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## How autosegmental is phonology?

**Abstract:** In this paper I raise the following questions: (i) How appropriate/effective are traditional autosegmental representations? (ii) What insights do autosegmental representations help us express? (iii) Where do autosegmental representations fall short? (iv) What does this all mean for phonology? Although there is still general acceptance of the “basic autosegmental insight”, i.e. that certain features are semi-autonomous from each other and their anchors (e.g. tones vs. tonebearing units), there has been decreasing interest in representational issues in some current approaches to phonology, as well as proposed frameworks which abandon some of the key properties of autosegmental phonology. In this paper I will be particularly interested in the intersection of the following properties assumed in traditional autosegmental phonology: (i) assimilation = spreading; (ii) no line-crossing; (iii) branching elements ≠ successive linking of identical elements. I will first review these three autosegmental assumptions – and the good things they do for us – and then present some unexpected tonal data which are potentially problematic for one or another of these assumptions. After identifying what makes the cited cases problematic and the choices we have in accounting for them, I will conclude with a discussion of the implications such facts have concerning phonology in general.

**Keywords:** tone, assimilation, spreading, depressor consonants

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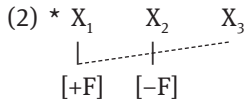
## 1 Introduction

In this paper I address the following questions: How appropriate/effective are traditional autosegmental representations? What insights do autosegmental representations help us express? Where do autosegmental representations fall short? And finally, what does this all mean for phonology? Such questions are particularly timely, as recent trends in phonology appear less interested in, if not

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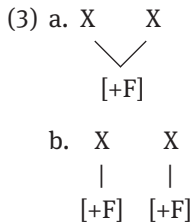
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As seen, the [+F] of  $X_1$  cannot spread across the following [-F] of  $X_2$  to reach segment  $X_3$ . Instead, the formalism predicts that a conflicting feature value on the same tier, if present, should automatically act as “opaque” to assimilation. However, there are cases which appear to require the [-F] to be transparent. One response, the parametric approach of Archangeli & Pulleyblank (1994), was to move away from the line-crossing account, allowing assimilation to go through “antagonistic” interveners that may lie in its way (cf. §4). While accurately characterizing the full range of opaque and transparent effects of such “neutral” segments has been the subject of numerous studies, some still on-going, line-crossing has significantly faded as an explanatory device in phonology.

iii. *A branching element ≠ a succession of two identical linked elements.* The third property made possible by autosegmental phonology was the distinction of between the representations in (3) (cf. Goldsmith 1990: 310):



As Pulleyblank (1989: 213) puts it, “. . . a linear model of phonology [such as SPE] makes the claim that all associations of features to segments are one-to-one” (as in (3b)). However, once features were placed on a separate tier, multiple linking made possible the distinction between a geminate (3a) vs. double (3b) representation, or what Hayes (1986b) refers to as “real” vs. “fake” geminates (cf. Archangeli & Pulleyblank’s “plateau” vs. “pseudoplateau”). While it was assumed early on that the distinct representations in (3) can contrast in the same language (cf. below), if multiple linking is given up, as in some frameworks, something else will be needed to capture the different phonological properties of multiple vs. one-to-one linkings of the same element.

The structure of the rest of the paper is as follows: In §2 I give specific examples of the good things that the above three properties of autosegmental phonology do for us. In §3 I turn to some unexpected tonal data which represent challenges for one or another of these assumptions. In §4 I identify what makes these

cases problematic and the choices we have in accounting for them. I conclude in §5 with some further difficulties for autosegmental representation of tone and discuss the implications of these findings concerning phonology in general.

## 2 In support of autosegmental representations

In this section I briefly consider tonal phenomena that appear to support the basic tenets of autosegmental phonology. Since my examples will all come from tone, the first question is: Why tone? One reason is that's where autosegmental phonology began (Goldsmith 1976a,b). Another is that tone is different, arguably the most autosegmental of features. As I have elsewhere stated (Hyman 2011: 214):

*“Tone is like segmental phonology in every way – only more so!*

*“QUANTITATIVELY more so: tone does certain things more frequently, to a greater extent, or more obviously (i.e. in a more straightforward fashion) than segmental phonology.*

*“QUALITATIVELY more so: tone can do everything segments and non-tonal prosodies can do, but segments and non-tonal prosodies cannot do everything tone can do.”*

Thus, if the autosegmental principles are expected to do good work for us, it will be in the area of tone. On the other hand, since tone offers properties not easily found, if at all, in the rest of phonology, it might be expected to present the greatest obstacles as well. In other words, “. . . anyone who is interested in the outer limits of what is possible in phonology would thus be well-served to understand how tone systems work.” (Hyman 2011: 198)

Let us begin with assimilation as spreading. As seen in the example in (4a) from Aghem, a Grassfields Bantu language of Cameroon, the H of the verb noun prefix /é-/ spreads onto the L of the verb root /nòm/ ‘be hot’, thereby producing an HL falling tone on the latter:

(4) a. é - nòm → é - nôm

H	L	H	L

NOT:

b. é - nòm → é - nôm

			^
H	L	H	HL

c. H-L → H-HL

As seen, the dashed line indicates that there is H tone spreading (HTS) rather than copying of the H tone, as in (4b). In pre-autosegmental phonology, the rule was often written informally as in (4c). While the formalism clearly is one of feature copying, tonologists intuitively conceptualized the process as one of spreading:

“Spreading is an assimilatory process of the progressive or perseverative type, rather than of the regressive or anticipatory type. That is, the earlier tone appears to last too long, rather than the later tone starting too early. This in fact is the way that we should like to view this phenomenon. There is no process of tone copying or tone addition in the second syllable. Rather, the earlier tone simply enlarges its domain.” (Hyman & Schuh 1974: 88)

Autosegmental phonology thus gave us the tools to express our insights.

Turning to a trisyllabic word, we see in (5a) that when the toneless causative suffix /-sɔ/ is added to /é-nòm/ ‘to heat’ to produce /é-nòm-sɔ/ ‘to heat (sth.)’, HTS again spreads the H of the prefix onto the following root syllable:

(5) a. é - nòm - sɔ → é - nôm - sɔ̀

H	L	L	H	L

NOT:

b. é - nòm-sɔ̀ → \*é - nòm - sɔ́

H	L	H	L

As also seen, the toneless suffix /-sɔ/ acquires its L tone by L tone spreading from the immediately preceding root /nòm/. What is not possible is (5b), where the H of the prefix /é-/ spreads across the root onto the toneless suffix to create an output H-L-H sequence. That /-sɔ/ is underlyingly toneless is seen from the fact that it is pronounced with H tone when it follows a H tone verb root: é-téé ‘to stand (intr.)’ → é-téé-sɔ́ ‘to stand (sth.)’. This is as expected: toneless TBUs most commonly acquire their tone by local spreading from the preceding TBU.

Turning now to branching vs. successive identical non-branching elements, let us briefly recall the case of Palestinian Arabic geminate consonants discussed by Hayes (1986b). In this language an epenthetic [i] is inserted between two consonants which are followed either by another consonant or a word boundary, i.e. /C \_\_ C {C, #}. As seen in (6a), however, epenthesis will not split up a final tautomorphic geminate:

(6) a. *tautomorphemic*

C V C C  
 | | √  
 ? i m  
 ‘mother’  
 [ʔimm] (\*[ʔimim])

b. *heteromorphemic*

C V C + C  
 | | | |  
 f u t t  
 ‘I entered’ (enter-1SG)  
 [futit] (\*[futt])

c. *assimilated*

C + C C V V C  
 † \ | | √ |  
 l z y i r  
 ‘small’ (DEFINITE-small)  
 [zzɪr] (\*[zizɪr])

Assuming that the epenthetic [i] would have to be on the same tier as the geminate, this would mean having to violate the no line crossing constraint. In (6b), however, where a double (or “fake geminate”) representation is created heteromorphemically, [i] is epenthesized. This suggests the need to distinguish the two representations of (would-be) geminates: a single feature matrix linked to two C slots in (6a) vs. two feature matrices, each linked to a C in (6b). The form in (6c) shows the assimilation of the definite prefix *l-* to the following /z/, thereby creating a derived geminate. With the assumption that assimilation = spreading, the derived representation is identical to that of a tautomorphemic geminate. As a result, epenthesis fails to split up the assimilated geminate, as expected.

