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*Compounding and tonal non-transfer in Bantu languages**

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In this paper I discuss a source of reduplicative (non-)correspondence common to Bantu tone languages which has not received attention in the formal literature. In many Bantu languages, the entire RED + Base complex forms a single domain for realisation of the Base stem tone, leading to the occurrence of non-corresponding marked tone in both the RED and the Base. I propose that this pattern of tone realisation in reduplicated forms falls out if the reduplicative complex is a compound verb stem, as compounds are frequently treated as single domains for the realisation of prosodic properties. The length condition on tonal transfer in reduplication which has proven a challenge for previous work on this topic (Myers & Carlton 1996, Hyman & Mtenje 1999) is also shown to follow from the compound structure of the reduplicative complex. This analysis confirms that the morphological status of the reduplicative complex plays an important role in determining the realisation of reduplicative morphemes.

1 Introduction

The defining hallmark of the process of reduplication is that the Base and the reduplicated portion of the word should have identical pronunciations (Wilbur 1973). Mismatches between the reduplicative morpheme (RED) and its Base are found frequently, however, and analysing these mismatches has been an important area of phonological research since work like Marantz (1982). Recent work in Optimality Theory (OT) has identified a number of common types of mismatch. For example, the RED can be constrained to have less marked prosodic or segmental structure than the

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Base. This is what Alderete *et al.* (1999) and McCarthy & Prince (1995, 1999) term the Emergence of the Unmarked (TETU) effect. Or a mismatch can arise because only the RED or only the Base is in the context to be the target of some regular phonological process (see e.g. McCarthy & Prince 1995, Myers & Carleton 1996, Struijke 2000, Pulleyblank, to appear).

In this paper I discuss a source of mismatch between RED and its Base commonly found in Bantu tone languages which has not received attention in the formal literature. In Bantu languages (where tone is contrastive and verbal reduplication commonly productive), there are three common patterns of tonal correspondence in verbal reduplication. Two of the patterns show either a match in the tone of the RED and its Base (tonal transfer) or a markedness motivated mismatch (TETU) familiar from other work on reduplication. The third pattern is the less familiar one: the entire RED + Base complex forms a single domain for realisation of the Base stem (BStem) tone. I will show that this three-way variation in tonal correspondence found in reduplicated verb stems (RStems) falls out if the reduplicative complex is a compound verb stem (CStem). All three patterns can then be accounted for by constraints aligning verb stem tone to the constituents of a CStem. An important argument in favour of the compounding analysis is that it solves a well-known problem for previous analyses of tonal transfer. In several Southern Bantu languages, one pattern of tonal correspondence – transfer or TETU – is found if the BStem has more than two syllables, but the reduplicative complex is a single tonal domain if the BStem has one to two syllables (Hewitt 1992, Myers & Carleton 1996, Cassimjee 1998, Hyman & Mtenje 1999). I will show that this length condition on tonal correspondence falls out simply from ranking the independently motivated constraints on non-reduplicative stem tone realisation for these languages with the constraints aligning stem tone within the CStem argued here to account for RStem tone realisation.

2 Reduplication as stem compounding in Bantu languages

2.1 Variation in tone realisation in verb stem reduplication

Work on tonal transfer in Bantu reduplication like Mutaka & Hyman (1990), Walsh (1992), Myers & Carleton (1996) and Akinlabi (1997) has focused on two possibilities of realising the tone within the reduplicative complex. Either tone is identical in the RED and Base, or High tones are realised only on the BStem. These two patterns of featural correspondence in reduplicated forms are ones which have also received much attention in OT. As McCarthy & Prince (1995, 1999) and Alderete *et al.* (1999), for example, argue, the identity between RED and its Base which defines the morphological process of reduplication is optimised by FAITH-BR (1a). If

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this constraint outranks tonal markedness constraints, like *H in (1c), then tonal transfer results: the tone is identical in the RED and Base.[1]

(1) a. FAITH-BR
Corresponding elements of RED and the Base have identical tone.
b. FAITH-IO
Corresponding elements of the Input and Output have identical tone.
c. *HIGHTONE (*H)
High tone is marked.
d. *Ranking defining tonal transfer*
FAITH-IO, FAITH-BR ≫ *H
e. *Ranking defining TETU*
FAITH-IO ≫ *H ≫ FAITH-BR

This and other work on reduplication (e.g. Clements 1985, Steriade 1988, Inkelas & Zoll 1999, 2000) has shown that prosodic information often corresponds as faithfully as segmental information in the RED to the Base. It is surprising, then, that tonal transfer appears to be rare in Bantu verbal reduplication. In fact, according to Hyman & Mtenje (1999), it is only found in Chichewa:

(2) *Chichewa verbal reduplication* (Myers & Carleton 1996: 49)

Unreduplicated		'X repeatedly'
tambalal-á	'stretch out your legs!'	tambalal-á-tambalal-á
phikits-á	'really cook!'	phikits-á-phikits-á
ndí-ma= [sangaláts-a	'I please (HAB)'	ndí-ma=[sangalátsa- sangalátsa
ti=[sangalats-é	'let's please'	ti=[sangalatsé- sangalatsé

More common in Bantu verbal reduplication systems is the TETU (see e.g. McCarthy & Prince 1995, 1999, Akinlabi 1997, Alderete *et al.* 1999) pattern defined by reversing the ranking of FAITH-BR and *H that optimises tonal transfer, as shown in (1e).[2] In this pattern, the RED always has Low (unmarked) tone even if the corresponding BStem syllable has High tone. An example of this pattern is provided by the KiHehe data in (3). As

[1] I am following work like McCarthy & Prince (1999) and Alderete *et al.* (1999) in using FAITH-BR and FAITH-IO as cover terms for all the faithfulness constraints optimising identity between RED and the Base or Input and Output, respectively (i.e. MAX, DEP and IDENT). See work like Steriade (1988), Inkelas & Zoll (1999, 2000) and Pulleyblank (to appear) for alternative approaches to defining reduplicative identity. And see work such as Akinlabi (1997) and Pulleyblank (1986) for arguments that High tone is marked.

[2] Ranking FAITH-IO above *H ensures that the Base will bear marked input tones in both the tonal transfer and the TETU pattern.

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Odden & Odden (1996) show, a High tone occurs on the stem-initial mora in unreduplicated verbs. In the corresponding reduplicated forms, the High tone is realised on the initial mora of the second half of the RED + Base complex. The first half bears a Low (unmarked) tone:

(3) *KiHehe verbal reduplication* (Odden & Odden 1985, 1996)

Unreduplicated		'X a bit'
si-tu=[dóongoleesa	'we won't roll'	si-tu=[dongolesa-dóongoleesa
si-tu=[fúlugala	'we won't be tired'	si-tu=[fulugala-fúlugala
si-tu=[déeña	'we won't cut'	si-tu=[deña-déeña
si-tu=[fúuwa	'we won't believe'	si-tu=[fuwa-fúuwa

As Odden & Odden (1985) and McCarthy & Prince (1995: 324–325) argue, the second half of the reduplicative complex is plausibly the BStem in KiHehe, as marked prosody like High tones and long vowels occur only in the second half.

Similarly, in Shona total reduplication, as Odden (1984: 270–273) shows, High tones are only realised on the first half of the RED + Base complex. The second half bears the unmarked tone. (Only stems are given in (4), with the tone pattern they have following, *handáká-* 'I didn't X'.)[3]

(4) *Shona verbal reduplication : total reduplication* (Odden 1984: (35), Hewitt 1992)

Unreduplicated		'X frequently'
-bikísa	'I didn't make cook'	-bikísa-bikisa
-bikísíra	'I didn't make cook for'	-bikísíra-bikisira
-tóresá	'I didn't make take'	-tóresá-toresa
-tóreserá	'I didn't make take for'	-tóreserá-toresera

Other examples of the TETU pattern can be found in Ndebele (Hyman *et al.* 1999, Downing 2001b), Swati (Downing 1994), Xhosa (Cassimjee 1998, Cassimjee & Kisseberth 1998) and Yao (Myers & Carleton 1996).

Besides the two patterns defined by the two possible relative rankings of FAITH-BR (1a) and *H (1c) shown in (1d) and (1e), another common pattern of tone realisation in Bantu verbal reduplication is for the RED + Base complex to have the same overall tone pattern as the unreduplicated form of the BStem. In these cases, like the TETU cases discussed just above, we do not find tonal identity between corresponding TBUs of the RED and the Base. However, in these examples, unlike the TETU cases, both the RED and the Base can bear marked tones because the RED + Base complex is treated as a single domain for BStem tone realisation.[4] For

[3] See Myers (1987) for discussion of reduplication in other verb paradigms in other dialects of Shona which also have the TETU tone pattern.

[4] See Downing (to appear) for examples from other African tone languages where the reduplicative complex is a single domain for Base tone realisation.

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example, Odden (1996b) shows that in Kikerewe, if a High tone is realised on the first (two) syllables of the unreduplicated stem, as in (5a), the High tone is also realised on the first (two) syllables of the reduplicative complex. However, if the stem High tone is realised on the final two syllables in the unreduplicated verb, as in the perfective forms in (5b), the High tone is also realised on the final two syllables of the reduplicative complex.

(5) *Kikerewe verbal reduplication* (Odden 1996b)

Unreduplicated		'X carelessly, here and there'
a. ku-[bíba	'to plant'	ku-[bíbá-biba
ku-[káláanga	'to fry'	ku-[káláanga-kalaanga
b. m-[baz-ílé	'I counted (yesterday)'	m-[bazile-bazílé
m-[bib-ílé	'I planted (yesterday)'	m-[bibile-bibílé

If we assume, plausibly, that the same half of the reduplicative complex consistently acts as the Base in the reduplicative verbal paradigms in (5), the different positions of the High tone (left edge *vs.* right edge of the reduplicative complex) are best explained by proposing that the entire complex is a single domain of Base tone realisation. Then it follows that the position of the High tone in the reduplicative complex is identical to its position in the unreduplicated form.

Another language where the reduplicative complex forms a single tone domain is Kinande. As shown by the data in (6), up to two High tones can be contributed by a verb stem, the lexical stem tone and a grammatical tone found in verb forms like the perfective, resulting in four possible combinations of these two tones in unreduplicated and reduplicated verbs. (Reduplication adds the meaning of doing the action quickly or here and there.) Mutaka & Hyman (1990) show that when there is neither a lexical nor a grammatical High tone, as in (6a), there are, unsurprisingly, no High tones in either form. When there is a lexical High tone, as in (6b), it is realised on the pre-stem vowel in both forms (assuming the RED morpheme counts as the left edge of the stem). When there is only a grammatical High tone, as in (6c), there is a High tone on the pre-stem vowel and the stem-initial syllable in both forms. And when there is both a lexical High tone and a grammatical High tone, as in (6d), there is a High tone on the pre-stem vowel, the antepenult and penult vowels in both forms.

(6) *Kinande verbal reduplication* (Mutaka & Hyman 1990: 102)

Stem H + grammatical H

a. ∅ + ∅ (no H tones on stem)		
eri=[hum-a	'to beat'	eri=[huma-huma
b. H + ∅ (H tone on pre-root vowel only)		
erí=[tum-a	'to send'	erí=[tuma-tuma

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c. ∅ + H (H tone on root vowel and pre-root vowel)
mó-tw-a-mú=[húm-irè 'we beat him' mó-tw-a-mú=[húma-humirè

d. H + H (H tone on pre-root vowel, penultimate and antepenultimate vowels)
mó-tw-a-mú=[túm-írè 'we sent him' mó-tw-a-mú=[tuma-túmírè

Other examples of the single tone domain pattern can be found in Ekoti (Schadeberg & Mucanheia 2000), Haya (Hyman & Byarushengo 1984), Kimatuumbi (Odden 1996a), Kinyamwezi (Maganga & Schadeberg 1992), Runyankore (Poletto 1998) and Shona partial reduplication (Odden 1984).

