ON THE PHONETIC INTERPRETATION OF THE YORUBA TONAL SYSTEM

Akin Akinlabi
Rutgers University

Mark Liberman
University of Pennsylvania

ABSTRACT

Yoruba is a tone language, with three lexically contrastive levels H(igh), M(id) and L(ow). Various phonological and phonetic properties of these tones are explained in terms of the view that M is phonologically unspecified, and that adjacent H and L join to form "derived pitch accents."

BACKGROUND

Yoruba has three phonemically distinctive tones—H(igh), M(id), L(ow). H occurs in word-initial position only in (marked) consonant-initial words, which reveal an implicit initial vowel when preceded by another word in a genitive construction. Most nouns and adjectives start with a vowel, which is L or M but not H. Except for these minor tonotactic restrictions, any lexical vowel can have any one of the three tonal specifications. There are no underlying tone glides.

ra H "to vanish"	**ra M** "to rub"	**ra L** "to buy"
ọkọ MH "hoe"	**ọkọ MM** "husband"	**ọkọ ML** "vehicle"
ilu LH "town"	**ilu LM** "opener"	**ilu LL** "drum"
pako HH "plank"	**kese HM** *place-name*	**pako HL** "chewing stick"

Thus Yoruba presents itself as a fundamentally tonal language, in which tonal features have a lexical distribution about as free as that of any other phonological features.

There are several reasons to believe that Yoruba M(id) tone is underlyingly just the absence of tonal features ([1], [12]). We will mention just one of these: tones L and H remain when their lexically-associated vowels delete, but M does not. Thus in the case of a verb followed by a vowel-initial object, one of the two adjacent vowels obligatorily deletes. The tonal consequences are simple to calculate if we assume that M is just the name for lack of tone—then all "real" tones remain stable under vowel deletion.

(1) a. wa (H) + ẹkọ(LH) ⇒
look (for) education
wẹkọ (H LH)
look for education

b. mu (H) + iwe (LH ⇒
take book
muwe (H LH)
take a book

c. jọ (M) + ajẹ (LH) ⇒
resemble witch
jajẹ (LH)
resemble a witch

d. sin (M) + oku (LH) ⇒
bury dead (body)
sinku (LH)
bury the dead

SOURCE OF DATA

There have been several earlier instrumental studies of Yoruba tone (e.g. [3], [14], [6], [4], [5]). In order to apply to Yoruba the scaling technique previously applied to English in [8] and to Igbo in [9], we devised 78 Yoruba phrases exhibiting an appropriate range of tone sequences, with texts that avoid consonants likely to interrupt or strongly affect F0. These phrases were read a total of 18 times each, six in each of three pitch ranges, by three native Yoruba speakers. Pitch range was varied by instructing the speaker, in each utterance, to address one of three (imaginary) interlocutors, placed immediately adjacent to the speaker, across the room, or out the door and down the hall. Within each recording session, the list of phrase/pitch-range combinations was randomized.

In this paper, space does not permit us to report fully on this experiment or to discuss its relation to previous work. Instead, we will focus on three key points and a general conclusion that is suggested by them.

TIMING OF TONE GLIDES

As was first noted in [15], Yoruba HL and LH sequences postpone the falling or rising F0 glide to the second syllable. By comparison, the transitional glide for sequences involving M (HM, ML, MH, LM) occurs significantly earlier.

Figure 1 shows the F0 tracks for the initial LH sequences in the six narrow-pitch-range repetitions of **ọ̀rúnlàmí lèmi** "I am Orunlami"[1] as produced by one male speaker.

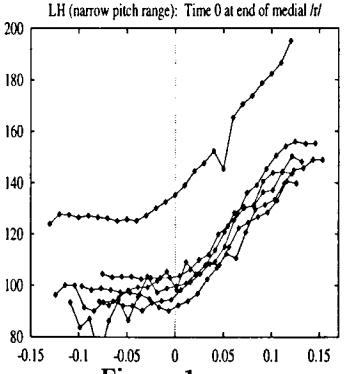

Figure 1

Figure 2 shows the initial LM sequences in six wide-pitch-range repetitions of **ọ̀runlèyẹ lèmi** "I am Orunleye," produced by the same speaker as in Figure 1. In both Figure 1 and Figure 2, the x-axis presents time in seconds, with zero set at the opening of the **/r/** in each utterance, while the y-axis shows F0 in Hz.

