Non-uniform Syllable Weight in Southern Kenyan Maa (Maasai)

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1. Introduction

Three phonological phenomena in Southern Kenyan Maa (Maasai [ISO 639-3 mas], Eastern Nilotic) are each sensitive to distinct language-internal categorizations and domains of syllable weight. Contour tones are constrained by a ternary categorization, showing sensitivity only to the weight of the nucleus. Restrictions on syllable templates are constrained by a binary contrast in the weight of the rhyme as a whole. Minimal verbal root requirements are sensitive to the weight of the onset and coda. This paper argues that the most accurate account of Southern Kenyan Maa syllable weight must incorporate phenomenon-specific categorization rather than language-specific categorization. In recent cross-linguistic and quantitative research (Gordon 2006, Ryan 2011), such a situation has been referred to as "non-uniformity" of syllable weight categorization.

Maa, an Eastern Nilotic language, is spoken by up to over a million people in Tanzania and Kenya (Greenberg 1963, Bender 1997, Ehret 2001, and Lewis et al. 2016). Maa as a language complex encompasses various regional and ethnic varieties that can differ in phonology, lexicon, morphology and syntax (Vossen 1988, Payne 2012). The foundational linguistic work on Maa is Tucker and Mpaayei's (1955) *Maasai Grammar, with Vocabulary*, which corresponds to the variety spoken in southern Kenya and which is often simply called "Maasai." Despite being primarily focused on the description of morphology and lexicon, the Tucker and Mpaayei work includes a brief introduction to the sound system and features consistent phonological transcription. It does not reference syllable structure but does include transcriptions of tone in some data. A number of significant works on Maa phonology have since followed. Notably, Levergood (1987) is an analysis of aspects of Arusa Maa phonology (which has at least some consonantal differences from Kenyan and other Tanzanian Maa varieties), while Levergood (1990) offers an extensive treatment of the syllable, using Tucker and Mpaayei's description of Southern Kenyan Maa as a primary source for data. Both of the Levergood works propose that the mora, rather than the syllable, is the tone-bearing unit (TBU) in Maa, but never explicitly address issues of syllable weight. The present study addresses this gap in the literature on the phonology of Maa.

Our operational definition of syllable for this chapter is grounded in a combination of the sonority hierarchy, i.e. a syllable edge is identified by a decrease in sonority (Zec 1995, Hooper 1976); plus in some more ambiguous situations an examination of acoustic intensity, i.e. a dip in intensity marks a syllable edge. The study is primarily phonological in nature, though we do present some acoustic formant tracings to demonstrate variations in the duration of vocalic segments within sequences.

The rest of this chapter is structured as follows: Section 2 introduces the basics of the phonological system, the inventory of vocalic sequences, and presents evidence that there are length contrasts in Southern Kenyan Maa. Section 3 then examines syllable weight phenomena, including restrictions on the inventory of syllable templates, minimal verbal root requirements, and the distribution of contour tones. Finally, Section 4 offers general discussion of the findings as well as some concluding remarks.

Let us begin with some brief remarks on the notation conventions used in this chapter. Where consonants are permissible but optional they are written in parentheses. Thus (C)VC indicates that the onset consonant is optional for the relevant variable, whereas CVC indicates that it is required; and VC indicates that no onset is possible. Where only the consonantal segments with a particular feature are required, that feature is written in subscript (e.g. $C_{[+sonorant]}$). Where vocalic sequences consist of distinct vowel phonemes (e.g. /ɛʊ/, /iai/), they are indicated with alternating subscript labels (e.g. V_xV_y, $V_xV_yV_z$). Where at least some of the vowels of a vocalic sequence are the same vowel quality (e.g. articulations which might be transcribed as /ɔɔ/, /ɛʊʊ/), the vowels of the same quality are indicated with the same subscript label (e.g. V_xV_x,

$V_xV_yV_y$). When the distinction between similar or different vowel qualities is not relevant, vowels may be indicated with no subscript marking (e.g. V, VV, VVV). Within example data, length in a single vowel quality is represented through repetition of the same vowel symbol (e.g. /òó/, /ìì/), in order to best represent tonal features**.** When different vowel symbols are contiguous (e.g. /ɛʊ/, /iai/), the overall behavior of the sequence for some syllable weight phenomena may correspond to the number of symbols, or it may behave as "lighter" than the number of symbols (sections 2.4 and 3). The symbol ">" indicates that material to the left of > patterns as having more weight than material to its right. When two patterns are enclosed in curly brackets on one side or the other of >, e.g. {VVV, VV}, it indicates that the patterns within the brackets comprise a single weight category relative to the phenomenon under discussion.

2. Southern Kenyan Maa Phonology

The phonological system of Southern Kenyan Maa bears on the question of whether all phonological phenomena in a given language are sensitive to a single notion of syllable weight (Gordon 2006). In order to best understand these phenomena, a brief overview of Southern Kenyan Maa phonology follows. The language features a register tonal system (section 2.3), three levels of syllable nucleus length (section 2.4), and a large inventory of vocalic sequences (sections 2.4 and 2.5).

