where there is a high tone preceding. Kanerva (1989) notes that the two high tones in this case are associated with the heads of two adjacent feet. He suggests that they interact because in a metrical sense they are adjacent.

Let us assume that any element associated with an element of metrical representation, including moras and syllables, is also considered to be associated with the whole grid column associated with that metrical element. The relevant definition of adjacency can then be defined as in (39) (cf. Kanerva 1989: 197):

(39) Two elements associated with grid columns are adjacent iff the two grid columns have adjacent entries at the highest grid level at which both columns have an entry.

Consider, for example, the adjacency relations in a sequence of two trochaic feet, such as occurs in the nominal reduplication construction under discussion. Two high tones associated with the two heads, as in (40a), are adjacent according to (39), since the grid columns they are associated with both have entries at the second grid level, and no entry intervenes between those two entires at that level. The two high tones are also adjacent in (40b), since the highest level at which both grid columns are represented is the first level, and on that level there is no grid entry intervening between the two grid columns. In (40c) and (40d), on the other hand, the two H's are not adjacent. In both of these cases, the relevant grid level is the first, and there are grid entries intervening between the two associated with the tones.

(40)

a.	b.	c.	d.
(x) (x)	(x) (x)	(x) (x)	(x) (x)
(x x) (x x)	(x x) (x x)	(x x) (x x)	(x x) (x x)
| |	| |	| |	| |
H H	H H	H H	H H

If the OCP forbids identical tones being adjacent in the sense of (39), then (40a) and (40b) violate the OCP, and (40c) and (40d) do not. Note that (40c) and (40d) are configurations that are found in reduplication (cf. (34) and (35) respectively), while (40a) and (40b) do not occur .

The structure in (40a) is what we would expect if an HL-final base were accurately copied as HL-HL. But instead of this, we get the OCP-obeying (40c). This suggests that the OCP dominates the constraints ALIGN (DOMAIN) and MAX, both of which require the H of the reduplicant to be on the first syllable. This is the dominance relation we assumed above in tableaux (37) and (38).

Given these assumptions, we can now present the following tableau for the form (34f), with reduplication of a HL-final base

(41) chigawénga-wengá ("a real terrorist", cf. (34f))

Input: / // h /][/ h /]
/ // : /][/ /]
[/chi//gawenga/][/RED/]

Candidates	OCP	PARSE (T)	ALIGN (DOMAIN)	MAX
a. H H | | chiga(wenga)(wenga) * *	*!			
b. H h | | chiga(wenga)(wenga) * *		*!		* (H)
c. ☞ H H | | chiga(wenga)(wenga) * *			*	* (H)

Candidate (41a) violates the OCP because the two parsed high tones are associated with the heads of adjacent feet. Candidate (41b) avoids violating the OCP, but only at the cost of violating PARSE (T). Candidate (41c) is optimal, although it violates ALIGN (DOMAIN) and MAX, because it doesn't violate the higher constraints. Shift of the high tone has thus been forced by the OCP.

This pattern of tone shift is not restricted to the reduplication construction; it occurs whenever two high tones are metrically adjacent at the end of a phonological word (Kanerva 1989). A class of disyllabic determiners shows a similar alternation of HL with LH, as illustrated in (42). HL occurs in isolation (as in (42a)) or after LL (as in (42b)), while LH occurs after either HL (as in 42c)) or LH (as in (42d)).

(42) a. wánga "mine" yékha "alone"
b. munthu wánga "my person" munthu yékha "only a person"
tambala wánga "my rooster" tambala yékha "only a roster"
c. mkázi wangá "my wife" mkázi yekhá "only a woman"
mwamúna wangá "my husband" mwamúna yekhá "only a man"
d. mwaná wangá "my child" mwaná yekhá "only a child"

The same pattern occurs on the determiners -**mwe** "the same", -**nse** "all, every" and -**ja** "that".

