Tone Mapping in Leggbó[1]

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1.   Introduction

Among the most persuasive arguments in favor of a suprasegmental analysis of tone derives from cases where a limited number of "tonal melodies" characterize a constituent or domain independent of the number of tone-bearing units (syllables, moras). The most well-known case, Mende, was analyzed by Leben (1973, 1978) as having five melodies, L(ow), H(igh), LH, HL, and LHL, which would be mapped onto mono-, bi- and trisyllabic words in a left-to-right fashion. While Dwyer (1978), Conteh et al (1983), and others have challenged this analysis of Mende, the Bantu language Kukuya less controversially limits mono-, bi- and trimoraic stems to one of the above tonal melodies (Paulian 1975). An issue, however, arises in this language concerning the correct notion of tone mapping. As expected, the HL melody maps as H-L-L on three moras, e.g. káràgà 'be entangled', suggesting left-to-right tone mapping. However, the LH melody is realized as L-L-H, e.g. mʷàrə̀gí 'younger brother', not as *L-H-H, (*mʷàrə́gí). Three different approaches have been taken to derive L-L-H:

The first approach is to assume that there is something special about the middle mora of a trimoraic stem. Paulian (1975) suggests that the first mora carries a primary accent, while the last mora carries a secondary accent. The middle mora of trimoraic stems is unaccented.[2] In what would now be referred to as edge-in association (Yip 1988), Paulian proposes that the HL and LH melodies map onto trimoraic stems by placing the first tone on the first mora and the last tone on the last mora. In case of the H and L "schèmes tonals", the H or L tone is assigned to both moras. Paulian suggests that the middle mora, as a consequence of being unaccented, takes the "unmarked" tone, i.e. L.[3]

The second approach, adopted by Hyman (1987), is to assume that mapping is indeed left-to-right, but that L-H-H must be converted by rule to L-L-H. The need for a patch-up rule is perhaps unfortunate, although it is argued that such an identical rule of L tone spreading is needed at the clitic group level.

A third approach is to draw on the asymmetry between H and L tones. Zoll (2002) questions whether there is evidence for left-to-right mapping independent of morphological considerations.[4] Rather, she proposes that languages can differ in their preference vs. dispreference for output HH (clash) vs. LL (lag) sequences. According to Zoll, Kukuya is in the latter category, where *Clash outranks *Lag. Thus, L-L-H is preferable to *L-H-H (and, of course, H-L-L is preferable to *H-H-L).

An important issue that needs to be raised in this context is the issue of morphology. Following Pulleyblank (1985), it is generally assumed that directionality effects may in some cases be

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[2]This corresponds to what has been called the "prosodic trough" in Bantu (Hyman 1998).

[3]In mapping the H melody to a trimoraic stem, the middle mora must also be pronounced H, or we would obtain an unacceptable *H-L-H sequence. In the case of a LHL melody, the two Ls will be assigned to the initial and final accented moras, thereby leaving the intervening H, which will in this one case link to the unaccented mora.

[4]That is, cases where it appears that tones map in a left-to-right fashion are either attributable to a cyclic assignment of tone, following the morphological structure, or to principles other than a phonological directionality parameter.

attributable to the morphological source of the implicated tones. Within Bantu and much of Benue-Congo there are many cases where a root tone is realized exactly on the one root vowel, and a second, suffixal tone is realized on all successive (suffixal) moras. This what what Meeussen (1967) reconstructs for Proto-Bantu.[5]

As Zoll points out, the arguments for directional tone mapping are based on surprisingly few cases. Concerning her proposal, if apparent directionality effects are instead attributable to whether a language likes to repeat a H vs. L tone, the question naturally arises as to how M(id) tone will be treated in a three-level system with tone melodies. Though rare within Bantu, M tones abound within neighboring Bantoid and other Benue-Congo languages to the West.

In this study we therefore consider mapping of H, L and M tones in the Upper-Cross language, Leggbó. Although most of our discussion will concern verbs, which are more robustly templatic, we first consider noun tones in §2 to establish the basic properties of the system. This is followed by our main discussion of verb tones in §3, and our conclusion in §4.

2.   Noun tones

As in many other languages, Leggbó nouns exhibit a wider range of tonal patterns than verbs. In order to avoid reduplications, compounds, and borrowing, we shall limit ourselves to nouns whose stems are clearly monomorphemic. Out of 844 nominal entries in our lexicon, 613 nouns fall into this category. Among these nouns, the vast majority carry one of the prefixes in (1).

(1)   Noun prefixes

li-	i-	N-	[m-, n-, ŋ-]
lɛ- ~ le-	ɛ- ~ e-		
gi-	a-		
gɛ- ~ ge-			

As seen, a noun prefix may have the shape CV- or V-, or it may consist of a homorganic nasal N-. As also seen in (1), the vowels are limited to /i/, /ɛ/ and /a/, round vowels being prohibited in prefixes.[6] Prefixal /ɛ/ harmonizes to [e] when followed by /i/, /e/, /u/ or /o/ in the root, e.g. lè-sàl 'tooth' vs. lè-bèl 'beard'.

