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Lingua 121 (2011) 1631–1648

Contents lists available at ScienceDirect

Lingua

journal homepage: www.elsevier.com/locate/lingua

Disambiguating Yorùbá tones: At the interface between syntax, morphology, phonology and phonetics

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ARTICLE INFO

Article history:
Received 9 March 2009
Received in revised form 26 May 2011
Accepted 28 May 2011

Keywords:
Tone
Interface
Morphosyntax
Mophophonology
Phonetics
Yoruba

ABSTRACT

This paper considers a particular type of tonal behavior in Yorùbá with the goal of testing whether syntactic and phonological domains converge or diverge. We consider two types of syntactically conditioned phonological rules: (i) the appearance of phonological elements not present lexically (epenthesis/insertion), (ii) the loss of phonological elements (deletion). These types of rules are often tightly interconnected as the (apparent) loss of one element may involve the appearance of some other element. The cases we consider here involve two Yorùbá tone rules whose surface effect is to change a lexically specified tone (or tone sequence). One of the rules is syntactically conditioned in that it applies across a phrasal boundary; the other rule is morphologically conditioned in that it applies within the word/X^0 domain. The two tone rules are conditioned by two distinct domains, namely syntax (the phrasal domain) versus morphology (the word-level domain). We will demonstrate that a consideration of two independent well-formedness conditions—syntactic inclusiveness and phonological structure preservation—leads us to entertain the possibility that the outputs of tone rules will be distinct from one another according to whether they apply across a phrasal domain (i.e. are syntactically conditioned) or whether they apply within a word (i.e. are morphologically conditioned).
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1. Introduction: grammar at the interface

As a broad research goal, we seek to test the degree of separation and the range of interactions between the subsystems that constitute knowledge of language. A central question is whether, and to what extent, syntax, morphology, phonology and phonetics share the same theoretical vocabulary. Is it the case, for example, that the domains relevant to morphosyntactic constraints converge with the domains relevant to phonological constraints and phonetic outputs? Consider the category X^0, which is defined as the head of a phrasal constituent XP. Syntax, morphology and phonology all manipulate X^0 elements, defined as simplex words or morphemes. In syntax, it is argued that X^0s divide into two classes: lexical (open-class) versus functional (closed-class) items (Abney, 1987). In morphology, X^0 is commonly considered to be a domain functioning at the interface between the lexicon and the syntax. For example, morphosyntactic categories (root, stem, word) are in a correspondence relation to phonological and phonetic domains; similarly syntactic categories and phrases map onto larger prosodic units (Nespor and Vogel, 1986; Kaisse, 1985; Selkirk, 1986, 1995; Truckenbrodt, 2007). While labels such as 'word' are used both in morphosyntax and morphophonology, it is not a trivial matter to establish whether the constituents so named are formally the same objects. For example, while inflectional affixes are commonly

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doi:10.1016/j.lingua.2011.05.008

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considered syntactic functional X^0 categories (Pollock, 1989; Ouhalla, 1991), they are also considered to be sub-word categories with respect to their morphophonology (Kiparsky, 1982, 1985; Mohanan, 1986). Not only is X^0 a prosodically indeterminate category, but also for analyses that do not adopt an X-bar template (Muysken, 1982; Kayne, 1994; Chomsky, 1995b; Carnie, 2000) a monomorphemic element is structurally ambiguous between X^{MAX} and X^{MIN}, corresponding respectively to XP and X^0 in X-bar theory. If monomorphemic forms are structurally ambiguous in this way, then rules of prosodification should sometimes parse them as heads and other times as phrasal categories.

In this paper, we consider a particular type of tonal behavior in Yorùbá with the goal of testing whether syntactic and phonological domains converge or diverge in this case. We consider two types of syntactically conditioned phonological rules: (i) the appearance of phonological elements not present lexically (epenthesis/insertion), (ii) the loss of phonological elements (deletion). These types of rules are often tightly interconnected as the (apparent) loss of one element may involve the appearance of some other element. The cases we consider here involve two Yorùbá tone rules whose surface effect is to change a lexically specified tone (or tone sequence). One of the rules is syntactically conditioned in that it applies across a phrasal boundary: it changes a lexical Low tone to a surface Mid tone, henceforth *L-raising*. For example, the verb *rà* 'buy' surfaces with a Low tone in final position but raises to Mid before a complement, as in *ra bàtà* 'buy shoes'. The other rule is morphologically conditioned in that it applies within the word/X^0 domain: it changes a High–Low tone sequence to a surface Mid tone, henceforth *HL-simplification*. An example of this is *ẹ́wàkẹ̀wà* 'any kind of beans', derived from the reduplication of *ẹ́wà* 'beans' with the intervening morpheme *kí* (ẹ́wà + kí + ẹ́wà). In our view, these two tone rules—L-raising and HL-simplification—are conditioned by two distinct domains, namely syntax (the phrasal domain) versus morphology (the word-level domain). We recognize that the identification of these domains is, to some extent, a theory-internal decision. For example, in analytic models where all complex expressions are treated as syntactic objects, the distinction that we draw between syntax and morphology would have be to drawn between two types of syntactic objects. The findings reported here bear on both approaches.

In the Yorùbá literature (Ward, 1952; Bámgbóṣé, 1966a; Akinlabí, 1984; Pulleyblank, 1986), it is widely assumed that the M-tone surface outputs of both L-raising and HL-simplification are both phonetically and phonologically non-distinct, both from each other and from underlying M-tones. As we will demonstrate, however, a consideration of two independent well-formedness conditions—syntactic inclusiveness and phonological structure preservation—leads us to entertain the possibility that the outputs of tone rules will be distinct from one another according to whether they apply across a phrasal domain (i.e. are syntactically conditioned) or whether they apply within a word (i.e. are morphologically conditioned).

1.1. Inclusiveness: a syntactic well-formedness condition

Consider first the impact of the inclusiveness condition (Chomsky, 1995a:228), which requires that syntactic derivations be information-preserving:

> A "perfect language" should meet the condition of inclusiveness: any structure formed by the computation... is constituted of elements already present in the lexical items selected for [the] N[umeration]; no new objects are added in the course of computation apart from rearrangements of lexical properties.

On the one hand, no information may be deleted in the course of a derivation; on the other hand, no information may be added in the course of a derivation that was not already present in the initial numeration. On this view, we expect that syntactically conditioned phonological processes will be highly limited in the operations that they can perform. While they might locally reorder elements, they would be prohibited from inserting or deleting them. This predicts that a syntactically conditioned rule such as Yorùbá L-raising cannot be the effect of tone deletion, but can only result from "under-parsing": the lexical L-tone should be present (as required by the inclusiveness condition), but could result in a M-tone pronunciation for other reasons. On independent grounds, exactly this type of analysis has been proposed by Déchaine (2001). In general, inclusiveness predicts that post-lexical phonological rules (Kiparsky, 1982; Mohanan, 1986) should be information-preserving. Note that there is a phonetic caveat to this claim. Information preservation predicts the retention of tonal information; the surface effect of a tone that is retained depends on the rules of phonetic tone realization. Hence it would be possible for a tone to be retained but have no surface effect if no rules of phonetic implementation were sensitive to the presence of such a tone.

Note however that the inclusiveness condition makes no claim about the status of insertion or deletion word-internally: derived X^0s can be, but need not be, information-preserving. Similarly, inclusiveness makes no claim about "insertion" (i.e. epenthesis) that is fully phonological since such phonologically motivated changes have no reflex in either the syntactic or the semantic components of the grammar. It is therefore possible that word-level processes exist that both insert and delete elements. For Yorùbá, this would imply that word-level HL-simplification might arise via tone deletion. Indeed, a consideration of the phonological condition of structure preservation suggests that this is the more likely analysis.

1.2. Structure preservation: a phonological well-formedness condition

In its strongest form, structure preservation refers to the requirement that a class of phonological constraints governs the entire lexicon, that is, governs all X^0s, both underived and derived (Kiparsky, 1985). Irrespective of whether this condition always holds, we test here lexically conditioned versus syntactically conditioned processes to see whether they behave in the same way with respect to constraints that are independently seen to hold of the lexicon.