We propose to represent these alternating determiners as having a floating high tone, like the nominal reduplicant. It is this that distinguishes these alternating determiners from others that do not alternate and are always LL:

(43) a. uyu "this (one)"
b. mwaná uyu "this child"
c. munthu uyu "this person" tambala uyu "this rooster"
d. mkázi uyu "this woman" mwamúna uyu "this man"

We assume that these determiners are underlyingly toneless.

The analysis is the same as for the reduplicative constructions, except that the reduplicative constraints are of course inapplicable. The tableau for for mkázi wánga in (42c) is given in (44).

(44) mkázi wangá ("my wife" (42c))

Input: [/ / /h /][/ //h // //]
[/ / / : /][/ // // //]
[/m/ /kazi/][/w//a //nga//]

Candidates	OCP	PARSE (T)	ALIGN (DOMAIN)
a. H H | | m(kazi)(wanga) * *	*!		
b. H h | | m(kazi)(wanga) * *		*!	
c. ☞ H H | | m(kazi)(wanga) * *			*

The high tone of the demonstrative is not underlyingly associated. If this tone is associated to the leftmost syllable in the demonstrative, as in (44a) or (44b), that obeys ALIGN (DOMAIN) but violates the higher ranking constraints OCP or PARSE (T), respectively. The optimal repesentation is thus (44c), in which H/DOMAIN is violated, but not those higher constraints.

The tone shift in such cases is a straightforward consequence of the OCP, given the metrical definition of adjacency in (39). The distortion of tone in the reduplication of HL-final

bases is due to this general phonological pattern, and so does not pose a problem for the view that reduplication involves tone as well as segments.[9]

4. Apparent Non-Transfer of Tone

In the Malawian dialect of Chiyao (Carleton 1993), tone in reduplicated verbs does not appear on the reduplicant, regardless of the tone of the base. The forms in (45) are infinitives, and those in (46) are immediate future forms.

(45) a.	ku-[télék-a] "to cook"	ku-[télék-a][teleka] "to cook repeatedly"
b.	ku[wómbók-a] "to save"	ku-[wómbók-a][womboka] "to save repeatedly"
c.	ku-[súlúmund-a] "to sift (flour)"	ku-[súlúmund-a][sulumunda] "to sift (flour) repeatedly"
(46) a.	tím-[délech-e] "I will cook"	tím-[déleche]-[teleche] "I will cook repeatedly"
b.	tím-[wómboch-e] "I will save"	tím-[wómboch-e][womboche] "I will save repeatedly"
c.	tím-[súlumund-e] "I will sift (flour)"	tím-[súlumund-e][sulumunde] "I will sift (flour) repeatedly"

The tones here are inflectional markers, but they are realized on the base. Why doesn't MAX require that these tones occur also on the reduplicant?

We propose that Chiyao verb stem reduplication differs in just one parameter from Chichewa: where the Chichewa reduplicative morpheme is a stem (cf. 28a), the reduplicant in Chiyao is an affix. The Chichewa reduplicative construction is thus a compound, while that in Chiyao is an affixation structure. The consequence for tone is that the reduplicative construction in Chiyao is one stem domain. Verb stems in Chiyao include at most one high tone, a generalization that we can capture, as in Chichewa, with the constraint OCP!, repeated here as (47).

(47) OCP! : There must not be two identical parsed feature specifications in the same minimal domain.

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9 See Kanerva (1989) for other instances of this tone shift, and an insightful discussion of the domain of this process.

Reduplication in Chiyao creates a stem domain that is twice as long as the base stem. Any copying of tone in that domain will violate the OCP! , which dominates MAX.

The tableau for (45a) is given in (48).