2.1 Consonantal Phoneme Inventory

The consonant inventory of Southern Kenyan Maa consists of 22 phonemes, listed in Table 1. Two series of voiceless plosives and voiced implosives occur at three places of articulation (labial, alveolar, and velar). Tucker and Mpaayei (1955: xv) report systematic variation in the phonetic voicing of voiceless plosive phonemes that follow nasal consonants. Doris Payne's field work data show that implosive phonemes may also be produced as voiced plosives by some speakers, which is corroborated by native speaker Leonard Ole-Kotikash. Tucker and Mpaayei 1955:xv state that the voiced alveopalatal affricate is also implosive. There is a fortis-lenis contrast for glides with a clear articulatory distinction in degree of lip or tongue-blade closure. The glottal stop is a rare phoneme in only some Southern Kenyan Maa sub-varieties, and does not appear to occur in others. The phoneme /h/ is also rare in Southern Kenyan Maa (though common in some Tanzanian varieties).

		Labial	**Alveolar**	**Post-alveolar / palatal**	**Velar**	**Glottal**
Stop	**Voiceless**	p	t		k	(ʔ)
	Voiced (implosive)	b	d		g	
Affricate				dʒ		
Fricative			s	ʃ ([tʃ] after consonants)		h
Nasal		m	n	ɲ	ŋ	
Liquid	**Lateral**		l			
	Tap		ɾ			
	Trill		r			
Glide	**Lenis**	w		y		
	Fortis	w͈		y͈		

Table 1: Consonant Phoneme Inventory of Southern Kenyan Maa

2.2 Vocalic Phoneme Inventory

The Southern Kenyan Maa vowel system consists of nine phonemes, listed in Table 2. The vowel phonemes are subject to a complex dominant-recessive Advanced Tongue Root (ATR) vowel harmony system (Baković 2002, Casali 2008, Quinn-Wriedt 2013), a common feature of Nilotic languages (Baković 2002). Guion et al. (2004) report that acoustic cues for the distinction between [+ATR] vowels and [-ATR] vowels include formant frequencies (lower for [+ATR]) and spectral slope (steeper in [+ATR]), but that voice quality (e.g. breathy, modal, or creaky voice) does not appear to be a significant cue. Morphophonemically, the single low vowel /a/ patterns as a [-ATR] vowel, but can co-occur in words with vowels of either the [+ATR] or the [–ATR] set and blocks the leftward spreading of the [+ATR] feature to other vowels (Wallace-Gadsen 1980).

	[+ATR]		**[-ATR]**	
	Front	**Back**	**Front**	**Back**
High	/i/	/u/	/ɪ/	/ʊ/
Mid	/e/	/o/	/ɛ/	/ɔ/
Low				/a/

Table 2: Southern Kenyan Maa vowel phonemes

2.3 Tone

Rasmussen (2002) demonstrates that Il-Keekonyokie Maa thoroughly meets Hyman's (2001, 2006) eight criteria for classification as a tone language, including the distribution, realization, and phonological effects of tones. Southern Kenyan Maa has two register tones, high (H) and low (L) (Tucker and Mpaayei 1955). Rasmussen (2002), Levergood (1987), and Tucker and

Mpaayei (1955: 167-174) report that there are word-final “falling” (F) tones that map to a single mora, and phrase-final downstepped H (ꜜH) tones. Each of these is lexically and grammatically contrastive. Tone is used to mark some verbal inflections, and to mark case on nouns and nominal modifiers (Tucker and Mpaayei 1955: 167-216, Rasmussen 2002: 22). Note the tone on the last vowel in the following examples (from Rasmussen 2002: 16-17 for the Il-Keekonyokie variety of Southern Kenyan Maa):

(1) a. **èìdóŋꜜó**

‘They (will) beat each other’ (Non-perfective)

b. **èìdóŋò**

‘She/he/it/they is/are beaten’ (Middle)

c. **éídóŋó**

‘She/he/it beat it/has beaten it’ (Perfect(ive))

d. **éídóŋô**

‘They beat it’ (Perfect(ive))

The F tone might be analyzed as H+L on a single phrase-final mora, which is the only environment in which an F tone is found in surface pronunciation. Tucker and Mpaayei (1955: 217) propose a Fall-Simplification rule which specifies that F tones are simplified to H tones phrase-internally, contrasting with HL sequences across two morae that do not simplify in this environment; compare (2) with (3-4) below. Levergood (1990) assumes that all phrase-final vocalic sequences with F tones contain a glide (and thus are monomoraic), either in onset or coda position. We address this issue below in section 2.5.