Unlike neighboring languages such as Lokaa and Mbembe, which have full concord systems, there is no noun class agreement in Leggbó. Instead, these nominal prefixes are simply lexical, although still easily isolable, as seen, for example, from nominalizations such as in (2).

(2)   Nominalizations

dzàŋà	'quarrel'	lì-dzàŋàl	'quarreling'
vè	'sing'	lè-vèl	'music, song'
mmàna	'be born'	lɛ̀-mmànàl	'birth'
baa	'marry'	gi-báà	'marriage'
dì	'speak'	gè-dì	'story, speech'
yàal	'paddle'	gɛ̀-yàlí	'paddle'

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[5]A case in point concerns the LHL melody in Kukuya, which is obtained only when a L verb root cooccurs with the aspectual suffix HL. Where the verb root is H, the expected H+HL sequence is treated as a HL melody, presumably an OCP effect.

[6]The absence of rounded vowels appears to be a general property of affixes in many Niger-Congo languages. In Leggbó verb suffixes are also limited to /-i/, /-E/ and /-a/, although the last of these assimlates to a preceding mid vowel in front/back and ATR (Hyman et al 2002).

kkpɔŋɔ	'be tall'	ì-kkpɔ́ŋɔ	'height'
dèem	'bathe'	e-dèèm	'bath'
vaan	'wrestle'	m-vaan	'wrestling'
doŋŋi	'beg'	n-doŋŋi	'begging'
kàam	'help'	ŋ-kaami	'assistance'

Concerning tone, of the 578 prefixed nouns entered into the lexicon, 380 have a L prefix, while 190 have a M prefix. This leaves only the following 8 nouns with H tone prefixes:

(3)   Nouns with H prefix

lí-ddaddil	'rejoicing'	á-kkpaŋ	'plate'
lí-dzil	'food'	lí-kpaal	'community'
í-kílíbí	'cowry'	á-ŋàlà	'garden egg'
é-kko	'vegetable (sp.)'	ɛ́-wàwàɛ́	'child-like'

The first two are nominalizations (cf. ddaddi 'rejoice', dzi 'eat'), while others may be borrowings.

Finally, approximately 5% of nouns occur without a syllabic prefix. The following is the list of the eight monosyllabic nouns we have found which lack a prefix:

(4)   Monosyllabic nouns lacking a syllabic prefix

a.	sìn	'hair'		dzɔ̀	'snake'
	ddɛ̀n	'eye'		kkwàl	'boat'
	dzè	'crocodile'		vèè	'theft, stealing'
b.	kkòo	'tomorrow'			
c.	vvɔ́m	'thing' (cf. vvɔ̀)			

As seen, the six nouns in (4a) all carry L tone. In (1b) the noun kkòo 'tomorrow' carries LM tone.[7] The one noun in (1c) which carries H tone is exceptional. Its final [m] often falls out, in which case it is pronounced with L tone, e.g. vvɔ́m lómin ~ vvɔ̀ lómin 'my thing'. It is likely that the prefix of the nouns in (4), which was probably L tone, either fused with the stems (which may have been vowel-initial)   or dropped out.

Noting that the vast majority of nouns carry a L or M prefix, let us now turn to the tones of noun stems. In (5) we present the number of each tone pattern on monosyllabic noun stems.[8]

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[7]The only other two nouns which carry this stem tone are ge-kùa 'masquerade' and ì-zɔ̀ɔn 'clay pot (generic)'.

[8]It should be noted that both H and M tones are pronounced as a fall, i.e. $\widehat{HL}$ and $\widehat{ML}$, respectively, when directly preceding a pause. We abstract away from this process in presenting lexical tones in this study.

(5)   Tone patterns of monosyllabic noun stems with a short vowel

	CV	CCV	CVC	CCVC	Totals
H	9	16	17	10	52
M	18	24	16	11	69
L	28	39	32	15	114
HM					
HL				1	1
MH					
ML					
LH		1		3	4
LM				1	1
Totals	55	80	65	41	241

The following generalizations can be gleaned from the table of monosyllabic noun stems in (5).

(i) 297 out of 326, or 91% of the monosyllabic noun stems, carry one of the three level tones H, M or L. This suggests strongly that there is a tendency to have one tone per tone-bearing unit (TBU). Examples of these major tonal patterns are given in (6).[9]

(6)   H stem   M stem   L stem
a.   CV   :   gὲ-dɔ́   'throat'   gὲ-kɔ   'bone'   gɛ-dɔ̀   'goitre'
b.   CCV   :   ὲ-bbɔ́   'branch'   ὲ-ttɔ   'house'   ɛ-ggɔ̀   'cloth'
c.   CVC   :   lì-tɔ́l   'ear'   lì-vɔl   'belly'   ὲ-nɔ̀n   'person'
d.   CCVC :   ὲ-ppyɔ́ŋ   'hornbill'   lè-ttol   'head'   lὲ-mmɔ̀l   'muscle'

(ii) Of the three level tones, L is by far the most frequent, almost equal to the combined number of H and M stems: 114 L stems vs. 52 H and 69 M. We already know that L prefixes outnumber M prefixes (and, of course, H prefixes, which are exceptional), but the same bias seems to be true of monosyllabic noun stems as well.

