

Tonal Feet

William R. Leben
Stanford University

Abstract

Morpheme-based tonal melodies tend to be very simple—often just a single element, e.g. H, as in many Bantu languages. But in tonal languages, tonal melodies sometimes include two or as many as three elements, if the analyses of Mende in Leben 1973 and of Kukuya by Hyman 1987 are right. Are such melodies simply linear sequences, as assumed in most early work? Do they interact with metrical structure? Do autosegmental tonal melodies themselves have hierarchical structure?

The increasing use of the term *tonal foot* in the literature is a sign of possible groupings among tones in a tonal melody and possible interactions with the kinds of syllable groupings more normally associated with metrical structure. This paper offers analyses showing how the construct *tonal foot* helps to explain two particular phenomena: tone assignment in Hausa to loan words from English, and the distribution of tone in Bambara.

Tonal feet present a special methodological challenge because they are intrinsically harder to document than the metrical feet surveyed so authoritatively by Hayes 1995. Metrical feet by definition contain only one stress per foot, while (if the analyses in this paper are on the right track) the makeup of tonal feet is not normally so consistent across languages or so obvious. Nonetheless, the correctness and subtlety of the predictions about the distribution and behavior of tones in the cases examined here offer some solid, though indirect, indications of tonal foot structure.

1. Background: pitch accent vs. tone

Much has been written about differences between pitch accent languages and tone languages. The general idea in classic works on tone like Pike 1948, McCawley 1965, 1978, has been that tone languages afford a richer set of tonal possibilities, pitch accent a more restricted set. This view remains intact, with further embellishments. For example, in pitch accent languages the occurrence of tone is commonly associated with a particular position that can be defined metrically. That position may incidentally also be marked by metrical stress, as in Serbo-Croatian (Inkelas and Zec 1988, Zec 1994), or not, as in Japanese, where there is no perceptible stress. Japanese, however, does seem to present some evidence outside of stress for bimoraic feet (Poser 1984).

Tone languages may thus conceivably contrast with pitch accent languages by virtue of having either no metrical feet or metrical feet that are irrelevant to the assignment of tone. Whether this is exactly right, in this paper I explore some phenomena in several tone languages that seem to provide indications of tonal, rather than metrical, feet. Such tonal feet offer some elegant explanations for distributional facts that up to now have gone unnoticed or unexplained.

2. Tone assignment in Hausa borrowings from English

In Hausa borrowings from English, binary tonal feet help to explain how English stresses are adapted tonally in Hausa (Leben 1997). Words like **gwámnà** ‘governor’ have a HL pattern, and words like **gàràntî** ‘guarantee’ compress this HL sequence onto the final syllable, as shown in (1).

- (1) H on the syllable corresponding to the English main-stressed syllable. L is assigned to the right of H.

gwámnà ‘governor’ vs. **gàràntî** ‘guarantee’

The result closely resembles the intonation of the English source, where the High tone of declarative intonation is assigned to the main-stressed syllable and Low tone is assigned to remaining syllables, if any, or otherwise to the right of the High tone on the stressed syllable.

The same is true of **tânkîífàa** ‘timekeeper.’ The two stresses in the English source are each matched by a HL pattern in the Hausa borrowing.

- (2) H on *each* main-stressed syllable. The two-word English compound *timekeeper* is treated in Hausa as having two main stresses and hence two H tones, each one followed by L.

tânkîífàa ‘timekeeper’

Yet it would be wrong to surmise that Hausa speakers simply attempt to match the tonal realizations of borrowings to surface intonational realizations of their source. For example, words like **máasínjà** and **Nàjéeriyàa** in (3), though they also end with a HL melody like the earlier examples, exhibit a one-syllable delay from where English declarative intonation would drop from High to Low. In English, the drop from H to L begins after the syllable **mess** of ‘messenger,’ and after the syllable **jeer** of ‘Nigeria.’ In Hausa, High extends over the syllable to the right of these, and the drop to L begins only after that extra syllable.