Returning now to tone, a particularly revealing case comes from Kukuya, a Bantu language spoken in the Republic of the Congo (Paulian 1975, Hyman 1987, Pulleyblank 1989). The following nouns, which consist of a class 6 plural prefix + stem, are shown in the presentative construction ‘they are . . .’ as realized when not in final position ( $X \neq \emptyset$ ):

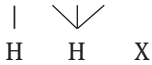
## (7) a. má- bá ‘oil palms’

| |  
 H H X

b. má- bágá ‘show knives’



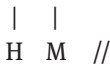
c. má- bálágá ‘fences’



Although realized all H, the above words clearly get their H tones from two sources: the presentative /H/ on the prefix and the /H/ on the stem (cf. the L prefixal tone on citation forms: *mâ-bá*, *mâ-bágá*, *mâ-bálágá*). Assuming that the Obligatory Contour Principle (OCP) is in effect, which prohibits identical adjacent elements on the same tier (Goldsmith 1976a, McCarthy 1986), each of the stems will have a single H autosegment which links to all of the available TBUs (= moras in Kukuya).

Evidence for the above representations with a single /H/ stem tone is seen in the corresponding realizations of the above words before pause (//):

(8) a. má- bā



b. má- bāgā

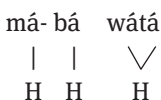


c. má- bālāgā



As seen, all of the stem TBUs are lowered to M (mid) tone before pause. The prefixal H is not affected. To see how this follows from the representations, compare now heteromorphic /má-bá/ ‘they are oil palms’ with tautomorphic /wátá/ ‘bell’:

(9) a. *medial*



b. *prepausal*

má-	bā	wātā
		∨
H	M	M

## c. a tonal tier “quality” rule

$$H \rightarrow M / \_ //$$

As before, /má-bā/ has two H autosegments coming from different morphemes. Since /wātā/ is monomorphemic, it has only one /H/. While both are pronounced medially as H-H, there is a difference prepausally between H-M vs. M-M. This follows from the presentations if we assume that the prepausal lowering rule is as formulated in (9c): A prepausal H autosegment is lowered to M, taking along with it however many TBUs it may be linked to. Any preceding TBUs that are linked to a separate /H/ autosegment are not affected, hence [má-bā].

That the autosegmental representations provide a straightforward account has been observed in other tone systems as well. Kenstowicz & Kidda (1987) show that tautomorphemic multiply-linked H is also required in Tangale, a Chadic language of Nigeria, which they analyze with a /H/ vs.  $\emptyset$  privative contrast. As seen in (10a), when the final [e] of /tu:žé/ ‘horse’ is deleted in close juncture with /lawo/ ‘child’, its H tone floating reassociates to the following syllable – something which Goldsmith (1976a) refers to as tonal stability:

- (10) a. /tu:že/ + /lawo/ → tu:ž lawo → tù:ž lāwò ‘child’s horse’
- |   |   |       |
|---|---|-------|
|   |   | ----- |
| H | H | H     |
- b. /ya:ra/ + /lawo/ → ya:r lawo → yá:r làwò ‘child’s arm’
- |   |   |   |
|---|---|---|
| ∨ |   |   |
| H | H | H |
- c. /ya:ra/ + /lawo/ → ya:r lawo → \*yá:r lāwò
- |   |   |   |       |
|---|---|---|-------|
|   |   |   | ----- |
| H | H | H | H     |

In (10b), on the other hand, when the final [a] of /yá:rā/ ‘child’ is deleted, the following word is not affected. As seen, this follows directly from the doubly linked representation: when the vowel is deleted, the H remains linked to the first syllable, hence is not set free to link to the following word. Had the representation



been a double one, as in (10c), a H would have been set free, and we would expect the indicated ungrammatical output.

As seen in the above examples, it is important to acknowledge the potential contrast between a single element linked to multiple anchors vs. sequences of identical elements, each individually linked to its anchor. The ability to capture such differences has served as a major argument in favor of the autosegmental approach in general. While heteromorphemic identical elements may violate the OCP (but may also be subject to “fusion” in individual cases), there are several reasons to enforce OCP-compliant, multiply linked structures tautomorphemically:

- i. If the OCP can be violated tautomorphemically, we should expect to find unpredictable variation and contrast: A morpheme such as Italian *otto* ‘eight’ might be /oto/ with a doubly linked /t/ in one language, but /otto/ with a sequence of two /t/’s in another. Alternatively, the same language might have a contrast between the two. Similarly, a morpheme such as *yá:rá* ‘arm’ in Tangale might be represented with a doubly linked /H/ in one language, but with a double /H-H/ in another – or the two could contrast in the same language.
- ii. If Kukuya *wátá* ‘bell’ had a double /H-H/ representation, it would be necessary to restate the H → M rule in (9c) to refer to sequences of tautomorphemic Hs, perhaps via co-indexing. (I return to this issue in §4.)
- iii. If Tangale *yá:rá* were represented with a double /H-H/ representation, one would have to stipulate that the delinked H in (10c) must be “absorbed” into the preceding H tone syllable, i.e. intermediate *yá:r ́* → [yá:r], rather than being able to relink to the following syllable. This result is automatic with the doubly linked /H/ representation.
- iv. Cases of tautomorphemic OCP violations are extremely rare and include a double representation of geminate consonants in Chukchi and Hua (Odden 1988) and a few tone cases, e.g. Shambala (Odden 1982, 1986) and Dioula d’Odienné (Braconnier 1982, Hyman 2011, Shih 2011). While such cases need to be scrutinized carefully, they are rare, and alternative interpretations are sometimes available.

A final assumption which is implicit in the above discussion is that Hs and Ls (or their tonal nodes) are on the same tier. This also allows for floating tones to be temporally sequenced. For example, consider the Aghem nouns *kí-fú* ‘rat’ and *kí-wó* ‘hand’, both pronounced H-H in isolation, but conditioning different tonal realizations on a following word. In the examples in (11), the class 7 noun class prefix /kí-/ deletes before most modifiers (which agree with the noun):

- (11) a.  $fú$      $kîa$  ‘your sg. rat’  
           |        |  
           H        L
- b.  $wó$      $kîa$  ‘your sg. hand’  
           |        |  
           HL      L  
       (floating L blocks H tone spreading)
- c.  $fú$      $kín$  ‘this rat’  
           |        |  
           H        H
- d.  $wó$      $↓kín$  ‘this hand’  
           |        |  
           HL      H  
       (floating L conditions downstep)

In (11a) we see the familiar HTS rule first encountered in (4a) above: the H of /- $fú$ / ‘rat’ spreads onto the L of / $kîa$ / ‘your sg.’ to pronounce a HL falling contour on [ $kîa$ ]. However, in (11b) the H of /- $wó$  ` / does not spread onto the possessive pronoun. As indicated, this is because the floating L blocks the HTS process. This is exactly what we would expect a floating L tone to do. Since HTS could have applied without a line-crossing violation in this case, we assume the double locality requirement on HTS indicated in (12).