To sum up this section, the three-way pattern of variation in stem tone correspondence found in Bantu languages includes a previously unanalysed type of mismatch between RED and Base prosody. In the last pattern discussed we find, namely, that both the RED and the Base can contain marked tonal structure, because the entire RED + Base complex forms a single domain for stem tone realisation. In the next section I argue that this range of variation is best accounted for by proposing that reduplicated verb stems are compounds.

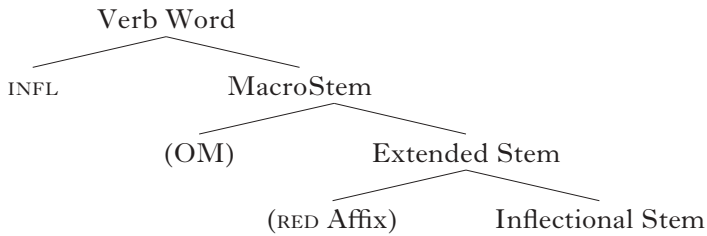
2.2 The reduplicative complex as a compound stem

If the RED + Base complex is a single domain for tonal realisation in some Bantu languages, then the null hypothesis is that it is also a single morphosyntactic constituent.[5] In fact, much recent work on reduplication in Bantu languages has argued that the RED + Base complex forms a single constituent, and there are two basic proposals for labelling this constituent, depending on the morphological category – affix *vs.* stem – assigned the RED morpheme. Work like Odden (1996a, b) assumes that the RED morpheme is an affix, forming an extended stem constituent with its Base, the inflectional (or derivational) stem, as shown in (7a). (Myers & Carleton 1996 similarly assume that the RED morpheme is an affix in Yao, but are not as explicit in labelling the constituent containing the RED and the Base verb stem.) The alternative proposal, found in work like Myers & Carleton (1996), Hyman *et al.* (1999), Inkelas & Zoll (1999, 2000) and Downing (2000), is that RED is a verb stem, forming a CStem with the BStem, as shown in (7b).

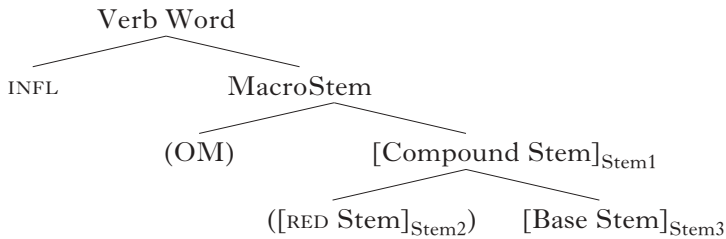
[5] See e.g. Inkelas (1989) for detailed discussion of the proposal that phonological domains and morphosyntactic constituents are coextensive in the default case.

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(7) a. *Affixal structure for reduplicated Bantu verb stems*
(adapted from Odden 1996b: 113)



b. *Compound structure for reduplicated Bantu verb stems*
(adapted from Myers & Carleton 1996: 50)[6]



As Downing (1999, 2000, 2001b), Hyman *et al*. (1999) and Inkelas & Zoll (1999, 2000) argue, there is a body of independent evidence from a number of Bantu languages showing that the RED is always best analysed as a verb stem, forming a compound with the Base, as in (7b), rather than an affix, as in (7a). Downing (1999, 2000) shows that the size of the RED is more consistent with that of stems than affixes. Bantu verb stems are typically minimally bisyllabic. Similarly, RED is minimally bisyllabic in most Bantu languages, even in cases of partial reduplication, and may be several syllables long in the languages where total verb stem reduplication is found. In contrast, affixes generally contain at most a single syllable, with a few exceptional bisyllabic forms (see e.g. Doke 1954, 1982, Meeussen 1967, Hyman 1993 for discussions of Bantu verbal morphology). Work like McCarthy & Prince (1994) proposes that this size difference is typical of affixes *vs*. stems: cross-linguistically affixes tend to be monosyllabic while stems are minimally bisyllabic. And, as Urbanczyk (1996, to appear) shows, cross-linguistically affix-like REDs tend to be monosyllabic, while root- or stem-like REDs are longer.

Further, the occurrence of a fixed /a/ in the final syllable of RED illustrated by the Kinande reduplication pattern in (6) is best explained if RED is a verb stem. Since /a/ is the morphological default verb stem-final morpheme, the occurrence of the fixed /a/ falls out if RED is morphologically categorised as a verb stem containing unmarked morphological

[6] The RED is shown as preceding the Base here. In languages where RED is analysed as following the Base, the reduplicative compound would have the structure shown in (7b), with the relative positions of the RED and Base reversed.

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structure. And if RED is a verb stem, the RED + Base complex is plausibly a compound, since generally only compounds contain more than one lexical morpheme like a stem. If RED is an affix, as in (7a), then one would have to find some other motivation for the fixed /a/, for example that it is the phonological default vowel. However, /i/ is the phonologically unmarked vowel in most Bantu languages, so it is unexpected for /a/ to replace the corresponding Base vowel in an affixal RED.[7]

A potential argument in favour of the affixal analysis in (7a) is that, at least in TETU languages, RED is toneless. As Myers & Carleton (1996) point out, stems contrast for tone in most Bantu languages, while most affixes bear unmarked tone. RED is, then, expected to be toneless if it is an affix. However, it is also completely consistent with the stem compounding analysis for RED to be toneless. A well-attested pattern of prosody realisation in compounds is for only one member to have marked prosody, like pitch accent, while the other is unmarked. In fact, the complete three-way pattern of tone realisation in Bantu verbal reduplication illustrated in the previous section finds an exact parallel in the cross-linguistic patterns of accent realisation in compounds. Accent (stress and/or pitch accent) in some languages is assigned and realised on each member of the compound independently. (Compare this pattern with the tonal transfer pattern illustrated in the Chichewa data in (2) above.) For example, in Malayalam co-compounds, Mohanan (1982) shows that each lexical morpheme in the co-compound is assigned main stress, and each half is a separate domain for realisation of the LH intonation melody.[8]

(8) *Malayalam co-compounds* (Mohanan 1982, Inkelas 1989)

a. [[[ácchan] [ámma]] maare] 'parents'
L H L H
father mother PL

b. [[[yáksa] [kínnara] [gándharwan]] maare] 'Yaksha, Kinnara, Gandharwa'
L H L H L H
Yaksha Kinnara Gandharwa PL

Other examples of this pattern of compound accentuation are found in Italian (Nespor & Vogel 1986: 130) and Dakota syntactic compounds (Chambers & Shaw 1980, Shaw 1985).

The second common pattern is for accent to be realised on only one half of the compound; the other half is unmarked for accent. (Compare this pattern with the tonal TETU pattern illustrated by the KiHehe data in (3).) For example, Amha (1996) shows that in Wolaitta, an Omotic language spoken in south-central Ethiopia, nouns have accent on either the penult or the final syllable. Numerous minimal pairs show that accent

[7] Space does not permit developing in more detail the arguments for considering RED a verb stem in Bantu languages. The interested reader may consult Downing (1999, 2000, 2001b), Inkelas & Zoll (1999, 2000) and Hyman *et al.* (1999) for discussion.

[8] In the data in (8)–(10), accent marks on vowels indicate stress or accent, not tone as in the other data.

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placement is unpredictable: e.g. *zaré* 'lizard' *vs. záre* 'relative'. As shown in (9), in compounds accent is only found on the first member of the compound, and it falls on the same syllable as when the word occurs in isolation. As a result, compound accent is often found on a syllable that is outside the two-syllable window at the right edge, where accent is usually assigned to nouns:

(9) *Wolaitta nominal compounds* (Amha 1996: 133)
   a. hayttá tukke 'spicy coffee made from coffee leaves'
      cf. hayttá 'leaf'; tukké 'coffee'
   b. haattá harge 'algae'
      cf. haattá 'water'; hargé 'illness'
   c. goóʃʃa giya 'a special market day in the second week of September'
      cf. goóʃʃa 'crazy'; giyá 'market'
   d. yeehó keetta 'mourning house'
      cf. yeehó 'mourning'; keettá 'house'

Other examples of this pattern are found in Japanese (McCawley 1978, Tsujimura 1996), Somali (Hyman 1981) and Turkish (Underhill 1976).[9]

The third pattern is for stress or pitch/accent to be realised over the entire compound as a single unit. (Compare this pattern with the single tone domain pattern illustrated by the Kikerewe data in (5).) For example, Malayalam has another form of compounding, sub-compounding, shown in (10). In contrast to the co-compounding pattern illustrated in (8), in sub-compounds the entire compound has a single main stress. And the entire compound is a single domain for realisation of the LH intonation melody:

(10) *Malayalam sub-compounds* (Mohanan 1982, Inkelas 1989)

   a. [[[táaraà] [kaàntan]] maare] 'Tara's husbands'
      L H H H
      Tara husband PL

   b. [[[máta] [widweèsam]] 'hatred of religion'
      L H H
      religion hatred

Other examples of this pattern are found in Dakota lexical compounds (Mohanan 1982, Shaw 1985) and Greek (Nespor & Vogel 1986: 112–113).[10]

[9] Languages like English seem to represent a combination of these first two patterns. Each member of the compound maintains some degree of stress, but the stress of all but a peripheral member is strikingly reduced – often to nothing – at a normal speech rate.

[10] Notice that it is mostly unpredictable which pattern or accent of tone realisation we will find in any particular language. It is true that the two types of compounding in Malayalam show a correlation between semantic cohesion and accent domain (that is, it is not surprising that the more lexicalised compounds form a single domain for accent assignment, while the less lexicalised do not). However, if we compare the

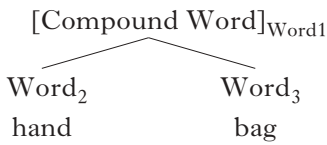
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The compounding analysis of Bantu reduplicated verbs confirms, then, work like Kiparsky (1986), Niepokuj (1991), McCarthy & Prince (1995), Fabb (1998), Yip (1998) and Inkelas & Zoll (1999, 2000), showing that cross-linguistically we find a number of phonological and morphological parallels between reduplicative structures and compounds.

2.3 Formal analysis

As work like Selkirk (1984), Nespor & Vogel (1986), Inkelas (1989) and Fabb (1998) demonstrates, the variation we find in accent realisation in compounds falls out from their morphosyntactic structure. Compounds are words (or stems) which consist of at least two lexical morphemes (like root, stem or word) of the same type. (This distinguishes them from other words or stems, which generally contain only one lexical morpheme.) As a result, a compound word like English *handbag* in (11), for example, is simultaneously a single word (*handbag* Word_1) and the two words (*hand* Word_2 and *bag* Word_3) of which it is composed:

(11) *Compound word structure*



Accentuation and other processes which take Word as their domain can define different constituents of this compound structure as relevant in different languages. If the sub-words (Word_2 and Word_3) are defined as relevant for Word-domain processes, then they will each be assigned accent. This accent is realised on all the sub-words in some languages (see e.g. Malayalam co-compounds (8)), while in others the accent is reduced on all the members of the compound except its morphological or phonological head (see e.g. Wolaitta (9)). Notice that this potential accentual asymmetry between the head of the compound and the other members is analogous to the asymmetrical relationship between the RED and the Base. The Base, as the phonological and morphological head of the reduplicative structure, bears marked features and/or prosody, while those of RED are commonly restricted to the unmarked. Similarly, the phonological or morphological head of the compound bears marked accent, while the accent of other members can be restricted to the unmarked. As work like Nespor & Vogel (1986) and Inkelas (1989) shows, the third pattern of

meanings of the compounds in Malayalam and Wolaitta (9), there is no obvious reason why compounds fit a different accentual pattern in these languages. This parallels tone realisation in reduplicated verbs in Bantu languages. Verbal reduplication appears to have the same range of meanings in all these languages (namely, to do the action haphazardly or here and there or quickly), but we find three different patterns of tone realisation.