- (3) transition from H to L delayed by one syllable:

máasínjà ‘messenger’
réedíyòò ‘radio’
kwálbátì ‘culvert’
Nàjéeriyàa ‘Nigeria’

In fact, the examples in (2) and (3) bring up two key respects in which Hausa tone assignment in borrowings does not try to mimic the intonation of the corresponding words of the source language. In English declarative intonation, the word *timekeeper* behaves just like the *messenger*. In both words, the initial syllable receives a H because it is stressed and the drop to L begins immediately afterwards. The drop onto the secondary-stressed syllable *keep* of *timekeeper* is indistinguishable from the drop onto the unstressed syllable *sen* of *messenger*.¹

¹ Differences between secondary stress and absence of stress can certainly be brought out. Leben 1976 describes a “vocative chant” or “calling intonation” where a fall from High to Mid happens after the first syllable of *Lancaster* but is delayed till after the second syllable of *Pamela*. In this intonation pattern, *timekeeper* and *messenger* behave

What is especially nice is that each tonal foot has the same tone pattern, HL, whether the foot is monosyllabic or disyllabic. Still, we cannot maintain that all tonal feet in Hausa have this pattern. Consider the examples in (5):

(5) A foot of a different tonal stripe:

(**máasín**)jà ‘messenger’
 (**réedí**)yòò ‘radio’
 (**kwálbá**)tî ‘culvert’
 Nà(**jeerí**)yàa ‘Nigeria’

Constructing a maximally binary tonal foot in accordance with (4) means aligning the left edge of the foot with the left edge of the stressed syllable in the English source word. When this is done in (5), we note that the tonal foot here has a level H tone on both syllables.

But there is no inconsistency, since the cases in (3) and (5) are in complementary distribution. The tonal feet in (5) are all followed by unfooted material, while those in (3) are either word-final or followed by another tonal foot. This permits us to establish the rule in (6):

(6) Tonal foot tone interpretation.

A tonal foot is interpreted as (**HL**) before unfooted material and elsewhere as (**H**).

This results in the tone assignments illustrated by the tone symbols H and L in (7). As above, the segments are marked with the tonal diacritics ´ and ` to indicate the corresponding surface tones.

(7)	(máasín)jà H	(gwámnà) H L
	Nà(jeerí)yàa H	gàrà̀n(tî) HL

These representations reveal how unfooted material is dealt with. In all cases, unfooted syllables are interpreted as Low-toned. Hence the rule in (8):

(8) Default Low insertion: assign L to a toneless syllable.

(máasín)jà H L	(gwámnà) H L
Nà(jeerí)yàa L H L	gàrà̀n(tî) L L HL

This is the core of the analysis in Leben 1997. While it is not possible to predict whether Hausa will honor an existing English stress 100% of the time (for example, English *organizer* with initial stress comes into Hausa as **ògànéézàa**, as if the first syllable were unstressed and the third

syllable had main stress in English), the patterns found are remarkably consistent across a sample of several hundred Hausa loanwords from English, and the generalization that tonal feet are H before unfooted material and HL elsewhere proves robust. This provides some initial support for a tonal foot in Hausa, at least in this section of the vocabulary.

3. What is a tonal foot?

The analysis in section 2 leaves open exactly what a tonal foot is. To keep the question as concrete as possible, let us review certain possibilities graphically. In its crudest formulation, autosegmental theory postulates distinct tiers of representation, which Goldsmith 1976 dubbed the segmental and tonal tiers. Under this conception, tonal foot structure could refer to prosodic structure on the segmental tier, on the tonal tier, or on both tiers.

The representations in (9) are pared down to bare essentials for illustrative purposes. In reality, the segmental tier is of course hierarchically structured, with segments belonging to syllables and perhaps other subsyllabic and supersyllabic units, with tones associated to TBUs, and perhaps with many other refinements.

- (9) a. Footing on the segmental tier

(gwamna)
| |
H L

- b. Footing on the tonal tier

gwamna
| |
(H L)

- c. Footing on both the segmental and tonal tiers

(gwamna)
| |
(H L)

In (9a), the parentheses indicating the prosodic grouping are restricted to the segmental tier. This conception is akin to the standard notion of metrical structure, which is also tied to the segmental tier. On this view, tonal feet might be incorporated into present conceptions of metrical structure by holding that syllables can be organized into metrical feet or into tonal ones, or perhaps into both.

In (9b), the prosodic organization shifts to the tonal tier. An instantiation of this view—the first one in a generative context—is Liberman's 1975 imposition of metrical structure onto the intonational melodies of English. In (9c), we see foot structure on both tiers. This is more precisely

what Liberman 1975 proposed for English intonation, along with introducing the notion of *congruence* between the segmental and tonal tiers. Congruence, when maximized, led to one tier being associated with the other. Liberman's approach has been extensively modified by others, including Pierrehumbert 1980 and Beckman and Pierrehumbert 1986. Current conceptions posit an internal structuring for the intonational melody that is more specifically tailored to the demands of intonation than Liberman's more generic metrical structure was. Still, this development certainly does not make the tonal tier any less highly structured than under Liberman's original proposal.

