Initial Vowel Length in Lulamogi: Cyclicity or Globality?

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1. Introduction

Over the past several decades there has been recurrent skeptism concerning cyclic derivations in phonology. Some of the proposed cyclic analyses have been argued not to require cyclicity, or to represent lexical relations that are not totally productive. For "surviving" cases, a major strategy within optimality theory has been to capture cyclic relations by surface output-output (O/O) constraints. To take a standard example, in an O/O approach, *génerative* and *derívative* have different stress patterns not because they are derived from *génerate* and *deríve*, but because the stress of each derivative must agree with the output stress of its respective corresponding base. A particularly explicit (and hence falsifiable) component of O/O correspondence is stated as follows by Steriade (2013):

> "a cyclic Base must be a freely occurring expression, a phrase or a free-standing word (Benua 1997, Kager 1999; Kenstowicz 1996; cf. Bermúdez-Otero 2010, Kiparsky 1998, Trommer 2013 for critical discussion and proposed counterevidence)."

In this paper I address some global effects concerning vowel length alternations in Lulamogi [ólumoojí], a small understudied Bantu language closely related to Luganda, which is often grouped with Lusoga, but is instead dialectal with Lugwere (Nabirye 2013, Hyman & Merrill 2014). In what follows I will contrast a cyclic analysis of the facts to be presented with one that requires global reference to the history of the derivation, in particularly whether the relevant vowel length is within the prefix vs. stem domain. I first present the basic facts in §2 and §3 and then turn to the different analyses in §4 and §5. After considering some residual cases in §6, I conclude with a brief summary conclusion in §7.[1]

2. Initial V- prefixes

As in Luganda (and many other Bantu languages in the area), Lulamogi has the five-vowel system /i, e, u, o, a/ which contrast in vowel length:[2]

(1)	a.	ó-ku-siβ-á	'to tie'		b.	ó-ku-siiβ-á	'to fast'
		ó-ku-sen-á	'to draw (water)'			ó-ku-seen-á	'to become thin'
		ó-ku-hol-á	'to lend (money)'			ó-ku-hool-á	'to differentiate between'
		ó-ku-tum-á	'to send'			ó-ku-tuum-á	'to jump'
		ó-ku-many-á	'to know'			ó-ku-maany-á	'to pluck'

[1] Work on Lulamogi is based on an undergraduate field methods course given in the Fall of 2013 and follow-up research based on the speech of Mr. Andrew Mukacha from Busulumba village in Kaliro district. Versions of this paper were presented at the University of California, Berkeley, Sept. 29, 2014 and Harvard University, Nov. 10, 2014. I am grateful to Mr. Mukacha, the undergraduates, and the different audiences for their comments and sympathy.

[2] High tone is marked by an acute (´) accent, while L tone is unmarked. For discussion of the tone system, see Hyman (2014).

While the above examples show length to be underlyingly contrastive on lexical morphemes (here, verb roots), length on prefixes is predictable. As illustrated in (2a,b), an onsetless V-prefix is realized long if it is followed by a monosyllabic stem, otherwise short:

(2)	a.	/i-jí/	→	ii-jí	'(it's an) egg'[3]
		/a-gu-a/	→	aa-gw-â	's/he falls'[4]
	b.	/i-sumó/	→	i-sumó	'(it's a) spear'
		/a-βal-a/	→	a-βál-a	's/he counts'
	c.	/ma-jí/	→	ma-jí	'(they are) eggs'
		/ba-gu-a/	→	ba-gw-â	'they fall'
		/ba-βal-a/	→	ba-βál-a	'they count'

As seen in (2c), the vowel in a CV- prefix is always short. The above initial vowel length alternation is quite robust, occurring in all word classes and affecting syllabic nasals as well:

