The Syllable as Contour Tone Host*

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1 Introduction

It has long been recognized that contour tones tend to gravitate toward longer sonorous intervals, presumably because the complex pitch excursions associated with a contour tone require more time (in comparison with level tones) to be fully articulated than their level-tone counterparts (Sundberg 1973, 1979). Often this means that tones are permitted only on heavy syllables (and sometimes just heavy syllables with long vowels or sonorant codas) or the final syllable of a word or utterance. Neither restriction is surprising: Heavy syllables, by definition, have more material (more segments or longer nucleus duration) than light syllables (e.g., Klatt 1973) and therefore provide more time during which a contour tone can be expressed. Likewise, word- and utterance-final syllables are longer than comparable medial syllables (see Lunden 2006a,b, Zhang 2000 and references therein), again providing more time for the articulation of a contour tone.

Early work on autosegmental theory (Goldsmith 1976) accounted for the attraction of contour tones to final syllables by requiring left-to-right association (linking) of tones to tone-bearing units (TBUs) in a one-to-one fashion as part of tonal Well-Formedness Conditions (Goldsmith 1976, Leben 1973, 1978, Pulleyblank 1986). When there are more tones than TBUs, left-to-right association ensures that the surplus tones are tacked onto the rightmost TBU. This is illustrated in (1), where T represents a tone and τ represents a TBU. This system accounts for the fact that tones tend to associate preferentially with the leftmost available TBU but pile up at the right edge in cases like (1).

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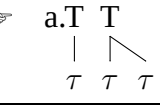
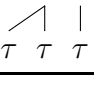
(1) 

The attraction of contour tones to heavy syllables is often taken as evidence that the mora is the TBU (Hyman 1985, Hayes 1989a, among others), at least in languages where contour tones do indeed prefer heavy syllables. Under this view, contour tones are just adjacent level tones that are linked to adjacent moras, and the inability of light syllables to host contour tones follows from the fact that light syllables are monomoraic, and at most one tone may associate with any mora.

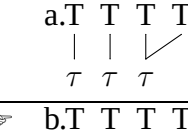
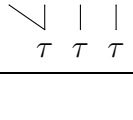
In Optimality Theory (OT; Prince & Smolensky 1993[2004]), directional processes (typically involving the creation of association lines or the construction of phonological structure) that start at one end of a phonological representation and progress toward the other end are commonly accounted for with Alignment constraints (McCarthy & Prince 1993). For example, McCarthy & Prince use Alignment to account for directionality in foot parsing and English ambisyllabification, and Cohn & McCarthy (1998) invoke Alignment in their analysis of various prosodic processes in Indonesian. Since tone mapping is also a directional process, it is a priori reasonable to assume Alignment constraints can also replicate the effects of the Well-Formedness Conditions. Attraction of (simplex) tones to the leftmost available TBU is captured by an ALIGN-L constraint that requires all tones to be as far to the left as possible. As (2) shows, this correctly accounts for the converse of (1) in which there are more TBUs than tones.

(2)

/τττ T T/	ALIGN-L
☞ a. 	*
b. 	**!*

But as Zhang (2000) points out, ALIGN-L makes the wrong prediction about where contour tones should appear. Fewer violations of ALIGN-R are incurred if contour tones appear on the left-most TBU (for expository purposes, one violation mark is assigned for each TBU that intervenes between each tone and the left edge of the word):

(3)

/τττ T T T T/	ALIGN-L
a. 	****!*
☞ b. 	***

Alternatives to Alignment, such as Coincide (Zoll 1998a,b), encounter the same problem. If COINCIDE-L, e.g., requires the left edge of a tone's domain to coincide with the left edge of a

word, left-to-right association as in (2) emerges, but the grammar also arranges contour tones at the left edge of the word as in (3) because this configuration puts the tones as close to the left edge as possible.

This observation leads Zhang (2000, 2001) to divorce contour tone placement from general tone mapping. Alignment constraints are fine for modeling left-to-right mapping tendencies, but the facts about contour tones require a phonetic explanation.[1] Zhang (2001) argues convincingly that contour tone distributions is cross-linguistically related to (often language-specific) facts about "sonorous rime duration." He shows that for the languages in his study, if a syllable has a sonorous rime of duration δ and can host contour tones, then all syllables with a sonorous rime duration greater than δ can also host contour tones.[2] In this light, contour tones' preference for heavy and final syllables is attributable to the greater lengths of the rimes in these syllables compared to light and medial syllables. Furthermore, Zhang shows that in languages where, say, word-medial CVV is phonetically longer than word-final CV, the medial CVV can host contour tones of greater complexity than the final CV, but in languages where final CV is longer than medial CVV, CV can host the more complex contour tones. This shows that contour tone distribution is dependent on phonetic measures of length rather than structural measures like the mora.

As further evidence for this position, Zhang shows that the assignment of weight for purposes of stress to various types of CVC syllables is not correlated with the ability of these syllables to bear contour tones. That is, if a CVC syllable counts as heavy for stress assignment, we cannot assume that it will not count as heavy (or long) for contour tone assignment. Thus moraic content is a poor indicator of contour tone distribution.

This paper presents more evidence for the position of Zhang (2001) that contour tone distribution is sensitive to phonetic rime length rather than moraic rime weight. Whereas Zhang argues that independent evidence for a syllable's moraic content is a worse guide to the syllable's ability to host contour tones than acoustic measures, the evidence presented here shows that even conclusions about what the TBU in a particular language is aren't necessarily reliable indicators of where the language permits contour tones to surface. On the basis of tone spreading, I argue that in Adhola, a Nilotic language spoken in Uganda, and Ikalanga, a Bantu language, the syllable is the most likely TBU. Consequently, there is not necessarily any expectation under a structuralist approach that the parameters governing contour tone distribution should be sensitive to moraic facts. But contour tones are in fact restricted to heavy—i.e. bimoriac—syllables, suggesting (following Hyman (1985), Hayes (1989a)) that the mora, not the syllable, should be the TBU. This apparent paradox is resolved by maintaining the syllable as the TBU and connecting the facts about contour

[1] Zhang (2001) notes that positional markedness (Alderete et al. 1999, Zoll 1998b, Steriade 1994) and positional faithfulness (Beckman 1999) both allow facts about contour tones to be captured separately from the left-to-right generalization. Constraints can discourage preservation of contour tones in certain positions or promote their preservation in other positions. Zhang argues for the superiority of positional markedness, and the insights of the positional markedness approach inform his analyses. I do not recapitulate his arguments here, but the phonetic account proposed below carries the essential insights of Zhang's research.

[2] Zhang's conclusion is actually more complex than this. He relates longer and more sonorous rimes to the ability to host contour tones of a complexity that is greater than or equal to that of the contour tones that can be hosted by shorter and less sonorous rimes. In addition to heavy and word-final syllables, Zhang shows that syllables from shorter words also have greater contour-tone-bearing abilities than their counterparts in longer words due to their greater duration (e.g., Lyberg 1977).

tones with phonetic (mainly durational) facts. Only by bringing in these phonetic facts can we explain why the TBU appears to be the syllable for purposes of tone spreading while the mora seems to be the TBU for purposes of contour tone regulation. Additionally, by stripping the mora of the explanatory burden in contour tone placement, this investigation implies, as others have suggested (e.g. Lunden 2006a,b), that the mora may not be a genuine phonological construct after all.