- (12) TBU    TBU : the TBUs must be contiguous (i.e. adjacent syllables or moras)  
           |        |  
           H        L : the trigger H and target L elements must be contiguous on their tier

Turning to the forms on the right,  $fú kîn$  ‘this rat’ surfaces unchanged as H-H in (11c), while  $wó ↓kîn$  ‘this hand’ shows a downstep on the demonstrative / $kîn$ /. Again, this is what we expect a floating L to do when wedged between two linked H tones. We thus gain a further advantage from the autosegmental representations: the floating tone posited in the root /- $wó$  ` / ‘hand’ both blocks HTS onto a following L and causes a downstep on a following H. The alternative, diacritic  $H_1$  vs.  $H_2$ , is particularly unappealing – and unhelpful (see Hyman 2003a for further discussion).

From the above examples and discussion, we can conclude that autosegmental representations do some good work for us. In the following section I will turn

to discuss cases where autosegmental representations seem to be less helpful, if not contradicted.

### 3 Challenges for autosegmental representations

In contrast to the demonstrations in §2, I turn now to consider the following four cases involving L tone which do not naturally fall out from autosegmental representations and may present potential problems: (i) depressor consonant L tone in Ribe, a Mijikenda Bantu language of Kenya and Tanzania (Cassimjee & Kisseberth 1992); (ii) stem-initial boundary L tone in Ndebele, a Bantu language of Zimbabwe (Sibanda 2004); (iii) post-/LH/ L tone insertion in Kalabari, an Ijoid language spoken in Nigeria (Harry & Hyman 2014); (iv) intonational penultimate L tone in Ikalanga, a Bantu language spoken in Botswana (Hyman & Mathangwane 1998). I discuss each of these in the following four subsections.

#### 3.1 Depressor consonant L tone in Ribe

In several Mijikenda languages, a H tone originating on a verb shifts to the penultimate mora of the phonological phrase. Thus, consider the following examples from Ribe, where vowels without an accent are pronounced with default L pitch (Volk 2011: 54):

- (13) a. ni-na-mal-a ku-gul-a ŋguuwo 'I want to buy clothes'  
 b. a-na-mal-a ku-gul-a ŋguúwo 's/he wants to buy clothes'
- ‡-----▶  
 H

While the underlyingly toneless sentence in (13a) is pronounced with default L pitch, in (13b) the H of the class 1 subject prefix /á-/ shifts to the penultimate mora of toneless /ŋguuwo/ 'clothes', thus pronounced [ŋguúwo]. Rather than a long distance shift, Cassimjee & Kisseberth (1992: 29) provide evidence for a spreading + delinking analysis. A similar contrast based on the different tones of the subject prefix is seen in (14).

- (14) a. /ni-a-sukum-a/ → n-a-sukum-a 'I am pushing' (→ all L tone)  
 b. /ú-a-sukum-a/ → w-a-sukúm-a 's/he is pushing'
- ‡-----  
 H                      ‡-----  
 H                      H

While the verb in (14a) is toneless, the H of /ú-/ spreads to the penult, accompanied by delinking of all but the rightmost link.

Evidence for the spreading + delinking analysis comes from verbs which contain voiced obstruents, known in the Bantu literature as depressor consonants. In this case the one input /H/ potentially produces more than one non-contiguous output H. Thus, compared to the toneless verb in (15a), which is realized all L, the form in (15b) shows two surface Hs. Similarly, (15c) is realized all L while (15d) has three surface Hs, the last two being separated by a downstep:

- (15) a. /ni-a-galuk-a/ → n-a-galuk-a ‘I am changing’  
 b. /ú-a-galuk-a/ → w-á-galúk-a ‘s/he is changing’  
 c. /ni-a-zi-fugul-a/ → n-a-zi-fugul-a ‘I am untying them’  
 d. /ú-a-zi-fugul-a/ → w-á-zi-fú<sup>↓</sup>gúl-a ‘s/he is untying them’

The generalization is that /H/ will not only be realized on the penult, but also on any vowel that precedes a voiced obstruent. To account for this, Cassimjee & Kisseberth propose derivations such as the following:

- (16) (a) (b)
- |                  |   |                |
|------------------|---|----------------|
|                  |   | L L            |
|                  |   |                |
| u- a- zi-fugul-a | → | w-a-zi-fugul-a |
| ↙                |   | ↘              |
| H                |   | H              |
- (c) (d)
- |                |   |                              |
|----------------|---|------------------------------|
| w-a-zi-fugul-a | → | w-á-zi-fú <sup>↓</sup> gúl-a |
| ∨              |   | ✕                            |
| H L H LH       |   | H L H LH                     |

In (16a) the H of /ú-/ spreads to the penult, as before. This is followed in (16b) by inserting a L tone onto each voiced obstruent (depressor consonant). While Cassimjee & Kisseberth insert the Ls on a separate tier, they then fold these Ls in with the Hs as in (16c) causing the multilinked H to undergo “tonal mitosis”. The final step in (16d) consists in delinking the left branch of any (remaining) multi-linked Hs, just as we saw in (14b). The downstep in (16d) is caused by the L that is linked to the [g].

As seen, the multiple Hs in (15b,d) and the derivation in (16) show that the /H/ in (13b) and (14b) does not shift to the penult in one step, rather there is spreading + delinking of any left branch of a multilinked H. With respect to (16b),

it should be noted that the Ls sponsored by the depressor consonants [z] and [g] cannot be both underlying and on the same tier as the /H/ tone or they would be expected to block H tone spreading, just as the floating L blocked HTS in (11b) in Aghem. Folding the Ls in with the Hs in (16c) certainly has a different motivation, but is perhaps reminiscent of the morphemic “tier conflation” discussed by McCarthy (1986).

### 3.2 Stem-initial boundary L tone in Ndebele

The second case from Ndebele also concerns H tone spreading which in this language targets the antepenult (Sibanda 2004: 229–230):

(17) toneless (→ all L)	H tone /ú-/ “augment”	with stem-initial boundary %L	
ku-phek-a	<u>ú</u> -kú-phek-a	ú-kú-phek-a	‘to cook’
ku-phek-is-a	<u>ú</u> -kú-phék-is-a	ú-kú- <sup>l</sup> phék-is-a	‘to make cook’
ku-phek-is-el-a	<u>ú</u> -kú-phék-ís-el-a	ú-kú- <sup>l</sup> phék-ís-el-a	‘to make cook for’
ku-phek-is-el-an-a	<u>ú</u> -kú-phék-ís-él-an-a	ú-kú-phek-is-él-an-a	‘to make cook for each other’

In these forms the source of the underlying /H/ is the underlined augment prefix /ú-/. (I do not show the lengthening that the penultimate vowel undergoes phrase-finally.) While there is variation among the other Nguni languages (Xhosa, Zulu, Swati) as to whether the H spreads vs. shifts to the antepenult (see, for example, Cook 2013), where there is spreading, as in the above Ndebele forms, the transcriptions typically show a plateauing of the Hs as in the second column of (17). In the case of *ú-kú-phek-a* ‘to cook’ there is no problem. However, as seen in the third column, the next two rows show a downstep before the root *-phek-* ‘cook’. The last form shows two L tone syllables intervening between the Hs of *ú-kú-* and the antepenultimate suffix *-él-*.