(3)	a.	*nouns class 5 prefix /i-/*		*noun classes 1, 9 and 10 prefix /N-/*	
		ii-bwá	'(it's a) wound'	mm-bwá	'(it's) dog(s)'
		ii-jé	'(it's an) army'	nn-swá	'(it's) white ant(s)'
	b.	*adjective class 5 /i-/*		*class 9 /N-/ adjective prefixes*	
		ii-sâ	'(it is) good'	nn-sâ	'(it is) good'
	vs.	i-savú	'(it is) fat'	n-savú	'(it is fat)'
		má-sa	'(they are) good' (cl. 6)	gí-sa	'(they are) good' (cl. 10)
	c.	*subject prefixes on verbs*			
		nn-ty-â	'I fear'	tu-ty-â	'we fear'
		oo-ty-â	'you (sg.) fear'	mu-ty-â	'you (pl.) fear'
		aa-ty-â	's/he fears'	ba-ty-â	'they fear'
	d.	*independent personal pronouns*			
		nn-zé	'me'	ii-swé	'us'
		ii-wé	'you (sg.)'	ii-mwé	'you (pl.)'
		ii-yé	'him, her'	ii-βó	'them'
	e.	*class 1 and 9 near-speaker and distal demonstratives*			
		oo-nó	'this (cl.1)' vs.	βa-nó (cl. 2), gu-nó (cl.3), gi-nó (cl. 4), lì-nó (cl.5), ga-nó	
		ee-nó	'this (cl.9)'	(cl. 6), ci-nó (cl.7), βi-nó (cl.8), ji-nó (cl.10), lu-nó (cl. 11),	
				ka-nó (cl.12), βu-nó (cl.14), ku-nó (cl.15), ha-nó (cl.16),	
				ku-nó (cl.17), mu-nó (cl.18)	
		oo-dí	'that (cl.1)' vs.	βa-dí (cl.2), gu-dí (cl.3), gi-dí (cl. 4), lì-dí (cl.5), ga-dí (cl.6)	

[3] Forms glossed with a parenthetical such as '(it's an)' are full sentences marked by the absence of the initial vowel known as the Bantu augment. Thus compare: *é-í-ji* 'egg' vs. *ii-jí* 'it's an egg'; *á-ma-jí* 'eggs' vs. *ma-jí* 'they are eggs'.

[4] In all cited verb forms *-a* represents a final inflectional suffix vowel (FV). Thus, the morphemes in 's/he falls' are /a-/ 's/he' (noun class 1), /-gu-/ 'fall', /-a/ 'FV'.

ee-dí ‘that (cl.9)’ ci-dí (cl.7), βi-dí (cl.8), ji-dí (cl.10), lu-dí (cl.11), ka-dí (cl.12), βu-dí (cl.14), ku-dí (cl.15), ha-dí (cl.16), ku-dí (cl.17), mu-dí (cl.18)

f. *near-he.arer demonstratives*

oo-yó (cl.1), aa-βó (cl.2), oo-gwó (cl.3), ee-jó (cl.4), ee-lyó (cl.5), aa-gó (cl.6), ee-có (cl.7), ee-βyó (cl.8), ee-yó (cl.9), ee-jó (cl.10), oo-lwó (cl.11), aa-kó (cl.12), oo-βwó (cl.14), oo-kwó (cl.15), aa-hó (cl.16), oo-kwó (cl.17), oo-mwó (cl.18)

g. *invariant words*

iinó ‘much, very’ (= ii-nó?)

Given the restricted distribution of the initial long VV- allmorphs, as well as our knowledge of other Bantu languages where the corresponding V- prefixes are always short, it is natural to assume a rule of initial V-lengthening applying before a monosyllabic stem:

(4) $V \rightarrow VV \;\; / \; {}_{word}[\;\_\; [\sigma]_{stem}]_{word}$

While this rule captures the facts presented thus far, the puzzling question is why a language would have such a rule. Given that only V- (and not CV-) prefixes lengthen, the alternation is not transparently motivated by minimality, for example, a requirement that there be a minimum of three moras per word. If not, what then does motivate it? While some Bantu languages prohibit long vowels in pre-penultimate position, e.g. Cokwe (van den Eynde 1960:17), this is not the case in Lulamogi:

(5) a. é-kí-fáánaní ‘picture’
b. ó-ku-huumúl-á ‘to rest’
c. ó-ku-seehúlík-á ‘to migrate’

Thus, even if one were to assume that all of the initial vowels in (3) were underlyingly long, there would be no reason for them to shorten in prepenultimate position.