2 Adhola

2.1 Spreading by Syllables

Adhola has two tones, and both tones seem to be active in the phonology. (All data from Adhola come from my own notes from a field methods course taught at UC Berkeley in the fall of 2005.) That is, the contrast is between H and L rather than, say, H and ∅. The only contour tones in Adhola are falling tones (HL and H$^{!}$H), and they only appear on phonological phrase-final syllables and on syllables with long vowels. CVN syllables (where N is a nasal) appear word-internally, and other closed syllables appear only word-finally. Neither kind of closed syllable can host a contour tone. Longer syllables (e.g. CVVC or CVCC) do not exist in the language.

Under certain conditions, a high tone may spread rightward to an adjacent low-toned syllable. The precise conditioning of this operation is currently unclear to me, but the details are not crucial to the current discussion. Some examples of high tone spreading (HTS) are shown in (4). It is crucial immediately below to note that these are citation (and hence utterance-final) forms.

(4) a. H L H
p a p aː l i [pápâːlíˊ] ‘papaya’

b. L H L
o y eː y o [òyéːyô] ‘rat’

By a separate process, the last preconsonantal vowel in the phonological phrase (PP), roughly speaking, is lengthened. Lengthening is confounded by other processes of shortening, but for present purposes these complications are irrelevant. The lengthening process, which I will call PP-lengthening, is illustrated in (5). In (5a), *gwòːkìˋ* surfaces with a long [oː] in PP-final position. But in (5b), the same word, *gwòk*, surfaces with a short [o] because this word is no longer in PP-final position. Both forms in (4) also show PP-lengthening.

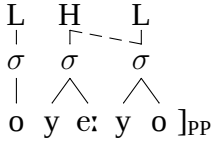
(5) a. *PP-final:* gɔ̀ nɛ́nɔ̀ gwòːkìˋ
he/she see-PRES dog
‘He/she sees the dog.’

b. *PP-internal:* á nɛ́nɔ̀ gwòk má tʃɔ̂ːl
I see-PRES dog black
‘I see the black dog.’

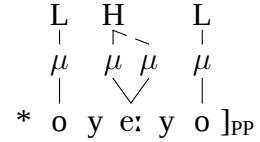
HTS is oblivious to PP-lengthening. H always spreads from one syllable to the next. It is not satisfied by spreading to the second mora of a lengthened syllable, even though this mora may be a viable target for spreading. This is demonstrated by (4b) above, where H could spread to the second mora of the lengthened syllable but instead spreads to the final syllable. HTS is therefore

best accounted for if the syllable is the TBU, as shown in (6a). Were we to select the mora as the TBU, we might expect HTS to be satisfied by (6b).

(6) a. *Syllable as TBU:*

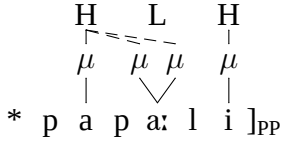


b. *Mora as TBU:*

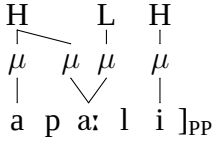


To avoid producing (6b) under a spreading-by-moras account, we might pursue the idea that HTS spreads H two moras to the right. Such a solution might correctly produce (4b) rather than (6b), but it would be disastrous for (4a); we would produce something like (7a) instead of (7b). Our hypothetical spreading operation misses the mark and spreads one TBU too far in this case. The problem is that (4a) requires HTS to target just the adjacent mora, whereas (4b) requires HTS to target the following two moras. These two words behave similarly if we take the syllable to be the TBU, but they require distinct HTS operations if the mora is the TBU.

(7) a.



b.



A crucial rule ordering in which spreading precedes lengthening may salvage the mora-as-TBU approach, although one would have to be careful of two details: (i) the epenthesized mora must acquire the correct tone through some process other than HTS, and (ii) repair rules must deal with contour tones that arise through HTS on syllables that are not subsequently lengthened. Of course, a solution through rule ordering is impossible in a strictly parallel system like (classic) OT. If these examples are to be unified under a single simple OT analysis (and without ad hoc repair rules in a derivational analysis), spreading by syllables is the best approach.

To account for spreading, I adopt the constraint MULTI-TBU SPAN (MTS) in (8).

(8) MULTI-TBU SPAN (MTS): The left edge of a high tone span is not the same as the right edge of the span.

The basis for this constraint, I suggest, is articulatory: Research has shown that high pitch targets take longer and are more difficult to reach than low targets, whether as part of a contour tone (Zhang 2001 citing Sundberg 1973, 1979) or as a simplex H target ("peak delay"; Silverman & Pierreumbert 1990, Pierrehumbert & Steele 1989, Myers 1998, 1999, 2003). H demands more articulatory effort than L or M, so the grammar may be interested in prolonging the time allotted for the high pitch target to be reached. One way to achieve this is to require H to be linked to multiple TBUs. MTS does just this.[3] When ranked with MAX(Tone) (which prevents deletion of

[3]Cf. Myers (1997), who produces tone movement/spreaeding by exactly one TBU through the constraint LOCAL. LOCAL restricts how far a tone may move or spread (see especially the redefinition of LOCAL in Yip (2002) for restricting spreading), whereas MTS requires at least minimal spreading.

H or L), extending a high tone span is preferred over deletion of what would be a singly linked H. Constraint formalisms such as Anchoring (McCarthy & Prince 1995), Alignment (McCarthy & Prince 1993), or COINCIDE (Zoll 1998a,b) can be used to select rightward spreading over leftward spreading (i.e., spreading of H instead of spreading of L). The choice among the available options is inconsequential to the task at hand, so I arbitrarily choose Alignment (9).[4]

(9) ALIGN(Tone, R, Wd, R): The right edge of every tone span should be aligned with the right edge of some word.

As (10) shows, these constraints correctly motivate HTS in the form *òyé:yô* 'rat.' The fully faithful candidate (a) is ruled out by MTS. Candidate (b) deletes the high tone and thereby eliminates the violation of MTS. But this move incurs a fatal violation of MAX(Tone).[5] Candidates (c) and (d) preserve all underlying tones and avoid violations of MTS by spreading H to an adjacent TBU. The candidate that uses rightward spreading wins. (Candidate (c) could also be ruled out because of its illicit contour tone on a short syllable.)

(10)

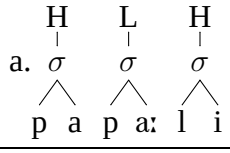
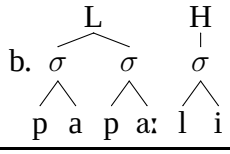
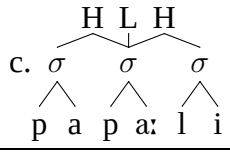
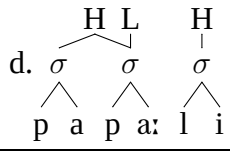
/òyéyò/ 'rat'	MTS	MAX(Tone)	ALIGN(Tone, R, Wd, R)
a. L H L o y e: y o	*!		***
b. L o y e: y o		*!	
c. L H L o y e: y o			***!
☞ d. L H L o y e: y o			**

These constraints also account for *pápâ:lí* 'papaya.' This is shown in (11). An additional constraint is needed to rule out candidate (c). Rising tones do not appear in Adhola (to say nothing of HLH contours), so spreading of the final H is blocked on these grounds. We also have evidence for the ranking MAX(Tone) ≫ MTS: compare candidates (b) and (d).

[4]It is possible that HTS could be accounted for by positing a constraint requiring all high tones to be aligned with the right edge of a word. This would render MTS extraneous, but I do not take this approach because significant machinery would be required to ensure that H does not spread (or simply move) all the way to the end of the word. See Kaplan (2006) for more discussion of noniterative spreading.