To account for this, the following derivation is required:

(18)	(a)	(b)
	ú-ku-phek-is-el-an-a	→ ú-kú-phék-ís-él-an-a →
	H	H



- b. the object ends H-H, H-<sup>↓</sup>H      sele → sélé      (= fúru, ními, érí, jíké)  
 náamá ‘meat’ H-H → ɔ náamá sélé té<sup>↓</sup>é ‘he has chosen the meat’  
 wá<sup>↓</sup>rí ‘house’ H-<sup>↓</sup>H → ɔ wá<sup>↓</sup>rí sélé té<sup>↓</sup>é ‘he has chosen the house’  
 búrumá ‘indigo’ H-H-H → o búrumá sélé té<sup>↓</sup>é ‘he has chosen the indigo’
- c. the object ends L-H                  sele → <sup>↓</sup>séle      (= <sup>↓</sup>fúru, <sup>↓</sup>ními, <sup>↓</sup>éri, <sup>↓</sup>jíké)  
 garí ‘garri’ L-H → ɔ garí <sup>↓</sup>séle té<sup>↓</sup>é ‘he has chosen the garri’  
 kókalí ‘fruit’ H-L-H → ɔ kókalí <sup>↓</sup>séle té<sup>↓</sup>é ‘he has chosen the fruit’

As seen in (20a), when the object ends L, verbs of all tone patterns become all L. Similarly in (20b), when the object ends H-H or H-<sup>↓</sup>H, verbs of all tone patterns become all H. (Longer verbs exhibit the same patterns.) What is surprising are the data in (20c), where the object ends L-H. In this case the H spreads onto the verb, as expected, but there is also a downstep that occurs between the object and verb. The question is why?

To answer this question at least in part, compare the following alternations involving the plural definite determiner *má*:

- (21) a. no downstep on *má*  
 féní ‘bird’ H-H → féní má ‘the birds’  
 wá<sup>↓</sup>rí ‘house’ H-<sup>↓</sup>H → wá<sup>↓</sup>rí má ‘the houses’
- b. downstep on *má*  
 ekpé ‘he-goat’ L-H → ekpé <sup>↓</sup>má ‘the he-goats’  
 ikpepú ‘padlock’ L-L-H → ikpepú <sup>↓</sup>má ‘the padlocks’  
 kókalí ‘fruit’ H-L-H → kókalí <sup>↓</sup>má ‘the fruits’

We know from forms such as *pulo má* ‘the oils’ and *béle má* ‘the lights’ that /*má*/ is underlyingly /H/. This is confirmed in (21a), where *má* is realized H when it follows a word ending H-H or H-<sup>↓</sup>H. However, in (21b), where *má* is preceded by a word ending L-H, a downstep occurs before it. In Kalabari, whenever a word ends L-H and the next word begins H, a L (which conditions downstep) is inserted between the two words, informally schematized in (22).

- (22)                    σ σ # σ  
                           | |    |  
 Ø → L / L H \_\_ H

As in Ribe and Ndebele, it again looks like the L insertion disrespects the multiply-linked H tone structure and splits the links by creating the downstep. In the following derivation I have assumed input Ls for clarity:





and H-H-Ø outputs. As indicated in the third column, there is a lengthening rule that affects the penultimate vowel at the intonational level. However, while we might expect *-túm-á* to maintain its H-H tone pattern under lengthening, thereby becoming *\*-túúm-á*, it instead is realized HL-H. (We obtain *-fúmûik-a* rather than *\*-fúmûik-a* by a subsequent, postlexical rule which in this case spreads the H onto the inserted penultimate mora).

Similar outputs are observed in the imperative forms in (25).

- (25) *underlying medial prepausal (with penultimate lengthening)*
- a. /wan-a/ + H wan-á → waan-á ‘find!’
- b. /shalul-a/ + H shalúl-á → shalúùl-á ‘choose!’
- c. /tukutil-a/ + H tukútíl-á → tukútîil-á ‘perspire!’
- 
- 

As seen, a toneless verb root acquires an imperative H suffix tone which links from the second syllable to the end of the stem. Again, with penultimate lengthening, the H is split. A derivation is provided for prepausal *ku-túúmá* ‘to send’ in (26).

- (26) (a) (b) (c) (d) (e)
- 
- ku-túm-a → ku-túm-á → ku-túúm-á → ku-túúm-á → ku-túùm-á
- 

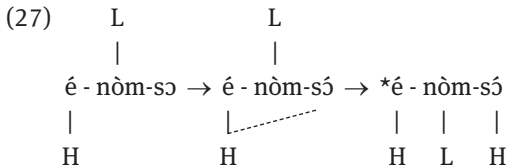
In (26b) the /H/ of /-túm-a/ spreads onto the final vowel. This is followed in (26c) by penultimate lengthening. Intonational L% insertion is shown in (26d). When the L% folds in with the doubly linked H, the latter splits, as in Ribe, Ndebele, and Kalabari. This is the effect that the multi-linked autosegmental representations do not lead us to expect. (In the case of (24b) the L% is able to link to the final toneless syllable.)

## 4 Discussion

In this section I attempt to consider the common properties of the examples in §3 that permit them to issue such a challenge to autosegmental representations – which, recall, were designed to allow us to express our tonal insights in a direct

way. To begin, the problem in all four cases involve the interaction of the following two processes: (i) an unbounded H tone spreading rule which creates multiply linked Hs; (ii) a L which splits the resulting multiply linked Hs. (I have not insisted on the unbounded nature of each of the rules, but longer examples can be cited to show that each of the H tone spreading rules potentially targets more than a following single TBU.) While such occurrences of Ls splitting multiply linked Hs and the challenge they pose for autosegmental representations may be relatively rare, the above four cases should suffice to show that we are not dealing with something which can be easily ignored.

Two questions arise concerning these rare occurrences: (i) Why can these Ls do this? (ii) Why can't all Ls do this? With respect to the second question, we still have no case such as was cited with prohibited line-crossing in (5b), but modified in (27), where the first /L/ of the underlying /H-L-L/ sequence appears on a separate tier:



As seen, what we do not obtain is that the H spreads to the third TBU, producing a H-L-H sequence: the presence of a /L/ on the root /nòm/ ‘be hot’ blocks the preceding H from spreading around it. Instead, the correct output *é-nòm-só* ‘to heat (sth.)’ is obtained by local H tone spreading.

The common properties of the tone systems in which we have found such H-splitting Ls can be characterized as follows:

- i. All four languages arguably have a /H/ vs. ∅ privative system, i.e. where L is otherwise not phonologically activated in the sense of Clements (2001: 2).
- ii. These Ls come in late in the derivation: postlexical L on depressors (Ribe), postlexical stem-initial L (Ndebele), postlexical L on in the environment L-H # \_\_\_ H (Kalabari), postlexical L on the intonationally lengthened penult (Ikalanga). (Like Ribe, both Ndebele and Ikalanga also have postlexical depressor Ls which can split Hs as well.)
- iii. These Ls are not linked to canonical TBUs. Instead, they are linked to voiced obstruent “depressor consonants” (Ribe), affiliated with the stem-initial boundary (Ndebele), not linked at all, rather inserted between words (Kalabari), linked to the second mora of the lengthened phrase-penultimate vowel – the only source of long vowels in the language (Ikalanga). A potential fifth example is presented in the Appendix, where the L in

question is linked to a non-syllabic nasal which allows a H to spread through it. About this case Hyman & Biloa (1992: 125) suggest that “. . . a L feature linked to a non-TBU can be ‘crossed’ by a H feature as it spreads across it to reach the next TBU.” The intuition, therefore, is that depressor, boundary, floating, and intonational Ls both arise late in the derivation and do not have TBUs. Instead, they act as L or downstep operators on the TBUs of other tones.

The question is how phonologists should respond to such “challenges”. The first possibility is to consider analytic moves designed to maintain the traditional autosegmental assumptions: (i) different tonal tiers, as above, with Hs on one tier and the inserted Ls on another; (ii) different tonal anchors, e.g. TBUs ( $\mu$ ,  $\sigma$ ) vs. non-TBUs (Cs, supralaryngeal node, register node, boundaries), versions of which are proposed by Lieber (1987), Bao (1999), Bradshaw (1999), Lee (2008), Yip (2002) and others; (iii) underspecification: if /H/ = [+upper] vs.  $\emptyset$  [o upper], maybe special Ls can be [o upper, -raised], thereby functioning as register features?

