Segmental Behavior of Suprasegmental Tone*

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1 Introduction

- One explanation in autosegmental phonology (Goldsmith 1976) for the fact that contour tones tend to surface on heavy syllables is that tones link to moras in a one-to-one fashion, and therefore only bimoraic syllables are capable of hosting more than one tone (i.e., a rise or fall in pitch, as represented by a sequence of tone features).

- Recent work (Zhang 2000, 2001) has shown that contour tone distribution cannot be predicted from independent evidence about what kinds of syllables are heavy in a particular language. Instead, contour tone distribution is correlated with phonetic facts about sonority and rime duration.

- Zhang (2000, 2001) and Gordon (2002) argue that phonology must take measurable phonetic facts into account when regulating the placement of contour tones.

- Whereas Zhang (2001) argues that independent evidence for syllables' moraic content is a poor guide to their tone-hosting ability, this paper argues that even conclusions about what the Tone Bearing Unit (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 structural approaches cannot account for contour tone distribution under the most reasonable assumptions about the TBU in the languages Adhola and Ikalanga.

- In both languages, tone spread indicates that the syllable is the TBU, but contour tones suggest that the mora is the TBU.

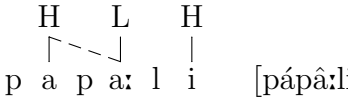
*I wish to thank Carlos Gussenhoven, Larry Hyman, Junko Itô, and Jaye Padgett for their helpful comments throughout the development of this paper.

2 Adhola

2.1 Tone Spread

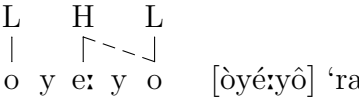
- In Adhola,[1] a Nilotic language spoken in Uganda, a high tone (H) spreads to the following low-toned (L) syllable under certain conditions.
- The target syllables can acquire contour tones. (HL and H!H are the only possible contour tones in Adhola.)

(1) a.



[pápâːlí] 'papaya'

b.



[òyéːyô] 'rat'

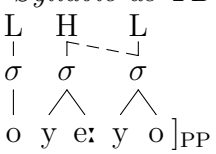
- Roughly, the last preconsonantal vowel in the Phonological Phrase (PP) is lengthened:

(2) a. *PP-final:* gɔ̀ nɛ́nɔ̀ gwòːkì̀
he/she see-PRES dog
'He/she sees the dog.'

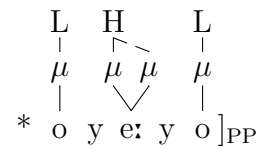
b. *PP-internal:* á nɛ́nɔ̀ gwòk má tʃɔ̂ːl
I see-PRES dog black
'I see the black dog.'

- But high-tone spreading (HTS) is oblivious to penultimate lengthening. H spreads to the following syllable, even if its own syllable has been lengthened (3-a).
- This is best understood if tones are linked to syllables rather than moras. If tones were linked to moras, we might expect HTS to be satisfied by (3-b).

(3) a. *Syllable as TBU:*



b. *Mora as TBU:*



- Spreading by moras, (1-a) requires HTS by one mora to the right, but (1-b) requires HTS to spread two moras to the right.
- Derivationally, HTS could be ordered before lengthening, but in a parallel system like Optimality Theory (Prince & Smolensky 1993), it would be difficult to develop an account in which HTS targets the following *underlying* mora, as would be required here.[2] A markedness constraint enforcing HTS would need access to the input (e.g. (4)), something that is impermissible in standard conceptions of OT. (See section 3.1.)

[1] All Adhola data are from my own notes from a field methods class taught at UC Berkeley. Thanks to Carlos Gussenhoven and Larry Hyman for helpful discussions of these data.

[2] Thanks to Larry Hyman for pointing this out.

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

- HTS is easiest to account for if syllables or rimes[3] are the TBU. A constraint like the one in (5) is sufficient to motivate HTS when ranked with MAX(Tone) (to prevent deletion) and Anchoring or Alignment constraints (to promote rightward HTS).

(5) *H-L: The tones in a HL cannot appear on separate, adjacent TBUs.

(6)

/òyéyò/ 'rat'	*H-L	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			**

2.2 Contour Tones

- While HTS indicates that the syllable is the TBU, contour tone distribution suggests something else.

- Contour tones surface only on heavy or PP-final syllables. Both kinds of syllable have been shown to be phonetically long (e.g., Klatt 1973, Lunden in preparation, Zhang 2000). CVN syllables occur word-internally but do not bear contour tones. Other CVC syllables appear only word-finally, and there are no trimoraic syllables.