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In Yorùbá, two X^0-level constraints are relevant to the tonal processes under consideration. First, there are three possible tones in Yorùbá (Ward, 1952; Bámgbóṣé, 1966a; Awóbùlúyì, 1978): High (H), Mid (M), Low (L). All lexical items involve these three tones, and no others. Second, the Yorùbá lexicon does not permit floating tones (Pulleyblank, 1986:188–195, 1994); rather, tones are associated in lexical representations and words do not tolerate more tones than there are tone-bearing units.[1] Regarding syntactically conditioned L-raising, which applies at phrasal boundaries, lexicon-based structure preservation makes no predictions about such a rule. Thus, L-raising may, but need not, obey constraints on tone mapping. In particular, it is possible that the L-tone may be unparsed/floated, and it is possible that the tonal result may be phonetically distinct from an underived M-tone. With respect to word-level HL-simplification, however, since lexical patterns require the obligatory association of all tones, this predicts that because the configuration undergoing simplification is an X^0, it crucially may not involve a floating tone and the tonal result must be featurally comparable to an underived M-tone.

1.3. Syntactically versus Morphologically Derived M-tones

Taken together, inclusiveness and structure preservation make the interesting and testable prediction that surface 'Mid' tones resulting from L-raising and HL-simplification could be representationally distinct from each other. Word-level HL-simplification could produce a M-tone that is identical to M-tones found in underived lexical items (a result of structure preservation). Syntactic L-raising should involve the retention of a floating L-tone (a result of the inclusiveness condition, which requires information-preservation). As we shall see below, experimental results are consistent with these predictions.

After describing the contexts which trigger L-raising and HL-simplification (section 2), we then present the experimental design and the results which confirm that the surface outputs of the two tone rules are distinct (section 3). We go on to consider the implications of these results, and identify directions for future research (section 4), and then conclude (section 5).

2. Syntactically versus morphologically conditioned tone rules

We begin by presenting the basic tonal properties of Yorùbá (section 2.1), and show that while L-raising is syntactically conditioned and applies across a phrase boundary (section 2.2), HL-simplification is morphologically conditioned and applies within a word (section 2.3).

2.1. Basic tonal properties of Yorùbá

Yorùbá has three lexical tone levels: H, M, and L. In addition, there are derived contour tones, namely falling (HL) and rising (LH). There are also cases involving apparent downstepping of mid tones, discussed in section 4.3. Assuming that distinctive features define binary contrasts, to specify a 3-tone inventory such as Yorùbá, at least two tone features are required. Using the features [±Upper Register] and [±Raised], Akinlabí (1984:54–58) and Pulleyblank (1986:125–133) propose the following specifications:

(1) *Yorùbá tone specifications (marked value is boldfaced)*

	[UPPER REGISTER]	[RAISED]
High	+	+
Mid	–	+
Low	–	–
(impossible in Yorùbá)	+	–

On the basis of various tonal asymmetries, the Yorùbá M-tone may be viewed as 'unmarked' relative to H and L (Akinlabí, 1984; Pulleyblank, 1986). Interpreted in terms of the features in (1), the unmarked nature of M results from the value [–Upper Register] being less marked than [+Upper Register], and [+Raised] being less marked than [–Raised]. This can be either achieved through underspecification and redundancy rules (Akinlabí, 1984; Pulleyblank, 1986) or through scalar constraints (Pulleyblank, 2004). Although we assume fully specified outputs with scalar constraints here (see also Laniran, 1992), we discuss both options below since underspecified representations have been assumed in much of the syntactic literature. Whichever mechanism is assumed, L and H each bear one marked feature—[+Upper Register] and [–Raised] respectively—while M is maximally unmarked. The maximally marked combination [+Upper Register, –Raised] is ruled out as impossible in Yorùbá.

[1] There is an interesting class of systematic exceptions to this generalization about floating tones, where what are arguably lexical items contain what are arguably phrasal inputs, for example, *abẹ́nilórí* 'executioner' (a 'agentive' + [bẹ́ 'cut off ẹni 'person' ní 'Case marker' orí 'head']), *abanilórí̩jẹ́* 'person who gets one into trouble' (a 'agentive' + [bà... jẹ́ 'spoil' ẹni 'person' ní 'Case marker' orí 'head']). See Pulleyblank and Akinlabí (1988) for discussion.

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In section 4, we return to the issue of tonal specification, comparing an underspecified analysis with a fully specified constraint-based analysis. At present, however, the crucial points are (i) that at least two features are required for a 3-tone system, and (ii) that M is featurally intermediate between H and L, and unmarked with respect to them. We now illustrate two cases in which Mid tones are derived from Low tones. In one case, M is derived from L (L-raising). In the other case, M is derived from a H-L sequence (HL-simplification).

2.2. Syntactically conditioned L-raising

Based on their forms in isolation, Yorùbá monosyllabic verbs divide into three tone classes: H, M, and L. The following examples illustrate this with the citation forms of verbs:

(2) (a) H-tone verb kọ́ [k ɔ́] 'build'
(b) M-tone verb jẹ [ɟ ɛ̄] 'eat'
(c) L-tone verb mọ̀ [m ɔ̀̄] 'know'

In Standard Yorùbá, before a direct object, monosyllabic H-tone and M-tone verbs maintain their lexical tones, as in (3) and (4). In contrast to this, in the same context, monosyllabic L-tone verbs are raised to M (Ward, 1952:83, *fn.* 1; 91; Abraham, 1958:*xiii*; Bámgbóṣé, 1966a:23; Awóbùlúyì, 1978:52); examples of L-raising are seen in (5).

(3) (a) Mo kọ́ ilé [k ɔ́]
1sg build house
'I built a house'
(b) Mo kọ́ Òjó [k ɔ́]
1sg teach Ojo
'I taught Ojo'

(4) (a) Mo jẹ ilá [ɟ ɛ̄]
1sg eat okra
'I ate (some/the) okra'
(b) Mo jẹ ẹ̀wà [ɟ ɛ̄]
1sg eat beans
'I ate (some/the) beans'

(5) (a) Mo mọ ilé e rẹ̀. [m ɔ̀̄] → [m ɔ̄]
1sg know house GEN 3sg
'I know his/her residence'
(b) Mo mọ ọ̀gá a Délé [m ɔ̀̄] → [m ɔ̄]
1sg know master GEN Dele
'I know Dele's master'
(c) Mo mọ Súlè [m ɔ̀̄] → [m ɔ̄]
1sg know Sule
'I know Sule'
(d) Mo na Tití [n à̄] → [n ā]
1sg beat Titi
'I beat Titi'

The context for L-raising is specified by Pulleyblank (1986) as being a right-adjacent NP, as in (6a). Carstens (1987) restates Pulleyblank's original formulation in terms of a case feature so that a verb's lexical L-tone is deleted before any Accusative XP, as in (6b). Accepting Pulleyblank's (1986) generalization that L-raising is syntactically conditioned and Carstens' (1987) claim that it correlates with Accusative Case, Déchaine (2001) proposes that the labeled bracketing relevant for Accusative Case assignment is (6c), where a verb takes a "Kase Phrase" (KP) complement.

(6) (a) L ->Ø/_]$_V$ [$_{NP}$ (Pulleyblank, 1986:117)
(b) L ->Ø / _]$_V$ [$_{V\ [+ACC]}$ (Carstens, 1987:10)
(c) . . .]$_V$ [$_{KP}$ . . . (Déchaine, 2001:89)

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What all the analyses in (6) share is the claim that the context for L-raising is the syntactic head-complement relation that holds between a verb and its (accusative) direct object. However, the proposals treat the surface output of L-raising differently.

Both Pulleyblank (1986) and Carstens (1987) treat L-raising as an instance of tone deletion. This accords with standard autosegmental analyses of Yorùbá tone (Akinlabí, 1984, Pulleyblank, 1986) that hold that both L and H are marked by tonal features in underlying representation, while M is the pronunciation of tonelessness, i.e. the absence of tonal specification (Kaye, 1981). From this standpoint, the surfacing of lexical L-tone verbs as M does not require substitution of M for L, but can be understood as rule-governed deletion of lexical L, and the subsequent default pronunciation of the resultant toneless syllable as M. On this view, one expects the output of L-raising to be indistinguishable from an ordinary lexical M-tone.