(iii) Only one out of 135 CV and CCV stems, i.e. .7%, carries a tonal contour (LH). Only five out of 106 CVC and CCVC stems, or 4.7%, carry a contour (HL, LH or LM). As seen in (7), all six of these noun stems begin with a fortis consonant (CC). Note also that two of these are temporal nouns, while the other four refer to animals, one of which is also reduplication.

(7)   Monosyllabic stems with a short vowel and contour tone

	HL stem	LH stem	LM stem
a. CCV :		e-ggǔ 'catfish (sp.)'	
b. CCVC :	ge-ppyôn 'afternoon'	le-ssĭl 'electric fish'	li-ssǒl 'last year'
		i-ffĭn 'cricket'	
		ttĕm-ttĕm 'pigeon'	

Let us now compare in (8) the tonal distributions on short stems which involve a long vowel (VV) or vowel sequence (V.V):

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[9]CC stands for a fortis (or geminate) consonant, which in lexical entries can only be preceded or followed by a short vowel. The one counterexample kkòo 'tomorrow', may be analyzed as bisyllabic (underlying /kkò-a/, where /-a/ assimilates to a preceding mid vowel (cf. the -a suffix in verbs in §3).

(8)   Tone patterns of short stems with VV or V.V

	CVV	CCVV	CVVC	CCVVC	CV.V	CCV.V	CV.VC	CCV.VC	Totals
H	2		7						9
M	2		15		2	1	1		21
L	10		13	1	3		2	2	31
HM	1						1		2
HL	2		2	1		2		1	8
MH			1						1
ML	1				2	2			5
LH	2		1				1		4
LM		1	1		1				3
Totals	20	1	40	2	8	5	5	3	84

Here we observe the following:

(i) As in (5), the number of L stems is roughly equivalent to the combined number of H and M stems (31 vs. 30). Examples are seen in (9).

(9)   VV and V.V stems with a single tone

			H stem		M stem		L stem	
a.	CVV	:	gè-tɔ́ɔ́	'work'	gè-bɔɔ	'arm'	i-tɔ̀ɔ̀	'dispute'
b.	CCVV	:	---		---		---	
c.	CVVC	:	lì-bɔ́ɔ́l	'poison'	lì-kɔɔl	'bush'	lì-tɔɔl	'harvest'
d.	CCVVC	:	---		---		lè-ddɛ̀ɛ̀l	'greeting'
e.	CV.V	:	---		gè-wai	'comb'	gè-bùà	'waterpot'
f.	CCV.V	:	---		gè-dzai	'richness'	---	
g.	CV.VC	:	---		ge-yuan	'humor'	li-vùàl	'ant (sp.)'
h.	CCV.VC	:	---		---		è-kpùàn	'money'

(ii) Compared to monosyllabic noun stems with a short vowel, the number and percentage of contour tones on short stems with VV or V.V is much higher, but with a difference: 13 out of 63 or 20.6% of the VV stems carry a contour, while nearly half (10 out of 21, or 46.7%) of the V.V stems carry a contour.

(iii) As seen in (9), there are many gaps. A long vowel (VV) is generally prohibited after a fortis consonant (CC) in lexical entries. Besides the derived noun lè-dɛ̀ɛ̀l 'greeting' in (9d) (cf. ddɛ̀ 'greet'), the temporal noun kkòo 'tomorrow' and the possibly borrowed noun à-ŋwááŋ 'cat' are also exceptional.

(iv) It should be noted that nouns with a vowel sequence do not occur with H tone. We shall see shortly that bisyllabic noun stems with H-H tone are extremely rare. Thus, if we analyze V.V as constituting two syllables, the gaps in the first column of (9e-h) fall into place. This also likely explains why there are so many tone sequences on V.V noun stems.

While it is clear that sequences of non-identical vowels should be analyzed as bisyllabic, the analysis of long vowels is ambiguous. In some cases we are dealing with an underlying long vowel, while in other cases we may have a vowel sequence. In §3 we shall see that verbs may occur with a lexical suffix /-a/ and that this suffix assimilates to a preceding mid vowel. Thus, phonetic [ee, ɛɛ, oo, ɔɔ, aa] may be analyzed either as underlying long vowels or as /ea, ɛa, oa, ɔa, aa/ sequences. Only one noun, lè-vîil 'owl' has a long [ii] and only two have a long [uu]: è-duum 'husband', gi-tuùtù(wɛ́) 'baby'. Examples of contours occurring on both VV and V.V are given in (10).