A quite different move would be to give up the traditional multilinked autosegmental representations. If we abandoned the assumption that assimilation = spreading, the H tone migrations could instead be formalized as copying, as in Optimal Domains Theory (ODT) (Cassimjee 1998, Cassimjee & Kisseberth 1998, Volk 2011). Ribe H tone assimilation could then be expressed as copying Hs up to the penult, as in (28).

(28) <i>underlying</i>	<i>copy Hs to penult</i>	$H \rightarrow \emptyset / \_ H$	<i>output</i>
/u- a- sukum- a/	u- a- sukum- a	u-a-sukúma	w-a-sukúma
H	HH HH	H	‘s/he is pushing’

As indicated, a rule deleting a H before another H would then apply. Prior to this, however, the depressor L tone would have to be introduced. With copying, the inserted Ls would trivially be able to intervene between the appropriate Hs (and similarly re Ndebele, Kalabari and Ikalanga):

(29) <i>underlying</i>	<i>copy Hs to penult</i>	<i>insert depressor<sup>L</sup></i>	$H \rightarrow \emptyset / \_ H$
/u-a-zi-fugul-a/	u-a-zi-fugul-a	u-a- zi-fu gul- a	u-a-zi-fugul-a
H	HHHH H	HH <sup>L</sup> HH <sup>L</sup> H	H <sup>L</sup> H <sup>L</sup> H
	<i>output: w-â-zi-fú<sup>L</sup>gúl-a</i>		‘she is untying them’

(Compare recent proposals of depressor consonant L register domains within ODT such as Cassimjee 1998, Cassimjee & Kisseberth 2001, Downing 2009, Donnelly 2009, and Volk 2011.)

However, if assimilation = copying, what about all the good results we got from multiply branching structures in §2? In this context, it might be instructive to ask if there is anything else that is like these tonal examples. Ettliger (2005, 2008) reports a potentially parallel case involving the interaction between a palatal prosody and local palatalization in Mafa, a Chadic language spoken in Cameroon. The palatal prosody potentially affects all vowels (and some consonants) within a word, producing alternations such as the following:

- (30) a. kərd̥ ‘grind’  
       pəz ‘cultivate’
- b. kird̥-eʔe ‘grind it!’  
       piʒ-eʔe ‘cultivate it!’

Quite separate from this prosody is a local rule which palatalizes /ə/ to [i] before or after the glide [y]:

- (31) a. sə ‘drink’  
       gudzə ‘tremble’
- b. si-y-aʔa ‘drink it!’  
       gudzi-y ‘tremble!’
- c. fókwayím-aʔa ‘cut it!’  
       gəlípá ‘rich’

As seen in (31b), this can result in disharmony, as the locally conditioned [i] now co-occurs with back vowels – in some cases interrupting the [+back] specifications, as in (31c). If a single [ $\pm$ back] specification is placed on a separate tier, it might be argued that the local palatalization creating the [i] in (31c) splits the multilinked [+back], as in our tonal examples. However, previous analyses of Mafa instead suggest a privative palatal prosody (Barreteau & Le Bleis 1987, Ettliger 2005). While the local palatalization process is a late process like L-insertion, neither the above nor any other facts of Mafa produce a spreading + splitting situation parallel to Ribe, Ndebele, Kalabari and Ikalanga.

Transparency effects in vowel harmony also seem a bit different, but raise their own problems for spreading and multilinked representations. Consider the case of Kalong, a Bantu language of Cameroon, where /a/ harmonizes to a neighboring mid /e, ε, o, ɔ/ (Paulian 1986, Hyman 2003b). Relevant (but not all of the) possibilities are illustrated below with the class 6a /mà-/ prefix:

- (32) a. *the root has a high or low vowel*  
 mà-lipà ‘plantes (sp.)’  
 mà-súmbà ‘vin de palme’  
 mà-sàŋ ‘sadisme’
- b. *the root has a Front mid vowel*  
 mà-pě → mè-pě ‘machination’  
 mà-té → mé-té ‘sève’
- c. *the root has a Round mid vowel*  
 mà-yòyó → mò-yòyó ‘safoutiers’  
 mà-yòyò → mò-yòyò ‘bave’ (38)

As seen now in (33), prefixal /I/ and /U/ (= high vowel archiphonemes specified as front and round, respectively) are transparent to F(ront) and R(ound) harmonies, producing the following four transparencies:

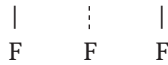
- (33) a. FRONT harmony through /I/  
 /á kɪ-sɪkɛl/ → é kɪ-sikɛl ‘en ce moment-là’  
 |                      |  
 F                      F
- b. FRONT harmony through /U/ (an  
 /á pÛ-té/ → é pù-té ‘dans l’arbre’  
 |                      |  
 F                      F
- c. ROUND harmony through /I/  
 /á kɪ-tòŋ/ → ó kɪ-tòŋ ‘au village’  
 |                      |  
 R                      R
- d. ROUND harmony through /U/  
 /á tÛ-nɔ/ → ó tù-nɔ ‘dans sommeil’  
 |                      |  
 R                      R

Arguing against “gapped structures” as in (33), Archangeli & Pulleyblank’s (1994: 232) solution is to recognize “an insertion rule with a contextual identity context” (372). While multiply linked structures = insertion + respect for the OCP (hence, spreading), as in (34a), “gapped structures” instead require an identical feature copy, as in (34b).

(34) a. /mà-té/ → mè-té ‘sève’



b. /á kǐ-sǐkèl/ → é kǐ-sikèl ‘en ce moment-là’



About this difference, Archangeli & Pulleyblank write:

“if a harmonic feature cannot link to some otherwise legitimate anchor, then harmonic spreading must stop since anchors cannot be skipped” (357)

“the segments bypassed by an insertion rule are those that are ineligible to receive the harmonic F-element because of some grounded condition.” (233)

Note that in their terminology, (33a,d) are “sympathetic” transparencies, since the transparent segment shares the F or R, while (33b,c) are “antagonistic”, since the transparent segment has the opposite F or R feature. It would be in these latter cases that a “grounding condition” would disallow the assignment of an F to an R vowel and vice-versa.

Among the other “fixes” to the vowel harmony problem which we may try to apply to the tonal cases include straight feature-copying, e.g. agreement by correspondence (Baković 2000, Rose & Walker 2004, Krämer 2003, Hansson 2010, Shih 2011 etc.) or “search and copy” (Nevins 2010, Samuels 2011). Samuels explicitly argues for the latter approach as a way to avoid line-crossing problems:

“Another way in which search-based models of harmony represent an improvement over autosegmental ones is that they can capture dependencies that run afoul of the No Line-Crossing Constraint on autosegmental representations.” (Samuels 2011: 145)

So the question is: What do we lose if we abandon “sharing by spreading” (Nevins 2010: 20) or SHARE(F) (McCarthy 2011: 200), which create multiply linked structures? For one thing, we potentially lose the distinction in (35) which was said to be useful in accounting for the facts of Kukuya and Tangale in §2.

(35) a. X X  

 F

b. X X  
 | |  
 F F

Our expectations of the different properties of (35a) vs. (35b) are as summarized in (36).

(36)	<i>underlying/input</i>	<i>assimilation/dissimilation</i>	<i>epenthesis</i>	<i>phonetic</i>
(35a)	single sponsor (e.g. tautomorphic)	co-undergoers	inseparable	one target
(35b)	two sponsors (e.g. heteromorphic)	independent undergoers	separable	two targets

While the above differences were claimed to flow directly from the representations, some of the predictive power can, however, be undermined, as both of the following “readjustments” have been proposed in the literature:

(37) a. *splitting*  
 (tier-conflation “mitosis”)

X	X		X	X
		→		
			H	H

b. *fusion*  
 (one gesture, as in articulatory phonology)

X	X		X	X
		→		
H	H			H

Concerning the issue of fusion, Leben (2011: 15) writes:

“Some of the most enduring results on the question [of the OCP] were captured in Odden (1986). . . . One of these is that languages differ in how they deal with sequences of identical tones across prosodic boundaries. Odden (1995: 462) suggests that Kipare fuses High tones across phrase boundaries into a single High tone. The evidence is that a prepausal sequence of High tones is realized as Low after a floating Low tone, even if they are from different prosodic words.”