Déchaine (2001) departs from previous analyses and argues that L-raising is an instance of underparsing. Extending Manfredi (1995), she proposes a metrical analysis of L-raising, whereby the phonetic output is the result of an unmetrified L-tone. On this view, it is possible that the output of L-raising would be phonetically distinct from a lexically underived M-tone.

One of the objectives of this paper is to determine whether the output of L-raising is non-distinct from an ordinary M-tone (as predicted by neutralizing accounts) or whether it is distinct from an ordinary M-tone (as predicted by the underparsing account).[2] While it is generally assumed that the derived M-tone of (5) is phonetically identical to the lexical M-tone of (4), we show below that this is not the case. Before turning to a consideration of the relevant phonetic data, we consider a second type of derived M-tone, namely the one that arises in the context of HL-simplification.

2.3. Morphologically conditioned HL-simplification

While L-raising is an instance of a syntactically conditioned derived M-tone, there are also instances of morphologically conditioned derived M-tones, where by 'morphological' we mean word-internal. This occurs with certain types of reduplication where a H–L sequence is simplified to M.[3] There are a wide variety of different types of reduplication in Yorùbá, two of which are relevant here: *-kí-* reduplication meaning 'any N' or pejoratively 'bad N' and *-ní-* reduplication meaning 'to have N' (Awóyalé, 1974; Ogunbowale, 1970; Awóbùlúyì, 1985, Bámgbóṣé, 1986, Pulleyblank and Akinlabí, 1988; Ọla, 1995; Pulleyblank, 2009). These reduplicative forms consist of a noun followed by a *-kí-* or *-ní-* infix followed by a second instance of the same noun, and present the following morphological structure[4]:

(7) a. [N – kí – N]
b. [N – ní – N]

Postma (1995) observes that the formation of reduplicative quantifiers is only possible with bare nouns. For example, like simple Ns (8), reduplicative bare Ns are compatible with pluralization and modification (9). However, it is not possible for reduplicative quantifiers to themselves be formed from modified or pluralized Ns, (10). We take the parallelism between (8) and (9), and the ill-formedness of (10) to indicate that reduplicative quantifiers are word-level forms, i.e. they are instances of X^0/X^{MIN}.

(8) a. ra **fìlà** ńlá
buy cap big
'Buy a big cap'
b. ra àwọn **fìlà**
buy PL cap
'Buy caps'
c. ra àwọn **fìlà** ńlá
buy PL cap big
'Buy large caps'

(9) a. **Fìlàkífìlà** ńlá tí o bá rí ni kí o rà
any.cap big C 2sg MODAL see C C 2sg buy
'Buy any big cap that you find (in the store)'
b. Kó àwọn **fìlàkífìlà** tí o bá ní wá
gather PL any.cap C 2sg MODAL have come
'Bring any kind of caps that you have'

[2] Additional cases comparable to the L-raising examples that are considered here are mentioned briefly in section 4.4.
[3] See section 4.4 for additional examples of H-L sequences being reinterpreted as M.
[4] For a recent treatment of these patterns of reduplication, see Pulleyblank (2009). Note that the cases involving *-ní-* infixation exhibit a productive process of n∼l alternation that is orthogonal to the tonal pattern being considered here.

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c. Kó àwọn **fìlàkífìlà** ńlá tí o bá ní wá
gather PL any.cap big C 2sg MODAL have come
'Bring any kind of large caps that you have'

(10) a. *__Fìlà__ńlá__kífìlà__ńlá tí o bá rí ni kí o rà
any.cap.big that you see be that you buy
[Buy any big cap that you find]

b. *Kó àwọn__fìlàk__áwọn__fìlà__ tí o bá ní wá
gather any-plural-cap that you have come
[Bring any kind of caps that you have]

c. *Kó àwọn__fìlà__ńlá__kífìlà__ńlá tí o bá ní wá
gather any-plural-cap-big big that you have come
[Bring any kind of large caps that you have]

The output of reduplicative forms is sensitive to whether the nominal base is consonant-initial or vowel-initial (Ọla, 1995). This is illustrated schematically in (11) with *-kí-*. With consonant-initial nouns, we observe that the infix is invariantly realized as *-kí-* (as schematized in (11a)); with vowel-initial nouns the juxtaposition of the *-kí-* infix with the second occurrence of the noun results in a vowel-vowel sequence which is resolved into a single short vowel (as schematized in (11b)).

(11)

	BASE	*OUTPUT*
(a)	CVCV	CVCV – kí – CVCV
(b)	VCV	*VCV – $kí_1$ – V_2CV
		VCV – k – V_2CV

Examples of consonant-initial nouns are given in (12). Note that there are no changes in either the segmental melody of the input forms or in the tone.

(12) *[N-kí-N] reduplication with consonant-initial nouns*

	NOUN	*GLOSS*	*N-kí-N*	*GLOSS*
LL	fìlà	'cap'	fìlàkífìlà	'any cap'
LLL	jàgùdà	'thief'	jàgùdàkíjàgùdà	'any thief'
LLLH	jàǹdùkú	'dubious person'	jàǹdùkúkíjàǹdùkú	'any dubious person'
LHMH	sọ̀wédowó	'cheque'	sọ̀wédowókísọ̀wédowó	'any cheque'
HH	ṣíbí	'spoon'	ṣíbíkíṣíbí	'any spoon'
HHH	pátákó	'wood'	pátákókípátákó	'any wood'
MM	tata	'insect'	tatakítata	'any insect'

In marked contrast, consider the V1–V2 sequences produced with the vowel-initial forms in (13). Segmentally, the vowel of the noun is retained (V2) both when the initial vowel bears a M-tone and when it bears a L-tone. Tonally, however, not all cases behave the same way. If the initial vowel of the noun is M-tone, as in (13a), then the H-tone of the infix (underlined in the output forms) survives at the expense of the non-high tone. The same behavior is attested if the initial vowel is L-tone and subsequent vowels are non-L, as in (13b). Relevant to the present discussion are cases where the base bears a LL... pattern. In such cases, as seen in (13c), the input H-L sequence surfaces with a M-tone (Akinlabí, 1984; Abíọ́dún and Ajíbóyè, 2007). We refer to these cases as HL-simplification.

(13) (a) *[N-kí-N] reduplication with vowel-initial nouns, initial M-tone*

	NOUN	*INPUT*	*OUTPUT*	*GLOSS*
MM	ọmọ	ọmọ-kí-ọmọ M M H M M	ọmọkọ́mọ M M **H** M	'any child'
ML	odò	odò-kí-odò M L H M L	odòkódò M L **H** L	'any river'
MH	eré	eré-kí-eré M H H M H	erékéré M H **H** H	'any play'
MML	olorì	olorì-kí-olorì M M L H M M L	olorìkólorì M M L **H** M L	'any queen'

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MHLH	akẹ́kọ̌	akẹ́kọ̌-kí-akẹ́kọ̌ M HLH H M HLH	akẹ́kọ̌kákẹ́kọ̌ M HLH **H** HLH	‘any student’	
MHL	alákọ̀wě	alákọ̀wě-kí-alákọ̀we M H LLH HM H LLH	alákọ̀wěkálákọ̀wě M H LLH **H** H L LH	‘any educated person’	
	(b)	*[N-kí-N] reduplication with vowel-initial nouns, initial L-tone*			
	NOUN	*INPUT*	*OUTPUT*		*GLOSS*
LLM	àkùkọ	àkùkọ-kí-àkùkọ L L M H L L M	*àkùkọkâkùkọ L L M HLL M	àkùkọkákùkọ L L M **H** L L M	‘any cock’
LM	ère	ère-kí-ère L M H L M	*èrekêre L M HL M	èrekére L M**H** M	‘any statue’
LH	àdá	àdá-kí-àdá L H H L H	*àdákâdă L H HL LH	àdákádă L H **H** LH	‘any cutlass’
(c)	*[N-kí-N] reduplication with vowel-initial nouns, L-tone throughout*				
	NOUN	*INPUT*	*OUTPUT*		*GLOSS*
LL	ẹ̀wà	ẹ̀wà-kí-ẹ̀wà L L H L L	*ẹ̀wàkệwà L L HL L	ẹ̀wàkẹwà L L**M** L	‘any beans’
LL	ọ̀rọ̀	ọ̀rọ̀-kí-ọ̀rọ̀ L L H L L	*ọ̀rọ̀kộrọ̀ L L HL L	ọ̀rọ̀kọrọ̀ L L**M** L	‘any talk/nonsense’
LL	èrò	èrò-kí-èrò L L H L L	*èròkêrò L L HLL	èròkerò L L**M** L	‘any thought/bad thought’
LLL	ọ̀gẹ̀dẹ̀	ọ̀gẹ̀dẹ̀-kí-ọ̀gẹ̀dẹ̀ L L L H L L L	*ọ̀gẹ̀dẹ̀kộgẹ̀dẹ̀ L L L HL L L	ọ̀gẹ̀dẹ̀kọgẹ̀dè L L L**M** L L	‘any banana’