(10)   Short stems with a long vowel and contour tone

			stem ending in VV(C)		stem ending in V.V(C)	
a.	HM	:	a-dáa-a-dáa	'baboon'	n-dzúan	'lie'
b.	HL	:	à-móò	'jug, cup'	gè-vvúà	'poverty'
			lὲ-báàl	'breast'	li-ssúàl	'feather'
c.	MH	:	ì-vɔ́ɔn	'tilapia (sp.)'	---	
d.	ML	:	i-yaà	'grandmother'	gè-zuà	'soup, sauce'
			lɛ-kkaàl	'message'	li-vɛ̀ìl	'wing'
e.	LH	:	gè-kpòó	'bug (sp.)'	---	
f.	LM	:	kkòo	'tomorrow'	ge-kùa	'masquerade'
			ì-zɔ̀ɔn	'clay pot'	---	

In (11) we summarize the attested tone patterns on bisyllabic noun stems. Only those which end in a short vowel or a Vl sequence have been considered.[10]

(11)   Tone patterns of bisyllabic noun stems

	CVCV	CCVCV	CVCCV	CCVCCV	CVVCV	Totals
H-H	1	1				2
H-M	11	1	1	4	5	22
H-L	6	5	3	1		15
M-H	1					1
M-M	15	3	10	3	3	34
M-L	7	3	1	1	4	16
L-H	10	2	3	5	1	21
L-M	7	4		1	3	15
L-L	20	10	5		7	42
Totals	78	29	23	15	23	168

This time we have arranged the tone patterns in terms of the tone of the first syllable. As seen, 78 bisyllabic nouns have an initial L tone, 51 have M, and 39 have H. While not all combinations occur with equal frequency (e.g. there is only one M-H stem in the corpus), the following seven seem to be robustly attested: H-M (22), H-L (15), M-M (32), M-L (16), L-H (21), L-M (16), and L-L (41). Thus, H is rare in a second stem syllable unless preceded by L. All nine patterns are exemplified in (11).

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[10] The reason for including nouns which end in Vl is that the final -l is not part of the stem, but rather a redundant suffix required on all nouns which take a li- or le-/lɛ- prefix. Thus compare the following related nouns which carry different prefixes (cf. also dum 'bite'   lè-dul 'a bite'):

lὲ-bɔɔl	'handle'	vs.	gè-bɔɔ	'hand'
lè-dil	'palm seed'		è-di	'palm (tree)'
lè-dzìl	'day'		è-dzì	'sunshine'
lὲ-káalal	'English'		ὲ-kaala	'European'
lὲ-mmàl	'door'		gὲ-mmà	'mouth'
li-vɛ̀l	'wing'		gὲ-vὲ	'foot, leg'

In addition, of the 86 nouns having a monosyllabic stem ending in [l], all but three have a li- or lɛ- prefix: ὲvaal 'chief' (but cf. lὲ-vaal 'chieftancy'), kwàl 'boat' (kwààl?), ŋ̀-kul 'flogging'. Nouns which end in a different consonant, or in a long vowel, are excluded from (10) since they have a greater chance of being a compound, borrowing, or reduplication.

(12) Bisyllabic noun stem tone patterns

a.	H-H	:	ì-válá	'shame'	gè-vvúlá	'water yam'
b.	H-M	:	ì-tóbo	'monkey'	ge-nyíli	'insult'
c.	H-L	:	ge-kúmmà	'shelter'	gè-ppáɲà	'part, piece'
d.	M-H	:	gɛ-badá	'whole'		
e.	M-M	:	gɛ-kɔmɔ	'heat'	ge-muni	'anthill'
f.	M-L	:	gè-tumì	'millipede'	ge-kubbà	'street'
g.	L-H	:	lè-kòlól	'calabash'	`m-bèkké	'pawpaw'
h.	L-M	:	ì-mène	'firewood'	i-yàŋa	'cane, whip'
i.	L-L	:	ì-dɛ̀lɛ̀	'vulture'	gè-lɔ̀bbà	'mud'

Besides the above patterns, two nouns have been found with contours on a short vowel: gè-vávǎ 'armpit' and dzêmmà 'today'. The possibility of a tonal contour on the first syllable of CVVCV nouns, however, has been noted and is directly relevant to the issue of tone mapping which will be discussed in §3. In particular, we are concerned whether the bitonal melodies in (11) map by syllable or by mora.