(48) kutélékateleka ("to cook repeatedly" (45a))

Input: [/h/]
ku [/telek/-/a//red/]

Candidates	OCP!	MAX
a. H H / \ / \ ku-[teleka-teleka]	*!	
b H ☞ / \ ku-[teleka-teleka]		* (H)

Because the reduplicative morpheme is an affix, there is only one stem domain in this construction. Candidate (48a) shows the most faithful copying, since the reduplicant is identical with the base in tone as well as segments. This violates the OCP!, and so is less optimal than the less complete copy in (48b).[10]

Another approach that would have the same result would be to say that the OCP! dominates MAX in Chiyao, but that the inverse ranking holds in Chichewa. But this would make incorrect empirical predictions. If the reduplicative construction in Chichewa was a single stem, as in Chiyao, the tones of the base should be realized on the penult or final syllable of the whole reduplicated stem. We would thus expect the form ndímasangalála in (27a) to reduplicate as *ndímasangalalasangalála, rather than as the correct ndímasangalálasangalála. In contrast, our analysis correctly predicts that the possibility of tone copying in verbs is related to whether the reduplicative construction counts as one or as two domains for tone placement.

We conclude that apparent noncopying of tones in Chiyao is due to phonological neutralization, governed by the constraint OCP!. The crucial difference between Chichewa and Chiyao in this regard is that in Chiyao the reduplicative construction is just one tone domain for that constraint, while in Chichewa it is two.

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10 This approach is reminiscent of Guthrie's (1948) analysis of Bemba. He distinguishes between reduplication constructions with a compound structure and those "where the reduplicated stem is an indivisible unit" (28).

5. Conclusion

Returning to our original question, we have argued that tone in reduplicative constructions is subject to the same correspondence as segments. In Chichewa verb stem reduplication, for example, every tone belonging to the base has a corresponding tone in the reduplicant. In OT, this generalization is expressed by making MAX sensitive to prosodic identity as well as segmental identity, as suggested in the original formulation of the constraint by McCarthy and Prince (1993a).

We have seen several instances in which a tone of the base has lacked a counterpart in the reduplicant, but these have been shown not to be problems for the view that tone is subject to reduplication. First, tones in Chichewa verb stems that do not get copied are simply tones that are not morphologically members of the base. Second, distortions in tones in nominal reduplication in Chichewa have been shown to follow from lexical prespecification and independently motivated phonological neutralization. Third, phonological neutralization is also responsible for the apparent noncopying of tone in Chiyao verbal reduplication.

Mutaka and Hyman (1990) note that it is frequent in the Bantu languages for tones to be copied in nominal reduplication, but not copied in verbal reduplication. Examples of such a pattern include Tonga (Carter 1962: 18-19), Kinyarwanda (Sibomana 1974), Lomongo (Hulstaert 1965: 25, 230), and Kinande (Mutaka and Hyman 1990). They note a widespread asymmetry between nouns and verbs in Bantu languages: the verbs have predictible tone association, whereas in the nouns, tone association is unpredictible and so must be represented underlyingly. We mentioned above that this is the case in Chichewa. Mutaka and Hyman's proposal is that what gets copied are the skeletal tier of the base "and all of the tiers that link to it (melodic, tonal)." Thus, tone is copied in nouns because it is underlyingly linked, but tone in verbs is left uncopied because it is not underlyingly linked.

The prediction is that tone will get copied if and only if its association is unpredictible. The Chiyao examples in (46) and (47) are consistent with this claim, but the Chichewa examples provide a counterexample. We have seen that although tone association in the verbs is completely predictible, there is nevertheless transfer of all and only the tones of the base.[11]

We have formulated our analysis of Chichewa and Chiyao in terms of Optimality Theory. The basic generalization about tone in reduplication is independent of this decision, since that generalization can also be expressed in a non-OT model such as Steriade (1988). Nevertheless, using OT has proven to yield some real benefits. First, it is the possibility of constraint interaction

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11 A particularly interesting case of tone and reduplication is that of verbs in Shona, in which the reduplicative construction is two domains for stems up to two syllables long, and one domain for longer stems. See Hewitt (1992) for an insightful analysis.

in OT that has allowed us to derive dissimilatory effects from the general constraints OCP and OCP!. Second, it is the fact that reduplication in OT involves matching of outputs that allowed us to capture the invariant presence of a high tone in nominal reduplication in Chichewa with an underlying floating tone. This tone is subject to the pressure to match the base, but it cannot be derived by copy in those forms with a LL-final base.

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