The above Lulamogi facts are in fact rare within Bantu, as far as I know reported only in Odden’s (2006) brief note on Zinza, a language of Tanzania. In his analysis he stipulates that the last two syllables constitute a phonological word (PW), and that a phonological word cannot begin with a short vowel. But why not? If we applied this approach to Lulamogi, it would look as in (6).[5]

(6) a. βa-[βál-a]$_{pw}$ ‘they count’
a-[βál-a]$_{pw}$ ‘s/he counts’

b. /βa-gu-a/ → [βa-gw-â]$_{pw}$ ‘they fall’
/a-gu-a/ → *[a-gw-â]$_{pw}$ ‘s/he falls’
↓
[aa-gw-â]$_{pw}$

The question for this analysis is why a PW (or prosodic stem—see note 5) cannot begin with a short vowel. As is well known, initial vowels are sometimes not “visible” in Bantu (Mutaka &

[5] Whle Odden adopts the phonological word, I personally would have preferred to identify this domain with the prosodic stem, which normally starts with the root, but sometimes incorporates a prefix (see Downing 1999, Hyman 2003, among others).

Hyman 1990, Odden 1995) and more generally (Davis 1988, Downing 1998, Topintzi 2010: 58ff, Kiparsky 2013 etc.). Marking off an initial V as extrametrical would mean that <V>CV would count as monosyllabic, thereby failing to meet a bisyllabic minimality requirement. That there are no monosyllabic "content words" in Lulamogi seems to support such a prosodic approach: all monosyllabic forms are clitics, e.g. *na=* 'with', *=kí* 'what, which', *=dí* 'when', *=mú* 'in it' (noun cl.18). Maybe the lengthening of an initial V- is therefore a "repair": the resulting <V>VCV would now count as bisyllabic. We will see below that the penultimate syllable is prosodically prominent in Lulamogi, as it is in many Bantu languages. Could it therefore simply be that a short vowel syllable cannot be the head of a trochaic foot?

Note that if minimality is involved, it would presumably be syllable- and not mora-based, since an initial V- prefix is realized long whether the monosyllabic stem is realized mono- or bimoraic:

(7) a. /o-ti-e/ → óó-ty-ee → óó-ty-e 'fear!'
b. óó-ty-éé =ku 'fear a little!'
c. óó-ty-e βuli lunakú 'fear every day!'

In (7a) the sequence /ti-e/ first undergoes gliding of /i/ with compensatory lengthening of /e/. The resulting syllable [tyee] then undergoes final vowel shortening (FVS). As seen in (7b), the noun class 17 enclitic *=ku* protects the stem [tyee] from shortening, revealing that it is something like the right edge of a clitic group that conditions FVS. When followed by a full standing word, FVS does apply, as in (7c). Initial vowel lengthening is therefore independent of the number of realized moras in the final syllable. As in Luganda, it can be shown that at least lexical monosyllabic stems (nouns, verbs, adjectives) are underlyingly bimoraic. Corresponding to the length alternation on the verb stem /ti-e/ in (7a,b) are monomorphemic noun stem alternations such as *mù-sú* '(it's a) squirrel' vs. *mù-súú =kí* 'which squirrel?' (cf. (26) below). Thus even if initial vowel lengthening owes its existence to a bisyllabic minimality constraint, an unprefixed stem must be minimally bimoraic.[6]

Up to this point we have considered two possible interpretations of initial vowel lengthening: (i) it has to do with the invisibility of an initial V, which makes a V-CV form count as monosyllabic, allegedly subminimal if there is a bisyllabic minimality constraint; (ii) it has to do with the inappropriateness of a short vowel syllable to head a trochaic foot constructed at the end of the prosodic word. We also alluded to the possibility of starting with all initial vowels as long (VV). There are doubtless other "solutions". Before addressing these it is necessary to extend our coverage of the data to consider V- prefixes that are not word-initial.

3. Non-initial V- prefixes

[6] The syllable is also the tone-bearing unit in Lulamogi (Hyman 2014). The only role the mora plays in the tonology is that a HL falling tone is restricted to CVV syllables. Out of a lexicon of 1683 entries, 71 lexical items have a HL falling tone, many of these borrowings: *é-kí-jîîkó* 'spoon', *é-séènté* 'money', *ó-bu-gáàndá* 'Ganda country'. The HL occurs on the penult in all but three of the 71 items: *ó-kú-βwáàtúká* 'thunder', *é-í-dwáàlíró* 'hospital', *é-í-lwáàlíró* 'place where you are treated (not necessarily a hospital)'. The last two are realizations of the same stem.