Since H-L and M-H are not found on CVVCV nouns, only the four tonal melodies in (13) can be considered:

(13) Bitonal melodies on CVVCV nouns

|						
a.	H-M	:	li-vɛ́ɛ́lɛl	'grass'	gɛ-káána	'star fruit'
			gɛ-kɔ́ɔ́mi	'cotton tree'	ge-tééwa	'rain'
b.	M-L	:	à-tɛ̀ɛmì	'farm'	n-zaànà	'maize'
			ì-laàsì	'rice'	ì-toòì	'pick' (for taking yams from pot)
c.	L-H	:	lɛ-màànál	'giving birth'		
d.	L-M	:	ǹ-tààmi	'gift'	ŋ̀-kààmi	'assistance'

As can be seen, H-M, L-H and L-M map by syllable, the ML-L stems in (13b) show that M-L maps by mora. As we shall see in §3, it appears that a descending melody tends to have this realization in verbs as well—although, as in nouns, M-L is more likely to be realized ML-L than is H-M likely to be realized HM-M. However, one noun out of the five H-M CVVCV stems is pronounced this way: lɛ-káalal 'English'. We shall see more such cases in our discussion of verbs.

To summarize this section, while nouns do not exploit every possible combination of tones, we clearly need H, M and L (and combinations thereof) in the lexical entries.[11] The situation in the verb system is interestingly different.

3. Verb tones

In this section we are concerned with tones of the morphological verb whose structure is as shown in (14).

(14) Verb structure

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                verb
               /    \
          (redup)   stem
                    /    \
                root   (suffix)
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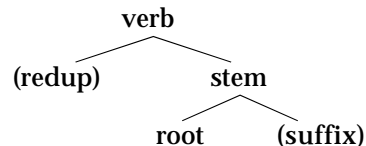
[11] For more on noun tonology, see Paster (in press).

As seen, a verb consists of an obligatory stem, which in turn consists of an obligatory root. This root may be followed by a suffix and preceded by a reduplication of its initial C(C)V. The different possible syllable shapes for each of the three subconstituents is schematized in (15.

(15)   redup   root   suffix

              CV   CV   V
              CCV   CVV   VCV
                          CCV
                          CVC
                          CVVC
                          CCVC
                          CVCC

The lexical suffixes are /-i/ and /-a/. In addition, a few verbs unpredictably occur with the pluractional suffix /-azi/ without having a corresponding non-derived form.

Given the distribution of C's and V's in (15), a Leggbó verb may consist of one, two, three or four syllables, as illustrated in (16).

(16)   Representative verb stems (L stems on left, M stems on right)

   a.   monosyllabic (252)
        CV: vὲ   'kill'   du   'beat'
        CCV: llì   'bury'   bbo   'die'
        CVV: kɔɔ   'vomit'   zoo   'find, search for'
        CVC: vɔ̀ŋ   'want'   wɔm   'bear fruit'
        CCVC: mmὲŋ   'swallow'   ssɛŋ   'go'
        CVVC: màan   'give birth'   wɔɔl   'flog'

   b.   bisyllabic (207)
        CVC-i   bàli   'step on'   zumi   'extinguish'
        CVC-a   mìna   'lie down'   mana   'catch, hold'
        CVVC-i   vèèli   'lend'   tɔɔŋi   'drip'
        CVVC-a   mɔ̀ɔŋɔ   'return'   tɔɔŋɔ   'cough'
        CCVC-i   vvèmi   'beg'   ttali   'untie'
        CCVC-a   bbàla   'remember'   kkana   'imitate'
        CVCC-i   kènni   'feed'   wukki   'be rough'
        CVCC-a   yɔ̀ŋŋo   'pass'   vɛmmɛ   'be small'
        CCVCC-i   ddaddi   'rejoice'
        CCVCC-a   gwekke   'lift up, raise'

   c.   trisyllabic (6)

               ggwàhazi   'walk fast'   jalazi   'investigate'
               yɔ̀hɔzi   'bluff, be winding'   yuŋazi   'scare'
                                                   zanazi   'look at with scorn'
                                                   kakaŋa   'be hard, strong'

   d.   quadrisyllabic (3)

               kòkonozi   'hover around'   yeyeŋezi   'sniffle (after crying)'
               noŋolozi   'be bent, winding'

However, as seen by the indicated numbers, almost all verb entries are monosyllabic or bisyllabic: Of 468 verbs in our lexicon, 252 (or 54%) are monosyllabic, while 207 (or 44%) are bisyllabic. We have found only the six trisyllabic verb entries in (15c), and only the three quadrisyllabic verb entries in

(16d). Of the nine tri- and quadrisyllabic verbs, six have a frozen pluractional suffix /-azi/. The trisyllabic verb kakaŋa 'be hard,, strong' has an initial reduplicated CV, while all three quadrisyllabic verbs are both reduplicated and have the suffix -azi.