In all the examples of (13a), the vowels that the morphology puts in contact with each other bear the tone sequence HM; this sequence is systematically resolved in favor of the H-tone (Akinlabí, 1984). In the cases of (13b), the input tone sequence on the vowels in contact is HL. In Standard Yorùbá, a ...L HL L... sequence is not permitted to surface with the HL as a falling tone, hence the potential HL fall is resolved in favor of a level tone. The default resolution is to simplify the HL fall as a level H-tone, similar to the resolution of a HM sequence. This can be seen in (13b) like *èrekére* ‘any statue’ and *àdákádă* ‘any cutlass’. As Akinlabí (1984) demonstrates, however, when the input sequence would produce a ...L HL... L pattern, this is resolved by simplifying the HL input into a level M-tone. (Note that all the patterns reported here for -kí- are comparable to those found with -ní-.) The standard assumption regarding such a derived M-tone is that it is phonetically identical to an underived (lexical) M-tone. As we will see below, instrumental investigation confirms this assumption.

In summary, there is a class of reduplicative nominals in Standard Yorùbá where we observe a derived M-tone. Although we would expect a falling contour on the basis of the input tonal sequence, such a fall is realized as a level M-tone when it occurs between two L-tones.

3. Experiment

The morphosyntax predicts that the result of L-raising maintains a L-tone in the representation (presumably as a floating L) which could influence the phonetic realization of the resulting tonal sequence. This prediction is compatible with morphophonological considerations, though not required. For HL-simplification, the morphophonology predicts that the result could be a M-tone indistinguishable from underived M-tones; this prediction is compatible with morphosyntactic considerations, though not required.

In order to test these predictions, an experiment was designed to identify whether different types of surface M-tones are phonetically identical. This was achieved by contrasting three environments for surface M-tones:

(a) underived (lexical) M-tones;
(b) derived M-tones arising from L-raising;
(c) derived M-tones arising from HL-simplification.

Fundamental frequency (pitch) values were compared for each category of M-tone.

3.1. Methods

The following sections discuss in turn the criteria for selecting subjects (section 3.1.1), the design and presentation of the stimuli (section 3.1.2), and the procedures used for recording and analyzing data (section 3.1.3).

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3.1.1. Subjects

Five native speakers (2 female, 3 male) of three Yorùbá dialects (Èkìtì, Ìjèsà and Òyó) participated in this study. All subjects were adults aged between 26 and 41 years before migrating to Canada, where they had resided for a period between 2 and 5 years as of data collection. The subjects are identified as MA, PA, FO, OI and BA.

3.1.2. Stimuli

Stimuli were designed to present test items in controlled sentence contexts. Test stimuli consisted of 90 sentences 5–6 syllables long (see Appendix A). Each sentence was presented only once, except in the reduplication frame, where some sentences were repeated to make up the needed number in that frame. Specifically, each of the two sentences containing the sonorant [l] was repeated five times.

3.1.2.1. Conditions tested. Three conditions were tested in the experiment: Underived (lexical) M-tones (Control condition); Syntactically Derived M-tones arising from L-raising; Morphologically Derived M-tones arising from HL-simplification. Where possible, each of these three conditions was tested across multiple contexts, represented as separate sets in the stimuli list shown in Appendix A. Each set contained ten sentences. Conditions included:

(a) Underived M (Control) condition: To ensure an accurate baseline value as an experimental control, examples were collected in several contexts:

(i) word-medial position of M-tone of underived nominals (Appendix A, sets 1–2).
(ii) monosyllabic M-tone verb followed by a direct object (Appendix A, sets 3–4).

(14) Underived M-tone: underived nominal

a.	ọ̀rọ̀ àrọwà wo	'Which persuasive word?'	Set 1, example 3
b.	ìgbà ìkẹfà ni	'It is the sixth time'	Set 2, example 9

(15) Underived M-tone: verb followed by object

a.	kò mà lọ kànga	'S/he never went to the well'	Set 3, example 1
b.	kò lè kọ "Pàta"	'S/he cannot write "Pàta"'	Set 4, example 3

(b) Syntactically Derived M condition (L-raising): Syntactically derived M-tones were collected from L-raising contexts where lexical L-toned verbs are followed by a direct object and surface as M (Appendix A, sets 5–6).

(16) Syntactically derived M-tone: verb followed by object, raised from L to M

a.	kò lè rẹ Dìran	'Dìran cannot fall sick'	Set 5, example 1
b.	kò lè kọ gèlè	'S/he cannot reject a/the head tie'	Set 6, example 6

(c) Morphologically Derived M condition (HL-simplification): The Morphologically derived M-tone in reduplication has as its underlying representation a sequence of H–L which surfaces as M (Appendix A, sets 7–8).

(17) Morphologically derived M-tone: nominal reduplication, HL-simplification to M

a.	ọ̀tọ̀lọtọ̀ ni	'It is entirely different'	Set 7, examples 1–5
b.	ẹ̀wàkewà ni	'It is any kind of beans'	Set 8, example 6

3.1.2.2. Factors controlled for. In collecting data on the fundamental frequency for the target M-tones, the following four factors were controlled for: tonal melody, vowel quality (height and tongue root values) of target M-tone, onset consonant of target M-tone syllable, and intonation effects.

(a) tonal melody: To control for local or sentential tonal interactions, the tonal melody was kept constant. First, the target M-tone, shown in (18) in square brackets, is always preceded and followed by L-tones. In addition, to ensure that the span of syntactically conditioned environments was comparable to the morphologically conditioned environments, all test sentences were constructed with a length of 5–6 syllables and with an invariant tonal melody, namely [(L)LLMLM].

(18) (L) L L [M] L M

(b) vowel height and tongue root values: To control for possible confounding influences on F0 of vowel height (Whalen and Levitt, 1995) and tongue root position (Ohala and Eukel, 1987; Whalen and Gick, 2001), the height and tongue root value of the target M-tone was held constant. Specifically, only mid RTR vowels were used, namely [ɛ] and [ɔ], as in (19):

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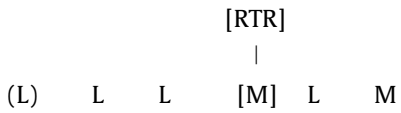
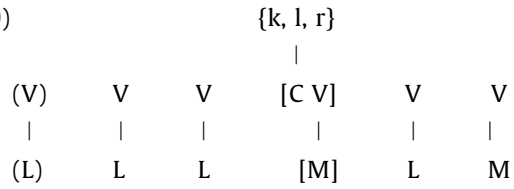
(19)



(c) consonant context: Properties of consonantal context, such as voicing, are well known to affect the pitch of a following vowel (Hombert et al., 1979). It is also possible that the initial consonant of a following syllable could have an effect on the pitch of a preceding vowel, though there is less evidence to support this possibility (Hombert, 1978). To control for possible effects of preceding context, the initial consonant of the targeted syllable was controlled in the experiment. As illustrated in (20), because of limitations on words available in the lexicon, the stimuli for this experiment comprised two near-complete datasets, one with all onsets containing only the sonorants /l, r/ (sets 1, 3, 5, 7), and the other with all onsets containing only the voiceless velar obstruent /k/ (sets 2, 4, 6, 8). The /l, r/ set is the primary set for the experiment, allowing for the testing of all conditions. However, we are aware of only two examples of reduplicated forms having a M-tone target with a sonorant onset (namely ọ̀tọ̀lotọ̀ 'entirely different' and ọ̀pọ̀lọpọ̀ 'plenty' in set 7). Thus, the /k/ sets were constructed to exclude the possibility of lexical effects in the Morphologically Derived condition, as most reduplicated forms of this kind contain /k/ as the M-tone syllable onset (set 8). While it was not possible to control the initial consonant of the following syllable as tightly as the initial consonant of the target syllable, potentially troublesome or unknown factors (e.g., labialvelars) were limited wherever possible. A two-way analysis of variance (ANOVA) was conducted to rule out the possibility that the voicing of the following consonant could have an effect (see section 3.2).