A significant complication arises when a V- prefix is preceded by another prefix. In the following examples /-a-/ marks a future tense and /-e-/ is the reflexive marker. As seen, the length alternations persist:

(8) a. /tu-a-gu-a/ → tw-áá-gw-a ‘we will fall’
/tu-a-sek-a/ → tw-á-sek-á ‘we will laugh’
b. /tu-e-ti-a/ → tw-ee-ty-â ‘we fear ourselves’
/tu-e-βal-a/ → tw-e-βál-a ‘we count ourselves’

In (8) the /tu-a-/ and /tu-e-/ sequences are realized with a long vowel if the stem is monosyllabic, but with a short vowel if the stem is bisyllabic (or longer). In order to derive these facts from the analyses considered in §2, the derivation would have to be cyclic. Assuming the PW approach proposed by Odden for Zinza, the lengthening rule in (4) would apply cyclically as in (9).

(9)

	cycle 1		cycle 2			
	morphology	phonology	morphology	phonology		
a.	[-a- [gu-a]]$_{pw}$	→ [-aa-gu-a]	→ tu [-aa-gu-a]	→ tw-áá-gw-a	‘we will fall’	
b.	[-e- [ti-a]]$_{pw}$	→ [-ee-ti-a]	→ tu [-ee-ti-a]	→ tw-ee-ty-â	‘we fear ourselves’	

On the first cycle the V- prefix lengthens. Then, when the subject prefix is added on the second cycle, gliding converts /tu-/ ‘we’ to *tw-* with the following vowel retaining the length it acquired on the previous cycle. If we were to do the derivations in (9) non-cyclically, i.e. waiting for the phonology to apply until /tu-a-gu-a/ and /tu-e-ti-e/ have been constructed, the *-a-* and *-e-* would no longer be initial and should therefore escape initial lengthening. The outputs would then be incorrectly derived as **tw-a-gw-â* and **tw-e-ty-â*. Since input prefixal vowel sequences are realized short before a bisyllabic or longer stem, as was seen in (8), we can assume that the gliding process involves the loss of the first of two successive vocalic moras. The longer forms fall into place with the same cyclic analysis:

(10)

		cycle 1	cycle 2			
		morphology	morphology	phonology		
a.	[sek-a]$_{pw}$ →	-a- [sek-a]	→ tu-a- [sek-a]	→ tw-á-sek-á	‘we will laugh’	
b.	[βal-a]$_{pw}$ →	-e- [βal-a]	→ tu-e- [βal-a]	→ tw-e-βál-a	‘we count ourselves’	

In the first cycle, *-a-* and *-e-* fail to lengthen, because they followed by a bisyllabic stem. When /tu-/ is added, the /tu-a-/ and /tu-e-/ sequences are consequently realized with a short vowel.

While the above facts can easily be derived via cyclicity, they pose a problem for the output-output approach cited in §1 where cyclic effects are dealt with as O/O correspondence to free-standing bases. The *-a-gu-a* and *-e-ti-a* bases in (9a,b) are clearly not “freely occurring expressions” (recall the Steriade 2013 quote at the beginning of the paper). This is because all verb forms require a subject (or infinitive) prefix, e.g. /tu-/ ‘we’, /ku-/ ‘class 15 infinitive prefix’. In fact, even the verb stem is not a freely occurring expression. Unlike most Bantu languages, the stem does not occur without a prefix in the imperative. Instead, Lulamogi requires a second person subject prefix:

(11)	*2sg. subject*	*2pl. subject*		*2sg. reflexive*	*2pl. reflexive*	
	óó-gw-e	mú-gw-e	'fall!'	w-éé-ty-é	mw-éé-ty-é	'fear yourself/ves'
	ó-sek-é	mú-sek-é	'laugh!'	w-é-βál-é	mw-é-βál-é	'count yourself/ves'

The above forms show the same alternation between -V- and -VV-, this time involving the second person singular and plural subject prefixes /ó-/ and /mú-/ followed by the reflexive prefix /-e-/. If cyclicity is in fact involved, it cannot be that the derived forms are conforming with freely occurring expressions.

To appreciate the full set of relevant forms that must be considered, the sequencing of prefixes within the Lulamogi verb is given in (12), where I have numbered the positions 1 to 4:

(12)	*1. subject*	*2. TAM*	*3. reflexive*	*4. stem*
	(C)V-	-a-	-e-	-iCV...

As elsewhere in Bantu, the stem consists of a root and suffixes. As seen, when the stem is V-initial this produces a maximum of four input vowels in a row. The possible vowels in V- and CV- subject prefixes (SPs) are /e-, o-, a-/ and /Ci-, Cu-, Ca-/. There also is the possibility of a nasal prefix in the first person singular, both subject and object. Other than this nasal and reflexive /-e-/, object prefixes (OPs) are all CV-. The reason to limit the stem to initial /i/ will be explained below.