- Lengthened PP-penultimate syllables can acquire contour tones:

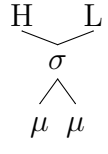
(7) a. *PP-final:* gɔ̀ wɔ́ˡɔ́lɔ́ 'he/she is coughing'
b. *PP-internal:* gɔ̀ wɔ́ˡlɔ́... 'he/she is coughing...'

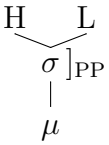
- From this point of view, the mora is the TBU.

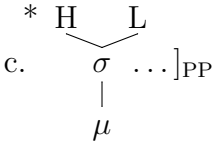
[3]The choice of syllable vs. rime is irrelevant for the arguments of this paper, so I will adopt the provisional hypothesis that the syllable is the TBU. See Gordon (1999), who concludes on the basis of a survey of 105 languages that rimes, not syllables, are crucial to distribution of tone. Zhang (2001) makes a similar conclusion.

2.3 A Phonetic Approach

- Under a purely structural approach, there is no reason to expect lengthening to be correlated with contour tones if the syllable is the TBU.
  - We must permit multiple tones to link to a single TBU, and it's not clear why this TBU must contain multiple (moraic) daughters.
- With the mora as TBU, the contour tone facts are more easily explained, but HTS is more complicated.
  - Sometimes tones spread by one mora, sometimes by two moras.
- The phonetic approach of Zhang (2001) resolves this conflict. With contour tone distribution tied to sonorous rime duration or sonorous phase (Gordon 2002) rather than structural configurations, we are free to posit the syllable as the TBU.
- An analysis of spreading is simple with the syllable as TBU, and phonetically oriented constraints or rules determine the conditions under which one TBU may be linked to multiple tones.
- In particular, bimoraic syllables (8-a) and PP-final syllables (8-b) can host contour tones because the long vowel and final-syllable lengthening provide a sufficient sonorous rime duration for the pitch excursions required by the contour tone.

(8) a. 

b. 

c. 

- Non-final monomoraic syllables (8-c) cannot host a contour tone because the sonorous rime duration of such syllables provides insufficient time for the pitch excursions to be articulated.
- By divorcing contour tone distribution from structural considerations, we can make conclusions about the TBU in Adhola based on tone spread.

3 Ikalanga

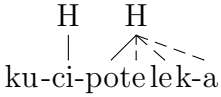
- In a slightly different fashion, Ikalanga[4] (Bantu) leads us to the same conclusion: We cannot rely on independent facts about what the language's TBU is to be an accurate guide to contour tone distribution.
- As in Adhola, tone spreads by syllables, but contour tones are sensitive to moras.

[4]All data from Ikalanga come from Hyman & Mathangwane (1998).

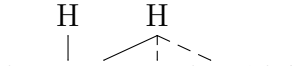
3.1 Tone Spread by Syllables

- Hyman & Mathangwane (1998) propose three rules of rightward HTS. The details are unimportant; Crucially, they combine to spread H on a verb stem throughout the stem (and, for mono- and disyllabic stems, one syllable to the right of the stem).

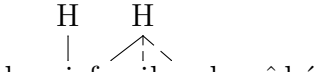
(9) a. ku-cí-pótélék-á… 'to surround it…'

b.


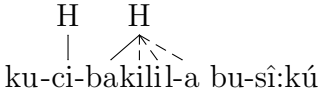
(10) a. ku-cí-túm-á bú-sî:kú 'to send it at night'

b.


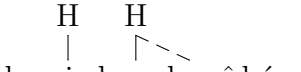
(11) a. ku-cí-fúmík-á bu-sî:kú 'to cover it at night'

b.


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

b.


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

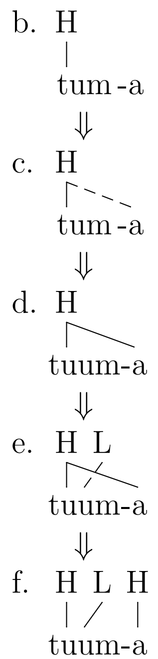
b.


- Syllables that are penultimate within an Intonational Phrase (IP) are lengthened. The epenthesized mora is skipped by HTS. L-epenthesis occurs, causing fission of H:[5,6]

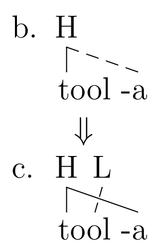
[5]The different orderings of HTS and lengthening in (14)–(17) come from the fact that in the analysis of Hyman & Mathangwane (1998), HTS is composed of three rules, and lengthening occurs between the second and third rule.