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accentuation (see e.g. Malayalam sub-compounds (10)) is derived by defining the compound word ($Word_1$ in (11)) as relevant as a unit for Word-domain processes. It is this pattern which takes advantage of the compound word's ambiguous structure: it is a single Word as well as the several Words of which it is composed.

If we assume the compound structure in (7b) for the RED + Base complex, then the three variants in Bantu reduplicative verb stem tone realisation, like the three variants in compound accent realisation, fall out from exploiting the fact that a CStem is simultaneously a single verb stem and the two stems contained in the compound, giving stem tone realisation the choice of stem domains shown in (12):

(12) a. Both BStem and RStem: tonal transfer (e.g. Chichewa (2))
b. BStem only: TETU (e.g. KiHehe (3))
c. CStem ($Stem_1$): single tone domain (e.g. Kikerewe (5))

In tonal transfer languages (12a), both sub-stems bear (identical) marked tones. In TETU languages (12b), only the BStem bears marked tone, while the RStem is restricted to bear unmarked tone. Finally, the entire reduplicative complex, as a CStem, can be defined as a unitary domain for the realisation of stem tone (12c).

In an OT analysis, we can account for the role of the CStem in determining this three-way pattern of tone realisation within reduplicative compounds with the constraints in (13):

(13) *Constraints defining three-way variation in tone assignment to* RED + Base[11]

a. *H
High tone is marked.
b. ALIGN-L(BStem, H) (ALIGN(BStem))
The leftmost TBU of the (input) BStem is linked to a stem H tone.
c. ALIGN-L(RStem, H) (ALIGN(RStem))
The leftmost TBU of the RStem is linked to a H tone.
d. ALIGN-L(CStem, H) (ALIGN(CStem))
The leftmost TBU of the CStem is linked to a stem H tone.

[11] The alignment constraints in (13) follow the generalised alignment schema of McCarthy & Prince (1993), in which every member of the first argument is aligned with some member of the second argument. Other work proposing constraints aligning features – and in particular morphologically affiliated features like stem H tone – with a morphological constituent edge include Akinlabi (1996), Myers & Carleton (1996) and Pulleyblank (1996). I follow Zoll (1997) in evaluating these constraints non-gradiently in (14)–(17).

ALIGN(BStem) is a typical constraint on stem tone linking for Bantu verb stems. It and the others in (13) are provided here for the sake of concreteness. I assume that in the default case the direction of alignment of the stem High tone will be the same for all stems. (Idsardi 1992 similarly suggests that the default directional parameter setting in stress systems is for all settings to refer to the same edge.) This expresses the generalisation that when the CStem is a single domain for tone realisation, the entire reduplicative complex has the same tone pattern as the unreduplicated BStem.

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e. DEP-IO
All tones of the output stem must occur in the corresponding input stem.

f. FAITH-BR
Corresponding elements of RED and the Base have identical tone.

*H (13a) is the same constraint as (1c), penalising any marked High tones in the Output. Recall from (1d, e) that it is the relative ranking of FAITH-BR (13f) and *H which is the main factor defining the tonal transfer *vs.* TETU patterns of tone realisation in reduplicated forms. In this analysis, it is the relative ranking of ALIGN(RStem) (13c) and *H which is the main factor defining the difference between the tonal transfer *vs.* TETU patterns. As shown in (14), if both ALIGN(BStem) and ALIGN(RStem) outrank *H, then tonal transfer is optimal. (The verb stems in the following tableaux are hypothetical forms chosen for the purposes of illustrating the basic approach. In §3 these constraints are applied to the analysis of particular languages.)[12]

(14) *Ranking optimising tonal transfer:* DEP-IO ≫ ALIGN(BStem), ALIGN(RStem), ALIGN(CStem), FAITH-BR ≫ *H

RED=fulugala, H	DEP-IO	ALIGN (BStem)	ALIGN (RStem)	ALIGN (CStem)	FAITH-BR	*H
☞ a. {⟨fúlugala=[fúlugala				*		**
b. {⟨fulugala=[fúlugala			*!	*	*	*
c. {⟨fúlugala=[fulugala		*!			*	*
d. {⟨fulugala=[fulugala		*!	*	*		

Candidate (14a), the tonal transfer candidate, is optimal, as a (stem) High tone is linked to the left edge of both RStem and BStem, satisfying the highest-ranked constraints. (When a High tone occurs on both the BStem and the RStem, as in a tonal transfer candidate, I assume that the stem High tone is the one linked to the BStem, the input source of the High tone, while the one linked to the RStem is the copy motivated by ALIGN(RStem) and FAITH-BR.) Candidate (14b), the TETU candidate, is non-optimal, as it violates ALIGN(RStem): no High tone is linked to the left edge of RStem. Candidate (14c), the single tone domain candidate, is non-optimal, as it violates ALIGN(BStem): the stem High tone is linked with the left edge of CStem, not with the left edge of BStem. Since (14b) and (14c) contain only a single High tone, each necessarily satisfies only one of the high-ranked stem–tone alignment constraints while violating the other. Candidate (14d), in which both halves of the reduplicative complex have identical unmarked tone, is non-optimal as it violates all the alignment constraints requiring a High tone at the left edge of some stem.

[12] In the tableaux in (14)–(17), '{' indicates the left edge of CStem, '⟨' the left edge of RStem, and '[' the left edge of BStem.

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In this simple tonal transfer example, where undominated ALIGN (BStem) (13b) is the only non-reduplicative tone constraint, FAITH-BR and ALIGN(CStem) play no role in the analysis. In the absence of positive evidence for ranking, they are ranked above *H. We shall see in the Chichewa analysis in §3.2 an example of a tonal transfer system where FAITH-BR and ALIGN(CStem) (and the other alignment constraints) are crucially ranked with respect to each other and play a role in choosing optimal candidates.

Tableau (15) illustrates the role of DEP-IO in the analysis. It is because this faithfulness constraint is high-ranked that toneless verb stems surface as toneless, even though the alignment constraints optimise a High tone in the output of all verb stems:

(15)

RED=fulugala	DEP-IO	ALIGN (BStem)	ALIGN (RStem)	ALIGN (CStem)	FAITH-BR	*H
a. {⟨fúlugala=[fúlugala	*!			*		**
b. {⟨fulugala=[fúlugala	*!		*	*	*	*
c. {⟨fúlugala=[fulugala	*!	*			*	*
☞ d. {⟨fulugala=[fulugala		*	*	*		

As shown in (15), inserting a High tone in the output, as in candidates (a–c), is non-optimal, as this violates highest-ranked DEP-IO. Candidate (d), which is tonally faithful to the input, is optimal, even though it violates all the alignment constraints. (DEP-IO is omitted from remaining tableaux in the paper, as it is never violated and so never plays a role in choosing optimal candidates.)

As shown in (16), ranking *H above ALIGN(RStem) and ALIGN(CStem) optimises the TETU tone realisation pattern. (FAITH-BR is low-ranked, as it plays no role in choosing optimal candidates.)

(16) *Ranking optimising the TETU pattern:* (DEP-IO ≫)ALIGN(BStem), *H ≫ ALIGN(CStem), ALIGN(RStem), FAITH-BR

RED=fulugala, H	ALIGN (BStem)	*H	ALIGN (CStem)	ALIGN (RStem)	FAITH-BR
a. {⟨fúlugala=[fúlugala		**!	*		
☞ b. {⟨fulugala=[fúlugala		*	*	*	*
c. {⟨fúlugala=[fulugala	*!	*			*

Candidate (16b), the TETU candidate, is optimal, as the stem High tone is realised only on the BStem. This satisfies high-ranked ALIGN(BStem) and incurs only one violation of *H. Candidate (16a), the tonal transfer candidate, is non-optimal as it incurs more violations of *H than the TETU candidate. Candidate (16c), the single tone domain candidate, is also non-optimal, as the stem High tone is linked to the leftmost TBU of

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the CStem (coinciding with RStem), not the BStem, violating high-ranked ALIGN(BStem).

Finally, as shown in (17), ranking ALIGN(CStem) and ALIGN(RStem) above ALIGN(BStem) optimises the single tone domain pattern. (Notice this reverses the relative ranking of these alignment constraints from the one optimising the TETU pattern.) FAITH-BR is low-ranked, as it plays no role in choosing optimal candidates:

(17) *Ranking optimising single tone domain pattern:* (DEP-IO ≫) ALIGN(CStem), ALIGN(RStem), *H ≫ ALIGN(BStem), FAITH-BR

RED=fulugala, H	ALIGN (CStem)	ALIGN (RStem)	*H	ALIGN (BStem)	FAITH-BR
a. {⟨fúlugala=[fúlugala	*!		**		
b. {⟨fulugala=[fúlugala	*!	*	*		*
☞ c. {⟨fúlugala=[fulugala			*	*	*

Candidate (17c), the single tone domain candidate, is optimal. There is only one High tone in this candidate, corresponding to the stem High tone of the input, and it is realised on the leftmost TBU of the CStem (coinciding with the RStem). Candidate (17b), the TETU candidate, is non-optimal, as it violates ALIGN(CStem) and ALIGN(RStem). Candidate (17a), the tonal transfer candidate, is also non-optimal. It violates ALIGN(CStem), since the stem High tone is aligned with the BStem, not the CStem, and it incurs more *H violations than the other candidates.

The analysis formalises the similarity between the TETU pattern (16) and the single tone domain pattern (17) through the similarity in the constraint rankings which define the two patterns. Both patterns satisfy high-ranking *H better than tonal transfer, as only one High tone occurs in the reduplicative complex. In the TETU pattern (16), the stem High tone is realised on the Base, as ALIGN(BStem) is high-ranked and ALIGN(CStem) and ALIGN(RStem) are low-ranked. As shown in (17), reversing the ranking of these two alignment constraints – and keeping the other rankings the same – optimises linking the stem High tone with the leftmost TBU of the CStem rather than realising the stem High tone within the Base.

To sum up this section, the three-way pattern of tone realisation within reduplicative verb stems attested in Bantu languages falls out if the reduplicative complex has the compound structure in (7b). In this structure, the BStem is a subconstituent of a compound verb stem, and the phonological and morphological head of the compound. As a result, it is not unexpected for prosodic properties of the Base to be realised either within the CStem which dominates the Base as a unit constituent or on the BStem alone (and potentially also on RED by tonal transfer). This is, in fact, the range of prosodic variation expected for compounds. Formalising the additional possibility of stem tone realisation provided by the compounding structure as a constraint optimally linking the stem High tone

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within the CStem (as in (13d)) allows the attested cross-Bantu variation to be accounted for easily within OT by the usual strategy of variable constraint ranking.[13]

2.4 Alternatives to compounding as an explanation for lack of tonal transfer

An important advantage of the compounding analysis is that it accounts for the complete range of variation in tone realisation attested for Bantu verbal reduplication by the relative ranking of related alignment constraints. In contrast, previous work on reduplicative identity accounts for two main types of correspondence: tonal transfer or TETU.