As we have seen, when prefixal vowels coalesce, the result is a short vowel, unless the stem is monosyllabic. Further examples are given in (13):

(13)					
1 + 2	/tu + a + βal-a/	→	tw-á-βal-á	'we will count'
	/tu + a + gu-a/	→	tw-áá-gw-a	'we will fall'
1 + 3	/tu + e + βal-a/	→	tw-e-βál-a	'we count ourselves'
	/tu + e + ti-a/	→	tw-ee-ty-â	'we fear ourselves'
1 + 2 + 3	/tu + a + e + βal-a/	→	tw-é-βal-á	'we will count ourselves'
	/tu + a + e + ti-a/	→	tw-éé-ty-a	'we will fear ourselves'

Since verbs require a subject prefix, position 1 occurs in each of the above prefix combinations. In the last set we see that three vowels in sequence shorten to a single short vowel if followed by a bisyllabic (or longer) stem.

Since each prefix contributes one vocalic mora, we will not only need the lengthening rule in (4), but also a shortening (mora deletion) rule. In order to determine when shortening applies, we need to consider how V + V coalescence works between a prefix and a stem-initial vowel. Stem-initial vowels differ in two ways. First, when preceded by a CV- prefix, the result is a long vowel independent of the number of syllables that follow in the stem:

(14)						
1 + 4	SP /tu-/	/tu + et-a/	→	tw-eet-â	'we call'
		/tu + agal-a/	→	tw-aagál-a	'we search'
cf.	OP /-mu-/	/tu + mu + et-a/	→	tú-mw-eet-â	'we call him'
		/tu + mu + agal-a/	→	tú-mw-aagál-à	'we search for him'

cf.	Infinitive	/ó-ku + et-a /	→	ó-kw-eet-á	‘to call’
	/ku-/	/ó-ku + agal-a/	→	ó-kw-aagál-á	‘to search’

Second, when preceded by a V- prefix, a *y*- appears (which can be analyzed as root allomorphy or *y*-insertion) and the first root vowel is always short:

(15)	1 + 4	SP /a-/	/o + et-a/	→	o-yét-a	‘you (sg.) call’
			/o + agal-a/	→	o-yagál-a	‘you (sg.) search’
	1 + 2 + 4	Future	/tu + a + et-a /	→	tw-á-yet-á	‘we will call’
		/-a-/	/tu + a + agal-a/	→	tw-á-yagal-á	‘we will search’
	1 + 3 + 4	Reflexive	/tu + e + et-a/	→	tw-e-yét-a	‘we call ourselves’
		/-e-/	/tu + e + agal-a/	→	tw-e-yágál-a	‘we search for ourselves’

Note that y-insertion also applies cyclically to the above forms, as in (16a). Otherwise it would be hard to explain how the outputs with vowel coalescence are avoided in (16b).

(16)

	cycle 1			cycle 2		
	morphology		phonology	morphology		phonology
a.	-a- [et-a]	→	-a-yet-a	→ tu- [-a-yet-a]	→	tw-á-yet-á
	-a- [agal-a]	→	-a-yagal-a	→ tu- [-a-yagal-a]	→	tw-á-yagal-á
b.	/tu-a-et-a/	→	*tw-eet-á			
	/tu-a-agal-a/	→	*tw-aagal-á			

In other words, *y*-insertion/allomorphy sees only the preceding morph, as in Luganda (Hyman & Katamba 1999). If its shape is V- (or a nasal), *y*- is inserted; if it is CV-, no *y* is inserted, and instead vowel coalescence applies between the CV- prefix and the root-initial vowel. It is important to point out that it is only root-initial Vs which alternate with *y*V. Prefixal V + V sequences always coalescence.[7]

I have thus far carefully avoided forms with root-initial /i/. This is because Lulamogi allows the diphthongs /ei/, /oi/ and /ai/. Before root /i/ there is neither lengthening nor *y*-insertion. Thus, while /u/ glides to [w] before /i/ in (17a), Vi sequences surface in (17b).