(2) a. **[ɛ̀mûɲ]**

'rhino' (cf. Tucker and Mpaayei 1955: 193, our retranscription)

b. **[ɛ̀múɲ sápɔ̀k]**

'big rhino' (cf. Tucker and Mpaayei 1955: 193)

(3) a. **[ɛ̀ndáà]**

'food'

b. **[ɛ̀ndáà sápɔ̀k]**

'big food'

(4) a. **[èìdóŋò]**

'She/he/it/they is/are beaten' (Middle)

b. **[èìdóŋò òlêŋ]**

'She/he/it/they are really beaten' (Middle)

2.4 Vocalic or Nucleic Length Contrasts

Some of the historical patterns of vowel length in Nilotic roots (e.g. as evident in many Western Nilotic languages) have been lost in the Eastern Nilotic branch (Dimmendaal 1995). However, vocalic length is contrastive in Southern Kenyan Maa within some roots, in certain morphological contexts, and occasionally due to the loss of a consonant such as /k/, /y/, or /ɾ/ (e.g. */aka/ > /aa/). Levergood (1990: 128) describes long vowels or vocalic length in the latter context as instances of compensatory lengthening, but we will consider them simply to be the diachronic joining of two short vowels after consonant deletion rather than the lengthening of a single vowel. Within the data used for this study, no differences in terms of phonetics or phonological behavior have been found between vocalic sequences that are tautomorphemic and vocalic sequences that are heteromorphemic or have resulted from the historical loss of a consonant.

Modern Southern Kenyan Maa demonstrates short, long, and extra-long length in monopthongs. Aside from ideophones, these extra-long or "triple-length" monopthongs are distributionally rather restricted. They can occur in verbs involving the plural infinitive prefix **aa[**HL^n**]-** (see 5c below), certain long-vowel person prefixes on verbs (5e), and also word-finally in the lexical item **èmúyòóò** 'ant species.' Long or "double-length" monopthongs are much more widespread, including morphological contexts involving the infinitive prefix **a[**L^{n}H**]-** ('singular infinitive') and root-internal length (see 5b, 5e, 6b and 7b below).

(5)	a.	**àdɔ́**	Morphemically:	**a-dɔ**	
		'to be red (of sth. SG)'		INF.SG-be.red	
	b.	**ààdɔ́**	Morphemically:	**a-adɔ**	
		'to be linearly extended (of sth. SG)'		INF.SG-be.extended	
	c.	**áàdɔ̀**	Morphemically:	**aa-adɔ**	
		'to be linearly extended (of sth. PL)'		INF.PL-be.extended	
	d.	**pèé àár**	Morphemically	**pee**	**a-ar**
		'so I will beat him'		so	1SG-beat
	e.	**pèé àààr**	Morphemically	**pee**	**aa-ar**
		'so I will beat you'		so	1SG:2SG-beat

(6)	a.	**àbɔ́**	Morphemically:	**a-bɔ**
		‘to extract the lower incisor teeth’		INF.SG-extract.teeth
	b.	**bɔ̀ɔ́**		**bɔɔ**
		‘cattle kraal, outside’		kraal
(7)	a.	**àléŋ**	Morphemically:	**a-leŋ**
		‘to be generous (of sth. SG)’		INF.SG-be.generous
	b.	**àlèén**	Morphemically:	**a-leen**
		‘to scout’		INF.SG-scout

2.5 Vocalic Sequences

The nature of vocalic sequences in Southern Kenyan Maa is challenging due to the large inventory of vocalic combinations that are permissible, and due to length differences in vocalic sequences. Dimmendaal (1995) posits that diphthongs (i.e. sequences of two vowel qualities perceived as “short”) in Maa should be analyzed as sequences of glides and vowels rather than sequences of phonological vowels, based on the relatively free distribution of [+high] segments with preceding and following vowels (cf. Table 3 below). Similarly, Levergood (1990), using Tucker and Mpaayei’s (1955) tone transcriptions as a guide, posits that a subset of vocalic sequences should be analyzed as phonological glide + vowel sequences. However, there are a number of issues with this approach to vocalic sequences in Southern Kenyan Maa. Both Levergood and Dimmendaal's analyses would feature complex syllable onsets when there otherwise are none, and they would require that the syllable onset contribute to weight in order to explain the distribution of branching codas (see section 3.1 below). Both analyses also require

[+ATR] and [-ATR] glides as part of the complex onsets or as codas (different from the distribution of fortis and lenis syllable-initial glides) to explain observed vowel-harmony processes. Yet further, neither analysis explains the tone-bearing capabilities of high segments while glides are incapable of bearing contrastive tones elsewhere. Finally, interpreting the high vocalic elements within vocalic sequences as glides (e.g. writing them as consonants) is rejected by literate native speakers who qualitatively feel they are different from the lenis glides /y/ and /w/, as well as from fortis /y͈/ and / w͈/.

Rather than assuming that the high segments within "short" or "shorter" vocalic sequences must be glides distributing as part of complex onsets or codas or contained within complex vowel segments (i.e. phonemically-contrastive diphthongs or triphthongs), they are interpreted here as individual vocalic segments. Further, we consider Southern Kenyan Maa vocalic sequences to be sequences of segments rather than complex segments. We will further avoid the terms "diphthong" and "tripthong" because we find that in the literature they are often used for sequences analyzed as unitary phonological segments. Our approach corresponds with native speaker intuitions, reduces the number of proposed contrastive phonemes, and is warranted by the sheer number of possible vocalic combinations in Maa, in addition to the fact that many pairings of vowels (especially among the [+ATR] set) seem possible in either order – e.g. both /io/ and /oi/ occur. The inventory of vocalic sequences found in Southern Kenyan Maa that consist of two vowel segments or three distinct vowel segments is listed in Table 3. This inventory is based on a lexicography database containing some 3600 head word records (i.e. 3600 essentially distinct lexical items).