Myers & Carleton (1996) discuss tone and total verb stem reduplication in Chichewa, where tone transfer is found (see (2) above), and in Yao, a TETU language (see e.g. the Shona total reduplication pattern shown in (4)). To account for the contrast in reduplicative tone realisation in these two languages, they propose that tone transfer is found in Chichewa because RED is a stem in this language. In contrast, in Yao the tone of the RED is not identical to tone of Base, because the RED is an affix.[14] Correlating the occurrence of marked structure in RED with its morphological status is also argued for in Urbanczyk (1996, to appear): affix REDs are expected to contain less marked prosodic and featural structure than root (or stem) REDs, in keeping with other root–affix asymmetries (see e.g. Beckman 1998). There are, however, numerous problems with the claim that REDs are affixes in the Bantu languages where the RED tone is not identical to that of the Base. First, as discussed in §2.2 above, there is considerable evidence showing that REDs are best analysed as stems in Bantu languages. Further, we can see in tableaux (14) and (16) that assuming RED is consistently a stem and re-ranking *H and ALIGN(RStem) straightforwardly derives the contrast between tonal transfer and TETU languages. Referring to a difference in the morphological status of RED in the two types of languages would be a superfluous additional complication. Finally, it is not clear how this proposal could be extended to account for the single-domain pattern exemplified in (17). As argued above, it is this pattern, in fact – not the tonal transfer pattern – which most strongly argues for the compound structure of the reduplicative complex.

As Myers & Carleton (1996) demonstrate, accounts of reduplicative tone which correlate stem tone transfer with the phonological representation of the Base tone are equally problematic.[15] Mutaka & Hyman (1990) propose that the difference between tonal transfer and TETU languages

[13] Variable ranking of the constraints in (13) predicts more patterns of tone realisation than the three discussed here. It is a matter for future research, beyond the scope of this paper, to determine how many of the predicted patterns are attested.

[14] See Hyman & Byarushengo (1984) and Kimenyi (1979) for similar proposals.

[15] Space does not permit more than this brief summary of Myers & Carleton's (1996) arguments against these alternatives. The interested reader is encouraged to consult their work for a more detailed discussion.

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falls out from different input tonal associations. If output tone realisation is predictable, tones need not be linked in the input. If output tone realisation is not predictable, tones do need to be linked in the input. Contrasts in tonal transfer would correlate with a contrast in input tone linking, if only linked input tones were transferred in the RED. However, comparing a tonal transfer language like Chichewa (2) with a TETU language like KiHehe (3) shows there is no consistent correlation between input tone linking and tonal transfer. In both languages – as in many Bantu languages (Downing 1996) – verb tone is arguably unlinked in the input as its output realisation is entirely predictable. Yet, we find a contrast in tone realisation in reduplicated verb stems in these languages.

Myers & Carleton (1996) show that the Chichewa pattern in (2) also provides a counterexample to Walsh's (1992) proposal that tone realisation in the RED correlates with the level of representation to which tone is linked. According to this proposal, tone is prosodically linked (to mora or syllable) in some languages but segmentally linked in others. The interaction of tone with other segmental features like [voice], for example, would provide evidence for segmental linking, while evidence for prosodic linking would come from prosodic conditioning on the output realisation. Further, segmental material of the Base is said to obligatorily transfer in reduplication, while prosodic Base material only optionally transfers. As a result, segmental tone is predicted in this analysis to always be realised in the RED while prosodic tone need not be. However, Chichewa output tone association is prosodically conditioned (see the next section for discussion), yet tone is realised in the RED. Further, consonant segmentism conditions output tone realisation in many Southern Bantu languages, like Ndebele and Xhosa (see e.g. Doke 1954, Cassimjee & Kisseberth 1992, 1998 for discussion), yet tone does not transfer in these languages, as noted in §2.1.[16] Prosodic *vs.* segmental association of tone – like a contrast in input linking – does not then reliably correlate with tone realisation in the RED.

These analyses share the common failing that they describe only a two-way contrast in reduplicative tone patterns: either stem tone transfers or it does not. As a result, all propose a single binary parameter to account for stem tone transfer: the RED is affix *or* stem; tone is underlyingly linked *or* unlinked; tone is segmental *or* prosodic; RED features are identical to Base features *or* unmarked. The advantage of the analysis presented here is that it recognises that there is a third common pattern of tone correspondence in reduplicative structures: the single tone domain pattern. Further, it demonstrates that analysing reduplicative structures as compounds

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As pointed out by an anonymous reviewer, an additional argument against appealing to input tonal association contrasts to account for contrasts in tonal transfer is that it is unclear whether such input tonal contrasts can be implemented in OT, given the Richness of the Base hypothesis (Prince & Smolensky 1993).

[16] See Akinlabi (1997) for discussion of other cases which are problematic for Walsh's (1992) proposal.

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provides the basis for a new parameter of variation in reduplicative tonal correspondence which accounts for all the attested patterns.

3 Variable domains for tone assignment in Southern Bantu languages

Perhaps because previous work within OT does not provide a formal analysis of the single tone domain pattern, it also does not straightforwardly account for those Southern Bantu languages – Chichewa (Myers & Carleton 1996, Hyman & Mtenje 1999), Shona (Odden 1984, Hewitt 1992), Swati (Downing 1994) and Xhosa (Cassimjee 1998) – where reduplicative tone correspondence is conditioned by the length of the BStem. In these languages, reduplicated one–two syllable Base verb stems have the single tone domain pattern, while longer Base verb stems have either the tonal transfer pattern (Chichewa, discussed in §3.2 below) or the TETU pattern (like Swati, discussed in §3.3 below). Work like Hewitt (1992), Myers & Carleton (1996) and Hyman & Mtenje (1999) argues that this length condition on reduplicative tone correspondence arises because one–two syllable stems are morphologically subminimal. The obvious problem with this proposal is that two-syllable constituents satisfy familiar morphological minimality constraints (see e.g. McCarthy & Prince 1986, Crowhurst 1992). I argue in this section it is because the tonal constraints of these languages can only be satisfied when reduplicating stems of at least three syllables that the length of the BStem determines the pattern of tone correspondence in reduplicated forms. Simply ranking the constraints on non-reduplicative tone correspondence independently motivated in previous work on each language with the constraints in (13) shown to account for reduplicative tone correspondence automatically optimises the length-determined alternation in reduplicative tone patterns. This pattern of alternation, then, provides an important argument in favour of the compounding analysis of reduplicated Bantu verb stems developed in the previous section.

3.1 Theoretical background

In this paper I adopt Optimal Domains Theory (ODT; Cassimjee 1998, Cassimjee & Kisseberth 1998) to formalise the tonal analyses. ODT is an alternative to autosegmental representations as a way of formalising the realisation of a feature on segments. The similarities and differences between ODT and autosegmental representations are highlighted in (18). The autosegmental representation of tone spread is shown in (18a). The High tone is linked by association lines to two vowels. Each vowel the High tone is associated with realises the High tone phonetically. In other words, the string of vowels associated with a single High tone defines the domain of realisation of the tone. In the ODT representation in (18b), the two vowels in the syllables in parentheses can be realised as High-toned,

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not by direct association with the High tone, but rather because they are parsed into a binary High tone domain.[17]

(18) a. *Autosegmental representation*



b. *ODT representation*

$(C\ V\ C\ V)_H$

Tonal domains are a type of prosodic constituent and, like other prosodic constituents, can be either binary or unbounded in size, and subject to minimality and non-finality. These properties follow if Bantu tone is analysed in terms of ODT's prosodic tone domains. They are stipulations in autosegmental theory. As we shall see, these properties are crucial to understanding the tone systems of Chichewa and Swati. An important difference between ODT and autosegmental representations of tone is that not all the TBUs parsed into a High tone domain (TD) are necessarily phonetically realised with a High tone. While each TBU within the domain is (potentially) High-toned, constraint interaction can penalise High tones on certain TBUs in the domain. An example of this will be provided in the discussion of Swati.[18]

3.2 Chichewa

Chichewa is a major language of Malawi. Two of its dialects – the Ntcheu dialect (Hyman & Mtenje's 1999 'Chichewa-Al') and the Central dialect (Hyman & Mtenje's 1999 'Chichewa-Sam') – have been the focus of work on tone and reduplication.[19] As shown by the data in (19), tonal transfer is found in both dialects if the verb stem has three or more syllables ('[' indicates stem edge):

(19) a. *Chichewa-Al and Chichewa-Sam verb stem reduplication*
stem High tone on penult (Hyman & Mtenje 1999: 116)

Stem		'X here and there'
ti-sa-[thandíz-e	'let's not help'	-[thandíze=thandíze
ti-sa-[vundikír-e	'let's not cover'	-[vundikíre=vundikíre
ti-sa-[fotokozér-e	'let's not explain to'	-[fotokozére=fotokozére

[17] Only High tones are subject to ODT alignment constraints in the Bantu languages discussed in this section, because only High tones are specified in the input and phonologically active, as the works cited make clear. See Downing (1996) and references cited therein for more discussion of this asymmetry between High and Low tones in Bantu languages.

[18] It is beyond the scope of this paper to motivate ODT in further detail. See work like Cassimjee (1998), Cassimjee & Kisseberth (1998), Downing (2001a) and Katamba (2001) for discussion of how ODT accounts for a number of Bantu tone systems. These works also lay out more fully the advantages of ODT over autosegmental theory in accounting for the prosodic aspects of many Bantu tone systems.

[19] The Central Chichewa dialect is the one also analysed in Kanerva (1990a, b) and Myers & Carleton (1996).

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b. *Chichewa-Al verb stem reduplication*
stem High tone on final (Hyman & Mtenje 1999: 118)

Stem		'X here and there'
ti-[thandiz-é	'let's help'	-[thandizé=thandizé
ti-[vundikir-é	'let's cover'	-[vundikiré=vundikiré
ti-[fotokozer-é	'let's explain to'	-[fotokozeré=fotokozeré

c. *Chichewa-Sam verb stem reduplication*[20]

Stem phrase-medial/phrase-final	'X here and there' (phrase-final)
ti-[thandiz-é … / -[thandíz-e	-[thandizé=thandíze
ti-[vundikir-é … / -[vundikír-e	-[vundikiré=vundikíre
ti-[fotokozer-é … / -[fotokozér-e	-[fotokozeré=fotokozére

In the Chichewa-Al dialect, as shown in (20), tonal transfer is also found when one–two syllable verb stems are reduplicated, though the tone pattern is not exactly identical in each half:[21]

(20) *Chichewa-Al verb stem reduplication : stems of one–two syllables*

Stem		'X here and there'
a. stem High tone on penult (Hyman & Mtenje 1999: 116)		
ti-sa-[phé	'let's not kill'	-[phé=i-phé
ti-sa-[mény-e	'let's not hit'	-[ménye=menyé (*-[ménye=ménye)
ti-sa-[péz-e	'let's not find'	-[péze=pezé (*-[péze=péze)
b. stem High tone on final (Hyman & Mtenje 1999: 118)		
ti-[phé	'let's kill'	-[phé=i-phé
ti-[meny-é	'let's hit'	-[menyé=menyé
ti-[pez-é	'let's find'	-[pezé=pezé

[20] As Kanerva (1990a, b), Myers & Carleton (1996: n. 1) and Hyman & Mtenje (1999: n. 7) explicitly note, in this dialect of Chichewa high tones are only realised on a word-final syllable when the word is phrase-medial. In phonological phrase-final position, word-final high tones are retracted to the penult. Unfortunately, penult retraction is not reflected in the transcriptions adopted by either Myers & Carleton (1996) or Hyman & Mtenje (1999). As we shall see, however, this process is crucial to understanding reduplicative tone realisation, so I have included in (19b, c) and (21) both the phrase-medial pronunciation given by the source and the predicted phrase-final pronunciation. However, I follow Myers & Carleton (1996) in abstracting away from other tonal alternations that obscure the tone patterns under analysis. Thanks to Al Mtenje for discussion of the reduplicative tone patterns in the two dialects of Chichewa.