So, assuming we do not want to eschew representations as an analytic device altogether, the question boils down to: One representation or two? If two, under what circumstances do we need to convert one representation into the other?

Odden (1986: 356) assumes that OCP effects and the difference between (35a) and (35b) fall out from Occam's Razor. He suggests that the branching structure in (35a) is "simpler" than the double representation in (35b) and hence should be the default in tautomorphemic representations and local assimilation (assumed to be by spreading). In this view, (35b) is needed only when there is independent evidence. This includes cases where identical Fs belong to different morphemes, since each feature clearly exists independently. However, (35b) may also be invoked when something in the phonology indicates that tautomorphemic identical Fs act independently, as in the case of the few tautomorphemic OCP violations that have been reported. In other words, OCP violations are tolerated only when they are recoverable. This potentially includes variation in how assimilation is expressed, i.e. either by local spreading or by non-local agreement. Rose & Walker (2004: 520) explicitly recognize both with, however, slightly different properties:

"Intrinsic to our proposal is a claim that there are two kinds of mechanisms at work in segmental assimilations. . . . Correspondence-based agreement is involved in cases where non-local agreement is witnessed. . . . Such patterns are also marked by . . . the absence of blocking by intervening segments. In contrast, feature spreading is at work in cases of local assimilation. . . . These cases also might show blocking effects, either by segments that are incompatible with the spreading feature or by ones that are already specified for it."

This raises the possibility that the inability of the "inserted" Ls to block unbounded H tone spreading and the gapped "mitosis" effects may be examples of copying or agreement by correspondence: We don't need assimilations to be spreading, as copying will do fine in every case, despite violations of the OCP – or (non-)identity conditions (Odden 1986, Archangeli & Pulleyblank 1994, Reiss 2003, 2008).

However, we still need to address the advantages of the multi-linked representations discussed in (6)–(15) above. Specifically, how do we model the fact that TAUTOMORPHEMIC adjacent identical elements tend to act together (as if respecting the OCP)? One possibility is to coindex the relevant tones to show a common underlying sponsor. Another is to refer to the relevant domain, especially where fusion of heteromorphemic features is invoked. To illustrate, let us return to the lowering of all stem Hs before pause in Kukuya formalized in (9c), repeated in (38).

(38) H → M / \_\_\_ //

As will be recalled, we successfully lowered all and only the stem Hs referring to the multiply branching structure in (39a).



(39) a. branching/OCP representation

má-bálágá → má-bālāgā  
 |    \        |    \  
 H   H        H   M  
 ‘they are fences’

b. representation coindexed by tone or domain

má- bá lá gá → má- bā lā gā̄  
 | | | |        | | | |  
 H<sub>i</sub> H<sub>j</sub> H<sub>j</sub> H<sub>j</sub> → H<sub>i</sub> M<sub>j</sub> M<sub>j</sub> M<sub>j</sub>  
 (H)<sub>i</sub> (H H H)<sub>j</sub> → (H)<sub>i</sub> (M M M)<sub>j</sub>

Without the multilinked structure, we would have to coindex the affected tones or group the relevant tones into domains (i,j), as in (39b). Similarly, the automatic non-stability of second H in Tangale /yá:rá lawo/ → yá:r làwò ‘child’s arm’ was automatically achieved as in (40a), but again would have to refer to coindexed or grouped tones as in (40b).

(40) a. branching/OCP representation

yá:rá → yá:r  
 \        |  
 H        H

b. representation coindexed by tone or domain

yá:rá → yá:r → yá:r  
 | |        |        |  
 H<sub>i</sub> H<sub>i</sub>    H<sub>i</sub> H<sub>i</sub>    H<sub>i</sub>  
 (H H)<sub>i</sub>    (H H)<sub>i</sub>    (H)<sub>i</sub>

Aesthetics aside (for me subscripting is not as “nice” as multiple linking), recall that the (tautomorphic) OCP usually works. That is, the multilinked structure is mostly correct, with a few exceptions, and with the observation that the late L tone insertions discussed in §3 show no respect for the (multilinked) tonal geometry.

It is important to note in this context another aspect in which representations have been useful (but also potentially problematic). In Kukuya as many TBUs are lowered as are linked to the one /H/ multilinked feature, as in (39a). In other languages only one TBU is affected. Sometimes this can be handled by targeting different subparts of a single representation. Thus, given the representation in (41a), where A–D = TBUs, a prepausal lowering process can target the H(s) of any of the following in (41b) (see also Archangeli & Pulleyblank 1987, 1994 re minimal vs. maximal scansion of a rule):



- b. D (last H TBU) : Kombe (Elimelech 1976: 120)  
 C-D (last H autosegment) : Kukuya (Hyman 1987: 318)  
 A-B-C-D (last H sequence, fused) : Kirimi (Odden 1988: 370)

As a case in point, consider Gwari, a Benue-Congo language spoken in Nigeria (Hyman & Magaji 1970), which contrasts underlying /H, M, L/:

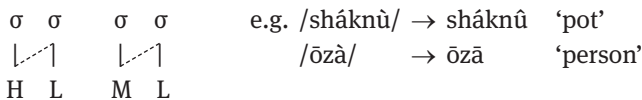
- (42) a. /H/ : gyí ‘eat’ knú ‘sell’ bé ‘come’  
 b. /M/ : sī ‘buy’ knā ‘fry’ gwō ‘grind’  
 c. /L/ : gā ‘give’ bmà ‘break’ gyè ‘sharpen’

As seen in (43), all nine input combinations of these three tones occur on bisyllabic words, with some modifications in the outputs:

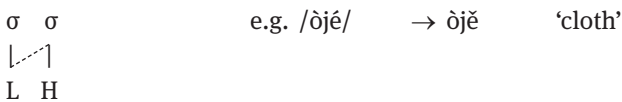
- (43) + /H/ + /M/ + /L/  
 /H/ túkwó ‘head’ gyí bā ‘profit’ sháknû ‘pot’  
 /M/ ōwyé ‘child’ ōsū ‘chief’ ōzà ‘person’  
 /L/ òjě ‘cloth’ ò<sup>↓</sup>bmyā ‘fish’ òvyì ‘thief’

The rules needed to derive the output tones are as follows:

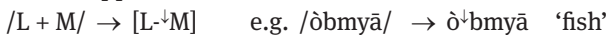
- (44) a. H- and M-tone spreading



- b. L tone spreading



- c. Downstepped (downdrifted) M after L



- d. LH simplified to M before a H or M (creating L-M vs. L-<sup>↓</sup>M contrast)

- i. gyìwyě ‘money’ gyìwyě dā ‘possessor of money’  
 ii. òjě ‘cloth’ òjě fyéwí ‘little cloth’ (small quantity)  
 cf. ò<sup>↓</sup>bmyā fyéwí ‘little fish’

It is this last realization of LH as M that potentially creates a problem. In (45) the verb + noun combination *sà àsé* ‘to sit (down)’ has been reversed to form a nominalization:

(45)	(a)	(b)	(c)	
	$/ase + sa/ \rightarrow$	$ase + sa \rightarrow$	$[às\bar{e} s\hat{a}]$	‘sitting’
		/ \		
	L H L	L H L	[L-M-HL]	

As seen, the input in (45a) consists of a /L-H + L/ sequence to which both L- and H-tone spreading applies in (45b). However, the derivation does not stop in (45b), which would be pronounced \**àsě sâ*, i.e. L-LH + HL. As seen in (45c), the LH rising tone is simplified to M. However, given that the H of the LH contour is also linked to the following syllable, we must find some way to get only “half” of the doubly linked H to combine with the preceding L without the following H TBU being affected. A similar case in Kom, a Grassfields Bantu language of Cameroon, was reported by Hyman & Pulleyblank (1988), who consider a parameters approach with a more developed tonal feature geometry. However, in the present context we have to wonder again whether the traditional autosegmental assumption of assimilation as spreading shouldn’t be questioned. An assimilation = copying approach can quite trivially effect the change of LH to M:

(46)	$/ase + sa/ \rightarrow$	$a se + sa$
		^ ^
	L H L	L LH HL
		↓
		M

With this in mind, we now turn to consider some of the meta questions that we have been only indirectly alluding to in the above discussion.