Returning to tonal languages, if tonal feet do involve items on both the segmental and tonal tiers, it is quite easy to imagine that the congruence of foot alignments in (9c) would constitute an ideal state that language-particular constraints might overrule, thanks to Optimality Theory, where differences between the boundary alignments of separate levels and mismatches of various other sorts are exploited extensively.

What linguistic realizations might correspond to the different configurations in (9) is too big a topic to pursue here, but there is one fact about Hausa that hints that the structure in question is more like (9a) or (9c) than like (9b). This is that the rule which determines whether the tonal foot is interpreted as H or HL depends crucially on whether there is "unfooted material" on the right. The illustrations in (5) and (7) above show that the "unfooted material" referred to by rule (6) is in the segmental tier, requiring that the foot structure be situated on that tier, as in (9a) or (9c) but not as in (9b). Possibly there are ways around this conclusion, but it seems the most straightforward one available.

Interestingly, this same set of interpretations for tonal feet is what works for the next case to be discussed.

4. Tone in exceptional Bambara words

The tone patterns of Bambara have been analyzed in many ways. Some frequently cited works on the topic, each with a different take on the Bambara system, are Welmers 1948, Leben 1973, Riailand & Badjime 1989, Bamba 1991, Creissels & Grégoire 1993, among others. Despite all the differences, the various analyses manage to capture the basic facts of the system.

In Bambara the vast majority of basic nouns have one or two syllables. Their tonal behavior is uniform and illustrated in (10).

- | | | | | | | |
|---------|-----------|------------|---------|-------------|-------------|---------|
| (10) a. | ji | 'water' | c. | yiri | 'tree' | |
| | H | | | H | | |
| | b. | so | 'horse' | d. | muso | 'woman' |
| | | L H | | | L H | |

Monosyllabic nouns appear with one of the two tonal patterns H (10a) or LH (10b). The same two patterns are the ones attested in disyllabic nouns, H in (10c) and LH (10d). When a H follows in certain constructions, LH words change their tone to all L, as shown in (11).

- (11) a. **ji tɛ yan** 'no water is here'
H H L
- b. **so tɛ yan** 'no horse is here'
L H L
- c. **yiri tɛ yan** 'no tree is here'
H H H L
- d. **muso tɛ yan** 'no woman is here'
L L H L

The change can be expressed by a rule whose basics are given in (12).

- (12) *H Deletion*
 L H] [H]
 ↓
 ∅

The precise transcriptions and formulations will of course depend on the choice of underlying representations and other basic assumptions, including whether the underlying entities are tones vs. accents, where one or the other of H tone, L tone, or an accent is taken to be marked vs. unmarked, whether the distribution of tones and the alternations among them are stated by rules, constraints, or some combination of firepower, and whether LH or L is the basic alternant in the cases where these two alternate. But, as the literature demonstrates, the core facts in (10) and (11) can adequately be handled by many, many different combinations of basic starting principles.

Here I focus instead on a different set of cases, which include *all* of the trisyllabic nouns mentioned in Creissels' 1978 analysis of Bambara tone. Below are examples from Creissels illustrating seven possible tone patterns. Words beginning H are on the left, and those beginning L or on the right.

- (13) a. **kamalen** 'young man'
H H H
- b. **kbasu** 'chalk'
H H LH
- c. **mangoro** 'mango'
H L H
- d. **tubabu** 'European'
L L H
- e. **nyoninsa** 'fever'
L H LH
- f. **jakuma** 'cat'
L H H
- g. **jankamu** 'black scorpion'
LH L H

As in (10), the alternants chosen as underlying all end in H tone, giving the form as it appears when the definite marker L is added to the final syllable, as can be seen by inspecting the list of corresponding definites in (14).