[21] I follow other work on Chichewa reduplication (Kanerva 1990a, Myers & Carleton 1996, Hyman & Mtenje 1999) in assuming RED is a suffix. It is, admittedly, difficult to decide which half of the reduplicative complex is the RED for languages like Chichewa where there is total identity between RED and Base for nearly all forms. However, Hyman & Mtenje (1999) plausibly argue that monosyllabic stems like *ti-sa-*[*phé=i-phé* 'let's not kill' show that RED is best analysed as a suffix. The epenthetic *i* is best motivated to satisfy a minimality requirement on the second copy of stem if it is the RED. The inflectional prefixes (e.g. *ti-sa-*) preceding the first copy allow it to satisfy minimality if it is the BStem. As it is beyond the scope of this

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In the Chichewa-Sam dialect, as shown in (21), we find the single tone domain pattern when these shorter verb stems are reduplicated. Notice there is only one High tone within the reduplicative complex in these forms, on the reduplicative suffix, rather than the two we expect from the tonal transfer pattern illustrated by the longer verb stems in (19a) and (19c):

(21) *Chichewa-Sam verb stem reduplication : stems of one–two syllables*

Stem		‘X here and there’
a. stem High tone on penult (Hyman & Mtenje 1999: 116)		
ti-sa-[phé	‘let’s not kill’	-[phe=í-phe (*-[phé=í-phe)
ti-sa-[mény-e	‘let’s not hit’	-[menye=ménye (*-[ménye=ménye)
ti-sa-[péz-e	‘let’s not find’	-[peze=péze (*-[péze=péze)
b. stem High tone on final (Hyman & Mtenje 1999: 118)		
ti-[phé … / -[phé	‘let’s kill’	-[phe=í-phe (*-[phé=í-phe)
ti-[meny-é … / -[mény-e	‘let’s hit’	-[menye=ménye (*-[menyé=ménye)
ti-[pez-é … / -[péz-e	‘let’s find’	-[peze=péze (*-[pezé=péze)

I will show in this section that there is a length condition on reduplicative tone realisation in the Chichewa-Sam dialect but not in the Chichewa-Al dialect because the Chichewa-Sam dialect contains a constraint on non-reduplicative tone realisation that is not active in the Chichewa-Al dialect. Simply ranking this constraint with the constraints in (14) defining the tonal transfer pattern automatically derives the length condition on reduplicative tone realisation. To show this, I first present an analysis of tone realisation in the unreduplicated stems. Then I extend the analysis to the reduplicated forms of these stems.

3.2.1 *Tone is unreduplicated verb stems.* As work like Kanerva (1990a, b), Myers & Carleton (1996), Hyman & Mtenje (1999) and others they cite make clear, verb stem High tones in Chichewa must occur on one of the last two syllables of the stem. (This is why, as noted in §2.4, Myers & Carleton (1996) argue that Chichewa verb tone is predictable and prosodic. High tone occurs in a predictable position, arguably within the final foot of the stem.) It is the inflectional morphology of the stem which determines whether the penult or the final syllable is the target for High tone association. The unreduplicated verbs in (18)–(21) above illustrate these points. To account for these tone patterns, I adopt Myers & Carleton’s

paper to pursue this problem further, the interested reader is referred to the works cited for discussion.

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(1996) proposal that this morphological condition on stem tone realisation can be accounted for by the interaction of the following two constraints (adapted slightly to make them consistent with the ODT framework).[22]

(22) *Constraints on Chichewa stem tone realisation*
(adapted from Myers & Carleton 1996: 44)

a. ALIGN-R(BStem, TD) (ALIGN(BStem))
The right edge of the BStem is aligned with the right edge of a stem High tone domain.

b. STEMNON-FINALITY
The right edge of the BStem-final syllable does not coincide with the right edge of a tone domain.

c. *Co-phonology for H-final paradigms*
ALIGN(BStem) ≫ STEMNON-FINALITY

d. *Co-phonology for penult H paradigms* (PRES HAB, NEG FUT, STRONG SUBJ, …)
STEMNON-FINALITY ≫ ALIGN(BStem)

Constraint (22a) is essentially the ALIGN-R variant of ALIGN(BStem) in (13b). I follow Inkelas (1998) and Orgun (1998) in adopting a co-phonology approach to accounting for the morphological conditioning on STEMNON-FINALITY (22b). The two co-phonologies required for the H-final *vs.* penult H inflections of Chichewa are given in (22c) and (22d), respectively.[23]

The tableaux in (23) and (24), adapted from Myers & Carleton (1996: 44–45), exemplify the analysis so far. Parentheses indicate Tone Domains:[24]

(23) *Chichewa-Al and Chichewa-Sam dialects: penult High on stem*
ndima-[sangalála 'I am happy (HAB)'

-[sangalala, H	STEMNON-FIN	ALIGN(BStem)
☞ a. -[sanga(lá)la		*
b. -[sangala(lá)	*!	

[22] From the available sources, it is hard to determine where the left edge of the High tone domain is in Chichewa. I am here following Cassimjee & Kisseberth (1998) in assuming that in the default case only the syllable bearing the High tone is parsed into a tone domain.

[23] Myers & Carleton (1996) adopt a different approach to accounting for this morphological conditioning, assuming that STEMNON-FINALITY is only violated if a High tone occurs on the stem-final syllable in one of the paradigms listed in (22d). Violations are ignored in other paradigms (the ones where the stem High tone must surface on the final syllable). It is beyond the scope of this paper to justify choosing the co-phonology approach. The interested reader can consult Inkelas (1998) and Orgun (1998) for general arguments in favour of co-phonologies.

[24] In the Chichewa analysis, I follow Myers & Carleton (1998) in assuming there is a High tone in the input of the verb stems that have a High tone in the output. This

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(24) *Chichewa-Al only: final High on stem*
tambalalá 'stretch out your legs!'

tambalala, H	ALIGN(BStem)	STEMNON-FIN
☞ a. tambala(lá)		
b. tamba(lá)la	*!	

The tableau in (23) exemplifies a tense with co-phonology (22d), in which STEMNON-FINALITY is high-ranked. In these paradigms, candidate (23a), which satisfies STEMNON-FINALITY, is optimal. The tableau in (24) exemplifies a tense with co-phonology (22c), in which STEMNON-FINALITY is low-ranked. Candidate (24a) is in this co-phonology optimal, as it violates no constraints. Candidate (24b) is non-optimal as it gratuitously violates ALIGN(BStem) by realising the High tone on the penult rather than the final syllable.

As shown by the data in (19b, c) and (21), High tone is only realised on the stem-final syllable (in paradigms which take the stem-final High pattern) in the Chichewa-Sam dialect when the verb occurs phrase-medially. Phrase-finally, the High tone 'retracts' to the penult syllable.[25] Penult retraction can be accounted for by the non-finality constraint in (25), identical to the one in (22b), except restricted to apply at phrase edges instead of having a grammatical context:

(25) PHRASENON-FINALITY

The right edge of a phrase-final syllable does not coincide with the right edge of a tone domain.

This constraint must be high-ranked in the Chichewa-Sam dialect, where it is active and never violated, but low-ranked in the Chichewa-Al dialect, where it is not active.

To sum up, Chichewa stem tone realisation in unreduplicated stems is determined by morphological and phonological factors. Stem High tones are realised on either the penult or the final stem syllable in both dialects, depending on the verb paradigm. In the Chichewa-Sam dialect, PHRASENON-FINALITY motivates retracting the final stem High tone to the penult. In the next section we will see that PHRASENON-FINALITY is crucial in explaining why tonal transfer is blocked in the Chichewa-Sam dialect when reduplicating one–two syllable BStems.

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assumption is in keeping with the lexicon optimisation hypothesis of OT (see e.g. Prince & Smolensky 1993, Itô *et al.* 1995).

[25] A contrast between the penult High and final High patterns is still maintained phrase-finally, though, because the penult vowel is lengthened in this context. The High which retracts from the Final vowel is realised on the second half of the long vowel, while penult High tones are realised on the first half. See Kanerva (1990a) for detailed discussion of tone in this dialect. The constraint in (25) is the ODT equivalent of Kanerva (1990a)'s Retraction Rule (§4.1.2).

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3.2.2 *Tone realisation in reduplicated verb stems.* As noted in introducing the data in (19)–(21), we find tonal transfer in both dialects of Chichewa only if the BStem has three or more syllables and is in a penult High paradigm, as in (19a). In other contexts, we find divergence from faithful tonal transfer, to the degree where, in the Chichewa-Sam dialect, the reduplicative complex is a single tone domain when one–two syllable BStems are reduplicated. In this section, I show that properly ranking the non-reduplicative tone constraints presented in the previous section with constraints specific to reduplicative tone straightforwardly accounts for the complete range of tone transfer (and non-transfer) effects in both dialects.

The data in (19a, b) illustrate the contexts where faithful tonal transfer is found in both dialects of Chichewa. This pattern can be accounted for as follows. Because RED is a suffix and because stem High tones surface at the right edge of the BStem (see (22a)), it is the ALIGN-R version of the constraint in (13d), given in (26a), which is relevant for reduplicative tone realisation:

(26) *Constraints and rankings for Chichewa tonal transfer*

a. ALIGN-R(CStem, TD) (ALIGN(CStem))
The right edge of the CStem is aligned with the right edge of the stem High tone domain.

b. ALIGN-R(RStem, TD) (ALIGN(RStem))
The right edge of the RStem is aligned with the right edge of a High tone domain.

c. *H
High tone is marked.

d. *Tonal transfer ranking*
ALIGN(BStem) (22a), ALIGN(RStem) (26b), ALIGN(CStem) (26a), FAITH-BR (13f)≫*H (26c)

e. *Penult H co-phonology, reduplicated stems*
(PHRASENON-FINALITY (25)≫) STEMNON-FINALITY (22b)≫ ALIGN(BStem) (22a), FAITH-BR (13f)≫ALIGN(RStem) (26b), ALIGN(CStem) (26a)≫*H (26c)

f. *Final H co-phonology, reduplicated stems*
(PHRASENON-FINALITY (25)≫) ALIGN(BStem) (22a), ALIGN (RStem) (26b), ALIGN(CStem) (26a)≫FAITH-BR (13f), *H (26c), STEMNON-FINALITY (22b)

The tonal transfer ranking in (26d) is the one motivated in (14). The Chichewa-specific co-phonologies in (26e) and (26f) for the most part simply straightforwardly incorporate the morphologically conditioned rankings of STEMNON-FINALITY (22b) motivated in (23) and (24). As noted when introducing the ranking in (14) – repeated as (26d) – that simple ranking derives tonal transfer when the only non-reduplicative tonal constraint is an ALIGN(BStem) constraint. In Chichewa, we find other constraints active in the non-reduplicative tonology. It is their interaction

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with the tonal transfer constraints in (26d) that motivates the rankings given in the two reduplicative co-phonologies.

In the Penult High co-phonology (26e), StemNon-finality must be ranked above both Align(BStem) (see (22d)) and Faith-BR to optimise aligning a High tone with the penult of both the BStem and the RStem/CStem. And Faith-BR must crucially outrank Align(RStem) and Align(CStem) to optimise matching in the RStem/CStem the tonal misalignment found in the BStem. These points are exemplified in (27).[26]

(27) *Analysis of* ti-sa-[thandíze-thandíze (19a)
Penult H co-phonology (26e)

ti-sa-[thandize= red, H	Stem Non-fin	Align (BStem)	Faith-BR	Align (RStem)	Align (CStem)	*H
☞ a. -[tha(ndí)ze]= tha(ndí)ze⟩}		*		*	****	**
b. -[thandize]= tha(ndí)ze⟩}		**!	*	*	*	*
c. -[tha(ndí)ze]= thandize⟩}		*	*!	****	****	*
d. -[thandi(zé)]= thandi(zé)⟩}	*!				***	**
e. -[tha(ndí)ze]= thandi(zé)⟩}		*	*!		****	**

Crucial constraint rankings:
StemNon-fin ≫ Align(BStem), Faith-BR
Faith-BR ≫ Align(RStem), Align(CStem)

Candidate (27a) is optimal as it best satisfies StemNon-finality and Faith-BR. Because this is a penult High stem paradigm, the stem High tone domain is not optimally aligned with a stem-final syllable of either the RStem or the BStem, leading to alignment violations even in the optimal candidate. (Recall from (14) that I am assuming in tonal transfer candidates like this one that the stem High tone is aligned with the BStem.) The single tone domain candidate, (27b), with only the red parsed into a tone domain, is non-optimal. It incurs more violations of Align(BStem) than the optimal candidate, since the only High tone domain is aligned two syllables to the right of the BStem. The TETU candidate (27c) is also non-optimal. It violates Faith-BR as well as both Align(CStem) and Align(RStem), since the only High tone domain is aligned several syllables from the right edge of the CStem.[27] Candidate (27d) satisfies all the

[26] In the tableaux in this section, ']' indicates the right BStem edge, '}' the right CStem edge and '⟩' the right RStem edge.