[5]For the purposes of this Tableau, I assume that the remaining low tones coalesce and that therefore the single L in candidate (b) stands in correspondence with both input tones. This accounts for the single violation of MAX(Tone) accrued by this candidate. It should be clear that regardless of how this candidate deals with the two input low tones, it necessarily loses because it deletes the H.

(11)

/pápàlí/ ‘papaya’	*LH	MAX(Tone)	MTS	ALIGN(Tone, R, Wd, R)
a. 			**!	***
b. 		*!		*
c. 	*!			***
☞ d. 			*	***

Taking the syllable as the TBU, simple and reasonable constraints can generate HTS. What would an OT account look like if the mora were the TBU? To answer this question, recall that HTS pays no attention to moras inserted by PP-lengthening. Since words like *pápâːlí* show that HTS spreads H one TBU (whether mora or syllable) to the right, we must conclude that in *òyéːyô*, HTS skips over the epenthesized mora and targets the next mora. This means the markedness constraint(s) enforcing HTS must be formulated so as to seek the following *underlying* mora when determining the extent of spreading. We need a constraint like the one in (12).

(12) HTS TO UNDERLYING μ: Spread H rightward to the next low-toned mora that stands in correspondence with a mora in the input.

But this is a highly unusual constraint: It is a markedness constraint that has access to the input and correspondence relations, and this sort of power is generally taken to be impermissible in standard conceptions of OT. Markedness constraints should evaluate candidates based solely on their surface configurations, not their status with respect to the input. It is possible to reinterpret (12) as an instance of HEAD-DEP (Alderete 1995, McCarthy 1995, Alderete 1996), but this leads to conceptual problems that are discussed in section 3.1 below.

The moraic approach can be salvaged in a derivational system by ordering lengthening after HTS, but since parallel frameworks like OT typically do not have intermediate stages, this strategy is unavailable to us. We could of course abandon OT or adopt some version of serial OT with the goal of anointing the mora Adhola’s TBU, but such moves are clearly overkill in light of the fact that a simple, non-serial OT analysis is available.

2.2 A Phonetic Account of Contour Tones

While the spreading facts analyzed above show that the syllable is most likely the TBU in Adhola, contour tone distribution in the language indicates that mora should be the TBU. This section examines these facts and resolves the conflict between spreading and contour tones by dissociating contour tone distribution from structural requirements and instead adopting a phonetic approach.

As mentioned above, contour tones in Adhola surface only on PP-final syllables and syllables with long vowels. Previous research has shown both kinds of syllable to be long (e.g., Klatt 1973, Lunden 2006a,b, Zhang 2000), so a phonetic account of their attraction of contour tones is already appealing. PP-lengthened syllables can acquire contour tones, as shown in (13). In (13a), the first syllable of verb, which is in PP-final position, is lengthened, and it has a contour tone (H$^{!}$H). But when this form is PP-internal, as in (13b), the same syllable is short. It therefore loses its contour tone (or perhaps it cannot acquire the contour—see immediately below) via delinking of the downstepped H.

(13) a. *PP-final:* gɔ̀ wɔ́$^{!}$ɔ́lɔ́ ‘he/she is coughing’
b. *PP-internal:* gɔ̀ wɔ́$^{!}$lɔ́… ‘he/she is coughing…’

With this alternation informing our analysis, it seems that the mora is the TBU. The most obvious explanation for the loss of the contour tone in (13b) is that the first syllable of the verb loses its second mora, and the association line between this mora and $^{!}$H disappears. Deletion of the mora automatically accounts for contour tone loss.

Alternatively, we could view the alternation in (13) as one of contour tone acquisition in (13a) rather than loss in (13b). Again, the mora seems to be the best TBU. The inserted mora needs a tone, and the language fills this need by spreading $^{!}$H leftward. This approach would seem to conflict with the observation from section 2.1 that tones tend to spread rightward in Adhola, but there is a very good rationale for leftward spreading this case. Only the second H in *wɔ́$^{!}$ɔ́lɔ́* is lexical; The first is morphologically associated with the imperfect aspect. It is inserted at the left edge of imperfective verbs but is absent from perfective verbs. This is illustrated in (14) with the high-toned verb *wɔ̀lɔ́* ‘cough’ and the low-toned verb *yɪ̀kɔ̀* ‘bury.’

(14)

Imperfect, PP-Internal	*Perfect, PP-Internal*
wɔ́$^{!}$lɔ́	*wɔ̀lɔ́*
yɪ́kɔ̀	*yɪ̀kɔ̀*

One could argue that leftward spreading in (13a) is due to a constraint against the imperfect H being linked to multiple TBUs, or a preference for the lexical tone in an imperfective verb to be linked to as many TBUs as possible. An analysis that takes the mora as the TBU is appealing in light of these facts.

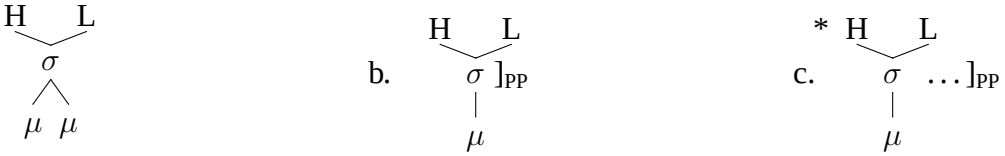
We therefore have a conflict: HTS requires the syllable as the TBU, but contour tones seem to require the mora. Under a purely structural approach, if the syllable is the TBU we have no reason to expect lengthening to be correlated with contour tone distribution. If tones are linked to syllables, it is unclear why contour tones should be dependent on the presence or absence of a non-TBU element like the mora.

On the other hand, with the mora as the TBU, the contour facts are less elusive, but HTS becomes much more complicated. Sometimes tones spread by one mora, sometimes by two moras. We need a highly suspect constraint to account for this fact in OT.

This conflict can be resolved by adopting the phonetic approach of Zhang (2001). With contour tone distribution tied to measurable properties such as sonorous rime duration or sonorous phase (Gordon 2002) rather than structural requirements, the impetus for adopting the mora as the TBU vanishes. This means there is no impediment to selecting the syllable as Adhola's TBU. As we've already seen, this move best lets us account for HTS, and we can rely on phonetically oriented constraints to pick up where structural factors fail. Moreover, by rooting contour tone permissibility in independent phonetic factors, we achieve a deeper level of understanding with respect to kinds configurations languages allow. Contour tones are not banned from short syllables for what amounts to arbitrary abstract limitations. Instead, there are real independent reasons to expect these patterns.

In particular, bimoraic syllables (15a) and PP-final syllables (15b) can host contour tones because the long vowel and final-syllable lengthening provide a sufficient sonorous rime duration for the articulation (and perception) of the pitch excursions required by the contour tone. As Zhang (2001) shows, contour tones requiring greater or more complex pitch targets need longer and more sonorous host rimes.

(15)



In contrast, non-final monomoraic syllables (15c) cannot host a contour tone because such syllables provide insufficient time and sonority for the pitch excursions to be articulated.

It is also important to note that the findings of Zhang (2001) and Gordon (2002) show that the entire sonorous portion of the syllable (namely the rime) is relevant to diagnosing the acceptability of a contour tone. This is further evidence that the syllable is a better choice of TBU than the mora. With tones linked to syllables, it is reasonable to expect a tone's acceptability to be tied to the syllable's contents. On the other hand, if the mora were the TBU, we would expect that tones would be dependent only on the segments under the particular mora to which the tones are linked.