## 5 Conclusion

Throughout the 1980s phonologists placed great emphasis (and faith) on how non-linear representations could straightforwardly express phonological generalizations, aptly captured by the following oft-cited characterization:

“Simply put, if the representations are right, then the rules will follow.” (McCarthy 1988: 84)

In the preceding sections we have seen that autosegmental representations come close to working, but not quite all the time. In fact, this is fairly typical of phonological representations and phonological analysis in general:

“Problems of phonemic analysis arise even in the best studied languages. This is a pervasive phenomenon. The fact is that quite often a phonemic transcription or orthography ALMOST works.” (Hualde 2004: 2)

This leads naturally to the question of why this should be, which in turn leads to even broader meta questions: Why do we have representations in the first place? What ARE representations? As Coleman & Local (1991: 302), put it, representations have meant different things to different scholars:

“We shall not consider what phonological representations in generative phonology denote. A large number of views concerning this question have been advanced over the years, and it seems unlikely to us that agreement will ever be reached. Some phonologists . . . believe they denote articulatory scripts. Some . . . believe they denote mental scripts. Some believe they denote abstract, purely phonological objects. . . . Some believe they are just convenient fictions, ephemeral constructions to aid in the development of theoretical ideas.”

Consider in this context the phoneme which has famously been considered all kinds of things, including an “abstractional, fictitious unit” (Twadell 1935: 33).

“. . . the phoneme is not an entity on any level – functional, phonetic, psychological or even metaphorical. Rather, at best, “phoneme” is merely a terminological expedient. . . .” (Silverman 2006: 215)

Perhaps autosegmental representations are also “convenient fictions”?

“It could be argued that Goldsmith’s formalization of APRs on which our argument is based is wrong-headed from the start, as A[utosegmental]P[honological]R[epresentations]s are not formal objects at all, but diagrams, metaphors, merely pictures of ‘convenient fictions’. . . . We accept that this is a possible position to adopt, but if this position is adopted, Autosegmental Phonology is beyond the reach of rigorous investigation.” (Coleman & Local 1991: 335)

However, this should not be a cause for rejection. Even if “fictitious”, representations constitute effective analytical tools for expressing (and in some cases discovering) linguistically significant generalizations. This has been especially true in the case of autosegmental representations:

“the general sense of coherence which autosegmental phonology has brought to the study of tone is the primary justification for accepting that theory” (Odden 1986: 353)

“... categorial patterning in languages’ sound systems can no longer be taken as immediate proof that phonological or phonetic forms are themselves represented in terms of categorial entities... the categories traditionally applied to the description of phonological representation – the features, syllables and feet... still have an important heuristic value as descriptors to be used in the building and experimental testing of models of phonological grammar.” (Harris 2007: 137)

Of course researchers have adopted as tools various different strategies (formalizing, measuring, counting, experimenting, etc.) in seeking evidence and insight into specific phenomena as well as addressing foundational issues in the field: “the goal of linguistics... is to explain why languages have the properties they do” (Evans & Levinson 2010: 2740). Others may prefer to rephrase this as: Why is Language (phonology) the way it is? Consider, for example, vowel harmony about which one might enumerate the following basic questions (Hyman 2002: 1–2):

*(i) Questions of synchrony:*

What is vowel harmony (VH)? How do we know it when we see it? Is VH the same as or different from processes identified as “umlaut”, “metaphony” or “vowel assimilation”?

What is possible vs. not possible? What vowel features can vs. cannot harmonize? Can VH be both bounded and unbounded? What are the constraints on triggers and targets of VH? Is the directionality of VH predictable? What are the possible domains of VH: stem, word, phrase? What can be a “neutral” vowel in VH systems?

How do we implement VH? Among the proposals: feature copying, spreading, government, licensing, metrical trees/grids, dependencies, alignment, agreement, no disagreement etc.

*(ii) Questions of diachrony:*

Where does VH come from? Does VH result from the “phonologization” of VCV coarticulation (coperception) effects? How does VH generalize from bounded to unbounded? Does VH develop to mark stem or word boundaries?

What other phenomena enhance or impede the development of VH? What is the relation of vowel reduction to VH? Is the development of VH dependent on the preexisting system of vowel contrasts?

Can VH have other than a phonetic source, e.g. restructuring, transphonologization, analogy?

*(iii) Questions of typology:*

How is VH the same as or different from other harmonies (nasal harmony, consonant harmony etc.)?

How is VH the same as or different from other assimilatory processes not identified as harmony (tonal assimilations, C to V and V to C assimilations)?

How is VH the same as or different from (vowel, consonant, tone) disharmony?

Insights and implementations are, however, logically independent. Consider for example two apparently opposite insights concerning vowel harmony: Kaun’s

(1995) trigger-based “bad vowels spread” vs. Nevins’ (2010) target-based “needy vowels harmonize”. In the first approach vowel harmony is seen as driven by the need of a feature to spread from the trigger; in the second vowel harmony is a response instead to the need of the target to get that feature. While Kaun expresses her idea within an autosegmentalized optimality-theoretic framework vs. Nevins’ search and copy approach, the two opposite insights can in principle be implemented either with the assumption that VH = spreading or that VH = copying. In this case, there is a big difference between an insight and an implementation, which should be carefully distinguished. As Akinlabi & Liberman (2000: 29) put it:

“Whether formal modeling is treated simply as programming for some practical purpose, or as a method of investigating the properties of the cognitive systems involved, it can and should be separated in most cases from the problem of determining the facts and the descriptive generalizations.”

So, whether implemented through unbounded spreading or copying/agreement, how can we understand why the four cases where an inserted L breaks up single-sponsored, multiple Hs? Perhaps the following is the best we can say concerning each of these cases:

- i. In Ribe, the inserted Ls represent the phonologization of pitch-depressing effects of voiced obstruents.
- ii. In Ndebele, the inserted L demarcates the stem-initial boundary.
- iii. In Kalabari, the inserted L keeps the preceding L-H from merging with L-L.
- iv. In Ikalanga, the inserted L keeps H-H from merging with H-L.

In support of the interpretation of Kalabari in (iii), note that the noun + noun construction exceptionally does not trigger downstep insertion. Instead, underlying /L-H/ either remains or optionally “flattens” to L-L, e.g. *bɔmá béle* ~ *bɔma béle* ‘Boma’s light’ (not \**bɔmá* ↓*béle*). The flattened option shows that there is a tendency to avoid L-H followed by H in the next word, something which is resolved in other constructions by inserting a downstep (unlinked L tone). In Ikalanga, if the intonational L% were to be assigned to the final syllable instead of the penult, H-H would become H:-L, not H:-HL, since HL is permitted only on a lengthened vowel. However, since final H-L is realized H:-L, not \*HL:-L, this would produce a merger. While one cannot predict when avoidance of merger will have an effect in a given language, this seems the most promising insight in response to the unusual facts of Kalabari and Ikalanga.