[27] I am following other work in ODT (Cassimjee 1998, Cassimjee & Kisseberth 1998) in assuming that alignment constraints are gradiently violable. However, see Zoll (1997) for a different point of view.

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alignment constraints but is non-optimal as it violates StemNon-finality. Candidate (27e) is non-optimal as it violates Faith-BR. Comparing (27a) with (27e) shows that in the paradigms where stem High tone is optimally misaligned with the BStem to satisfy StemNon-finality, the ranking of Faith-BR plays a crucial role in optimising an identical misalignment in the RStem (and CStem).

In the Final High paradigms, we find an important difference between the Chichewa-Al dialect and the Chichewa-Sam dialect, illustrated by the data in (19b, c). As shown in (19b), in the Chichewa-Al dialect we continue to find faithful tonal transfer when reduplicating BStems of three or more syllables that are in the final stem High paradigms. In contrast, in the Chichewa-Sam dialect (19c) non-faithful tonal transfer is found in these stems. The red and the Base are both parsed into TDs, but the penult syllable of the red suffix is parsed, not the final syllable like the Base. This mismatch is motivated by PhraseNon-finality, an inviolable constraint in the Chichewa-Sam dialect.

The tableau in (28) shows that ranking PhraseNon-finality above the other constraints in (26d) accounts for the data in (19b). The other crucial constraint ranking in the Final High co-phonology (26f) exemplified in (28) is that all the alignment constraints must outrank Faith-BR, as the optimal candidate in the Chichewa-Sam dialect is the one which best satisfies the alignment constraints at the expense of faithfulness.

(28) *Analysis of* ti-[thandizé-thandíze (19c)
Final H co-phonology (26f)

ti-[thandize= red, H	PhraseNon-fin	Align (BStem)	Align (RStem)	Align (CStem)	Faith-BR
a. -[thandi(zé)]= thandi(zé)⟩}	*!			***	
☞ b. -[thandi(zé)]= tha(ndí)ze⟩}			*	**	*
c. -[tha(ndí)ze]= tha(ndí)ze⟩}		*!	*	**	
d. -[thandize]= tha(ndí)ze⟩}		*!*	*	*	*
e. -[thandi(zé)]= thandize⟩}			**!*	***	*

Crucial constraint rankings

PhraseNon-fin is high-ranked as it is never violated; StemNon-fin and *H are omitted as they are too low-ranked to play a role in choosing the optimal candidate.

Align(BStem), Align(RStem), Align(CStem) ⩾ Faith-BR

Candidate (28b) is optimal, as it satisfies PhraseNon-finality and better satisfies the high-ranked alignment constraints than competing candidates

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(FAITH-BR is ranked too low in the Final High co-phonology to play a role in choosing the optimal candidate). Candidate (28a) is non-optimal as it violates PHRASENON-FINALITY, while candidate (28c) is non-optimal as it gratuitously violates ALIGN(BStem). Notice that (28a) is the candidate which would be optimal in the Chichewa-Al dialect, where PHRASENON-FINALITY is not active. As we can see, the analysis predicts this, since (28a) only violates PHRASENON-FINALITY. Candidate (28d), the single tone domain candidate, is non-optimal, as the only TD it contains is severely misaligned with the BStem. The TETU candidate (28e) is non-optimal for a similar reason: the only TD it contains is severely misaligned with CStem and RStem. As the analysis makes clear, what is interesting about Chichewa-Sam tone transfer is that tone is 'transferred' in the sense that both the RED and Base optimally contain a High tone domain, so that the optimal candidate is the one that best satisfies ALIGN(BStem) and ALIGN(RStem). However, the High tone domains in each half do not always parse corresponding syllables, as each is aligned in the way that best satisfies high-ranked constraints on tone realisation like PHRASENON-FINALITY.

The data in (20a) illustrates the one context in the Chichewa-Al dialect where we do not find tonal transfer. When one–two syllable stems in the penult High paradigms are reduplicated, the High tone of the RED suffix is realised on the final syllable, unlike the High tone of the Base, which is realised on the penult syllable (except in the case of the monosyllabic stem *-phé*). Previous analyses of Chichewa reduplicative tone (Kanerva 1990a, Myers & Carleton 1996, Hyman & Mtenje 1999) agree that faithful tone transfer – the starred forms in (20a) – are non-optimal as this pattern would incur an OCP violation: the two High tones are too close to each other (or in a 'bumpy' relationship, to use Hyman & Mtenje's terminology). Since the High tones are not linked with adjacent syllables in these starred forms, though, this configuration does not violate the standard definition of the OCP (e.g. Myers 1987). The two High tones must, then, be adjacent at some other level of representation, if this is to qualify as an OCP violation. I follow Myers & Carleton (1996: 61) in proposing that stem penult syllables head trochaic feet in Chichewa, and tones linked to the heads of adjacent feet violate the OCP constraint in (29):

(29) OCP_{Grid}
Identical grid-adjacent elements are prohibited.[28]

[28] As Kanerva (1990a, b) and Myers & Carleton (1996) show, there are numerous arguments in favour of parsing stem-final syllables into trochaic feet. For example, word-penult syllables are often lengthened; stem tone is realised within the last two stem syllables. Both the RED stem and BStem are plausibly parsed into trochaic feet to satisfy a metrical variant of FAITH-BR (1a).

Space does not permit presenting the arguments in favour of this definition of the OCP for Chichewa in more detail. See Kanerva (1990a), Myers & Carleton (1996) and Hyman & Mtenje (1999) for further discussion of why some version of the OCP

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As shown in (30), High tones linked to adjacent syllables (30a) violate OCP_{Grid}, as do High tones linked to syllables which are heads of adjacent feet (30b). In contrast, the High tones in (30c–e) do not violate OCP_{Grid}, because the High tones are not linked to grid-adjacent syllables. In (30c, d), the High tones are not both linked to the heads of the adjacent feet. And in (30e) the feet containing the syllables to which the High tones are linked are not adjacent, as they are separated by a syllable (*tha*).

(30) *Evaluating* OCP_{Grid} (after Myers & Carleton 1996: 61)

Representations which violate (29) *and so incur* OCP_{Grid} *violations*

a. -[menyé=ménye b. -[ménye=ménye
(*) (*) (*) (*)

Representations which satisfy (29) *and so incur no* OCP_{Grid} *violations*

c. -[menyé=menyé d. -[ménye=menyé e. -[thandíze=thandíze
(*) (*) (*) (*) (*) (*)

OCP_{Grid} must be high-ranked, as it is never violated. The tableau in (31) shows that adding high-ranked OCP_{Grid} to the existing analysis accounts for the non-faithful tonal transfer pattern in (20a). (PHRASENON-FINALITY is omitted from this tableau, as this constraint is not active in the Chichewa-Al dialect. FAITH-BR and *H are also omitted, as higher-ranked constraints choose the optimal candidate.)

(31) *Analysis of* ti-sa-[péze=pezé (20a)
Penult H co-phonology (26e)

ti-sa-[peze=RED, H	OCP	STEM NON-FIN	ALIGN (BStem)	FAITH-BR	ALIGN (RStem)	ALIGN (CStem)
a. (pé)ze]=(pé)ze⟩} (*) (*)	*!		*		*	***
☞ b. (pé)ze]=pe(zé)⟩} (*) (*)			*	*		***
c. peze]=pe(zé)⟩} (*) (*)			**!	*		
d. (pé)ze]=peze⟩} (*) (*)			*	*	*!**	***
e. pe(zé)]=peze⟩} (*) (*)		*!	*	*	**	**

Crucial constraint rankings
same as (27), except:
OCP_{Grid} is high-ranked, as it is never violated

most plausibly motivates the prohibition against High tones in the configuration defined by OCP_{Grid}, and for alternative motivations for parsing both the RED and the Base into trochaic feet. And see Myers (1997) and Cassimjee & Kisseberth (1998) for other OT analyses of the role of the OCP in Bantu tone systems.

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Candidate (31b) is optimal as it satisfies OCP_{Grid}, and best satisfies the other highest-ranked constraints. Candidate (31a) is non-optimal as it violates OCP_{Grid} (cf. (30b)). The single tone domain candidate (31c) is non-optimal, as the only TD it contains is misaligned with the BStem. The TETU candidate (31d) is non-optimal for a similar reason: the only TD it contains is severely misaligned with CStem and RStem. And candidate (31e) is non-optimal as it violates StemNon-finality.

In the Chichewa-Sam dialect, tonal transfer is never found when reduplicating one–two syllable BStems. (The starred forms in (21) indicate the expected tonal transfer pattern.) Instead, the single tone domain pattern is found, with a single High tone on the penult of the reduplicative complex. As shown in the tableaux in (32) and (33), this is exactly the result predicted by the analysis so far. High-ranking OCP_{Grid} and PhraseNon-finality – crucially active and so high-ranked in the Chichewa-Sam dialect, in contrast to the Chichewa-Al dialect – make tonal transfer non-optimal. The single tone domain is the optimal alternative pattern:

(32) *Analysis of* ti-sa-[peze=péze (21a)
Penult H co-phonology (26e)

ti-sa-[peze=red, H	PhraseNon-fin	OCP	StemNon-fin	Align (B Stem)	Faith-BR	Align (R Stem)	Align (C Stem)
a. (pé)ze]=(pé)ze⟩} (*) (*)		*!		*		*	***
b. (pé)ze]=pe(zé)⟩} (*) (*)	*!			*	*		***
☞ c. peze]=(pé)ze⟩} (*) (*)				*	*	*	*
d. (pé)ze]=peze⟩} (*) (*)				*	*	**!*	***

Crucial constraint rankings
same as (31), except:
PhraseNon-fin is high-ranked, as it is never violated in the Chichewa-Sam dialect

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(33) *Analysis of* ti-[peze=péze (21b)
Final H co-phonology (26f)

ti-[peze=RED, H	PHRASE NON-FIN	OCP	ALIGN (BStem)	ALIGN (RStem)	ALIGN (CStem)	FAITH-BR
a. pe(zé)]=pe(zé)⟩} (*) (*)	*!				**	
b. pe(zé)]=(pé)ze⟩} (*) (*)		*!		*	**	*
☞ c. peze]=(pé)ze⟩} (*) (*)			*	*	*	*
d. pe(zé)]=peze⟩} (*) (*)				**	**!	*

Crucial constraint rankings
same as (28), except:
OCP_{Grid} is high-ranked, as it is never violated

The single tone domain candidates, (32c) and (33c), are each optimal, as they satisfy high-ranked PHRASENON-FINALITY and OCP_{Grid}, while also best satisfying the other constraints. The tonal transfer candidates, whether faithful ((32a), (33a)) or non-faithful ((32b), (33b)), are non-optimal, as they violate either PHRASENON-FINALITY ((32b), (33a)) or OCP_{Grid} ((32a), (33b)). (Compare (32a) with (30b) and (33b) with (30a).) The TETU candidates, (32d) and (33d), are non-optimal, as the only TD each contains is severely misaligned with CStem.[29] Even though ALIGN (CStem) is low-ranked, we see in these tableaux that it plays a decisive role in optimising a High tone towards the right edge of the reduplicative complex rather than the Base in shorter reduplicated stems where only one High tone domain can optimally surface.