Two-Quality Vocalic Sequences (V_xV_y)	**Three-Quality Vocalic Sequences ($V_xV_yV_z$)**
iu, ie, io, iɔ, ia	iei, ieu, ioi, iai, iau
ei, eu	uei, uɛɪ, uoi, uai, uau,
ɛɪ, ɛʊ	ʊɪa, ʊai
ui, ue, uɛ, uo, ua	aei, aui, aoi
ʊɪ, ʊɛ, ʊa	
oi, ou	
ɔɪ, ɔɛ	
ai, aɪ, aɛ, au, aʊ, ao	

Table 3: Attested heterogeneous vocalic sequences in Southern Kenyan Maa

The length of vocalic sequences which include only two distinct vowel qualities is contrastive in Maa. These vocalic sequences may consist of two vowel segments (V_xV_y) or three vowel segments ($V_xV_xV_y$, $V_xV_yV_y$). These contrasts in length were determined through work with five native speakers including one linguistically trained native speaker, and they confirm length contrasts evident in the work of Tucker and Mpaayei (1955). Examples (8) and (9) show minimal pairs for two-quality vocalic sequences consisting of (a) two vowel segments and (b) three vowel segments. Example (10) demonstrates a three-way contrast between word-final vocalic sequences of the two vowel phonemes /a/ and /i/. In ‘earthworm’ in (10a) the two final vowels are roughly equal in phonetic length. For ‘God, sky’ in (10b), formant trajectories (discussed below) suggest three vowel segments where the last two have the same vocalic quality. In ‘it is mine’ in (10c), formant trajectories suggest three vowel segments where the first two segments have the same vocalic quality (i.e. **aa** in the sequence **aai)**.

(8) a. **ɛ̀mbúátá**

‘gap in teeth’

b. **ɛ̀mbúáátá**

‘the act of shouting’

(9) a. **àrɛ́ʊ́**

‘to drive (e.g. cattle)’

b. **àrɛ̀ʊ̀ʊ́**

‘to drive (towards reference point) (e.g. cattle)’

(10) a. **òlàrʊ́káî**

‘earthworm’

b. **ɛ̀nkáíí**

‘God, sky’

c. **ènàáí**

‘It is mine’

Part of the phonetic detail of the length contrasts in the final vocalic sequences in (10a-c) can be seen in the formant trajectory plots in Figure 1, Figure 2, and Figure 3. These figures represent measurements of the first and second formants taken at twenty equal intervals across the duration of each final-syllable vocalic sequence. This normalization allows for direct comparison of formant trajectories among sequences that may differ in actual duration. The lower series of each figure represents F1 measurements, while the upper series of each figure represents F2 measurements. Words were elicited three times in isolation and three times in a frame (**ádʒó** ____ **táàtà** “I said _____ today”).

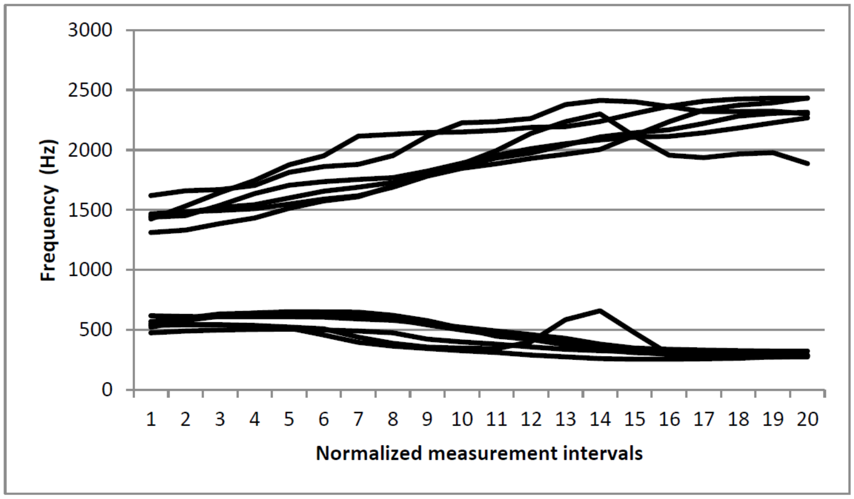

Figure 1: Formant trajectories for the word-final vocalic sequence of **òlàrʊ́káî** ‘earthworm’

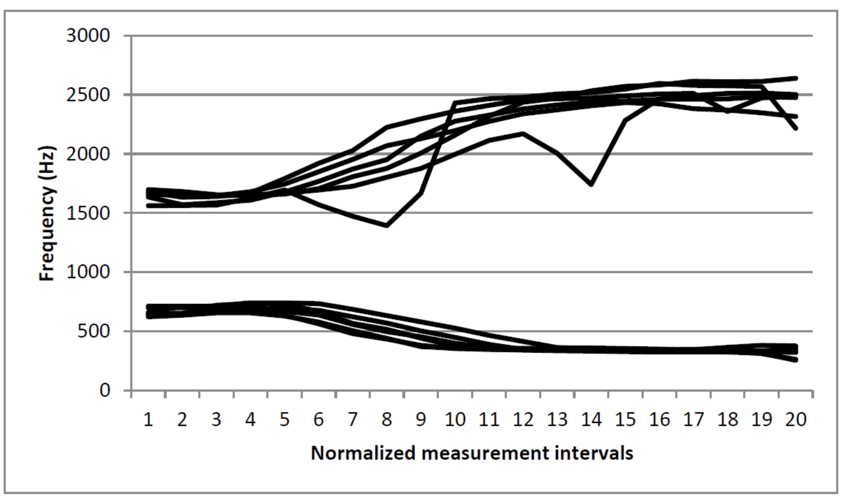

Figure 2: Formant trajectories for the word-final vocalic sequence of **ɛ̀nkáíí** ‘God’