Zhang formulates constraints that ban contour tones of a certain complexity from appearing on syllables that don't meet a minimum sonorous rime duration requirement. Without delving into the details of Zhang's constraints, I adopt the constraint in (16) to rule out configurations like the one in (15c). I take no position on what, in raw phonetic terms, counts as a "short" syllable or whether the dividing line between short and long syllables is universally determined. See Zhang (2001) and references therein for investigations of these questions. For the purposes of a present analysis, it suffices to say that syllables with long vowels and PP-final syllables are long, and PP-internal syllables with short vowels are short. This assumption is consistent with the findings of Zhang, Gordon, and others, although I am aware of no studies confirming the validity of this assumption for Adhola specifically. In any case, the generalization remains that heavy and final (i.e. longer) syllables are better contour tone hosts than light (shorter) syllables, all else being equal. It thus

falls to constraints like *TT/σ_{short} to capture the comparative advantage of heavy syllables. It is not the moraic content of a syllable that determines its suitability as a contour tone host. The crucial factor is the phonetic consequence of bimoraicity (and finality): greater duration.

(16) *TT/σ_{short}: Contour tones on short syllables are banned.

This constraint is never violated in Adhola, so I rank it at the top of the constraint ranking. Presumably, following Zhang (2001), there are also constraints militating against (15a) and (15b), but these are ranked sufficiently lowly in Adhola as to be ineffective.

As (17) shows, when MTS motivates creation of a contour tone on a syllable with a long vowel, as is the case at the end of a PP, *TT/σ_{short} is not violated. The contour tone is created as expected. I assume that other constraints prevent the imperfective H from spreading.

(17) *PP-Final*

	/wɔlɔ́ H/ 'fall (pres)'	*TT/σ_{short}	MTS	MAX(Tone)	ALIGN-R
☞	a. gɔ̀ wɔ́ˡɔ́lɔ́		*		***
	b. gɔ̀ wɔ́ːˡlɔ́		**!		***

But in (18), the candidate with the contour tone on the first vowel is eliminated by *TT/σ_{short}. The diacritic over the vowel in candidate (a) is meant to indicate that this short vowel hosts a high tone followed by a mid (i.e. downstepped high) tone. Since this form is PP-internal, both vowels are short. *TT/σ_{short} therefore prevents the first syllable from hosting a contour tone, and ALIGN-R cannot be satisfied. Notice that (18) provides evidence for the ranking *TT/$\sigma_{short} \gg$ MTS.

(18) *PP-Internal*

	/wɔlɔ́ H/ 'fall (pres)'	*TT/σ_{short}	MTS	MAX(Tone)	ALIGN-R
	a. gɔ̀ wɔ́́lɔ́	*!	*		*
☞	b. gɔ̀ wɔ́ˡlɔ́		**		*

To summarize, by divorcing contour tone distribution from structural considerations, we can make conclusions about the TBU in Adhola based on solely on tone spread. This leads to better analyses of both HTS and contour tones. Tones spread from syllable to syllable because the syllable is the TBU. Contour tones seem to be sensitive to moraic configurations only because moras affect the phonetic properties of rimes and therefore can determine whether or not a syllable is long enough to host a contour tone.

3 Ikalanga

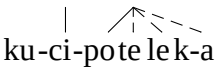
In a slightly different fashion, Ikalanga points to the same conclusion that Adhola led us to: We cannot rely on independent facts about what the language's TBU is to be an accurate guide to contour tone distribution, and we must therefore separate the factors regulating contour tone placement

from structural facts about the TBU. As in Adhola, tone spreads by syllables, but contour tones are sensitive to moras.

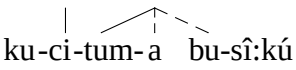
3.1 Tone Spreading by Syllables

Hyman & Mathangwane (1998), from whom all data on Ikalanga in this paper are taken, propose three rules of rightward HTS relevant to verb stems. One spreads H to the right edge of the word, and the other two spread H one syllable rightward. The details of these rules are unimportant for current purposes; Crucially, they typically combine to spread H on a verb stem throughout the stem. For mono- and disyllabic stems, HTS also spreads H one syllable beyond the right edge of the stem. A more nuanced view of HTS within verb stems will be necessary for a complete analysis of the facts (see section 3.3), but I adopt this simplified view provisionally for now. Examples of HTS in Ikalanga are shown in (19)–(23). In each case, the verb stem's H spreads from the left edge of the stem to the right edge, and in (20) and (23) it spreads one syllable beyond the stem because these are short stems.

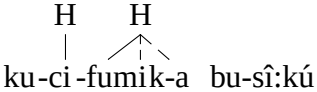
(19) a. ku-cí-pótélék-á… 'to surround it…'

b.


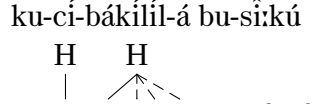
(20) a. ku-cí-túm-á bú-sî:kú 'to send it at night'

b.


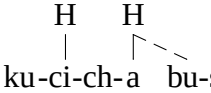
(21) a. ku-cí-fúmík-á bu-sî:kú 'to cover it at night'

b.


(22) a. ku-cí-bákílíl-á bu-sî:kú 'to fence it in at night'

b.


(23) a. ku-cí-ch-á bú-sî:kú 'to fear it at night'

b.


Syllables that are penultimate within an Intonational Phrase (IP) are lengthened. But as (24)–(27) show, the mora inserted by penultimate lengthening is skipped by HTS. A low tone is inserted (apparently linked to the inserted mora, but see below), as shown in (24e), and the stem's H undergoes fission (24f).

The other examples below show the same process, but because the derivational analysis on which these examples are based orders lengthening between two HTS rules, the order of events varies. The result is always the same: HTS fails to target the epenthesized mora.

(24) a. tûːm-á 'send!'

b. H
   |
tum -a
   ⇓

c. H
   ⌜ - - -
tum -a
   ⇓

d. H
   ⌜\
tuum -a
   ⇓

e. H L
   ⌜\ /
tuum -a
   ⇓

f. H L H
   | / |
tuum -a

(25) a. tôːl-á 'take!'

b. H
   ⌜ - - -
tool -a
   ⇓

c. H L
   ⌜\ /
tool -a

(26) a. fúmîːk-á ‘cover!’

b. H

fumik-a

⇓

c. H L

fumiik-a

(27) a. bákílîːl-á ‘fence in!’

b. H

bakilil-a

⇓

c. H L

bakiliil-a

All imperative forms, like those given above, show this pattern. IP-finally, non-imperative monosyllabic and disyllabic stems show this pattern, too (as in (28)), but longer stems show a different pattern in IP-final position (see (29)). The lengthened vowel is entirely high toned, and the final syllable is unexpectedly low toned.

(28) a. ku-cí-tûːm-á ‘to send it’
b. ku-cí-tûːk-á ‘to insult it’

(29) a. ku-cí-fúmíːk-a ‘to cover it’
b. ku-cí-táfúːn-a ‘to chew it’
c. ku-cí-bákílíːl-a ‘to fence it in’
d. ku-cí-pótélé:k-a ‘to surround it’

IP-internally, where they are not subject to lengthening, these longer forms behave as expected. H spreads to the right edge of the stem:

(30) a. ku-cí-fúmík-á bu-sîkú ‘to cover it at night’
b. ku-cí-táfún-á bu-sîkú ‘to chew it at night’
c. ku-cí-bákílíl-á bu-sîkú ‘to fence it in at night’
d. ku-cí-pótélék-á bu-sîkú ‘to surround it at night’

The exceptional behavior of the longer forms demands a more intricate understanding of HTS, and I put this off until section 3.3. First I present an analysis of the imperative and short verbs that lays the groundwork for the more nuanced examination of HTS.