To sum up this section, in Chichewa the BStem length conditions tone realisation in reduplicated forms, because the tone processes of the language can only be satisfied on reduplicative complexes of three or more syllables. In both dialects of Chichewa, OCP_{Grid}, a constraint sensitive to string length, is violated by faithful tonal transfer when reduplicating stems of one–two syllables. In the Chichewa-Al dialect, the High tone

[29] As an anonymous reviewer correctly points out, this analysis only accounts for the lack of tonal transfer in one–two syllable stems when they occur phrase-finally. It does not explain why there is also no tonal transfer phrase-medially, where PHRASENON-FINALITY is not applicable. I suggest that since the phrase-final pronunciation is also the isolation pronunciation, it can be considered the basic pronunciation and influences the phrase-medial pronunciation as a Paradigm Uniformity effect. See work like Kenstowicz (1996), Benua (1997) and McCarthy (to appear) for further discussion of the role of Paradigm Uniformity in a variety of phonological systems, and see Downing (1999) for discussion of the role of Paradigm Uniformity in accounting for reduplication in other Bantu languages.

This analysis also only aims to account for non-transfer of verb stem tone. See Myers & Carleton (1996) for a thoughtful discussion of other cases of tone non-transfer in Chichewa.

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domain can be realised in both the Base and RED while satisfying OCP_{Grid}, as High tones are allowed on final syllables. (This is shown in (31).) However, in the Chichewa-Sam dialect, high-ranked PHRASENON-FINALITY makes it impossible to both satisfy OCP_{Grid} and realise a High tone in both the Base and RED. (This is shown in (32) and (33).) The optimal alternative means of realising the stem tone, given the constraints and rankings motivated to account for reduplicative tone realisation in longer stems, is to define the reduplicative complex as a single tone domain.

3.3 Swati

Swati is an Nguni language (closely related to Ndebele, Xhosa and Zulu) spoken mainly in Swaziland. Like Chichewa, Swati has a length-conditioned alternation in choice of reduplicative tone pattern. If the BStem is three syllables or longer, as in (34b), Swati reduplicated stems have the TETU tone pattern. The stem High tone is realised within the BStem, while the RED preceding the Base is toneless.[30] However, if the BStem is one or two syllables long, as in (34a), then we find the single tone domain pattern. The stem High tone is realised on the antepenultimate or penult syllable of the RED + Base complex:

(34) *Swati verbal reduplication* (Downing 1994; only the stem contributes a High tone to these forms)

Unreduplicated stem		'X here and there or now and again'
a. *BStems of one–two syllables*		
u-ya:-[phá	'you give'	u-ya-[phayí:-pha
u-ya-[tfú:tsa	'you move house'	u-ya-[tfutsá-tfu:tsa
u-ya-[ká:la	'you weigh'	u-ya-[kalá-ka:la
u-ya-[bó:na	'you see'	u-ya-[boná-bo:na
b. *BStems of three or more syllables*		
u-ya-[kalé:la	'you weigh for'	u-ya-[kale-kalé:la
u-ya-[khulú:ma	'you talk'	u-ya-[khulu-khulú:ma
u-ya-[boní:sa	'you show'	u-ya-[boni-boní:sa
u-ya-[bonísa:na	'you show each other'	u-ya-[boni-bonísa:na
u-ya-[khulumísa:na	'you talk to each other'	u-ya-[khulu-khulumísa:na

[30] It is three-syllable stems like /-bónisa/ that most clearly demonstrate the contrast in tone domain between one–two syllable and longer stems. If three-syllable Bases formed a single tone domain with RED, we would wrongly predict that the stem High tone would surface on the antepenult – *[-boni=bóni:sa] – as it does in all other reduplicated forms with BStems of at least two syllables.

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I will show in this section that in Swati, as in Chichewa, this length condition on reduplicative tone realisation falls out from ranking the constraints independently required to account for tone in unreduplicated stems with the constraints motivated in §2.3 above, defining the pattern of reduplicative tone realisation (in this case, the TETU pattern defined in (16)). To show this, I first develop an analysis of tone realisation in the unreduplicated stems. Then I extend the analysis to the reduplicated forms of these stems.

3.3.1 *Tone in unreduplicated verb stems.* In Swati, only the verb stem-initial syllable contrasts for tone. However, as shown in the data in (34b), the High tone does not surface on the stem-initial syllable if the stem has three or more syllables. The high tone surfaces on the antepenult in stems of at least four syllables. However, if the stem-initial syllable is also the antepenult, the high tone shifts to the penult. The data in (34a) show that the High tone does not shift when the only available target is the final syllable. In this section, I adopt the ODT analyses of work like Cassimjee (1998), Cassimjee & Kisseberth (1998) and Downing (2001a) to account for these non-reduplicative tone patterns.[31]

The generalisation that High tones shift towards the right edge of the stem is accounted for by the alignment constraint in (35a). The left edge of the tone domain is the left edge of the stem, optimised by the alignment constraint in (35c), the Swati-particular ODT variant of (13c). ALIGN(TD) (35a) must be outranked by the NON-FINALITY constraint in (35b) – a variant of the non-finality constraints ((22b), (25)) shown to play an important role in Chichewa tone realisation – as High tones never shift to the final syllable. To account for the fact that only the rightmost TBU in the TD surfaces with a High tone, I follow Cassimjee (1998: 19) in proposing this follows if the rightmost TBU is the head of the TD, and non-head TBUs cannot optimally realise a High tone due to the high-ranked constraint in (35d):

(35) a. ALIGN-R(TD, Word) (ALIGN(TD))
The right edge of the tone domain is aligned with the right edge of the word.

b. NON-FINALITY
The right edge of a stem-final syllable does not coincide with the right edge of a tone domain.

[31] Cassimjee (1998), Cassimjee & Kisseberth (1998) and Downing (2001a) present similar analyses of identical stem tone patterns in Xhosa and Zulu. Specific references for particular constraints are only given when there is some difference among these analyses.

See these authors, along with Kenstowicz (1993), for discussion of why properties like headedness and minimality are problematic for autosegmental theory.

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c. ALIGN-L(BStem, H) (ALIGN(BStem))
Align the left edge of the (input) BStem with the left edge of the stem H TD.

d. HEAD-H
A High tone is realised only on the Head of the TD.

Ranking NON-FINALITY above ALIGN(TD) optimises realising the rightmost high tone on the penult. (Non-reduplicative tone patterns do not provide evidence for the ranking of ALIGN(BStem). Its ranking will be motivated in detail in the next section.)

I follow Cassimjee & Kisseberth (1998) in proposing that AVOIDPROMINENCE accounts for why the antepenult, instead of the penult, is the rightmost target of high tone realisation in stems of four or more syllables:

(36) AVOIDPROMINENCE (adapted from Cassimjee & Kisseberth 1998: 79)
A stress-prominent syllable may not be internal to a TD.

The motivation for AVOIDPROMINENCE is that in Nguni languages like Swati, as in most other Southern Bantu languages (see e.g. Doke 1954), the penult syllable is stressed (lengthened) when words are in phrase-final position. (All the verbs cited here are in the citation form, where the verb is phrase-final and the penult would be lengthened.) As Hyman (1989) and Cassimjee & Kisseberth (1998) argue, it is certainly not a coincidence that the penult is avoided as a target for high tone shift/spread in Nguni languages only when it is stressed.[32] AVOIDPROMINENCE explicitly formalises this relation between tone realisation and stress.

The analysis so far is exemplified in (37). HEAD-H – high-ranked and never violated – is omitted from tableaux in this section to save space.[33]

[32] As shown by the following contrasting examples, when the verb is followed by an object or adverb, the penult syllable is not lengthened and the high tone from the subject prefix is realised on the penult rather than the antepenult (*-ya-*; the verb focus marker in the present tense is also missing when the verb is followed by an object): *bá-yá-phuupha* 'they are dreaming' *vs.* *bá-phúpha ébú-súuku* 'they dream every night'. See Khumalo (1987) and Downing (1990) for more data and discussion. The constraints necessary to define the penult as the stress-prominent syllable are not given in the tableaux, to save space.

As Downing (2001a) points out, AVOIDPROMINENCE is a surprising constraint to place on tone, given the amount of research establishing that High tones and stress prominence often 'attract' each other. (See e.g. Bickmore 1992 and Downing 1996 for discussion and further references.) It is an area for further research, unfortunately beyond the scope of this paper, to see whether AVOIDPROMINENCE plays a role in the phonology of languages outside the Nguni group.

[33] In the Swati tableaux, parentheses indicate tone domains and '[' the BStem edge; the prominent vowel is lengthened.

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(37) *Tone domain targeting antepenult*

-bónisana	NON-FIN	ALIGN(BStem)	AVOIDPROM	ALIGNTD
☞ a. -[(boní)sa:na				**
b. -[(bonisá:)na			*!	*
c. -[(bonisa:ná)	*!		*	
d. -[(bó)nisa:na				***!

Crucial constraint rankings
NON-FIN ≫ ALIGN-TD (optimises excluding final syllable from TD)
AVOIDPROM ≫ ALIGN-TD (optimises not including penult in TD)

As shown in (37), AVOIDPROMINENCE optimises realising the rightmost High tone on the antepenult, as in candidate (37a). Extending the tone domain through the penult (candidate (37b)) or the final syllable (candidate (37c)) violates AVOIDPROMINENCE and/or NON-FINALITY. And having the tone domain only include the stem-initial syllable, as in (37d), violates ALIGN(TD). (HEADEDNESS, a constraint not included here, would account for why the stem High tone only surfaces on the rightmost syllable of the TD in Swati. If that syllable is the Head of the domain, one can constrain tones to only be realised on the Head.)

The constraints and rankings so far wrongly predict that in three-syllable stems, where the High tone is on the antepenult in the input, the High tone should stay on the antepenult. However, as shown in (34b), the High tone surfaces on the penult in these forms. To account for this, I follow Cassimjee & Kisseberth (1998) in proposing that High tone domains are subject to the MINIMALITY constraint in (38):

(38) MINIMALITY
Tone domains must be minimally bisyllabic.

As shown in (39), ranking MINIMALITY above AVOIDPROMINENCE correctly accounts for why stem High tones shift to the penult in three-syllable stems:

(39)

-bónisa	NON-FIN	MIN	ALIGN(BStem)	AVOIDPROM	ALIGNTD
☞ a. -[(boní:)sa				*	*
b. -[(bó)ni:sa		*!			**

Crucial constraint rankings
same as (38), plus:
MIN ≫ AVOIDPROM (optimises including penult in TD just to satisfy MIN)
NON-FIN ≫ MIN (optimises excluding final syllable even if MIN is violated)

Candidate (39b), with the High tone on the antepenult, is non-optimal, as the TD consists of a single syllable, violating MINIMALITY. Candidate

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(39a), with the High tone on the penult, is optimal, as the TD satisfies MINIMALITY and NON-FINALITY, the two highest-ranked constraints. Tableau (40) shows that ranking NON-FINALITY above MINIMALITY accounts for why the stem High tone remains on the stem-initial syllable in two-syllable stems. Notice that the optimal candidate, (40b), satisfies NON-FINALITY at the expense of violating MINIMALITY:

(40)

-bóna	NON-FIN	MIN	ALIGN(BStem)	AVOIDPROM	ALIGNTD
a. -[(bo:ná)	*!			*	
☞ b. -[(bó:)na		*		*	*

To sum up the discussion of Swati tone in non-reduplicated stems, we can see that there is clearly a correlation between the length of the stem and its ability to satisfy the highest-ranked tone constraints of the language. As shown in (37), the highest-ranked constraints on the stem tone realisation can only be satisfied in stems of four or more syllables. As shown in (39) and (40), in shorter stems the optimal TD parse necessarily violates some high-ranked constraint. In the next section we shall see that this point is crucial in understanding the length condition on reduplicative tone realisation.