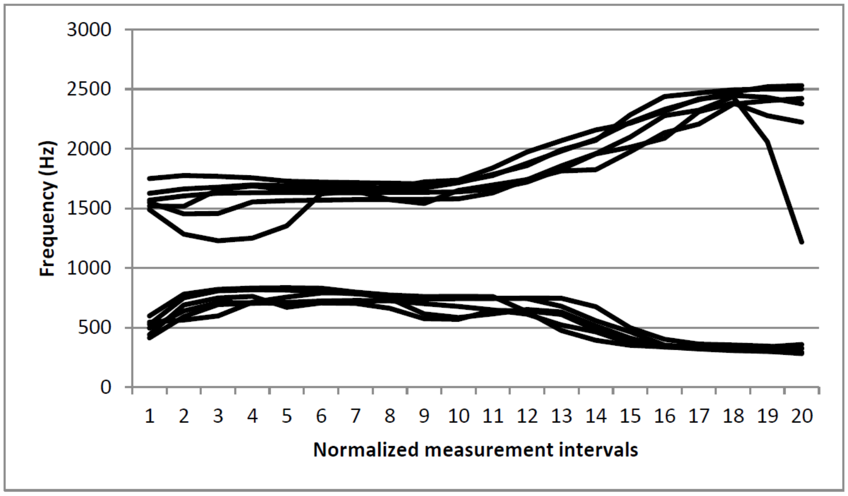

Figure 3: Formant trajectories for the word-final vocalic sequence of **ènàáí** 'It is mine'

Figure 1 shows the formant trajectories for a two-vowel-quality sequence where each vowel quality is of equal duration, with no visible plateauing effect. Figure 2 shows the formant trajectories for a two-vowel-quality sequence where the second quality is of longer duration than the first. This figure shows that a large portion of F1 and F2 measurements for the duration of the sequence corresponds to the vowel phoneme /i/, where F1 measurements are lower and F2 measurements are higher than those of the initial /a/ vowel; there is also a prominent plateauing effect at the end of the sequence. Figure 3 shows the formant trajectories for a two-vowel-quality sequence where the first quality is of longer duration than the second. This figure shows that a larger portion of formant measurements correspond to /a/, as well as prominent sequence-initial plateauing.

Altogether, the formant tracings in Figures 1 through 3 demonstrate at least a three-way contrast in relative duration of vocalic elements within two-vocalic quality sequences: relatively equal timing, first vocalic quality longer than second, and second vocalic quality longer than first.

What the figures do not demonstrate, given the nature of the normalized measurements, is whether the final syllables in (10a-c) have the same or different overall durations. In fact, the durations of the final syllables of **ɛ̀nkáíí** 'God' and **ènàáí** 'It is mine,' ranging from 300 to 360 ms, are markedly longer than that of **òlàrʊ́káî** 'earthworm,' ranging from 110 to 140 ms (measured across six tokens of each word).

Though comparable measurements of formant trajectories have not been done for a larger sample of words, the inventory in Southern Kenyan Maa of two-vowel-quality sequences where one quality is longer than the other, as determined through transcription with native speakers, is listed in Table 4 below.

$V_xV_yV_y$	$V_xV_xV_y$
iaa, ioo	eei, eeu
uaa, uoo	ooi
ʊaa	aai, aaɪ, aau
euu	
aii, auu, aɛɛ	

Table 4: Southern Maa two-vowel-quality sequences with one quality that is longer than the other (i.e. $V_xV_yV_y$ or $V_xV_xV_y$)

With this essential background on relevant features of Maa phonology, we now turn specifically to issues regarding syllable weight.

3. Syllable Weight Phenomena in Southern Kenyan Maa

Southern Kenyan Maa, like most of the languages in Gordon's (2006) cross-linguistic survey, has phonological phenomena that are sensitive to different categorizations of weight. All of these phenomena are sensitive to the weight of the nucleus in one way or another, but may differ with regard to the contribution of the syllable coda and onset. Three phenomena that demonstrate sensitivity to alternative weight categorizations in Southern Kenyan Maa are syllable templates, minimal verbal root constraints, and the distribution of contour tones.