Hyman & Mathangwane (1998) analyze the non-imperative forms as the basic pattern and stipulate an exceptional templatic pattern for the imperative forms. This is reasonable because many Bantu languages exhibit exceptional tone patterns in their imperative forms (L. Hyman, p.c.). But the imperative verbs in Ikalanga behave just like short non-imperative verbs. I take this to indicate that Ikalanga's imperatives are not terribly exceptional as far as the properties under discussion are concerned. In the analysis below, then, imperatives are subject the same constraints that govern non-imperative verbs. There is no templatic stipulation, and the only exceptional property of imperatives is that they are exempt from a NON-FINALITY constraint that holds for other verb forms.

The skipping of epenthesized moras seen in (24)–(27) is not an artifact of penultimate lengthening occurring within a pre-existing high tone span. As (31) shows, HTS also ignores epenthesized

moras that appear at the edge of a high tone span. Crucially, the spreading shown in (31d) does not occur. The spreading process that would be responsible for this operation is not sensitive to OCP effects (Hyman & Mathangwane 1998:201), so the absence of spreading is not explicable on these grounds.

(31) a. kù-cî:-ch-á ‘to fear it’

b.
```
     H   H
     |   |
ku-ci-ch-a
```
⇓

c.
```
     H   H
     |   |
ku-cii-ch-a
```

d.
```
     H   H
     ⍀   |
*ku-cii-ch-a
```

Spreading by syllables offers the best account of the skipping facts. If tones were to spread by moras, we’d expect HTS to target the epenthesized mora, creating entirely high-toned stems such as **túúmá* and **fumíík-á*. As with Adhola, lengthening can be ordered after HTS in a derivational system, allowing us to adopt the mora as the TBU. But such an analysis is impossible in a parallel system like OT in the absence of intermediate stages.

Keeping our simplified view of HTS, the constraint in (32) enforces spreading. Although the analysis below will eventually account for the failure of HTS to spread a high tone to the end of a stem in certain cases (e.g. (29)), spreading beyond the stem will remain unaccounted for here. See Hyman & Mathangwane (1998) for the details of this phenomenon.[6]

(32) H-STEM SPAN: A high tone span whose H is supplied by the verb stem should include all TBUs in the stem.

H-STEM SPAN requires spreading of a high-toned stem’s tone throughout the stem. IP lengthening is enforced by the cover constraint LENGTH.

As (33) shows, when the mora is the TBU, we get the wrong result (indicated by ⊗) for the IP-final imperative forms given above. The actual output, candidate (d), is suboptimal because H fails to spread to every mora in the stem. The second mora of the long vowel is not high toned. Candidate (e) wins instead: It violates neither constraint, but unfortunately it doesn’t have desired the L-epenthesis. Candidates (a) and (b) don’t have lengthened penultimate vowels, and candidates (b) and (c) fail to spread.

[6]Kaplan (2006) speculates that constraints imposing a minimum size on a high tone domain may be appropriate for Ikalanga, much like the MTS constraint proposed here for Adhola.

(33) *Mora as TBU, IP-Final*

	/tum-a H/	H-STEM SPAN	LENGTH
	a. túmá		*!
	b. túmà	*!	*!
	c. túúmà	*!	
(☞)	d. túùmá	*!	
⊗	e. túúmá		

To select candidate (d) over candidate (e), we need a constraint like the one in (34), which prevents the linking of H to an epenthesized mora. As with the constraint needed under the moraic approach in Adhola (see (12)), this constraint would be very unusual in OT: Markedness constraints shouldn't have access to the input. Also, this constraint must outrank HTS constraints to get the right result here, but for forms like *ku-cí-fúmí:k-a* 'to cover it' (29a), HTS constraints would have to outrank (34). This ranking paradox casts suspicion on the moraic analysis.

(34) *H ON EPENTHESIZED μ: Moras that do not stand in correspondence with an input mora should not be linked to H.

But there are deeper reasons to reject *H ON EPENTHESIZED μ. This constraint is reminiscent of HEAD-DEP (Alderete 1995, McCarthy 1995, Alderete 1996), which penalized epenthetic elements that are in prominent (head) positions. It is easy to see how *H ON EPENTHESIZED μ could be interpreted this way and therefore be defended as a reasonable constraint. If we adopt the position that H is the prominent tone in a two-tone system, then *H ON EPENTHESIZED μ just militates against prominent epenthetic moras.

But there is an important difference between *H ON EPENTHESIZED μ and HEAD-DEP: The former is a markedness constraint and the latter is a faithfulness constraint (see (35)). Faithfulness constraints may (and in IO-Faithfulness, must) refer to the input, so HEAD-DEP is unproblematic. But *H ON EPENTHESIZED μ is a markedness constraint and therefore has no access to the input.

(35) HEAD-DEP: Every segment contained in a prosodic head in S_2 has a correspondent in S_1. If β is contained in a prosodic head in S_2, then $\beta \in$ Range($\Re$). (Alderete 1995:8)

It is possible to recast *H ON EPENTHESIZED μ as a faithfulness constraint and avoid this criticism:

(36) HEAD-DEP(μ_{H}): Epenthesis of a high-toned mora is disallowed.

However, this reformulation is contrary to the intent of HEAD-DEP-like constraints. HEAD-DEP captures the observation that non-underlying elements are avoided in the assignment of prominence, but it would be odd to claim that the epenthesized mora in **túúmá* is in a prominent position by virtue of being high-toned. In fact, it seems to be non-prominent compared to its counterpart in the actual output *túùmá*. (HEAD-DEP(μ_{H}) is meant to select *túùmá* over **túúmá*.) Units are prominent by virtue of having a property that distinguishes them from surrounding elements: stress,

length, pitch, etc. In **túúmá*, the epenthesized mora fits in with the other moras in the form by being linked to a high tone, whereas it stands out in *túùmá* because its tonal association is different from the other moras in the word. The only prominent aspect of the epenthesized mora in **túúmá* is its presence in a heavy syllable, but ruling out this form on the basis of length would also rule out *túùmá*: The epenthesized mora is still in a heavy (i.e. prominent) syllable. If we are to be mindful of the motivation for HEAD-DEP, we must adopt a constraint that at best favors neither **túúmá* nor *túùmá* and at worst favors the former over the latter. Redesigning *H ON EPENTHESIZED μ as a faithfulness constraint resolves one problem, but it creates another problem.

The same argument can be made against HTS TO UNDERLYING μ (12). Viewed as a ban on prominent epenthetic moras (by enforcing spreading only to underlying moras), this constraint, like HEAD-DEP(μ_{H}), relies on H being universally prominent. But in favoring HTS to underlying moras, HTS TO UNDERLYING μ creates exactly what is disfavors: Low-toned epenthetic moras are prominent because they interrupt the otherwise homogenous high-toned span. Adopting HTS TO UNDERLYING μ and HEAD-DEP(μ_{H}) the grounds of prominence considerations would be simply disingenuous.