- (14) a. **kamalen** 'the young
H H HL man'
- d. **tubabu** 'the European'
L L HL

b. kabasu	‘the chalk’	e. nyɔninsa	‘the fever’
H H LHL		L H LHL	
c. mangoro	‘the mango’	f. jakuma	‘the cat’
H L HL		L H HL	
		g. jankamu	‘the black scorpion’
		LH L HL	

Recall from above that the underlying forms in (10b,d) ending in LH had an alternate form ending in L. The same appears true for the trisyllabic cases. Creissels’ analysis predicts cases like the following, corresponding to those in (13).²

(15) a. kabasu tɛ yan	‘no chalk is here’	c. nyɔninsa tɛ yan	‘no fever is here’
H H L H L		L H L H L	
b. mangoro tɛ yan	‘no mango is here’	d. jankamu tɛ yan	‘no black scorpion is here’
H L L H L		LHL L H L	

This is the same alternation between final L and final LH that was observed in (10b,d).

A look at the tonal shapes in (13) raises some distributional questions, particularly about the occurrence of LH contours. As already noted, LH can occupy a single syllable in final position (in (13b, e), and it can also occupy a syllable in initial position (13g). But no form in (13) has a LH contour on the middle syllable. Furthermore, there is no form that has LH on the first syllable which also has LH on the final syllable. It is always possible that such gaps are purely accidental. But interestingly, a very straightforward foot-based account would predict that the tonal patterns in Bambara trisyllables would be *exactly* as shown here.

Suppose that Bambara, like Hausa, has tonal feet and that these creating groupings of syllables on the segmental tier at the very least, and possibly also groupings on the tonal tier. For now we concern ourselves only with the segmental tier. Judging purely from the mono- and disyllabic forms in (10), the tonal foot would have the properties in (16):

(16) **Tonal foot formation (*Bambara*)**

1. The tonal foot is maximally binary.
2. The tonal foot can be associated with the tone pattern H or LH.
3. Tonal feet are constructed maximally. Otherwise we could have a disyllabic structure of the form [CV][CV], either or both of whose putative monosyllabic feet could have the tone pattern LH, yet such forms are not found.

² Creissels (p. 31) cites (15b) explicitly. He indicates that the same L which ends **mangoro** in this context also appears at the end of the other three examples, with the observation that this happens “dans le cas des trisyllabes à ton final bas.” On p. 33, lists the trisyllables ending in L, and indeed all four examples in (15) appear on the list.

4. Tonal feet parse a form exhaustively. Otherwise, it would be possible, at least under our current assumptions, to leave some syllables underlyingly toneless, which at best are unnecessary.

The resulting analyses for (10) are below, where parentheses mark the required foot boundaries:

- (17) a. **(ji)** c. **(yiri)**
 H **H**
- b. **(so)** d. **(muso)**
 LH **LH**

(17) shows that monosyllabic feet appear only where the form is too short to have a disyllabic foot (namely in (17a,b)), and that both monosyllabic and disyllabic feet can be interpreted tonally either as H as in (17a,c) or as LH(as in (17b,d)).

Let us now examine what this system predicts for trisyllabic forms. (18) shows the two possible groupings of Bambara syllables (here represented by CV for convenience) into maximally disyllabic feet, reserving monosyllabic ones only for the cases where otherwise a syllable would go unfooted:

- (18) a. [CVCV][CV]
 b. [CV][CVCV]

These, then, are the only two foot patterns that we would expect to find in trisyllabic words, on the assumptions in (16). Associating these two patterns with all possible combinations of the two melodies H and LH yields the following predicted structures:

(19) Combinations of possible feet and possible melodies

- | | | | | | |
|-----|------|------------|---|------|------------|
| (a) | i. | (CVCV)(CV) | b | i. | (CV)(CVCV) |
| | | H H | | | H H |
| | ii. | (CVCV)(CV) | | ii. | (CV)(CVCV) |
| | | H LH | | | H LH |
| | iii. | (CVCV)(CV) | | iii. | (CV)(CVCV) |
| | | LH H | | | LH H |
| | iv. | (CVCV)(CV) | | iv. | (CV)(CVCV) |
| | | LH LH | | | LH LH |

There are eight structures, but the two that are at the top of the their respective columns are different bracketings of all H words. If foot boundaries are inaudible, then (19ai) will not be distinct from

(19bi), and so the two really are different foot parsings of the same pattern, the trisyllabic all H word. Possibly one should be eliminated by convention, or possibly they should be left as is.

Six structures remain, and for the most part it is easy to see how each one corresponds to a form in (13), repeated below as (20), this time in grid form with a box to match up with a structure in (19) and with foot boundaries marked on the segmental tier where an identification with the structures (19) has been made.