3.1 Syllable Templates

Gordon (2006: 51) writes that, in many languages, weight-sensitive syllable template restrictions prevent the occurrence of long vowels in closed syllables (i.e. *CVVC). The situation in Southern Kenyan Maa is more nuanced. Syllables in Southern Kenyan Maa may contain up to three different vowel segments and/or qualities within the nucleus. Syllables with a single consonant (sonorant or obstruent) in the coda may also contain three vowel segments and/or qualities in the nucleus, but such syllables are restricted to word-final position. One possible interpretation of these distributional facts is to consider every vowel and coda consonant as constituting at least one weight unit for purposes of syllable structure constraints, and to state that syllables with more than two weight units are dispreferred except in word-final position. For example, the nuclei of the final syllables in (9) above would thus be said to contain at least two weight units for purposes of syllable-structure constraints, regardless of phonetic duration or moraic behavior for other phenomena. Maa syllables with branching codas (e.g. CVCC) must have nuclei which contain a single vowel segment (i.e. short and consisting of a single vowel quality), and are restricted to word-final position. If morphemes with such syllables are in positions where they will take a suffix, the CVCC sequence will be reparsed as CVC.C.... This results from the fact that Maa suffixes are – interestingly – all vowel-initial.

A summary of attested and unattested syllable templates is presented in Table 5; shaded cells contain syllable structures that are attested only in word-final position. The shaded cells suggest that the most complex rhyme patterns are dispreferred and only occur in word-final position. These word-level patterns indicate that codas contribute to syllable weight with regard to Southern Kenyan Maa syllable template phenomena. The unattested syllable types (indicated by asterisks) also suggest that, though both complex nuclei and complex codas are permissible, there are constraints on the overall weight combination. Examples of each attested syllable template are presented in Table 6, with the illustrative syllables underlined.

	Complexity of Nucleus	**No Coda**	**Single Consonant Coda**	**Branching Coda (word-final)**
Attested	Monovocalic	(C)V	(C)VC	(C)V$C_{[+liquid]}C_{[+coronal\ +obstruent]}$
	Bivocalic	(C)V_xV_y / (C)V_xV_x	(C)V_xV_yC / (C)V_xV_xC	
	Trivocalic	(C)$V_xV_yV_z$ / (C)$V_xV_xV_y$ / (C)$V_xV_yV_y$ / (C)$V_xV_xV_x$	C$V_xV_yV_z$C / C$V_xV_yV_y$C / (C)$V_xV_xV_x$C	

Unattested	Monovocalic			
	Bivocalic			*(C)V_xV_yCC / *(C)V_xV_xCC
	Trivocalic		*(C)$V_xV_xV_y$C	*(C)$V_xV_yV_z$CC / *(C)$V_xV_xV_y$CC / *(C)$V_xV_yV_y$CC *(C)$V_xV_xV_x$CC

Table 5: Attested and unattested syllable templates in Southern Kenyan Maa. Shaded cells contain syllable structures that only occur in word-final position

Complexity of Nucleus	Syllable Template	Example Words
Monovocalic	V CV	**<u>ɔ̀</u>.là.bí.kò.nì** ‘inhabitant’ **<u>ò</u>.lè.lé↓ó** ‘broken gourd’ **à.<u>bó</u>.ɾ↓í** ‘under’ **è.lí.kí.nò.<u>tó</u>** ‘message’
	VC CVC	**<u>ɛ̀n</u>.kà.bò.bó.kì** ‘tree bark’ **<u>ɔ̀l</u>.mɛ̀ʊ́t** ‘giraffe’ **à.<u>bák</u>** ‘to treat’ **ɔ̀.láí.<u>báɾ</u>.tà.nì** ‘male initiate’
	CVCC	**ɔ̀.lár.<u>tàrt</u>** ‘walking stick for older people’ **àì.sìà.<u>píɾd</u>** ‘to scatter’

		à.káld ‘to becon secretly’
		a.bárn ‘to shave sth.’
Bivocalic	V_xV_y	**àì.dʒʊ̀.lʊ̀.dʒʊ́l** ‘to upturn’
		òì.tò.ríó.rì ‘straight, truthful’
	CV_xV_y	**nàì.pí.rù kɔ́p** ‘vertical plant’
		ɛ̀.náú.dó.tó ‘hole’
	V_xV_x	**àà.dɔ́** ‘to be linearly extended’
		èé.r⁺ó ‘male term of address’
	CV_xV_x	**bɔ̀ɔ́** ‘cattle kraal, outside’
		ɛ̀m.báá.rɛ́ ‘treatment’
	V_xV_yC	**àódʒ** ‘to rub’
		àír ‘to clean’
	CV_xV_yC	**ɛ̀n.kìɔ̀n.dɔ̂** ‘basket’
	V_xV_xC	**íîp** ‘hundred’
	CV_xV_xC	**ɔ̀l.kúùn.tà** ‘castrated bull’
		ɛ̀n.gɛ́ɛ́m ‘morsel of meat’
		ɔ̀l.bɔ̀ɔ́ɲ ‘chin’
Trivocalic	$CV_xV_yV_z$	**ɛ̀.nàì.mʊ́.rʊ́àì** ‘grass sp.’
		ʃó.rúéí.ʃò ‘friendliness’
	$CV_xV_xV_y$	**à.màáí** ‘to be docile’
		ɛ̀m.pá.kááí ‘swamp’
	$CV_xV_yV_y$	**à.dúáà.nì** ‘observant’ **ò.lá á.lí. kíóò.rò.nì** ‘speaker, preacher, messenger’
	$V_xV_xV_x$	**áàà.dɔ̀** ‘to be linearly extended