No such problematic constraint is required in a syllable-as-TBU analysis. As (37) shows, the L-epenthesis candidate's violation of H-STEM SPAN disappears when the syllable is the TBU. This is because every syllable in the stem is linked to the stem's high tone. H-STEM SPAN doesn't care that one of these TBUs is also linked to a low tone. It is subsequently up to the constraint(s) enforcing L-epenthesis (represented in (37) by L-INSERTION and to be investigated below) to select between the candidates. Indices mark correspondence relations.

(37) *Syllable as TBU*

/tum-a H_i/	H-STEM SPAN	LENGTH	L-INSERTION
☞ a. H_i L H_i σ σ t ú ù m á			
b. H_i σ σ t ú ú m á			*!

Even if we adopt L-INSERTION in the moraic approach, we still have to deal with the intended winner's fatal violation of H-STEM SPAN because the middle mora will necessarily be linked to the inserted L. Ranking L-INSERTION over H-STEM SPAN solves the problem, but I argue in section 3.2 that the ranking H-STEM SPAN $\gg$L-INSERTION is necessary. In contrast, under the syllabic approach, both halves of the HL contour are linked to the initial syllable. This means there is no problematic exclusively low-toned TBU.

Candidate (a) in (37) seems to violate the spirit of HTS because there is no multiply linked H, which is what is usually meant by the term "spreading." However, any analysis of Ikalanga will have to either permit crossing of association lines or allow fission candidates like candidate (a)

to count as satisfying HTS. There seems to be no way around the conclusion that a low tone can break up an otherwise well-formed high tone span in a way reminiscent of transparency in vowel harmony (e.g., Ní Chiosáin & Padgett 1997, Walker 2000). Crucially for candidate (a), each TBU in the stem is linked to the stem's underlying H. This is truly a fission candidate: The input tone has two output correspondents, and between these two output tones every TBU in the stem is linked to a stem-supplied high tone. The input tone is literally in two places at once. L-epenthesis does not prevent satisfaction of H-STEM SPAN.

3.2 L-Epenthesis

Although L-epenthesis does not run afoul of H-STEM SPAN, there is so far no motivation for L-epenthesis in the analysis. A fully high-toned candidate like **tú:má* is quite reasonable and even preferable under the existing analysis (see (33)). The epenthesized mora ought to be assimilated into the existing H span.

In this section I propose that L-epenthesis is a prominence-enhancing operation that promotes the introduction of L on high-toned lengthened syllables.[7] Lengthened penultimate syllables, I assume, are heads of IPs, and creation of a HL contour on these syllables enhances their prominence. Similar enhancement-driving phenomena are the motivation for constraints like PEAK PROMINENCE (Prince & Smolensky 1993[2004]).

The constraint that motivates L-epenthesis is TONAL PROMINENCE, defined in (38). This constraint specifies the way in which IP-penultimate syllables are to be marked as tonally prominent, but this is just an expository convenience. It is more likely that HL is selected over LH by markedness constraints encoding the fact that falling tones are generally less marked than rising tones (see section 3.4). The issue of what counts as "tonally prominent" is also significant: Why is HL more prominent than L, in the context of the discussion of HEAD-DEP above? Perhaps the answer is simply that H-STEM SPAN requires the lengthened syllable to be linked to a high tone, so a simple L is impossible. There may be deeper reasons for HL to be favored over L (such as the fact that the former has a pitch transition that may be perceptually salient), and these possibilities deserve a full experimental and cross-linguistic investigation that cannot be undertaken in the present study. It is also worth noting that the Japanese pitch accent is a HL contour (), so perhaps there is some cross-linguistic preference for this sequence as a marker of prominence.

(38) TONAL PROMINENCE: IP-head syllables are tonally prominent: They have a HL contour.

Not all IP-head syllables have HL contours. (39) shows low-toned verbs in IP-final position. The high tones on the first two syllables of the stem are the result of spreading from *cí*. The penultimate syllables are lengthened but they are still low-toned. H is not epenthesized or spread from the preceding syllable to create a contour. This means TONAL PROMINENCE must be ranked below *H. TONAL PROMINENCE can cause insertion of L, but it cannot influence high tones.

(39) a. ku-cí-ámúciil-a 'to receive it'
b. ku-cí-nyébúnuus-a 'to raise it'

[7] Thanks to Jennifer Smith for suggesting this possibility to me.

The Tableau in (40) illustrates this ranking. I do not account for HTS from (39), but the relevant constraints obviously must outrank *H.

(40)

	/ku-cí-amuciil-a/	*H	TONAL PROMINENCE
☞	a. ku-cí-ámúciil-a	***	*
	b. ku-cí-ámúcíil-a	****!	

For our purposes, *H penalizes both distinct instances of H and "extra" association lines from a single H. The latter may be better handled by constraints limiting the extent of HTS. Crucially, *H must also rank below H-STEM SPAN, or else HTS will be blocked altogether:

(41)

	/tum-a H/	H-STEM SPAN	*H	TONAL PROMINENCE
☞	a. túùm-á		**	
	b. túùm-à	*!	*	

By transitivity, H-STEM SPAN must outrank TONAL PROMINENCE. This means that under a mora-as-TBU analysis, TONAL PROMINENCE cannot override H-STEM SPAN's desire to link every TBU with a high tone, and the fully high-toned candidate therefore wins. This is shown in (42) (cf. (33)). H-STEM SPAN eliminates the intended winner, and although promotion of *H or TONAL PROMINENCE will rectify the problem, the previous Tableaux have demonstrated the necessity of these rankings.

(42) *Mora as TBU*

	/tum-a H/	H-STEM SPAN	*H	TONAL PROMINENCE
	a. túùm-á	*!	**	
⊗	b. túúm-á		***	*

Since each mora is a TBU, H-STEM SPAN blocks any attempt to insert a low tone.[8] As already shown in (37), the syllable-as-TBU approach does not encounter this problem:

(43) *Syllable as TBU*

	/tum-a H/	H-STEM SPAN	*H	TONAL PROMINENCE
☞	a. tû:m-á		**	
	b. tú:m-á		**	*!

[8]The candidate **túûmá*, with a HL contour on the second mora, fares better than either candidate shown in (42) but violates the common assumption within the mora-as-TBU approach that at most one tone may be linked to a (non-final) TBU (e.g., Hyman 1985). This restriction is untenable with the syllable as the TBU because contour tones on a single syllable are extremely common cross-linguistically. Also, the transcription **túûmá* is not consistent with the transcriptions of Hyman & Mathangwane (1998), who show the high tone of HL contour on the first mora and the low tone on the second mora. I know of no evidence contradicting this view, so I assume their transcriptions are correct.

There are also conceptual reasons to favor the syllabic approach in the context of L-epenthesis. It has already been noted that HEAD-DEP-type considerations disfavor placing L on the epenthesized mora in the middle of a high tone span. In adopting the syllable as the TBU, the desired output becomes more compatible with HEAD-DEP. L is placed on a syllable, not a mora, so there is no conflict between HEAD-DEP's prominence-minimizing and TONAL PROMINENCE's prominence-enhancing effects. The TBU itself is not epenthesized[9] and thus cannot violate HEAD-DEP, even though it contains an epenthetic mora. The syllabic approach is superior empirically and conceptually in the face of L-epenthesis.

3.3 Long Non-Imperative Verbs

Long non-imperative verbs do not show the L-epenthesis pattern. The data from (29) are repeated in (44). In this section I show that these forms can be accounted for within the existing analysis. The constraint that prevents L-epenthesis is one that captures the more general fact that HL contours are banned from syllables that precede a low-toned syllable in Ikalanga (L. Hyman p.c.).