[6]I show imperative forms to avoid distractions involving prefixes and because IP-final infinitive forms behave less consistently. Although the shorter stems show the same pattern illustrated here in the infinitive (*ku-cí-tû:m-á* 'to send it,' *ku-cí-tû:k-á* 'to insult it'; see also (18)), the longer stems show a different pattern: *ku-cí-fúmí:k-a* 'to cover it' (**ku-cí-fúmî:k-á*). Time doesn't permit a detailed explanation of why these forms

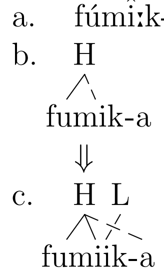
(14) a. tûːm-á 'send!'



(15) a. tôːl-á 'take!'



(16) a. fúmîːk-á 'cover!'



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are different, but the direction of the analysis is this: Spreading to the final vowel is blocked in infinitives except where this would mean no HTS at all (so spreading to the final vowel in the shorter stems is still required). Constraints preventing a HL contour before a L syllable trigger a repair strategy that creates *ku-cí-fúmíːk-a* rather than **ku-cí-fúmîːk-à*.

(17) a. bákílîːl-á 'fence in!'

b. H

bakilil-a

⇓

c. H L

bakiliil-a

- Skipping isn't an artifact of lengthening occurring within a pre-existing high tone span. HTS in other locations also ignores epenthesized moras at the edge of a high tone span (and spreading isn't sensitive to OCP effects (Hyman & Mathangwane 1998:201)):

(18) a. kù-cîː-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 is the only possible account. If tone spread by moras, we'd expect HTS to target the "new" mora, creating, e.g., **túúmá* and **fumíík-á*.

- A derivational analysis in which lengthening is ordered after HTS will permit the mora as TBU, but such an analysis is impossible in a parallel system like OT.

- Again simplifying matters, I adopt the constraint in (19) to motivate HTS, abstracting away from cross-stem spreading.

(19) H-Stem Span: A high tone span within a verb stem should include all TBUs in the stem.

(20) *Mora as TBU*

	/tum-a H/	H-Stem Span	Length
	a. túmá		*!
	b. túmà	*!	*!
	c. túúmà	*!	
(☞)	d. túùmá	*!	
☠	e. túúmá		

- Candidate (d) is the intended winner, but candidate (e) better satisfies HTS.
- To select candidate (d) over candidate (e), we need a constraint like the one in (21). This would be very unusual in OT: Markedness constraints shouldn't have access to the input.

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

- With the syllable as TBU candidate (d)'s violation of H-STEM SPAN disappears.
- Although other options are available,[7] I suggest that fission is motivated by constraints on feature percolation (Hayes 1990, Scobbie 1997) such that only the head (first) mora of a syllable and its daughters can inherit the tonal "properties" of the syllable. Further constraints can require all moras to have tonal properties, and low-tone properties are inserted by default, triggering L-epenthesis. Time doesn't permit development of this proposal, so I use the cover constraint L-INSERTION.[8]

(22) *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			*!

- Spreading by syllables is the best way to account for these data.

3.2 Contour Tones

- As with Adhola, contour tone distribution is sensitive to moras.
- The data in (14)–(17) show this: When a mora is epenthesized, it acquires a low tone, even in the middle of a high tone span:

[7] E.g., constraints on syllable well-formedness, high-tone distribution, contour-tone distribution, or prominence-driven contour insertion. (I thank Jen Smith for suggesting the last option to me.) See also Newman (1972).

[8] Subscripts on the high tones indicate correspondence.

(23) a. tû:m-á ‘send!’

b. H L

tuum-a

⇓

c. H L H

tuum-a

- If tone associates with syllables, there’s no reason to expect L-epenthesis in (23).
- While tone spreading indicates that the syllable is the TBU, contour tone assignment under penultimate-syllable lengthening leads us to conclude that the mora is the TBU.
- Once again, by making contour tone permissibility dependent on phonetic properties, we can resolve this conflict. Tones link to syllables, and contour tones appear on heavy syllables because these syllables are phonetically long enough to host such tones.
- The process responsible for L-epenthesis can operate under penultimate lengthening because the contour tone it creates appears on an acceptably long and sonorous host.

4 Conclusion

- In both Adhola and Ikalanga, contour tone placement is correlated with syllables’ moraic content.
- But spreading facts indicate that the syllable is the TBU.
- This conflict is resolved by making contour tone placement dependent on phonetic properties of the syllable. In both languages, contour tones appear on syllables that have been shown to be phonetically long.
- Consequently, we have more evidence for the position of Zhang (2001) and Gordon (2002): As Zhang notes, independent conclusions about structural configurations are poor indicators of contour tone distribution, and here we have evidence that conclusions about the identity of a language’s TBU are poor predictors of contour tone behavior.

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