	$V_xV_xV_xC$	pl.' **pèé àààr** 'so I will beat you'
	$V_xV_yV_zC$ $CV_xV_yV_zC$	<u>**àíúl**</u> 'swerve' <u>**àúáp**</u> 'seize' **Pàr.<u>múàìn</u>** 'God (lit. one of many colors)'
	$CV_xV_yV_yC$	**ì.<u>lìàát</u>** 'vomitus (of infant)' <u>**kíòòk**</u> 'mirror'

Table 6: Syllable template example words

Although CVVVC syllable templates are attested in Southern Kenyan Maa, their apparent restriction to word-final position indicates that they are not as freely distributed as (C)VC or (C)VVC syllables. There is little or no difference between the distribution of CVVC and CVC syllables, indicating the binary weight categorization of syllables with single consonants in the coda slot: CVVVC > {CVC, CVVC}.

The attestation of $CV_xV_yV_yC$ syllables and the lack of $(C)V_xV_xV_yC$ syllables is more difficult to explain, but the attested pattern is perhaps not principled and may simply be a consequence of lower overall frequency of extra-complex nuclei.

Syllables with branching codas are restricted to word-final position and only occur when the nucleus consists of a single vowel segment. As noted in Table 5, the first consonant in a branching coda is always a liquid, and the second consonant may be a nasal, affricate, or stop. The restriction against CV_xV_yCC and $CV_xV_yV_zCC$, as well as CV_xV_xCC syllables indicates a binary categorization of nucleus weight with regard to syllables with branching codas:

{CVVVCC, CVVCC} > CVCC. It also indicates that, with regard to syllable template phenomena, greater nuclear complexity counts as heavier.

3.2 Minimal Verbal Root Requirements

Gordon (2006) observes that many languages exhibit minimality constraints on content words that are sensitive to syllable weight. Some languages, such as Classical Greek, also exhibit minimality constraints on roots (Gordon 2006: 6). In Southern Kenyan Maa, minimal content words are disyllabic (V.CV(C) for verbs,[1] and V.CVC or V.CVV for nouns). A small set of verbs with roots that consist only of vowels, such as **à-(w)ó** 'to bleed,' **à-(y)ɛ́** 'to die,' and **à-(y)ìí** 'to sharpen,' may include a lenis epenthetic intervocalic glide, depending on the speaker, although speakers tend to equivocate on whether a glide should be written orthographically. Minimal nominal and verbal roots are monosyllabic, but lexicalized nominal stems tend to include (at least historically) embedded morphology and will not be considered in the discussion just below.

Minimal verbal roots are monosyllabic, but nearly always require a consonant in either onset or coda position (i.e. CV or VC), with no apparent sensitivity to the sonority of the consonant. Ryan (2014) reports that, although syllable weight phenomena are typically only sensitive to the weight of the rhyme, syllable onsets may in fact contribute to weight in a number of languages, especially if gradient or non-categorical weight is considered. The relevant categorization here, {CV, VC} > V, is therefore reasonable, albeit typologically uncommon.

1

The imperative of 'come' **óꜜú** is one of the rare exceptions.

3.3 Contour Tones and the TBU

The distribution of contour tones (e.g. HL, LH) is sensitive to syllable weight in a number of languages. This is true whether the contour is analyzed as single phonemic patterns as in some Asian and Mesoamerican languages, or as complexes of register tones as in most African languages. Gordon (2001) observes that tone most often treats CVV and/or $CVC_{[+sonorant]}$ as heavy (i.e. they may bear contour tones), which is attributed to the fact that sonorants are more likely to have tone-bearing properties than obstruents. CV and $CVC_{[+obstruent]}$ are thus less likely to be able to bear contour tones. Coda consonants in Maa, which may contribute to weight elsewhere, are not able to bear tones and thus do not contribute to the weight categorization that tone is sensitive to. Levergood (1990: 91) claims that word-medial codas in Arusa Maa can bear tone, but no evidence of this property has been found in our data. Contour tone patterns (e.g. HL, LH) are sensitive to the number of weight units solely within the nucleus of a syllable. That is, with the exception of the very restricted phrase-final F tones (which may be analysed as HL on a single mora), HL and LH tones can only occur on nuclei with two or more morae.

Falling (F) tones in Southern Kenyan Maa are a lexical feature of certain morphemes. Recall that they associate with a single final mora (section 2.3 above), but simplify to H tones phrase-medially. If these F contour tones are considered to map two tones onto a single phrase-final mora, then they “disobey” the general Maa rule that a single mora cannot bear more than one tone. However, their positional restriction plus the fact that they simplify to H in phrase-medial position (with no particular Downstep effects) conforms to the general pattern of the mora as the TBU in Maa. The fact that two tones may map lexically to a single word-final mora again points to the fact that final syllables are somehow "extra normative" for weight issues in

Maa. Unlike F tones, contour patterns internal to a word or phrase, as well as H+L on two final morae, do not simplify to a single register tone phrase-medially. Contour tone patterns are thus sensitive to a three-way categorization of weight (Table 7): (C)VVV(C) > (C)VV(C) > (C)V(C)(C). “V” in Table 7 should specifically be read as corresponding to a nuclear mora (in the sense of a TBU).