(44)

a.	ku-cí-fúmíːk-a	'to cover it'
b.	ku-cí-táfúːn-a	'to chew it'
c.	ku-cí-bákílíːl-a	'to fence it in'
d.	ku-cí-pótéléːk-a	'to surround it'

In the derivational approach of Hyman & Mathangwane (1998), these verbs are subject to final vowel extrametricality. This explain why HTS stops short of the final syllable. The same effect can be achieved here with a version of NON-FINALITY:

(45) NON-FINALITY: The final syllable within IP in a non-imperative construction is not a possible host for H.

This constraint affects only non-imperative forms because HTS spreads to the final syllable in imperative forms.[10] Further constraints on word minimality (which I do not formalize here) block NON-FINALITY in short non-imperatives. HTS can therefore target the final syllables of imperative and short verbs.

NON-FINALITY outranks H-STEM SPAN, as (46) shows.

(46)

/ku-cí-fumik-a H/	NON-FINALITY	H-STEM SPAN	*H	TONAL PROMINENCE
☞ a. ku-cí-fúmíːk-a		*	***	*
b. ku-cí-fúmíːk-á	*!		****	*

[9] Unless all syllables are "epenthesized" in the sense of not being present in underlying forms. In this case efforts to disqualify certain syllables from prominent positions are futile because all syllables have the same epenthetic status.

[10] In this sense, imperatives are still somewhat exceptional in this analysis, so the exceptional nature of Bantu imperatives is not entirely ignored. The approach taken here is still an improvement over the templatic stipulation of Hyman & Mathangwane (1998).

This ranking does not prevent H-STEM SPAN from correctly producing the forms in (30), repeated in (47), because these verbs are not IP-final and are therefore not subject to NON-FINALITY. However, *bu-sîkú* is subject to NON-FINALITY. I assume the same minimality constraints that block NON-FINALITY in short verbs is also at work here, preventing NON-FINALITY from bumping the H off the final syllable in the disyllabic *sîkú*.

(47)
a.	ku-cí-fúmík-á bu-sîkú	'to cover it at night'
b.	ku-cí-táfún-á bu-sîkú	'to chew it at night'
c.	ku-cí-bákílíl-á bu-sîkú	'to fence it in at night'
d.	ku-cí-pótélék-á bu-sîkú	'to surround it at night'

With high tones banned from the final syllables of long verbs, L-epenthesis on the penultimate vowel is easy to block. In Ikalanga, HL contours are not licensed when their host syllable is followed by a low-toned syllable. The constraint in (48) captures this.

(48) *HL-L: A HL contour cannot precede a low-toned syllable.

Ranked alongside NON-FINALITY, this constraint correctly produces the forms in (44):

(49)

	/ku-cí-fumik-a H/	NON-FIN	*HL-L	H-STEM SPAN	*H	TONAL PROM
☞	a. ku-cí-fúmí:k-à			*	***	*
	b. ku-cí-fúmî:k-à		*!	*	***	
	c. ku-cí-fúmí:k-á	*!			****	*
	d. ku-cí-fúmî:k-á	*!			****	

Candidates (c) and (d) in (49) lose because they fail to respect NON-FINALITY. Candidate (a) is superior to candidate (b) because the latter has an improperly placed HL contour. Notice that L-epenthesis is blocked here even though the L-epenthesis candidates fare better with respect to TONAL PROMINENCE. As candidate (d) shows, NON-FINALITY prevents a strategy in which a violation of *HL-L is avoided by placing a high tone on the final syllable.

For completeness, the next two Tableaux show that this ranking does not prevent L-epenthesis in short non-imperative forms (50) and all imperative forms (51). NON-FINALITY is inactive in both cases.[11]

(50) *Short Non-Imperatives*

	/ku-cí-tum-a H/	*HL-L	H-STEM SPAN	*H	TONAL PROM
☞	a. ku-cí-tû:m-á			***	
	b. ku-cí-tú:m-á			***	*!
	c. ku-cí-tú:m-à		*!	**	*
	d. ku-cí-tû:m-à	*!	*	**	

[11] NON-FINALITY is not shown in these Tableaux: Its force is suppressed by higher word-minimality constraints in (50), and it is inactive in (51) because the form under consideration is an imperative verb.

(51) *Imperatives*

/fumik-a H/	*HL-L	H-STEM SPAN	*H	TONAL PROM
a. fúmí:k-à		*!	**	*
b. fúmî:k-à	*!	*	**	
c. fúmí:k-á			***	*!
☞ d. fúmî:k-á			***	

The apparently exceptional long non-imperative verbs can be accounted for by adopting a NON-FINALITY constraint whose force is blunted by minimality and morphological restrictions. Together with constraints on high tone placement, these restrictions block L-epenthesis in longer verbs.

3.4 Contour Tones

The previous sections have shown that adopting the syllable as the TBU is the best way to account for HTS in Ikalanga. On the other hand, contour tone distribution points toward a mora-as-TBU approach. We've already seen evidence to this effect. When a mora is epenthesized under penultimate lengthening, it seems to acquire a low tone, even in the middle of a high tone span:

(52) a. tû:m-á ‘send!’

b. H L

tuum -a

⇓

c. H L H

tuum -a

The most obvious explanation is that the epenthesized mora is a toneless TBU, and default tone assignment links it to a low tone. But the analysis presented here shows that this is not necessary. L-epenthesis can be motivated by non-moraic considerations like prominence. This means there is no reason to adopt the moras the TBU. On the other hand, as we have seen, there is good reason to adopt the syllable as the TBU.

The constraints linking contour tone assignment to sonorous rime duration from Zhang (2001) replace the structurally grounded contour regulations of the moraic approach. HL is permitted on heavy syllables not because these syllables have two moras, but because these syllables are long enough and sonorous enough to host such tones. It is also possible that Zhang's constraints play a role in determining what sort of contour tone is inserted at the behest of TONAL PROMINENCE: LH requires a longer or more sonorous host than HL, and penultimate lengthening may provide a sufficient host for one but not the other. Other contours can be ruled out similarly: HLH, for example, requires a more sonorous or longer host than HL, and can be ruled out on these grounds, even though HLH may do more to enhance the prominence of the long syllable.

While L-epenthesis in Ikalanga seems at first glance to argue for a moraic TBU, the investigation presented here shows that a syllabic approach is superior. The syllabic approach is better equipped to handle the facts of HTS and L-epenthesis than the moraic approach. It cannot regulate contour tone placement in the moraic approach's structural fashion, but a phonetically based theory of contour tone distribution performs this duty adequately.

4 Conclusion

This paper has presented analyses of HTS in Adhola and Ikalanga that argue for the syllable as the tone-bearing unit. This move conflicts with the observation that contour tone distribution is sensitive to syllable weight, a fact which seems to call for the mora to be the TBU. Phonetically grounded accounts of contour tone placement, in the vein of Zhang (2001) and Gordon (2002), free contour tone facts from moraic content and consequently make way for the syllable-based analyses of spreading developed here. The present work complements the arguments in Zhang (2001) that syllable weight requirements for non-tonal factors often conflict with weight requirements for contour tone distribution under the assumption that the mora is the TBU. Here, we've seen evidence that conclusions concerning the identity of the TBU for purposes of HTS can conflict with conclusions made on the basis of contour tone permissibility. The solution to both problems is to divorce contour tone assignment from structural factors and shift the burden of explanation in this domain to more reliable phonetic properties like sonorous rime duration.