(17)	a.	/tu + ib-a/	→	tw-iib-â	‘we steal’
	b.	/o + ib-a/	→	o-ib-â	‘you (sg.) steal’
		/a + ib-a/	→	a-ib-â	‘s/he steals’
		/e + ib-a/	→	e-ib-â	‘it (cl. 9) steals’

As a result we do not derive the following outputs for the indicated reasons:

(18)	a.	/o + ib-a/ →	*w-iib-â	:	no gliding; /o/ doesn’t glide before /i/
	b.	/o + ib-a/ →	*o-yíb-a	:	no y-insertion; *[yi] is prohibited in Lulamogi[8]

[7] When the preceding prefix is the first person SP or OP /n-/, the inserted *y* hardens to an affricate: *n-jét-a* ‘I call’.

[8] There are a few exceptions. In my lexicon of 1,673 entries, there are seven entries with [yi], although none in stem-initial position: *ó-ku-hayírír y-á* ‘to slander, gossip’, *ó-ku-zeiyík-á* ‘to become old’, *ó-mú-zéìyí* ‘old person’, *é-cí-kóóyi* ‘woman’s loin cloth’, *é-ky-áìyi* ‘cut banana stems’, *ó-mu-aayí* ‘person looking after cattle’, *ó-mú-sááyi* ‘blood’.

c. /o + ib-a/ → *oo-ib-â : no lengthening in diphthongs
*o-iib-â

Because of *y*-insertion before other root-initial vowels, it is only root /i/ that produces the following vowel sequences:

(19)	1 + 2 + 4	future prefix /-a-/	/tu + a + it-a /	→	tw-á-ít-a	'we will kill'
	1 + 3 + 4	reflexive prefix /-e-/	/tu + e + it-a/	→	tw-e-it-â	'we kill ourselves'
	1 + 2 + 3 + 4	both /-a/ and /-e-/	/tu + a + e + it-a/	→	tw-é-ít-a	'we will kill ourselves'

Again, as seen, penultimate vowel lengthening will not occur if the output is Vi.[9]

4. Representational analyses

Having seen the major alternations in vowel length, two questions naturally arise: (i) Why should the penultimate position play a special role? (ii) Why are only V-prefixes sensitive to the penultimate position? The first question naturally finds its explanation in the fact that the penult is often a strong position in Bantu (Downing 2004, Hyman 1978, 2013). The second question is more puzzling, as it is hard to choose among the speculations in §2 as to why only V- prefixes undergo penultimate lengthening vs. CV- prefixes. The more pressing issue is how to account for the above length alternations.

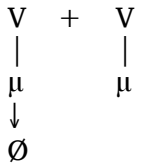
In this section I consider two representational strategies in response to this question, either of which can be implemented with either rules or input/output constraints. Both assume the availability of input representations of vowel-initial prefixes as VV-:

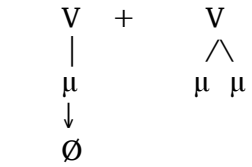
(20) a. V- prefixes have two allomorphs: /VV-/ in penultimate position, /V-/ in pre-penultimate position
b. V- prefixes are all underlyingly /VV-/

The first alternative is to set up two allomorphs of each vowel-initial morpheme.[10] To illustrate how this would work, let us interpret vowel shortening as a derived environment rule which deletes a vocalic mora when the following morpheme also begins with a vowel, as in (21a).

[9] Forms with long *Vii* were occasionally accepted as having special emphasis but were not limited to penultimate postition, e.g. *é n-á-íb-a* ~ *é n-á-ííb-a* 'if I steal', *é n-á-íkut-á* ~ *é n-á-ííkut-á* 'if I am satisfied'. This was particularly observed when the reflexive prefix *-e-* was present: /i/: /tú-a-e-it-a/ → *tw-e-it-â* ~ *tw-e-iit-â* 'we will kill ourselves'. Given this inconsistency, it is not clear how to interpret this variation, which should be checked with other speakers.

[10] This approach is reminiscent of the analysis of Chindali (Botne 1998) and Malila (Kutsch Lojenga 2007), where the facts are different, but the authors also consider the possibility that vowel prefixes are underlyingly /VV-/.

(21) a.


b.