To summarize, autosegmental representations provide useful analytical tools for capturing certain facts, e.g. tautomorphic OCP effects, most (tonal) assimi-

lations etc. However, there is a class of tonal facts that do not automatically fall out from the multilinked representations enforced by the OCP and assimilation as spreading. Some of these facts are reminiscent of transparency in vowel harmony, hence subject to similar interpretations. As we have seen, the problem is not coming up with an analysis (there are lots of possibilities!) – the problem is coming up with an implementation that captures all of the facts in a principle way and without loss of generalization. Finally, in case there is any doubt, these “exotic” cases show that we still don’t know everything that phonology can do – especially in the area of tone.

## Appendix: The mysterious case of the L tone nasal prefix in Tuki

In this appendix I want to recapitulate an additional potential case of a L tone splitting a H which has spread by assimilation. Since I will offer an alternative interpretation, however undesirable, and since this case differs in some ways from the other four, I have decided to place it separately in this appendix.

The case comes from Tuki, a Bantu language spoken in Cameroon (Hyman & Biloa 1992: 105). As seen in (47), Tuki has a rule of bounded H tone spreading (which is already different from the above four unbounded cases):

### (47) a. *low tone verbs*

ò-mw-à	‘to shave’
ò-dìng-à	‘to love’
ò-ryàmàn-à	‘to dream’
\	
L   L   L	

### b. *high tone verbs*

ò-ny-á	‘to eat’
ò-dáng-â	‘to lose’
ò-bángén-à	‘to break’
\	
L   H   L	

The forms in (48) show that singular object prefixes are L, while plural object prefixes are H:

(48) a. *low tone verb*

ò-n-dìng-à 'to love me'  
 ò-ò-dìng-à 'to love you sg.'  
 ò-mù-dìng-à 'to love him/her'  
 ò-sú-dìng-à 'to love us'  
 ò-nú-dìng-à 'to love you pl.'  
 ò-wú-dìng-à 'to love them'  
 | | ↘ † |  
 L H L L

b. *high tone verb*

ò-n-dáng-â 'to lose me'  
 ò-ò-dáng-â 'to lose you sg.'  
 ò-mù-dáng-â 'to lose him/her'  
 ò-sú-dáng-â 'to lose us'  
 ò-nú-dáng-â 'to lose you pl.'  
 ò-wú-dáng-â 'to lose them'  
 | | | ↘ † |  
 L H H L

While the H of the object prefix spreads onto the L verb root in (48a), delinking the L, the H of the H verb root spreads onto the final vowel in (48a). The same rules apply in (49):

(49) a. *low tone verb*

à-mù-dìng-à-rím 's/he loves him/her'  
 vá-mú-dìng-à-rím 'they love him/her'  
 | ↘ † | | |  
 H L L LH

b. *high tone verb*

à-mù-dáng-â-rím 's/he loses him/her'  
 vá-mú-<sup>↓</sup>dáng-â-rím 'they lose him/her'  
 | ↘ † | ↘ † |  
 H L H LH

As seen these forms involve either a L or H subject prefix *à-* 's/he', *vá-* 'they'. The new observation to make in (49b) is that when the H of *vá-* spreads onto the L object prefix *-mu-* 'him/her', delinking the L, the following H verb *-dáng-* is realized with a downstep. (A separate rules deletes the L of the final vowel *-a* which does not condition a downstep on the present tense suffix *-rím*.)



While the above seems rather commonplace, a problem arises with the non-syllabic nasal first person singular object prefix /-*n̄*-/ in (50).

(50) a. *low tone verb*

à-n-dìng-à-*m̄* 's/he loves him/her'  
 vá-*n̄*-dìng-à-*m̄* 'they love me'  
 |    |    |    |  
 L    L    L    L  
 H    L    L    L H

b. *high tone verb*

à-n-dáng-à-*m̄* 's/he loses me'  
 vá-*n̄*-dáng-à-*m̄* 'they lose me'  
 |    |    |    |  
 L    L    L    L  
 H    L    H    L H

As seen in (50a), the H of *vá-* spreads across the L tone nasal prefix to link to the verb root, whose L delinks. While we have indicated in (50b) that the L of /-*n̄*-/ delinks, we cannot do the same in (50a), or the L would float after the doubly linked H. Somehow H tone spreading has taken place across the L tone non-syllabic nasal prefix, the result being that the second link of the resulting branching H is downstepped.

The same problem arises when /-*n̄*-/ is preceded by a H tense marker ( $P_{1-2}$ ,  $F_{1-2}$  = different degrees of past/future tense):

(51) a. *preceding tense marker is L*

à-n-dìng-à-*m̄* 's/he loves me'  
 à-mà-n-dìng-à 's/he loved me' ( $P_3$ )  
 à-mû-n-dìng-à-*m̄* 's/he will love me' ( $F_1$ )  
 |    ^    |    |    |  
 L    HLL    L    L H

b. *preceding tense marker is H*

à-mú-*n̄*-dìng-à 's/he loved me' ( $P_1$ )  
 à-má-*n̄*-dìng-à 's/he loved me' ( $P_2$ )  
 à-mú-*n̄*-dìng-à-*m̄* 's/he will love me' ( $F_2$ )  
 |    |    |    |  
 L    L    L    L  
 L    H    L    L H

Given the transparency of the L of the nasal prefix, but its downstepping effect on a H spreading through it, the question how it should be represented. It is quite clear that the L cannot be an “ordinary” linked tone or it would block H tone

spreading. If it were not linked, H tone spreading would be able to apply across it, but how would the L downstep only the second link? The only other option is to do as we did in the four cases discussed in §3: place the L on a separate tier, as in (52).

- (52)     L  
           |  
 vá - N - dǐng - à - m̐   ‘they love him/her’ (cf. (49a))  
       |-----‡     |   |  
       H       L   L H

It should be noted that only the first person singular morpheme has this property: tautomorphemic NC does not condition downstep, as seen in (53):

- (53) a. /vá-ŋgbààtì-m̐/   → vá-ŋgáàtì-m̐     ‘they disdain’  
       /vá-ndéndèn-à-m̐/ → vá-ndééndèn-à-m̐   ‘they walk for’  
       b. /vá-dáng-à-m̐/    → vá-dáng-á-m̐     ‘they lose’  
       /vá-vángèn-à-m̐/   → vá-vángénà-m̐   ‘they fry for’  
       (\*vá-<sup>↓</sup>ŋgáàtì-m̐, \*vá-<sup>↓</sup>ndéndèn-à-m̐, \*vá-dá<sup>↓</sup>ng-á-m̐, vá-vá<sup>↓</sup>ngénà-m̐)

Because only one morpheme is involved, it is, of course, possible to play with the underlying forms. We thus could set up the allomorphy in (54):

- (54) a. /-N-/ after L  
           |  
           L  
       b. /-N-/ after H  
           |  
           LH

The expected /L/ allomorph would in this case be chosen if the preceding tone is L, the floating L + linked H allomorph if the preceding tone is H. In this latter case the floating L will condition a downstep between the preceding H tone and the H which would automatically follow the nasal prefix (either because the root is /H/, or because the linked H will have been assigned to the root by the same H tone spreading rule we have saw in the earlier examples).

Either way the Tuki case differs from those from Ribe, Ndebele, Kalabari and Ikalanga in that the problematic L tone is morphological, hence not a late insertion. It shares with the other languages that the nasal to which the L is linked is

not a canonical TBU. If the /L/ analysis is accepted, making the nasal fall into place with the other singular object pronouns in (48), it would share with the other languages that it lets H tone spreading apply across it, but then splits the doubly linked H in two. Because the /L/ is underlying in Tuki, if this analysis is correct, the behavior of this specified L resembles transparency effects in vowel harmony, a situation not otherwise noted in the tonal literature.

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