3.3.2 *Tone realisation in reduplicated stems.* As noted in introducing the data in (34), reduplicated verb stems have the TETU tone pattern if they are three or more syllables in length. However, they have the single tone domain pattern if they are shorter (34a). I show in this section that this alternation has the same analysis as for Chichewa. Properly ranking the constraints developed in the previous section on the tone realisation for unreduplicated stems with the constraints which independently define the TETU pattern for reduplicated stems predict this result.

The constraints and ranking which optimise the TETU pattern of reduplicative tone realisation are given in (41). These are essentially the Swati-specific, ODT variants of the constraints in (13) and the TETU ranking in (16) above:

(41) *Constraints and ranking defining TETU tone pattern in Swati*

a. ALIGN-L(BStem, H) (ALIGN(BStem))
Align the left edge of the BStem with the left edge of stem H TD.

b. ALIGN-L(CStem, H) (ALIGN(CStem))
Align the left edge of the CStem with the left edge of stem H TD.

c. ALIGN-L(RStem, H) (ALIGN(RStem))
Align the left edge of the RED Stem with the left edge of a H TD.

d. *H
High tones are marked.

e. *Ranking optimising the TETU pattern*
ALIGN(BStem), *H ≫ ALIGN(CStem), ALIGN(RStem)

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The tableaux in (42) show why the TETU pattern is non-optimal when reduplicating one–two syllable BStems. NON-FINALITY and MINIMALITY cannot be satisfied within the BStem if it has only one or two syllables. However, taking the CStem (the RED + Base complex) as a single domain for stem tone realisation, as in the optimal candidates, provides sufficient syllables to satisfy MINIMALITY without violating NON-FINALITY.[34]

(42)

	two-syllable base stem -RED=bóna	NON-FIN	MIN	AVOIDPROM	ALIGNTD
a.	☞ i. -{⟨(boná)=[bo:na				**
	ii. -{⟨bona=[(bo:ná)	*!		*	
	iii. -{⟨bona=[(bó:)na		*!	*	*
b.	*one-syllable base stem* -RED=phá				
	☞ i. -{⟨(phayí:)=[pha			*	*
	ii. -{⟨phayi:=[(phá)	*!	*		

The generalisation that emerges is that Swati stem tone aligns within the CStem instead of the BStem *only when* NON-FINALITY and MINIMALITY would be otherwise be violated. This generalisation can be straightforwardly captured by intercalating the TETU ranking from (41e) with the constraints of the existing analysis (43a) to give the overall ranking in (43b):

(43) a. *Ranking optimising tone realisation in unreduplicated verb stems*
NON-FINALITY ≫ MINIMALITY ≫ ALIGN(BStem), AVOID PROMINENCE ≫ ALIGN(TD)

b. *Ranking for Swati defining length-conditioned reduplicative tone realisation*
NON-FINALITY ≫ MINIMALITY ≫ ALIGN(BStem), *H ≫ ALIGN (CStem), ALIGN(RStem), AVOIDPROMINENCE ≫ ALIGN(TD)

The tableaux in (44) through (46) exemplify the analysis. As shown in (44), the ranking in (43b) makes it optimal to realise the stem High tone within the BStem when it has three or more syllables:

(44) *Three-syllable base stem*

-RED=bónisa	NON-FIN	MIN	ALIGN (BStem)	*H	ALIGN (CStem)	ALIGN (RStem)	AVOID PROM	ALIGN TD
☞ a. -{⟨boni=[(boní:)sa				*	**	**	*	*
b. -{⟨(boni=[(bó)ni:sa			*!*	*				**
c. -{⟨(boní)=[(boní:)sa				**!	**		*	*

[34] In the tableaux in this section '[' indicates BStem edge, '{' CStem edge and '⟨' RStem edge.

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The TETU candidate (44a) is optimal, as it satisfies NON-FINALITY, MINIMALITY and ALIGN(BStem), the highest-ranked constraints. The single tone domain candidate (44b) is non-optimal, as it violates ALIGN(BStem). Candidate (44c), the tonal transfer candidate, is non-optimal, as it incurs more violations of *H than the optimal candidate.

As shown in tableaux (45) and (46), this same ranking makes it optimal to align the stem High tone domain with the CStem for one–two syllable BStems:

(45) *Two-syllable base stem*

-RED=bóna	NON-FIN	MIN	ALIGN (BStem)	*H	ALIGN (CStem)	ALIGN (RStem)	AVOID PROM	ALIGN TD
☞ a. -{⟨(boná)= [bo:na			**	*				**
b. -{⟨(bó)na= [(bó:)na		*!*		*	**		*	*
c. -{⟨bona= [(bó:)na		*!		*	**	**	*	*

(46) *One-syllable base stem*

-RED=phá	NON-FIN	MIN	ALIGN (BStem)	*H	ALIGN (CStem)	ALIGN (RStem)	AVOID PROM	ALIGN TD
☞ a. -{⟨(phayí:)= [pha			**	*			*	*
b. -{⟨phayi:= [(phá)	*!	*		*	**	**		
c. -{⟨(phá)yi:= [(phá)	*!	**		**	**			

Crucial constraint rankings

NON-FIN, MIN ≫ ALIGN(BStem) (optimises alignment of the stem High TD with the CStem rather than the BStem in order to satisfy NON-FIN and MIN)

The single tone domain candidates, (45a) and (46a), are optimal as they satisfy high-ranked NON-FINALITY and MINIMALITY. The TETU candidates, which are optimal for longer stems, are non-optimal here as they violate MINIMALITY as in (45c), or NON-FINALITY as in (46b). The tonal transfer candidates, (45b) and (46c), are also non-optimal, as they also violate MINIMALITY and/or NON-FINALITY.

To sum up this analysis, the correlation between the length of the BStem and the preferred tone domain in reduplicated forms is accounted for by noting that there is a correlation in general in Swati between the length of a verb stem and how well the stem satisfies high-ranked tone constraints. In non-reduplicated stems, stem tone constraints must be satisfied as well as possible within the BStem. However, in reduplicated

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stems, the CStem provides an alternative stem for stem tone realisation. Ranking ALIGN(BStem) below constraints on optimal tone domains – NON-FINALITY and MINIMALITY – makes it optimal to realise the stem tone within the crucially longer CStem when that allows these higher-ranked constraints to be satisfied.

3.4 Problems with the alternatives

As we have seen, in Southern Bantu languages like Chichewa and Swati, stem tone is realised within the reduplicative complex as a single domain when reduplicating one–two syllable BStems, but a different pattern of stem tone realisation is found when reduplicating longer stems. I have shown this has a phonological explanation: the important stem tone principles in these languages can only be satisfied if the reduplicative complex is a single tone domain when shorter stems are reduplicated. This approach contrasts with previous analyses, beginning with Hewitt (1992), which propose instead that reduplicated one–two syllable BStems have a different pattern of tone realisation because they are morphologically subminimal.

For example, Myers & Carleton (1996) argue that both one- and two-syllable BStems are morphologically subminimal in Chichewa, because Prosodic Stems must contain two prosodic constituents:

(47) PS-MIN (Myers & Carleton 1996: 54)

The prosodic stem must include at least two prosodic constituents.

According to this definition, even when RED is disyllabic 'in order to satisfy PS-MIN, it must also include some prosodic constituent such as a syllable, in addition to that [disyllabic] foot … The syllables within the foot do not count as two distinct constituents for PS-MIN' (Myers & Carleton 1996: 55). The problem with this proposal is that the interpretation of PS-MIN relies on a typologically unusual definition of minimality. Bisyllabic stems fulfil standard minimality requirements (see e.g. McCarthy & Prince 1986, Crowhurst 1992). It is ad hoc to propose they are subminimal in languages like Chichewa to account for the reduplicative tone pattern if an alternative analysis is available.

Similarly, Hyman & Mtenje (1999) propose that monosyllabic and bisyllabic REDs are not long enough for both the BStem and RED to be associated with tone in Chichewa because the one–two syllable REDs lose their 'stemicity'. A problem with this proposal, as Hyman & Mtenje (1999) concede, is that monosyllabic stems are made bisyllabic by epenthesis, as shown in (20) and (21), in order to satisfy a minimal word requirement.[35]

[35] In the analysis developed in §3.2, the RED is a stem, and epenthesis satisfies a minimal stem requirement. This difference does not affect the argument here, namely, that there is no correlation between the stem status of the RED and its status as an independent tone domain.

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It is inconsistent to say these REDs must be word-like to motivate epenthesis, yet they are not stem-like for tone realisation, since stem is a subconstituent of word. Bisyllabic stems are also clearly stem-like in being identical to the Base, which is uncontroversially a stem.

The underlying problem with these alternatives is that they confound morphological minimality with what one might call 'phonological minimality'. Bisyllabic stems uncontroversially satisfy morphological minimality requirements. However, phonologically, one–two syllable BStems are 'subminimal' in the sense that they are too short to allow optimal satisfaction of constraints on tone realisation. In Chichewa-Sam (21) reduplicated one–two syllable BStems violate OCP_{Grid} if tone is transferred, while reduplicated longer stems incur no violation of this constraint because the corresponding High tones of the RED and Base are not grid-adjacent. In Swati, one–two syllable stems (34a) are too short to satisfy the high-ranked tone constraints of the language. In non-reduplicated stems, the only option is for the stem tone constraints to be violated, even in the optimal forms. When these short stems are reduplicated, an alternative – crucially longer – stem domain, the CStem, is available for stem tone realisation. In both languages, the single tone domain pattern is chosen for reduplicated one–two syllable stems, but another pattern is chosen for longer stems because this alternation in tone realisation allows the best satisfaction of both reduplicative and non-reduplicative tone realisation constraints. Morphological minimality plays no role in the analysis.

4 Conclusion

This paper has addressed a type of reduplicative correspondence which, as far as I know, has not received attention in the formal literature, namely, the possibility for prosodic features, like tone, to treat the entire reduplicative complex as a single realisation domain. I have argued that this possibility falls out if the reduplicative complex is a compound. Cross-linguistically, compounds frequently are treated as single domains for the realisation of prosodic properties like accent. One contribution of the paper, then, is to support work like McCarthy & Prince (1995, 1999), Urbanczyk (1996, to appear), Downing (1999, 2000) and Inkelas & Zoll (1999, 2000), showing that the morphological status of the RED and the reduplicative complex play a crucial role in determining the phonetic realisation of the reduplicative string.

A further contribution of the paper is to show that morphological minimality is not the only explanation for length conditions on the realisation of prosodic properties, like tone, within the reduplicative complex. Other phonological constraints – like the OCP and tone domain minimality, both crucially interacting with NON-FINALITY – also can only be satisfied if strings have a particular minimum length. As we have seen, when such constraints are high-ranked, they optimise treating the CStem as a single domain to provide a longer string for tone realisation, even in

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languages like Chichewa and Swati where this is not optimal for longer stems.

Finally, it is an important advantage of the compounding analysis motivated here that it can account both for languages where the main pattern of tone realisation is to treat the reduplicative complex as a single tone domain and for languages where this is the exceptional pattern through the standard OT device of constraint ranking. No special devices or constraints are required to derive either pattern, given the compound structure of the reduplicative complex.

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