(20) a.	(kama)(len) H H H (ka)(malen) H H H	‘young man’	=19ai, 19bi	d.	tubabu L L H	‘European’	
b.	kabasu H H LH	‘chalk’		e.	nyoninsa L H LH	‘fever’	
c.	mangoro H L H	‘mango’		f.	jakuma L H H	‘cat’	
				g.	jankamu LHL H	‘black scorpion’	

Let us go through (20) example by example. (20b) can only be analyzed as having a disyllabic foot followed by a monosyllabic one, since a monosyllabic foot followed by a disyllabic one would require the nonexistent melody HLH for the disyllabic foot. Similarly, since there is no disyllabic foot interpreted tonally as HL, (20c) must consist of a monosyllabic foot followed by a disyllabic one. These analyses are filled in here:

(21) a.	(kama)(len) H H H (ka)(malen) H H H	‘young man’	=19ai, 19bi	d.	tubabu L L H	‘European’	
b.	(kaba)(su) H H LH	‘chalk’	=19aai	e.	nyoninsa L H LH	‘fever’	
c.	(man)(goro) H LH	‘mango’	=19bii	f.	jakuma L H H	‘cat’	
				g.	jankamu LHL H	‘black scorpion’	

Proceeding now to the forms on the right, we see that (21d) cannot begin with a monosyllabic foot, since monosyllabic feet interpreted as L are nonexistent (at least before another

L). Hence (21d) must begin with a disyllabic one. The tonal melody of (21d) clearly cannot be H and so must be LH. It is realized as simple L in (21d) precisely because here it is before a H, in the next foot. Thus (21d) corresponds to (19aiii), with the understanding that the alternant L appears in place of LH in the first foot, due to (12) H Deletion.

For consistency's sake, we now must apply rule (12) to the structures in the (b) column. In (19biii) the environment of (12) is met, and applying it leads to the prediction that LH in (19biii) will be realized tonally as L HH. That pattern is indeed attested, as (21f).

These cases are added, giving (22):

(22) a.	(kama)(len) H H H	'young man'	=19ai, 19bi	d.	(tuba)(bu) L L H	'European'	=19aiii
	(ka)(malen) H H H						
b.	(kaba)(su) H H LH	'chalk'	=19aii	e.	nyɔninsa L H LH	'fever'	
c.	(man)(goro) H LH	'mango'	=19bii	f.	(ja)(kuma) L HH	'cat'	=19biii
				g.	jankamu LHL H	'black scorpion'	

Only two forms remain to be identified, and both consist exclusively of LH sequences. (22e) must have a disyllabic first foot, since the first LH is spread over the first two syllables, while the second LH is restricted to the final, monosyllabic, one. In (22g), the pattern is obviously reversed, with the monosyllabic foot preceding the disyllabic one, and this is precisely what we want. The full analysis is in (23):

(23) a.	(kama)(len) H H H	'young man'	=19ai, 19bi	d.	(tuba)(bu) L L H	'European'	=19aiii
	(ka)(malen) H H H						
b.	(kaba)(su) H H LH	'chalk'	=19aii	e.	(nyɔnin)(sa) L H LH	'fever'	=19aiv
c.	(man)(goro) H LH	'mango'	=19bii	f.	(ja)(kuma) L HH	'cat'	=19biii
				g.	(jan)(kamu) LH L H	'black scorpion'	=19biv

Thus, the gaps in Creissels' data are *all and only* those that the foot-based analysis predicts. As already noted, this prediction could be turned against this analysis, should further work show that the gaps here found to be principled are instead accidental.

However, another prediction flows from this analysis, adding totally independent support to the foot-based analysis. The operation of (12) has been governed by a simple principle that has yet to be made explicit. The realization of feet alternating between LH and L was seen to be triggered by the absence or presence of a following H tone. Before H, the foot is L, while before anything else (i.e. before L or before nothing), the foot is H. What has yet to be made explicit is that the LH sequence alternating with L *must be in the same foot*. Let us make that assumption, since it is a strong one and since it is consistent with the data so far.