(20)



(d) intonation effects: To control for potential list intonation effects across the experiment, test sentences were interspersed with distractor sentences and randomized. 42 distractor sentences were included (see Appendix A), with tonal melodies distinct from the one used in the test sentences, namely [L. . .LM], as in (18). Distractor sentences were designed so that, at the left edge, distractors could begin with H or M, but not L, while at the right edge, distractors could end in MH, HH, LH, HL but not LM:

(21) *tonal melodies of distractor sentences*
[{H, M, *L} . . . {MH, HH, LH, HL, *LM}]

Test stimuli were combined with 20 of the distractor sentences and randomized. In order to further neutralize the presentation of the data, each randomized block of 10 sentences began and ended with a distractor from the remaining 22 distractors. The resulting blocks of sentences (12 sentences per block) were presented to subjects as described below. All data collected from distractor sentences were omitted from analysis.

3.1.3. Procedures

Data collection for this study took place at the Interdisciplinary Speech Research Laboratory (ISRL) at the University of British Columbia. Each recording session began with a pre-recording test to ensure consistency in dialect and to anticipate any other potentially confounding issues. Participants were seated in a sound protected booth and presented with a printed copy of the stimuli from which they were instructed to read aloud comfortably and at a normal speech rate and pitch.

During data collection, in cases where a sentence was skipped or contained an error because of a misreading of the stimuli, the relevant part of the data set was re-recorded. To ensure continuity within blocks of test items, the subject was stopped at the end of the block where the error was committed and the entire block was repeated.

Acoustic data were recorded using a Marantz model PMD430 cassette tape recorder with an external microphone attached to a stand in front of the subject. Recordings were digitized to a Macintosh computer using Sound Edit 16 v. 2 software. Acoustic analysis was done using Praat software (http://www.praat.org). Pitch tracks were automatically extracted for each target M-tone syllable, and peak F0 values were measured for each target vowel. Statistical analysis was conducted using Statview.

3.2. Results

A two-way analysis of variance (ANOVA) was conducted to compare peak F0 values across M-tone conditions and subjects. Data were collapsed across preceding consonant control contexts (/k/ and /l, r/) as the dataset was balanced for this factor and differences between these contexts were found to be small enough in magnitude not to mask any significant

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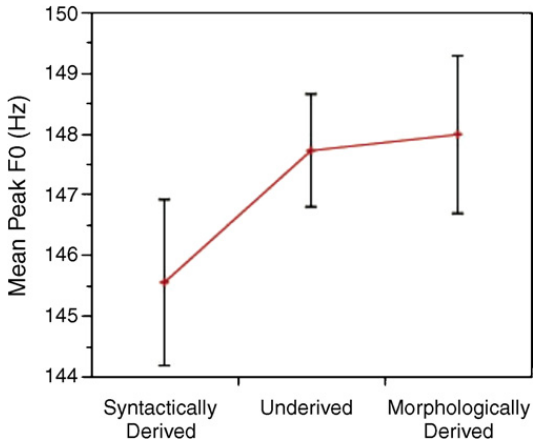

Fig. 1. Mean peak F0 values across speakers comparing Syntactically Derived, Underived, and Morphologically Derived conditions. Error bars show standard deviation.

effects in the data. Also, prior to testing for significance across experimental conditions, a separate two-way analysis of variance (ANOVA) was conducted to test for possible effects of voicing of the following consonant on vowel F0. Results for factor FollowingC [$F(2, 376) = 0.32$; $p > .05$] and for the interaction between factors Subject × FollowingC [$F(8, 370) = 1.45$; $p > .05$] indicated that there was no significant effect of following consonant on the pitch of the target vowels.

The overall effect indicated highly significant differences across subjects and conditions in peak F0 [$F(14, 364) = 442.7$; $p < .0001$]. Not surprisingly, the effect for the factor Subject indicated significant differences in peak F0 [$F(4, 374) = 1387.99$; $p < .0001$]. Likewise, the effect for the factor Condition (which included the three major experimental conditions described in section 3.1.2.1: Underived M-tone [Control], Syntactically Derived M-tone, and Morphologically Derived M-tone) also showed significant variance [$F(2, 376) = 4.11$; $p = .0171$]. As shown in Fig. 1, post hoc (Student's t) results for Condition indicate significant differences between:

(i) the Syntactically Derived M-tone condition and the Underived M-tone (Control) condition ($t = 2.593$; $p = .0099$), with the former being 2.2 Hz lower than the latter; compare "Syntactically Derived" and "Underived" in Fig. 1;
(ii) the Syntactically Derived M-tone condition and the Morphologically Derived M-tone condition ($t = 2.53$; $p = .0118$), with the former being 2.44 Hz lower than the latter; compare "Underived" and "Morphologically Derived" in Fig. 1.

No significant difference was observed between the Morphologically Derived M-tone condition and the Underived M-tone (Control) condition ($t = 0.291$; $p = .7710$). While within-subject results lacked sufficient power to achieve statistical significance in some cases, it is worth noting that every subject followed the same pattern of means (i.e., that the mean peak F0 for the Syntactically Derived M-tone condition was lower than the means for the other two conditions).

3.3. Summary of results

The results of this experiment show that there is a small but consistent difference between the pitch of M-tones derived syntactically from L-tones and other instances of M-tones. Specifically, the syntactically derived M-tones are significantly lower in pitch than lexical or morphologically derived M-tones. While the difference is small (just over 2 Hz), it is similar in magnitude to the frequency difference observed in an incomplete neutralization in Taiwanese Mandarin tone (2.3 Hz; Peng, 2000), and more than double the pitch discrimination threshold for an average adult (about 11.0 cents, or 1 Hz in the 146–147 Hz range of the present findings; see Seashore, 1967:54–55). Research on incomplete neutralization suggests that speakers and perceivers robustly make use of this kind of low-level phonetic information in the perception of duration and final devoicing (e.g., Warner et al., 2004; Ernestus and Baayen, 2006) as well as in tone (Myers and Tsay, 2003; Yu, 2007). Implications or our results are discussed further in the following section.

4. Discussion and implications

The results of this investigation strongly motivate a distinction between the surface representation of underived and lexically derived Mid tones, on the one hand, and syntactically derived Mid tones, on the other. The precise nature of the distinction is a matter of some interest. In this section, we consider three inter-related issues. We first discuss the broad implications of our findings (section 4.1) in connection with the question of how the syntactic inclusiveness condition (assumed in many minimalist style analyses) interacts with the phonological notion of Richness of the Base (postulated in optimality theoretic approaches). We then consider how our findings bear on the language-specific question of how Yorùbá tones are represented (section 4.2). Finally, we contrast the M-tone lowering reported here (induced by a floating L-tone) with the M-tone "lowering" induced in contexts of H-tone raising (section 4.3).

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4.1. Inclusiveness and richness of the base

In terms of the syntax, recall that the *inclusiveness condition* requires that no interpretable features may be added or deleted in the course of a syntactic derivation (Chomsky, 1995a).[5] That is, any interpretable feature must be part of the initial numeration. In terms of the phonology, morphological entries (that is, those forms that enter into the numeration) may contain both phonologically marked and phonologically unmarked features, a consequence of *richness of the base* (Prince and Smolensky, 2004). The phonological grammar itself consists of *faithfulness* conditions and *markedness* conditions. Faithfulness constraints seek to preserve those (marked and unmarked) features that are part of morphological entries; markedness constraints, in contrast, seek to replace marked values by unmarked ones (Prince and Smolensky, 2004).