Weight Category:	**Light**	**Heavy**	**Superheavy**
Tone-bearing properties	Single Register Tone	One or Two Register Tones	One, Two, or Three Register Tones
Syllable Structure	(C)V(C)(C)	(C)VV(C)	(C)VVV(C)

Table 7: The ternary categorization of weight with regard to tones

Examples of each attested tonal pattern (not including word-final F tones) are listed in the underlined syllables in Table 8. We take no particular stand here on whether an H or L in any particular example is autosegmentally extended from an H or L on a preceding or following syllable or mora. For instance, the Singular Infinitive **a[**L^nH]**-** morpheme consists of a word-initial /a/ plus a LH pattern where the L distributes across the verb until the final mora. Our point here is simply to illustrate what can happen internal to a single syllable.

	Tonal Pattern	**Examples**
One Register Tone	H	**báɾ.láí** ‘bright orange’ **à.bó.ɾꜜí** ‘under’
	L	**á.lá.bàɲ** ‘complacent’ **à.pù.tú** ‘to wake s.o. up’
	HL	**ɔ̀.làì.bóò.nì** ‘preventer’

Two Register Tones		**ɛ̀.máà.lò** ‘kudu’
	LH	**à.bɔ̀ín** ‘to turn’ **ɛ̀n.kà.làó.nì** ‘ant’
Three Register Tones	LHL	**ɛ́.pàɛ́ɛ̀** ‘certainly’ **è.mú.yòóò** ‘ant sp.’

Table 8: Examples of register tone sequences on single syllables

Finally, some verbal forms containing the Singular Infinitive **a[**L^{n}H**]-** morpheme appear to treat a subset of word-final two-vowel sequences as monomoraic, where the H tone docks to two vocalic segments rather than one.

(11) **apíú** ‘to revive’

a-piu

INF.SG-revive.self

(12) **a-ɪrʊ́ɪ́** ‘to exercise crowd control’

a-ɪrʊɪ

INF.SG-control.crowd

Examples (11) and (12) demonstrate that a subset of vocalic sequences pattern as monomoraic with regard to certain tone-bearing phenomena, and potentially that syllable weight categorization within the domain of tone is non-uniform. Due to the fact that syllables containing such vocalic sequences are treated as “heavy” with regard to other phonological phenomena (e.g. syllable template restrictions), they are transcribed in (11) and (12) in the same manner with regard to vocalic elements as those sequences that are treated by the Singular Infinitive morpheme as monomoraic.

3.4 Summary

In the previous three subsections, three phonological phenomena of Southern Kenya Maa were shown to be sensitive not only to different categorizations of syllable weight, but also to different domains within the syllable. The details of these three phenomena are summarized in Table 9.

Phonological Variable	**Domain of Weight Sensitivity**	**Weight Categorization(s)**	**Description**
Syllable Template Restrictions	Rhyme	VVV > {VV, V} {VVV, VV} > V	• VVV restricted distribution in syllables with single C in coda • VV, VVV not permitted in syllables with two Cs in coda
Minimal Verb Root Preferences (strong tendency)	Syllable	{CV,VC} > V	• Minimal verb roots have a C in onset or coda
Register Tone Quantity	Nucleus	VVV > VV > V	• Moraic weight of nucleus determines number of possible register tones

Table 9: Summary of weight sensitive phenomena in Southern Kenyan Maa

The weight categorization relevant for contour tones demonstrates the following principles of syllable weight (Ryan 2011): the moraic structure of the nucleus, which involves the segments of greatest sonority, takes precedence in determining weight, and more structure is directly associated with greater weight. Syllable template restrictions follow the principles of sonority and precedence of the rhyme, but group either VV and VVV or VV and V nuclei together. Minimal verbal root constraints exhibit the most distinct categorization pattern. This pattern aligns with the principle of "more structure makes greater weight," it is neutral with regard to the sonority principle, and it does not align with the principle of the syllable rhyme taking precedence over the onset.

4. Conclusion

As observed by Ryan (2014), the current focus of studies on syllable weight is shifting away from language-specific binary categorizations between “light” and “heavy” syllables. The generalizations of cross-linguistic syllable weight hierarchies reported in Ryan (2011) appear to hold true in most cases – but not all. Languages like Maa with ternary length contrasts and large inventories of vocalic sequences are fruitful for exploring whether the typologically-proposed principles of syllable weight hold true beyond the most common syllable structures. What has been argued here is that Gordon’s (2006) claim that determinations of syllable weight are best viewed as phenomenon-specific is supported by the non-uniformity of syllable weight categorizations in Maa. The treatment of some vocalic sequences as monomoraic, both with regard to the F tone and the Singular Infinitive morpheme, further indicate that syllable weight categorization may be non-uniform within a single domain such as tone. Finally, a subset of the principles of syllable weight outlined in Ryan (2011) minimally apply to these categorizations, supporting their status as prototypical features of syllable weight phenomena.

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