Studies of this sort also call into question the utility of the mora as a formal phonological unit. The analyses of Adhola and Ikalanga presented above show that we cannot use tone to argue for the mora's necessity. Although it remains to be seen whether the mora can be dispensed with altogether, this is the unavoidable implication of recent phonological research which challenges the most fundamental arguments for the mora as expressed in, e.g., Hyman (1985), McCarthy & Prince (1986), and Hayes (1989b). The present work argues that the mora is needed neither as a TBU (the syllable does that) nor as an arbiter of contour tone permissibility (that's the job of phonetic properties). Other work has argued that the mora is unhelpful in analyses of geminates (Curtis 2006) and stress patterns (Lunden 2006a,b). With respect to the latter phenomenon, syllable duration—a phonetic property—seems to be more useful than moraic weight distinctions. Taken together, this body of work suggests that while the mora may be a good first approximation of phonetic properties like duration and sonority, as phonological theory advances, we will have to discard the mora in favor of distinctions more closely tied to phonetic properties. Coupled with this this shift away from the mora is the need to reassign roles that were previously the burden of mora. Adopting the syllable as the TBU is one of these reassignments.

References

Alderete, John (1995) Faithfulness to Prosodic Heads. ROA-94 http://roa.rutgers.edu.
Alderete, John (1996) Prosodic Faithfulness in Cupeño. ROA-131 http://roa.rutgers.edu.
Alderete, John, Jill Beckman, Laura Benua, Amalia E. Gnanadesikan, John J. McCarthy, & Su-

sanne Urbazczyk (1999) Reduplication with Fixed Segmentism. *Linguistic Inquiry* **30**(3): 327–364, ROA-226 http://roa.rutgers.edu.

Beckman, Jill N. (1999) *Positional Faithfulness*. New York: Garland.

Cohn, Abby & John McCarthy (1998) Alignment and Parallelism in Indonesian Phonology. In *Working Papers of the Cornell Phonetics Laboratory*, vol. 12, 53–137, ROA-25 http://roa.rutgers.edu.

Curtis, Emily (2006) OT vs Hungarians Final Geminates. Albuquerque, NM: Annual Meeting of the Linguistic Society of America.

Goldsmith, John (1976) *Autosegmental Phonology*. Ph.D. thesis, MIT.

Gordon, Matthew (2002) A Typology of Contour Tone Restrictions. *Studies in Language* **25**(3): 423–462.

Hayes, Bruce (1989a) Compensatory Lengthening in Moraic Phonology. *Linguistic Inquiry* **20**: 253–306.

Hayes, Bruce (1989b) The Prosodic Hierarchy in Meter. In *Phonetics and Phonology: Volume 1: Rhythm and Meter*, Paul Kiparsky & Gilbert Youmans, eds., 201–260, San Diego: Academic Press.

Hyman, Larry (1985) *A Theory of Phonological Weight*. Dordrecht: Foris.

Hyman, Larry M. & Joyce T. Mathangwane (1998) Tonal Domains and Depressor Consonants in Ikalanga. 195–229, CSLI Publications.

Kaplan, Aaron F. (2006) The Nature of Iterativity: Evidence from Lango, ms., University of California, Santa Cruz.

Klatt, Dennis H. (1973) Interaction Between Two Factors that Influence Vowel Duration. *Journal of the Acoustical Society of America* **54**: 1102–1104.

Leben, Will (1973) *Suprasegmental Phonology*. Ph.D. thesis, MIT.

Leben, Will (1978) The Representation of Tone. In *Tone: A Linguistic Survey*, Vicki Fromkin, ed., 177–220, New York: Academic Press.

Lunden, S.L Anya (2006a) Explaning Final Consonant Extrametricality: Norwegian Case Study. Albuquerque, NM: Annual Meeting of the Linguistic Society of America.

Lunden, S.L. Anya (2006b) *Weight, Final Lengthening and Stress: A Phonetic and Phonological Case Study of Norwegian*. Ph.D. thesis, University of California, Santa Cruz.

Lyberg, Bertil (1977) Some Observations on the Timing of Sweedish Utterances. *Journal of Phonetics* **5**: 49–59.

McCarthy, John & Alan Prince (1986) Prosodic Morphology, ms., University of Massachusetts, Amherst, and Brandeis University.

McCarthy, John & Alan Prince (1993) Generalized Alignment. In *Yearbook of Morphology*, 79–153.

McCarthy, John & Alan Prince (1995) Faithfulness and Reduplicative Identity. In *University of Massachusetts Occasional Papers in Linguistics 18: Papers in Optimality Theory*, Jill Beckman, Laura Walsh Dickey, & Suzanne Urbancyzk, eds., 149–348, Amherst: GLSA Publications.

McCarthy, John J. (1995) Extensions of Faithfulness: Rotuman Revisited. ROA-110 http://roa.rutgers.edu.

Myers, Scott (1997) OCP Effects in Optimality Theory. *Natural Language and Linguistic Theory* **15**: 847–892.
Myers, Scott (1998) Surface Underspecification of tone in Chichewa. *Phonology* **15**(3): 367–391.
Myers, Scott (1999) Tone Association F_0 Timing in Chichewa. *Studies in African Linguistics* **28**(2): 215–239.
Myers, Scott (2003) F_0 Timing in Kinyarwanda. *Phonetica* **60**(2): 71–97.
Ní Chiosáin, Máire & Jaye Padgett (1997) Markedness, Segment Realisation, and Locality in Spreading. Tech. Rep. Report no. LRC-97-01, Linguistics Research Center, UCSC, Santa Cruz, CA.
Pierrehumbert, Janet & Shirley Steele (1989) Categories of Tonal Alignment in English. *Phonetica* **46**: 181–196.
Prince, Alan & Paul Smolensky (1993[2004]) Optimality Theory: Constraint Interaction in Generative Grammar, ms., Rutgers University, New Brunswick and University of Colorado, Boulder. Published in 2004 by Blackwell Publishers.
Pulleyblank, Douglas (1986) *Tone in Lexical Phonology*. Dordrecht, Holland: D. Reidel Publishing Company, Kluwer Academic Publishers Group.
Silverman, Kim & Janet Pierreumbert (1990) The Timing of Prenuclear High Accents in English. In *Papers in Laboratory Phonology I*, John Kingston & Mary Beckman, eds., 72–106, Cambridge: Cambridge University Press.
Steriade, Donca (1994) Licensing by Cue, Ms, UCLA.
Sundberg, Johan (1973) Data on Maximum Speed of Pitch Changes. *Speech Transmission Laboratory Quarterly Progress and Status Report* **4**: 39–47.
Sundberg, Johan (1979) Maximum Speed of Pitch Changes in Singers and Untrained Subjects. *Journal of Phonetics* **7**: 71–79.
Walker, Rachel (2000) *Nasalization, Neutral Segments, and Opacity Effects*. New York: Garland.
Yip, Moira (2002) *Tone*. Cambridge: Cambridge University Press.
Zhang, Jie (2000) The Phonetic Basis for Tonal Melody Mapping. In *WCCFL 19 Proceedings*, Roger Billerey & Brook Danielle Lillehaugen, eds., 603–616.
Zhang, Jie (2001) *The Effects of Duration and Sonority on Contour Tone Distribution–Typological Survey and Formal Analysis*. Ph.D. thesis, University of California, Los Angeles.
Zoll, Cheryl (1998a) *Parsing below the Segment in a Constraint-Based Framework*. Stanford, CA: CLSI Publications.
Zoll, Cheryl (1998b) Positional Asymmetries and Licensing, Ms., MIT ROA-282 http://roa.rutgers.edu.

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