Together, these principles of the phonology and syntax impose three requirements. First, lexically listed forms may contain both marked and unmarked values. Second, before lexical items are selected for a numeration – at the "pre-numeration" stage – phonological processes may delete marked features and may insert unmarked features. Third, after lexical items enter a numeration – when they are active in a derivation – phonological processes may only insert unmarked features. In other words, once a derivation is active, the only applicable phonological markedness conditions are those which do not violate syntactic inclusiveness.

The cases discussed here are consistent with all three requirements. Lexical entries in Yorùbá may contain instances of both the marked tones {H, L} and the unmarked tone {M}. The rule of HL-simplification applies before the numeration is formed; it deletes both H and L, replacing them by M.[6] Finally, L-raising applies after the numeration is formed: in the course of the derivation, when the structural description of the rule is satisfied, the unmarked tone M is inserted, and in accordance with the syntactic inclusiveness condition, the marked L is not deleted. By viewing these patterns from the perspective of a theory that integrates both syntax and phonology, the particular cluster of properties attested are expected instead of constituting a random coincidence.

4.2. The representation of Yorùbá M-tones

Two hypotheses have been proposed in the literature to account for the unmarked status of Mid tones in Yorùbá. As mentioned above, Akinlabí (1984), Pulleyblank (1986) and Akinlabí and Liberman (1995) propose that the unmarked status of Yorùbá Mid tones derives from underspecification whereas Pulleyblank (2004) argues instead that the asymmetric patterns observed with Mid tones are due to the encoding of markedness as a set of scalar constraints.

Consider a form such as *mo ra igbá* 'I bought a calabash', involving the verb *rà* 'buy' which is underlyingly Low but undergoes raising. According to the underspecification hypothesis, the output of L-raising would be as in (22a); according to the scalar markedness hypothesis, the output of L-raising would involve a specified Mid tone (22b)[7]:

(22) Output of L-raising

	Underlying	Surface	Schematic
a.	L H | | mo ra igba	L H | mo ra igba	L μ
b.	M L M H | | | | mo ra igba	M L M M H | | | | mo ra igba	L M | μ

If the output of L-raising was exactly the same as an underived M-tone, then the behavior of L-raising would not argue for either an underspecified representation or for a specified one. Since our results show that the M derived by L-raising is lower

[5] The notion of *containment* in pre-correspondence versions of OT would have a related effect (Prince & Smolensky, 2004). Unlike *inclusiveness*, however, *containment* would fail to distinguish between the morphologically and syntactically derived Mid tones since *containment* would apply to both. Similarly, if *containment* was added to stratal OT (Bermúdez-Otero, 1999, Kiparsky, 2000, etc.), there would be no obvious reason for requiring that *containment* hold post-lexically but not lexically.

[6] An anonymous reviewer raises the question of whether the change of the H-L sequence to M is a rule of "fusion" or "replacement". That is, there appear to be two formally different options: (i) the tone specified [+upper, +raised] fuses with the following tone specified [−upper, −raised], with the result retaining the unmarked values of the two: [−upper register, +raised]; (ii) the marked H–L sequence is deleted, replaced by an unmarked M-tone. Given our assumptions, either would be possible. As the reviewer points out, however, the former seems plausible in the sense that a tone taking one value from each of the two tones would either end up as [+upper, −raised] or [−upper, +raised]. Both tones are "mid", but the first would be lexically prohibited by structure preservation. This reviewer also notes another point about this type of case. An alternative to fusion or replacement for the medial HL sequence in such a case is to simply delink one of the tones. For example, Bamileke-Dschang simplifies a L–HL–L sequence to L–!L–L. In Yorùbá, this would be impossible lexically given the prohibition on floating tones lexically; in Dschang, the reviewer points out that if the downstep is due to delinking of the H, retention would be required since the process in that language is post-lexical.

[7] In the scalar markedness approach, we assume because of the downstepping facts discussed later that L-raising results in displacement of the Low tone to the left. This accounts for the lowering effect on the following Mid, and could be achieved by a constraint on tonal alignment.

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than an underived M, this argues in favor of the fully specified representation in (22b).[8] There are three reasons for this conclusion.

First, in the representation in (22a), there is no precedence relation between the floating L and the unspecified mora. The second, related problem relates to the absence of tonal target on the unspecified vowel. If we assume that tonal targets must be phonologically specified and that unspecified elements receive values by interpolation (Pierrehumbert and Beckman, 1988; Cohn, 1990), then we would expect an unspecified vowel to have its tone dependent on context, rather than have a Mid-tone target as actually attested. A third problem arises in fast speech in Yorùbá. Bámgbóṣé (1966a:161) notes that in fast speech, a HM pattern may shorten to M, for example, [gbé ē] can be realized as [gbē].

(23) (a) MH ∼ H [mo jẹ ẹ́] ∼ [mo jẹ́]
1sg eat 3sg
'I ate it'

(b) HM ∼ M [mo gbé e] ∼ [mo gbe]
1sg lift eat
'I lifted it'.

If H were specified and M unspecified, then it would be surprising for a specified tone to lose out to a completely unspecified one, as in (23b).

It might be argued that an underspecification analysis would be consistent with the representation in (22b) if redundancy rules were to assign Mid specifications at the end of the lexicon prior to lexical insertion (see Laniran, 1992 for discussion). While this is, in principle, a possible analysis, Pulleyblank (1986:23–24) argues that asymmetric tonal behavior in Yorùbá persists to the postlexical level. As such, we would need an account producing asymmetric patterns at a stage where L-raising is applicable.

4.3. Sources for phonetic M-tone lowering

Independent of the question of how to represent M-tones, note that our results show that floating L-tones have a lowering effect on M-tones. This raises the question as to whether this lowering property is specific to floating tones, or whether all L-tones—linked and floating—have such an effect. Laniran (1992, 1995) and Laniran and Clements (2003) present evidence that linked L-tones do not lower M-tones. The observed lack of M-tone lowering in the context of linked L-tones is consistent with Akinlabí and Laniran (1988) and Akinlabí and Liberman (1995). In contrast, Courtenay (1968, 1971) and Welmers (1973) claim that linked L-tones do cause lowering of M-tones. Whatever the case for linked tones, it is clear in our data that the unparsed (i.e. floating) L of verbs triggers M-tone lowering.

Two issues arise in this context. First, is there independent evidence in Yorùbá for the postulation of floating L-tones? Second, is there independent evidence for such floating L-tones to produce lowering of M-tones? On the first point, there is clear evidence in the literature for the postulation of floating L-tones. Bámgbóṣé (1966b) observes that in cases of vowel deletion, certain L-tones, even when not directly realized, influence surface tones. For example, the final M-tones of (24a) and (24b) are distinct, with the final M of (24b) described as a lowered M-tone (indicated by Bámgbóṣé's 'dot' convention).

(24) (a) Ó fágbo < Ó fẹ́ agbo
3sg want.circle
'S/he wants a circle'

(b) Ó fá.gbo < Ó fẹ́ àgbo
3sg want.infusion
'S/he wants an infusion'

Laniran (1992) discusses this and related cases, providing clear phonetic evidence for the postulation of L-tone effects even when there are no (linked) surface L-tones to induce such an effect. She argues, however, that the effect of the floating L-tone in cases such as (24b) is different in nature than the case we report here (Laniran, 1992, 1995). This is because there is an independent effect whereby H-tones (and not M-tones) are locally raised before L-tones (Connell and Ladd, 1990; Laniran, 1992; Akinlabí and Liberman, 1995). The increased pitch interval observed with the lowered M-tone cases such as (24b) can be attributed to the local raising of H, on the assumption that the latter occurs before any L, whether linked or floating. That is, given an input sequence [H L M] such as (25a), if L floats as in (25b), this yields a surface [H (L) M] ("H !M")sequence. In such a context, the (floated) L would be expected to raise the H. As a consequence of this local H-raising, the interval between

[8] Note that it is not plausible to account for the difference between the two Mid tones featurally. If we were to assume that one of the Mid tones was [+upper, −raised] and that the other was [−upper, +raised], then the mid derived by L-raising would need to be the lower of the two ([−upper, +raised]) since it is lower than the mid derived by HL-simplification. This is doubly wrong in that it predicts that the lexically derived Mid would be higher than an underived Mid and that the Mid derived by L-raising would be the same as an underived Mid.