As the examples in (15) showed, LH changes to L before **té yàn** 'is here.' Our trisyllabic nouns fall into two classes before this expression, word-final LH feet and word-final LH sequences where the L and H are in different feet. There are four cases of the former kind: the monosyllabic foot (**sǔ**) of (23b) and (**sǎ**) of (23e) and the disyllabic feet (**gòró**) of (23c) and (**kàmú**) of (23g). And there are two cases of the latter kind: (23d), where the monosyllabic foot (**bú**) is preceded by L, and (23f), where the disyllabic foot (**kúmá**) is preceded by L. The prediction is clear. If LH needs to be in a foot in order to alternate with L before **té yàn**, then the four cases (23b, c, e, g) should alternate and the cases (23d, f) should not. This is exactly what happens.³

The restriction that the alternation between L and LH applies only to foot-internal LH also sheds light on tone patterns word-internally. If a LH foot precedes a H foot word internally, (12) predicts that this LH will change to L. That is the case of (**jà**)(**kúmá**) in (23f). But if L from one foot precedes a HH from another foot word internally (i.e. a L syllable precedes two syllables, both H), there should be no corresponding change from (L)(HH) to (L)(LH). That is, the surface form **jàkúmá** should not change its pattern to LLH. As already seen, it doesn't. Of course, there could be other equally valid reasons why it doesn't. But only the foot-based analysis explains in addition why no Bambara word with the surface realization LLH has an alternant LLL before **té yàn** 'is here.' The reason, as noted earlier, is that (L)(LH) is not a possible foot structure. Hence all LLH words must be analyzed as having the foot structure (LL)(H), which as we have seen cannot alternate with (LL)(L).

Creissels 1978 does not explicitly claim to include all or even a representative set of cases, so it would be wrong to try to read too much into this account. Yet we see that a very simple set of assumptions about foot structure in these nouns predicts all and only the patterns in Creissels' data. In a sense, it is easy to see why an analysis employing monosyllabic and disyllabic feet works so well, since, as in other Mande languages, Bambara trisyllables are most part either borrowings or historically built on morphological compounds of basic monosyllabic and disyllabic words. However, it cannot be the morphological compound structure *per se* that explains the phonological facts, since many of the analyses that take trisyllables back to their historical sources are

³ Once again, Creissels does not cite all of the relevant forms but makes clear in his description what happens. On pp. 31-32 he notes, "On voit ici que *mángòro* fait au défini *mángòrô* exactement come *mùso* qui deviant au défini *mùsô* – on ferait des observations analogues pour les autres schémas de trisyllables a ton final bas."

synchronously opaque (Yousouf Keita, p.c.). But if Bambara is characterized by maximally disyllabic feet, it is understandable that this prosodic structure is imposed on borrowings (as in Hausa) and at the same time has endured on native forms, perhaps with occasional restructuring in individual words as etymological connections were lost.

This analysis seems to motivate assumptions similar to those that worked for Hausa. In Bambara, the key to explaining the distribution of tone in trisyllables is to divide them exhaustively into maximally binary feet and to associate each foot with one of two possible tonal patterns. In Hausa, we did not need to parse words exhaustively into feet, and the choice of tonal pattern in borrowed nouns was predictable from the position of the tonal foot in the word. In Bambara, parsing seems to be exhaustive, and the choice of LH vs. H for each melody is contrastive. But both languages appear to call for monosyllabic and disyllabic tonal feet, with at least tonal melodies associated with them.

More fundamentally than that, the tonal foot is tied to the segmental tier in Bambara as in Hausa. Recall that in Hausa it was noted that the choice between the melodies H and HL was governed by the presence or absence of “unfooted” material to the right, where the unfooted material in question was in the segmental tier, not the tonal one. Bambara makes crucial reference to the segmental tier in its requirements of exhaustive parsing and of feet that are maximally binary: a three-syllable foot is not permitted.

As with Hausa, the Bambara analysis is consistent with either dividing or not dividing the tonal melody into chunks whose boundaries are independent of the feet on the segmental tier. The prediction that LH will alternate when it is associated with a foot but not when the LH straddle a foot boundary will be made in either case, as long as the foot referred to is the foot on the segmental tier.

5. Tonal feet and the theory of tone.

The cases analyzed in this paper suggest that tonal feet play a key role in explaining tonal phenomena and further offer some at least preliminary idea of the properties of a coherent theory of tonal feet. Conceivably, tonal feet and metrical feet are parallel kinds of structures, syllable groupings within prosodic words in the prosodic hierarchy of Selkirk 1980 and others. Perhaps, in addition or instead, tonal feet are special cases of the tonal domains discussed by Kisseberth 1994 and by Cassimjee and Kisseberth 1998.