What is of concern to us here is how tones are realized over verbs of varying sizes. We shall set aside reduplications for a moment, and consider the realization of tone on verb forms of one, two and three syllables. As discussed in Hyman et al (2002), Leggbó verb tones are determined by two factors: the tone of the verb root and the tonal suffix, restricted to L or M, which depends on aspect, mood, polarity and construction type. Whereas noun roots show an underlying opposition between H, M and L tones, verb roots fall into two classes, which we identify as L and M. In some verb forms which have a M suffixal tone, L roots are instead realized H. In one case, the purposive consecutive, M roots are realized H. Of the nine logical bitonal melodies the five in (17a) are attested, while the three in (17b) are not:

(17) Verb tone melodies

	a.	attested		b.	unattested	
		HM	LM		HH	MH
		MM	LL		HL	LH
		ML				

In addition, there is one tritonal melody, LHM, which can be added to the five attested bitonal melodies in (17a).[12]

In order to investigate how the six melodies are mapped onto verb forms, we selected the following verb stems of different shapes and sizes:

(18) Verbs used in examples to follow (tones unmarked)

			L verbs		M verbs	
a.		CV	ddɛ	'greet'	tta	'shoot'
		CVV	cee	'share, divide'	zoo	'find'
		CVC	num	'take'	dum	'bite'
		CVVC	kaam	'help'	tɔɔm	'send'
b.		CV+V	bua	'follow'	dua	'hide'
		CVCV	fina	'touch'	mana	'hold, catch'
		CVVCV	teemi	'strike'	beeli	'escort'
		CVCCV	kenni	'feed'	yɔmmɔ	'measure'
c.		CV+azi	ddɛɛzi	'greet (pl.)'	ttaazi	'shoot (pl.)'
		CVC+azi	numazi	'take (pl.)'	dumazi	'bite (pl.)'
		CVVC+azi	kaamazi	'help (pl.)'	tɔɔmɔzi	'send (pl.)'

The verbs in (18a) are monosyllabic, those in (18b) bisyllabic, and those in (18c) trisyllabic. To study the six tonal melodies, we placed each of the above verbs in the following frames:

(19) Sources of tonal melodies in examples to follow

    a. LL   :   L verb root + suffixal L used in irrealis
    b. LM   :   L verb root + suffixal M used in imperative

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[12] For reasons we discuss below, the LHM melody is better analyzed as a HM melody preceded by a floating L prefix.

c.	ML	:	M verb root + suffixal L used in irrealis		
d.	MM	:	M verb root + suffixal M used in imperative		
e.	HM	:	M verb root, modified to H, and used with suffixal M in purposive consecutive		
f.	LHM	:	M verb root, modified to H, preceded by L, and used with suffixal M in perfect		

The results are seen in (20).[13]

(20)   Tonal melodies on mono-, bi- and trisyllabic verb stems

	L Verb Roots		M Verb Roots			
	LL (irrealis)	LM (imper.)	ML (irrealis)	MM (imper.)	HM (purpose)	LHM (perf.)
CV	ddɛ̀	ddɛ̄̌	ttā	ttā	ttá	ttǎ
CVV	cèè	cèē	zōō	zōō	zóó	zòó
CVC	nùm	nūm	dūm	dūm	dúm	dǔm
CVVC	kààm	kàām	tɔ̄ɔ̄m	tɔ̄ɔ̄m	tɔ́ɔ́m	tɔ̀ɔ́m
CV+V	bùà	bùā	dūà	dūā	dúā	dùá
CVCV	fìnà	fìnā	mānà	mānā	mánā	màná
CVVCV	tèèmì	tèèmī	bēēlì	bēēlī	béélī	bèèlí
CVCCV	kènnì	kènnī	yɔ̄mmɔ̀	yɔ̄mmɔ̄	yɔ́mmɔ̄	yɔ̀mmɔ́
CV+azi	ddɛ̀ɛ̀zì	ddɛ̀ɛ̄zī	ttāàzì	ttāāzī	ttáāzī	ttàázī
CVC+azi	nùmàzì	nùmāzī	dūmàzì	dūmāzī	dúmāzī	dùmázī
CVVC+azi	kààmàzì	kààmāzī	tɔ̄ɔ̄mɔ̀zì	tɔ̄ɔ̄mɔ̄zī	tɔ́ɔ́mɔ̄zī	tɔ̀ɔ̀mɔ́zī

For clarity, in the transcriptions in (20) we have used a macron (¯) to mark M tone. Since the issue is to determine how unlike tones are mapped on the verb, the LL and MM columns are of no interest. A comparison of the remaining forms suggest the following two generalizations:

First, a second, higher tone is always mapped, whereas a second, lower tone will only be mapped if there is an independent TBU available to take it. As seen in the second column of (20), both tones of a LM melody map as a rising tone on monosyllabic verbs. On the other hand, the forms in the third column show that only the M of the ML melody maps onto monosyllabic verb stems. Similarly, the M of the HM melody in column five does not map onto a monosyllable, whereas the H of the LHM melody does. On monosyllabic verb stems we thus can have either a LM or a LH rising tone, but not a ML or HM falling tone.[14] By the same generalization, the LHM melody maps as L-H on two syllables (màná), not as L-HM (*màná¯). As a result, the second syllabic of a bisyllabic verb stem must be H, M or L, and not a contour.

Second, bisyllabic and trisyllabic forms seem to suggest that tone mapping is by syllable rather than by mora: Thus, LM maps as tèèmī (two syllables), rather than *tèēmī, and ML maps as tɔ̄ɔ̄m (one syllable) rather than *tɔ̄ɔ̀m. Contrasting with these forms are ddɛ̀ɛ̄zī (three syllables) and dūà (two syllables).