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H and M would be greater than with a normal [H M] sequence. Thus, the "M lowering" effect could in fact be an instance of local H-raising.

(25) (a)
```
H    [H  L     M]
|     |  |     |
o  f  e  a  gb  o
```
(b)
```
H    [H  L     M]
|     |        |
o  f  a     gb  o
```

Laniran's overall conclusion is that floating L-tones, like linked L-tones, do not induce lowering, but that both floating and linked L-tones induce H-raising (1992, 1995). Given the results reported here, it is clearly important to further investigate the effects of unparsed/floating L-tones in Yorùbá, particularly with respect to their potential lowering of M-tones. Although Laniran's conclusion is that there is no such lowering effect, she notes that for some speakers "the f0 value for the !M is slightly lower than that of the M tone" (Laniran, 1995:391). Unfortunately she does not provide actual figures for this aspect of her study. In addition, Laniran and Clements (2003) observe that one speaker in their study appears to exhibit extra lowering of M-tones after downstepped H-tones, perhaps the conjunction of H-raising with M-tone lowering. What is clear from our study is that floating L-tones can induce lowering of M-tones in a context where H-raising is not relevant. Moreover, the small but significant effect that we observe may in fact be compatible with Laniran's data if not her precise interpretation of the data, and is definitely compatible with Laniran's evidence that floating L-tones in Yorùbá can have an impact on the phonetic realization of tones.

4.4. Directions for future research

We have shown that the phonetic outputs of (26) and (27) are not identical with respect to the realization of the M-tone.

(26) L-raising:

ra bàtà	'buy shoe'	<[rà bàtà]
M L L		**L** L L

(27) HL-simplification:

èròkerò	'any kind of thought'	<[èrò-kí-èrò]
L L **M** L		L L **H** **L** L

The M-tone derived from L-raising is at a lower pitch than an ordinary M-tone. In contrast to this, the M-tone derived from reduplicative HL-simplification is at the same pitch as an ordinary M-tone. The generalization that emerges is the following: syntactically conditioned M-tones do not have the same status as morphologically conditioned ones.

In terms of the syntax-phonology mapping, a possible correlate to this tonal differentiation is in terms of the traditional distinction between a phrasal XP boundary in (26) versus a word-level X^0 boundary in (27). However, in a derivational bare syntax framework, this representational contrast is not statable. In a derivational analysis, one way to distinguish the two contexts is in terms of the mechanism that determines when lexical items are assigned phonological content, namely the point in the derivation where they are "spelled out". Concretely, the concatenation in (26) would be subject to late spell-out; this is equivalent to saying that syntax is opaque to word-internal structures, a recasting of the lexical integrity hypothesis. Such late spell-out is not subject to phonological structure preservation, but is subject to syntactic/semantic information preservation. In contrast, the (word-internal) concatenation in (27) would be subject to early spell-out: by hypothesis, such early spell-out is not subject to syntactic/semantic information preservation, but tends to exhibit phonological structure preservation.

The second crucial point concerns the phonetic interpretation of phonological representations. On the one hand, phonetic interpretation depends crucially on the featural content of the segments and tones comprising a phonological representation. As such, the featural representation of tones is critical. This is not sufficient, however. We also assume following much previous work that the phonetic component interprets phonological representations, assigning detailed pitch representations to tones based (in part) on other adjacent tones. In the case at hand, it is crucial for the interpretation of Mid tones that we know their featural make-up as well as whether they are preceded by an unassociated Low tone.

In future research, we aim to test these experimental results across a broader range of syntactic and morphological contexts. Regarding L-raising, there are (at least) two other contexts which are relevant. First, L-raising also applies within the domain of nominalization (Ajíbóyè et al., 2003) (28). Second, another kind of syntactically conditioned L-raising is found with genitive case assignment (Bámgbóṣé, 1966b), when an LL noun surfaces LM in the context of a genitive construction (29).

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(28) *agentive nominalization*

arabàtà	'shoe buyer'	<[a-rà-bàtà]	
M **M** L L		M **L** L L	

(29) *genitive L-tone raising*

ìlu bàtá	'bata drum'	<[ìlù bàtá]	
L **M** L H		L **L** LH	

As for HL-simplification, a similar phenomenon occurs with loanwords used as a form of address, as in (30).

(30) *loanword HL-simplification*

tiṣa fákúnlé	'teacher Fakunle'	<[tíṣà fákúnlé]	
M M H H H		**H L** HH H	

In addition to testing other instances of L-raising and HL-simplification, as already mentioned above, another area for future investigation is the status of the "assimilated L-tone" (Bámgbóṣé, 1966b; Laniran, 1992, 1995), where a HLM sequence is simplified to HM, as in (31), where the 'dot' indicates the 'assimilated L-tone'. Relevant to the present findings is the question of how this M-tone compares to other derived M-tones.

(31) *assimilated L-tone*

jí .re	'steal statue'	<[jí ère]	
H M		HLM	

5. Conclusion

The results of this investigation motivate a distinction between underived and morphologically derived M-tones, on the one hand, and syntactically derived M-tones, on the other. We found that morphologically derived M-tones are nondistinct from other lexical M-tones, precisely as expected if all such tones are governed by the same set of lexical constraints. In contrast, we found that syntactically derived M-tones are distinct from both derived and underived lexical M-tones. The syntactically derived M-tones are systematically lower than their lexical counterparts, consistent with the preservation of the L-tone in the representation as mandated by information preservation in the syntax. This result is important, both methodologically and theoretically. We investigated the relevant distinction because of the predictions made by integrating morphosyntactic and morphophonological principles, and we tested the predictions using the methodology of instrumental phonetics.

Appendix A. unrandomized stimuli and distractor sentences

The stimuli data set, which as mentioned above consists of 80 distinct sentences, is divided into sets of ten sentences each, as follows:

Underived (lexical) M-tone (Control) condition

Set 1: in medial position of underived nominals (l/r context)

1	Ọ̀rọ̀ Ìrẹṣà ni	'It is a matter relating to Ìrẹṣà'
2	Ìlù Ìlọfà yẹn	'That drum from Ìlọfà'
3	Ọ̀rọ̀ àrọwà wo	'Which persuasive word?'
4	Ẹ̀wà ìrẹsì yẹn	'It is beans meant for that rice'
5	Ìlù Ìrẹṣà ni	'It is a drum from Ìrẹṣà'
6	Ọ̀nà Ìrẹṣà kan	'A road to Ìrẹṣà'
7	Òkè Ìlọfà wo	'Which of the Ìlọfà hills?'
8	Èdè Ìrẹṣà wo	'Which Ìrẹṣà language?'
9	Àjò àlọbọ̀ ni	'It is a journey to go and return'
10	Òdù Ìrẹṣà ni	'It is Ìrẹṣà pot'

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Set 2: in medial position of underived nominals (k context)

1	Ọ̀rọ̀ àkẹtẹ̀ wo	'Which matter relating to àkẹtẹ̀?'
2	Ìlù Ìkẹjà yẹn	'That drum from Ìkẹjà'
3	Ọ̀rọ̀ àkẹtẹ̀ ni	'It is a matter relating to àkẹtẹ̀'
4	Ọ̀rọ̀ ìkẹkùn ni	'It is a matter relating to bondage'
5	Òwò àkẹtẹ̀ ni	'It is a business that involves àkẹtẹ̀'
6	Òdì àkẹtẹ̀ yẹn	'The inside of that àkẹtẹ̀'
7	Ọ̀nà Ìkẹjà kan	'One way to Ìkẹjà'
8	Àṣà ìkọlà yẹn	'That custom of tribal mark'
9	Ìgbà ìkẹfà ni	'It is the sixth time'
10	Ọ̀rọ̀ ẹ̀kọ mà ni	'It is a matter relating to ẹ̀kọ'

Set 3: lexical M-tone verbs followed by object (l/r context)