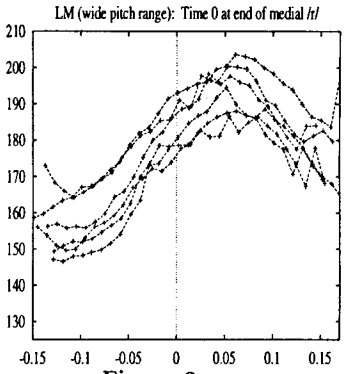

Figure 2

This postponement of the HL and LH glides in Yoruba is a well-established fact. Our contribution is to compare it systematically to HM, ML, MH, LM glides across pitch ranges, and to verify the stability of the difference under this manipulation.

TONE DISSIMILATION

In Yoruba, H is raised before L (as opposed to before M), and L is lowered before H (as opposed to before M). The raising of H before L has been cited in [2], [4], [5]. The lowering of L before H is (we believe) a new observation.

Table 1 exemplifies the raising of H before L, by showing the means and standard errors of peak F0 measurements in each of the three pitch range conditions, for one of three subjects.

	narrow	middle	wide
mean H/_ML	125	154	250
standard error	3.2	8.8	2.6
mean H/_LM	143	182	287
standard error	3.3	7.0	2.9

Table 1

For evidence of the lowering of L before H as opposed to before M, see Figure 3, which plots the relationship of successive L tones in the sequences HLHLM (plotted with squares) and HLHLH (plotted with pluses).

When both L tones are followed by H, the second L tone is considerably

[1] All examples in this paper use the standard Yoruba tone marking convention, according to which H is marked with an acute accent, L with a grave accent, and M with no accent. Vowels with a dot underneath are non-ATR.

lower than the first. This is consistent with the general expectation of downdrift in such sequences; dissimilatory lowering applies to both L tones in this case. When the first L is followed by an H, while the second L is followed by an M, the expected downdrift effect is almost completely nullified. This is because the first L is lowered because it is in an LH sequence, while the second L does not experience this effect. Thus dissimilatory lowering of the first L, and downdrift lowering of the second L, leave them at about the same level.

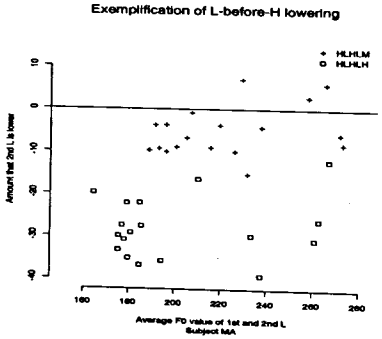

Figure 3

DOWNDRIFT

Since [16] and [13] it has been understood that the tendency of pitch to fall in the course of phrases in tone language like Yoruba is not a sort of phrasal wave on which tonal ripples ride, but rather is connected specifically with alternating high and low tones. Sequences of like tones, especially H tone sequences, remain more or less level.

Since [2], it has been known that in Yoruba, this *downdrift* does not extend to sequences in which H or L alternate with M (HMHM...or MLML...). At least, the amount of downtrend is much lower in these latter cases.

For a quantitative picture of the difference between the amount of lowering in HLHL vs. HMHM or MLML, see Figure 4. Here we show the relationship between adjacent F0 maxima in the sequences HLHL (plotted with squares), HMHM (plotted with pluses) and MLML (plotted with triangles). The x-axis gives the average height of the two F0 maxima, while the y-axis shows the difference between them. In the case of HLHL, this difference is about 15–35 Hz., showing a healthy amount of downdrift, the tonally-conditioned effect that has been called "catathesis." In the case of HMHM and MLML, the difference is about 5–15 Hz., perhaps reflecting the more general downtrend sometimes distinguished as "declination."