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[13] Since H and M tones are pronounced [HL] and [ML] before pause, the forms in (20) represent how these verb stems are pronounced when followed by an appropriate post-verbal complement.

[14] This interestingly contradicts the well-known generalization that falling tones are less marked than rising tones. Note that because the second tone is M in both the LM and HM melodies, we cannot get around this by referring to the identity of the tone which maps or fails to map. We are thus forced to conclude that some languages like Leggbó prefer lexical rising tones to falling tones.

Looking at the trisyllabic forms in (20), it would appear that the bitonal LM, ML and HM melodies map from left-to-right. We thus obtain L-M-M, M-L-L, and H-M-M instead of *L-L-M, *M-M-L, and *H-H-M. The question is how to produce this effect.

All along we have said that verb tone melodies consist of a root tone followed by a suffix tone. The table in (21) summarizes the assignment of tone melodies according to aspect, mood, polarity, and construction type:

(21) Distribution of verb tone melodies

	MCA		SRA		ORA		CCA		NEG	
	root	sfx	root	sfx	root	sfx	root	sfx	root	sfx
Perfective	H,M	-M	L,M	-M	H,M	-M	L,M	-L	H,M	-M
Progressive	H,M	-M	L,M	-M	H,M	-M	L,M	-L	H,M	-M
Habitual	L,M	-L	L,M	-L	L,M	-L	L,M	-L	H,M	-M
Irrealis	L,M	-L	L,M	-L	L,M	-L	L,M	-L	L,M	-L
Imperative	L,M	-M					L,M	-M	L,M	-L

Abbreviations: MCA: main clause affirmative; SRA: subject relative affirmative;
CCA: consecutive clause affirmative, NEG: negative (all contexts)

Under each construction type (MCA, SRA etc.), the first column indicates the tone of the root, while   the second column indicates the suffix tone. In each root column, the first tone indicates how a /L/ root will be realized (either L or H), while the second tone indicates how a /M/ root will be realized (always M in the above inflectional contexts). As seen, the tone of the suffix is always M or L. Since a /L/ root can be H only when followed by a M suffix, the above table defines exactly five tone melodies: H-M, M-M, L-M, M-L, L-L.

To the forms in (19) we need to add the two restricted melodies in (22).

(22) Restricted verb tone melodies

	root	sfx	
Purposive	L,H	-M	found only in CCA
Perfect	L,LH	-M	found only in MCA

The purposive ('in order to') construction appears only as a consecutive affirmative, as indicated. Neither the LM nor HM melodies are exceptional. What is unique is the pairing: Whereas the root tones are H,M or L,M in (19), here they are L,H. We have not found any other construction with this property.

The tones of the perfect are also restricted, this time to main clause affirmative. As indicated, /L/ verbs take a LM melody, while /M/ verbs are realized as LHM, the only case of a tritonal melody. This time, however, we have reason to think that the L tone is in fact a prefix. The evidence comes from reduplication.

As seen in (23), verbs can be reduplicated. The semantic result is an intensification, often translated by 'really':

(23) Reduplicated verbs

a.   ba-fína lìzol sɛ́   'they touched the bird'
     ba-fí-fína lìzol sɛ   'they really/still touched the bird'

b. ba-mana lìzol sɛ   'they held the bird'
    ba-ma-mana lìzol sɛ   'they really held the bird'

The table in (24) provides reduplications of verb forms with all six tonal melodies:

(24) Reduplication involving all six verb tone melodies

LL	bá-fìnà	bá-fì-fìnà	'they will touch'	(irrealis)
LM	fìna	fì-fìna	'touch!'	(imperative)
ML	bá-manà	bá-ma-manà	'they will hold'	(irrealis)
MM	mana	ma-mana	'hold!'	(imperative)
HM	ba-fína	ba-fí-fína	'they touched'	(perfective)
LHM	ba-màná	ba-mà-mána	'they have held'	(perfect)

As seen, reduplication is produced by copying both the segments and tone of the first CV of the verb stem, although with one interesting complication. The LHM melody of the /M/ root mana 'hold' is distributed over the three syllables of the reduplicant + base: mà-mána (cf. pluractional mà-mánazi). What we predict instead is *mà-màná (and *mà-mànázi). Our proposal is that the initial L is not part of the stem tone melody, but rather a prefix. The perfect melody would then be {L,H} + M, i.e. exactly the same as the purposive in (22). The difference is that the perfect has a floating L prefix, i.e. ˋ mána, ˋ mánazi. When it looks to simple forms, the one H shifts to the right: màná, mànázi. In reduplicate forms we first obtain ˋ má-mána and ˋ má-mánazi by copying the initial CV with its (H) tone. When the L links, it replaces the first H: mà-mána, mà-mánazi.