1	Kò mà lọ kànga	'S/he never went to the well'
2	Kò lè lọ Pàta	'S/he cannot go to Pàta'
3	Kò lè lọ kànga	'S/he cannot go to the well'
4	Kò lè rọ ọ̀bẹ	'S/he cannot make a knife'
5	Kò lè rẹ gèlè	'S/he cannot soak a/the headtie'[9]
6	Kò lè rẹ fìlà	'S/he cannot soak a/the cap'
7	Kò lè rẹ Dère	'S/he cannot soak Dère'
8	Kò lè rẹ Dẹ̀jọ	'S/he cannot soak Dẹ̀jọ'
9	Kò lè rẹ Sàra	'S/he cannot soak Sàra'
10	Kò lè rẹ Dàda	'S/he cannot soak Dàda'

Set 4: lexical M-tone verbs followed by object (k context)

1	Kò lè kọ "màna"	'S/he cannot write "know in-law"'
2	Kò lè kọ "kànga"	'S/he did not write "well"'
3	Kò lè kọ "Pàta"	'S/he cannot write "Pàta"'
4	Kò lè kọ "Ṣògo"	'S/he cannot write "Ṣògo"'
5	Kò lè kọ "Dẹ̀jọ"	'S/he cannot write "Dẹ̀jọ"'
6	Kò lè kọ "jẹ̀kọ"	'S/he cannot write "jẹ̀kọ"'
7	Kò lè kọ "tòro"	'S/he cannot write "tòro"'
8	Kò lè kọ "gàgbọn"	'S/he cannot write "gàgbọn"'
9	Kò lè kọ "jòro"	'S/he cannot write "jòro"'
10	Kò lè kọ "pẹ̀fọn"	'S/he cannot write "pẹ̀fọn"'

Syntactically derived M-tone condition (L-raising)

Set 5: syntactically derived M-tone from L-raising on verbs (l/r context)

1	Kò lè rẹ Dìran	'Dìran cannot fall sick'
2	Kò lè rọ Sàra	'S/he cannot urge Sàra'
3	Kò lè rẹ Dẹ̀jọ	'Dẹ̀jọ cannot fall sick'
4	Kò lè rọ Dère	'S/he cannot urge Dère'
5	Kò lè rẹ Ṣògo	'Ṣògo cannot fall sick'
6	Kò lè rọ Ṣògo	'S/he cannot urge Ṣògo'
7	Tètè rọ Dàda	'Urge Dàda in good time'
8	Kò lè rẹ Dère	'Dère cannot fall sick'

[9] Four forms were excluded from the analysis as they did not meet the tonal restriction of having the invariant melody [(L)LLMLM]: 3.5, 3.6, 6.6, 6.9.

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9 Kò lè rọ Dẹ̀jọ ‘S/he cannot urge Dẹ̀jọ’
10 Tètè rọ Dẹ̀jọ ‘Urge Dẹ̀jọ in good time’

Set 6: syntactically derived M-tone from L-raising on verbs (k context)

1 Kò lè kọ Dìran ‘S/he cannot reject Dìran’
2 Kò lè kọ Sàra ‘S/he cannot reject Sàra’
3 Kò lè kọ Dẹ̀jo ‘S/he cannot reject Dẹ̀jo’
4 Kò lè kọ Kànga ‘S/he cannot reject the well’
5 Kò lè kọ Sògo ‘S/he cannot reject Sògo’
6 Kò lè kọ gèlè ‘S/he cannot reject a/the head tie’
7 Tètè kọ Dàda ‘Reject Dàda in good time’
8 Kò lè kọ Dère ‘S/he cannot reject Dère’
9 Kò lè kọ fìlà ‘S/he cannot reject a/the cap’
10 Tètè kọ Dẹ̀jọ ‘Reject Dẹ̀jọ in good time’

Morphologically derived M-tone condition (HL-simplification)

Set 7: derived M-tone from HL-simplification (l/r context)

1-5 Ọ̀tọ̀lọtọ̀ ni ‘It is entirely different’
6-10 Ọ̀pọ̀lọpọ̀ ni ‘It is plenty’

Set 8: derived M-tone from HL-simplification (k context)

1 Ọ̀tẹ̀kọtẹ̀ wo ‘Which of the intrigues?’
2 Ẹ̀bàkẹbà wo ‘Which kind of ẹbà ?’
3 Ọ̀fọ̀kọfọ̀ wo ‘What kind of sorrow?’
4 Ẹ̀ṣẹ̀kẹṣẹ̀ ni ‘It is any sin’
5 Ọ̀dàkọdà wo ‘Which kind of paint?’
6 Ẹ̀wàkẹwà ni ‘It is any kind of beans’
7 Ọ̀rọ̀kọrọ̀ ni ‘It is any matter’
8 Ẹ̀fẹ̀kẹfẹ̀ wo ‘What kind of jest?’
9 Ọ̀kọ̀kọkọ̀ ni ‘It is any kind of spear’
10 Ẹ̀yàkẹyà ni ‘It is any tribe’

Distractor sentences

1 Tolú fáta rẹ̀ ‘Tolú wants his/her pepper’
2 Pẹ̀kun kájọ rẹ̀ ‘Pẹ̀kun collected his (monetary) contribution’
3 Túndé fẹ́yẹ rẹ̀ ‘Túndé wants his/her bird’
4 Òjó káṣọ rẹ̀ ‘Òjó packed his clothes’
5 Dère mẹ́ja bọ̀ ‘Dère brought fish’
6 Bàbá dọ́bẹ rẹ̀ ‘The father broke his knife’
7 Délé jẹ́rọ bọ̀ ‘Délé stole an engine while coming’
8 Kúnlé géku rẹ̀ ‘Kúnlé cut his rat’
9 Dàda fére rẹ̀ ‘Dàda wants his image’
10 Òjó márọ bọ̀ ‘Òjó brought a funnel’
11 Adé wẹ ajá ‘Adé bathed the dog’
12 Kúnlé na Títí ‘Kúnlé beat Títí’
13 Òjó bẹ Adé ‘Òjó begged Adé’
14 Adé kọ Bísí ‘Adé divorced/rejected Bísí’
15 Délé gba Fúnmi ‘Délé snatched Fúnmi’

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16 Títí so ajá ‘Títí tied the dog’
17 Tolú jẹ múkẹ́ ‘Tolú ate múkẹ́’
18 Kíkẹ́ ṣe Dúpẹ́ ‘Kíkẹ́ harmed Dúpẹ́’
19 Ṣopé so ajá ‘Ṣopé tied the dog’
20 Jọkẹ́ lọ Osí ‘Jọkẹ́ went to Osí’
21 Rọ́pò gbẹ̀bẹ̀ ‘Rọ́pò has accepted the apology’
22 Kúnlé fárígá ‘Kúnlé rejected it outrightly’
23 Bọ́sẹ̀ kò sọkún ‘Bọ́sẹ̀ did not weep’
24 Títí bẹ̀ ẹ́ tì ‘Títí begged him without success’
25 Súlè ti débí ‘Súlè has arrived here’
26 Fẹ́mi máa sùn kẹ̀ ‘You mean Fẹ́mi will sleep’
27 Jọ́kẹ́ ti sá lọ ‘Jọ́kẹ́ has escaped’
28 Akin kò wá ‘Akin did not come’
29 Olòṣì ni wọ́n ‘They are paupers’
30 Onílé ti dé ‘The landlord has come’
31 Jọkẹ́ kúkú oró ‘Jọkẹ́ died a painful death’
32 Àṣàkẹ́ kò mọ̀ mí ‘Àṣàkẹ́ does not recognize me’
33 Ṣadé dèrò ẹ̀wọ̀n ‘Ṣadé is in jail’
34 Bàbá Ọlá dà ‘Where is Ọlá’s father?’
35 Ó ṣẹ̀rù bà wọ́n ‘S/he made them tremble’
36 Ó yọ lójijì ‘S/he suddenly appeared’
37 Àdìgún lá àlá ‘Àdìgún had a dream’
38 Mo rí òkú àgbò ‘I saw the corpse of a ram’
39 Dúpẹ́ jẹ tẹ́tẹ́ ‘Dúpẹ́ won a lottery’
40 Fànkúfà wù mí ‘I love Vancouver’
41 Arọ fò fáyọ̀ ‘The lame jumped for joy’
42 Ẹ̀bà sú mi ‘I am tired of eating ẹ̀bà’

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