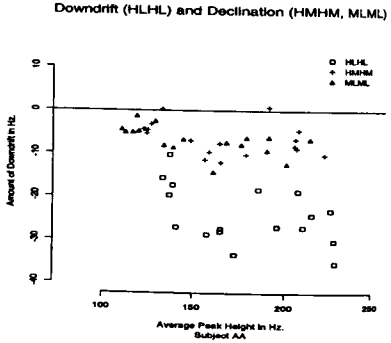

Figure 4

PHONOLOGICAL REPRESENTATION

The postponement of HL and LH tone glides in Yoruba has been treated as a case of tone spreading: an H or L associated with a given syllable comes to be simultaneously associated with the following syllable iff the following syllable bears the opposite tone. This account offers no motivation for the circumstances of the spreading: why should a tone spread to the following syllable if and only if the following syllable is already specified for (a different) tone?

We suggest that the motivation is simple. HL and LH tone glides are phonologically and phonetically natural entities, just as CV syllables are. Yoruba tone spreading is exactly analogous to the re-syllabification of a syllable-final consonant to fill the empty onset of a following onsetless syllable. Thus Yoruba tone spreading is a natural process because it forms cognitively favored structures. There are various plausible ways to express this notion formally, for which space is lacking here.

This idea says, in effect, that Yoruba forms "derived pitch accents" out of adjacent HL and LH tones. Although this does not in itself explain tonal dissimilation and the special status of HL or LH sequences in downdrift, it suggests a direction of research by connecting them to comparable phenomena in Japanese and other languages.

Japanese accent is interpreted (e.g. by [10] as a lexically-specified HL sequence that functions as a unit. *Catathesis* is triggered only by accents in Japanese according to [11]. Each accentless "minor phrase" has an (ungrouped) H and L tone pair, but accentless sequences rise and fall with only a small amount of *declination*. Japanese accentual H is higher than non-accentual H ("accentual boost") according to [7], even though Japanese accent is not stress-like, does not cause greater segment durations, and is not considered a strong position for alignment with music.

REFERENCES

[1] A. Akinlabi. *Tonal Underspecification and Yorùbá Tones.* PhD thesis, University of Ibadan, Nigeria, 1985.

[2] A. Akinlabi and Y. Laniran. Tone and intonation in Yorùbá declarative sentences, 1987.

[3] J. Carnochan. Pitch, tone and intonation in Yoruba. In D. A. et al., editor, *In honour of Daniel Jones*, pages 397–406. Longmans, 1964.

[4] B. Connell and D. R. Ladd. Aspects of pitch realization in Yoruba. *Phonology*, 7:1–30, 1990.

[5] Y. Qlabisi Laniran. *Intonation in Tone Languages: The Phonetic Implementation of Tones in Yorùbá.* PhD thesis, Cornell, January 1992.

[6] J.-M. Hombert. The perception of bisyllabic nouns in Yoruba. *Studies in African Linguistics*, Supplement 6:109–121, 1976.

[7] H. Kubozono. *The Organization of Japanese Prosody.* Kurosio Publishers, Tokyo, 1993.

[8] M. Liberman and J. Pierrehumbert. Intonational invariance under changes in pitch range and length. In M. Aronoff and R. Oehrle, editors, *Language Sound Structure*, pages 157–234. MIT Press, 1984.

[9] M. Liberman, J. M. Schultz, S. Hong, and V. Okeke. The phonetic interpretation of tone in Igbo. *Phonetica*, 50(3):147–160, 1993.

[10] J. B. Pierrehumbert and M. E. Beckman. *Japanese Tone Structure.* MIT Press, Cambridge, MA, 1989.

[11] W. J. Poser. *The phonetics and phonology of tone and intonation in Japanese.* PhD thesis, Massachusetts Institute of Technology, 1984.

[12] D. Pulleyblank. *Tone in Lexical Phonology.* Reidel, Dordrecht, 1986.

[13] J. M. Stewart. Niger-Congo: Kwa. In T. A. Sebeok, editor, *Current Trends in Linguistics 7: Linguistics in Sub-Saharan Africa.* Mouton, The Hague, 1971.

[14] C. L. Velle. An experimental study of Yoruba tone. *Studies in African Linguistics*, Supplement 5:185–194, 1974.

[15] I. Ward. *An introduction to the Yoruba language.* W. Heffer and Sons Ltd., Cambridge, 1952.

[16] W. E. Welmers. Tonemics, morphotonemics, and tonal morphemes. *General Linguistics*, 4:1–9, 1959.