Yip 1996, referring to work by Shih 1986 and Duanmu, among others, notes that in Chinese, tonal feet of two varieties have been proposed. One type has lexical tone on its head syllable, while the others are toneless; the other type has lexical tone on all syllables. The Hausa and Bambara cases look like instances of the latter type. Cases of the former type might on further analysis turn out to be related to what was earlier known as pitch accent. However, since Yip discusses these in lexical tone languages, more work is needed if any clarity is to be brought to this topic.

References

- Bamba, M. 1991. De l'interaction entre tons et accent. Université du Québec à Montréal dissertation.
- Beckman, M. E., and J. B. Pierrehumbert 1986. Intonational structure in Japanese and English. *Phonology Yearbook* 3.255-309.
- Cassimjee, F., and C. W. Kisseberth. 1998. Optimal Domains Theory and Bantu Tonology: A Case study from Isixhosa and Shingazidja. In L. M. Hyman and C. W. Kisseberth, eds., *Theoretical Aspects of Bantu Tone*. Stanford: CSLI Publications, 33-132.
- Creissels, D. 1978. A propos de la tonologie du bambara. *Afrique et Langage* 9.5-70.
- Creissels, D., and C. Grégoire. 1993. La notion du ton marqué dans l'analyse d'une opposition tonale binaire: Le cas du mandingue. *Journal of African Languages and Linguistics* 14.107-154.
- Duanmu, S. 1995. Metrical and tonal phonology of compounds in two Chinese dialects. *Language* 71:225-259.
- Goldsmith, J. 1976. Autosegmental phonology. M.I.T. dissertation. New York, Garland Press, 1979.
- Hyman, L. M. 1987. Prosodic domains in Kukuya. *Natural Language and Linguistic Theory* 5:311-333.
- Inkelas, S. and D. Zec 1988. Serbo-Croatian pitch accent: The interaction of tone, stress and intonation. *Language* 64.227-248.
- Kisseberth, C. 1994. On domains. In J. Cole and C. Kisseberth, eds. *Perspectives in Phonology. Lecture Notes*, CSLI Publications. Stanford U., 133-166.
- Leben, W. R. 1973. *Suprasegmental Phonology*. M.I.T. dissertation. Garland Press, 1980.
- Leben, W. R. 1973. *Suprasegmental Phonology*. M.I.T. dissertation. Garland Press, 1980.
- Leben, W. R. 1976. The tones in English intonation. *Linguistic Analysis* 2.69-107.
- Leben, W. R. 1978. The representation of tone. In V. Fromkin, ed., *Tone: A Linguistic Survey*. New York: Academic Press, 177-219.
- Leben, W. R. 1997. Tonal feet and the adaptation of English borrowings into Hausa. *Studies in African Linguistics* 25: 139-154.
- Leben, W. R. 1997. Tonal feet and the adaptation of English borrowings into Hausa. *Studies in African Linguistics* 25: 139-154.
- Lieberman, M. Y. 1975. The intonation system of English. M.I.T. dissertation. New York, Garland Press, 1979.
- McCawley, J. D. 1965. What is a tone language? Winter LSA meeting.
- McCawley, J. D. 1978. What is a tone language? In V. Fromkin, ed., *Tone: A Linguistic Survey*. New York: Academic Press, 113-131.

- Pierrehumbert, J. B. 1980. The phonology and phonetics of English intonation. M.I.T. dissertation.
- Pike, K. L. 1948. Tone languages. Ann Arbor: U. of Michigan Press.
- Poser, W. J. 1989. Phonetics and Phonology of Tone and Intonation in Japanese. M.I.T. dissertation. Stanford: CSLI Publications.
- Rialland, A., and M. Badjime. 1989. Réanalyse des tons du Bambara: des tons du nom à l'organisation générale du système. *Studies in African Linguistics* 20.1-27.
- Selkirk, E. O. The role of prosodic categories in English word stress. *Linguistic Inquiry* 11.563-605.
- Shih, C. 1986. The Prosodic Domains of Tone Sandhi in Chinese. UC San Diego dissertation.
- Welmers, W. E. 1949. Tonemes and tone writing in Maninka. *Studies in Linguistics* 7.1-7.
- Yip, M. 1996 Feet, tonal reduction and speech rate at the word and phrase level in Chinese. ROA.
- Zec, D. 1994. Footed tones and tonal feet: Rhythmic constituency in a pitch accent language. Working Papers of the Cornell Phonetics Laboratory 9.223-283.