For this analysis to work, it is of course necessary to hold out the prefix L until after reduplication. Adopting a stratified approach to Leggbó lexical phonology, we distinguish between stratum 1, where all of the stem-level morphology and phonology takes place, vs. stratum 2, where prefixes come into play. The floating L prefix belongs to this latter stratum and hence escapes being reduplicated. Note that none of the other root-tone alternations can be attributed to a prefix: whether a /L/ root is realized H or L, its tone reduplicates, as seen in (24). As tempting as it is to assume a floating H prefix that changes /L/ verbs to H, by our logic, the H vs. L root tone must be assigned at stratum 1.

4.   Conclusion

In the preceding sections we have documented the tonal properties of Leggbó. We saw first that H, M and L tones are lexically contrastive on nouns, whereas verb roots show only a binary tonal opposition, which we characterized as /L/ vs. /M/. Whether these roots tones will be realized as L, M or H depends on the various combinations of inflectional features, which also determine whether the suffixe tone will be M or L. In this study we have considered only the verb stem. Although prefix tones have an interesting phonology of their own (see Hyman et al 2002), with the exception of the floating L prefix just discussed, they do not interact tonally with the stem tones.

We wish to conclude by addressing the issue of directionality in tone mapping. Why are LM, ML, and HM realized L-M-M, M-L-L and H-M-M on three syllables? Two solutions immediately come to mind. The first, assumes that these bitonal melodies map left to right, as shown in (25).

(25) Left-to-right mapping of tone

dumazi   dumazi   dumazi   dumazi
                   | | | | |╱
    M L   M L   M L   M L

As in the original formulation of autosegmental phonology (Goldsmith 1976), each tone maps to a TBU in a left-to-right fashion. In the last stage of the derivation, the L tone spreads onto the last TBU, which would otherwise be toneless.[15]

The second solution would be to adopt cyclicity, as in (26).

(26)   Cyclic mapping of tone

    Cycle 1   **Cycle 2**

    dumazi   dumazi   dumazi   dumazi
            | | | |⁄
     M   M   M L   M L

First there would be a root cycle, where only the M is present.[16] It would link to the left-most TBU, as shown. This is followed by a second cycle in which the inflectional L suffix tone comes in. As seen, it links to the leftmost available TBU, and then spreads to the right. However, note that we need to account for why the M links to the leftmost TBU in cycle 1, and why the L links to the second, rather than third TBU in cycle 2. That is, why is left-to-right mapping preferred over, say, edge-in association?

Either way, it appears that a left-anchoring of tone is necessary. It also seems that we cannot get the effect by generalizing over which tones Leggbó prefers to repeat: In the case of M-L-L it is L that is repeated (rather than M), while in L-M-M it is the M that is repeated (rather than L). The system is therefore different from Kukuya, where HL and LH are mapped as H-L-L and L-L-H.

We believe that if more tonal systems are taken into consideration some will have the left-to-right properties of Leggbó, others the edge-in properties of Kukuya, and still others a combination of both. Some of the variation may be metrically determined, as Paulian (1975) originally proposed. In many Bantu languages the vowels (TBUs) which occur between the first and last syllables of a verb stem constitute a "prosodic trough" (Hyman 1998), both as concerns their segmental properties as well as their tone. Other edge-in effects may be stratal: Just as our prefixal L had to "wait" to come in at stratum 2, so may a suffixal H, which may in fact function as an enclitic. In the absence of these effects, the strongest tendency may be to effect a melodic pitch change between the first root TBU and what follows. Perhaps this is the distinction: the metrical structure of a verb stem may be either s-w-s (prosodic trough) or simply s-w. Leggbó would fall in the latter category.

On the other hand, when a new L suffix is created by the normal grammaticization processes, we speculate that there may be a tendency for [[H-H] + L] to become H-L-L! The question is how left-to-right tone mapping effects arise in the first place. It would be valuable to study such developments from a diachronic perspective, which we unfortunately have not been able to do.[17]

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[15] Throughout our study we have avoided identifying one of the tones as underspecified. Whereas M is usually assumed to be the unmarked tone in a three-level system (Pulleyblank 1986), Paster (in press) suggests rather that L is underspecified in Leggbó. If correct, it would have to be determined how the floating L prefix would be represented. Our own view is that all three tone levels must be there from the beginning.

[16] We ignore the fact that dumazi has the structure [[dum] azi] for the purpose of this discussion. Although all trisyllabic verbs are morphologically complex in this way, the suffixal tone is affiliated with inflectional features, and is quite independent of the pluractional suffix -azi.

[17] We do note, however, that there is some tendency in Leggbó for M-L-L to be realized ML-L-L when the vowel is long. Thus, besides the form beelì which was reported for the irrealis of 'escort' in (20), we can also obtain beèlì. The corresponding realization of H-M-M as HM-M-M is more rare, while L-M-M

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is never realized as *LM-M-M. We believe that these are secondary developments, though perhaps not irrelevant to our speculation.