The rule in (21a), which will shorten a V + V sequence to V, will have to be constrained to not delete the the first mora if the VV sequence is /ei/, /oi/ or /ai/ (cf. (17b)).[11] By this assumption, an input such as in (21b) will shorten a V + VV sequence to VV. In other words, the surface length will always be identical to the input length of the the last -V- or -VV- morpheme:[12]

(22)	a.	$V_1 + V_2$	→	V_2	/tu-a-βal-a/	→	tw-á-βal-á	'we will count'
	b.	$V_1 + VV_2$	→	VV_2	/tu-aa-ti-a/	→	tw-áá-ty-a	'we will fear'
	c.	$V_1 + V_2 + V_3$	→	V_3	/tu-a-e-βal-a/	→	tw-é-βal-á	'we will count ourselves'
	d.	$V_1 + V_2 + VV_3$	→	VV_3	/tu-a-ee-ti-a/	→	tw-éé-ty-a	'we will fear ourselves'

In (22a,b), the future prefix has the two allomorphs, /-a-/ and /-aa-/, while in (22c,d), the reflexive prefix similarly has the two allomorphs /-e-/ and /-ee-/. The advantage of this analysis is that cyclic derivations such as in (9) can be avoided. This is also true of the second strategy in (20b) according to which all vocalic prefixes are /VV-/. In this case the derivations would be as in (23).

(23)	a.	$V_1 + VV_2$	→	V_2	/tu-aa-βal-a/	→	tw-á-βal-á	'we will count'
	b.	$V_1 + VV_2$	→	VV_2	/tu-aa-ti-a/	→	tw-áá-ty-a	'we will fear'
	c.	$V_1 + VV_2 + VV_3$	→	V_3	/tu-aa-ee-βal-a/	→	tw-é-βal-á	'we will count ourselves'
	d.	$V_1 + VV_2 + VV_3$	→	VV_3	/tu-aa-ee-ti-a/	→	tw-éé-ty-a	'we will fear ourselves'

In this case whenever prefix vowels come together they coalesce as VV in penultimate position, but as V in pre-penultimate position. The extreme case is where five vocalic moras truncate to a single short vowel, as in (23c). While possible, proliferating vocalic moras in this way seems less desirable than setting up long and short allomorphs, as in (22).[13]

An allomorph approach may seem also motivated by the stem-initial V ~ *y*V alternations seen in (15). While there are several possible analyses (cf. Hyman & Katamba 1999), one is that roots such as 'call' and 'search' have two underlying allomorphs: /-yet-/ and /-yagal-/ after a V- (or nasal) prefix and /-et-/ and /-agal-/ after a CV- prefix.[14] If the latter were instead represented as /-eet-/ and /-aagal-/, the observed stem-initial length in (14) would automatically result. However, we would have to extend this approach even further to account

[11] A separate vocalic mora deletion rule will come into play to guarantee that no syllable will have more than two moras, a process that Clements (1986) called "V-trimming" in Luganda.

[12] We will see in §5 that the same generalization holds for vowel coalescence across words.

[13] An optimality theory analysis assuming richness of the base would of course have to consider such potential inputs as (23).

[14] More accurately, this may be stated as /-et-/ after a CV- prefix, elsewhere /-yet-/, since a [y] is also found in reduplicated forms: *ó-kw-aagálá-yágálá* 'to search here and there'. Note that this is a case of "outward-looking" allomorphy, hence relatively rare.

for stem-internal and stem-final derived vowel length. In (24a), the stem /-ti-a/ has been analyzed with two moras, which become first *-ty-aa* and then *-ty-a* by FVS in the first example (recall (7) above):

(24)	a.	/ó-ku-ti-a/	→	ó-ku-ty-á	'to fear'
		/ó-ku-ti-a =kú/	→	ó-ku-ty-áá =ku	'to fear a little'
	b.	/ó-ku-ti-is-i-a/	→	ó-ku-ti-is-y-á	'to frighten'
		/ó-ku-ti-is-i-a =kú/	→	ó-ku-ti-is-y-áá =ku	'to frighten a little'
	c.	/ó-ku-lim-a =kú/	→	ó-ku-lim-á =ku	'to cultivate a little'
		/ó-ku-lim-is-i-á/	→	ó-ku-lim-ís-y-á	'to cause to cultivate, cultivate
		/ó-ku-lim-is-i-á =kú/	→	ó-ku-lim-ís-y-áá =ku	with sth. (a little)'

The length is preserved in the second example of (24a), where *-ty-aa* is followed by the enclitic *=ku* 'a little' (noun class 17). In (24b), where the root /-ti-/ is followed by the long causative suffix /-is-/, a long vowel results, as it does in the stem-final syllable before *=ku*, where the short causative suffix /-i-/ is followed by the inflectional final vowel (FV) /-a/. The examples in (24c) demonstrate that both the causative suffix /-is-/ and the FV /-a/ have an underlying short vowel. In order to derive the long vowels of *-ty-aa*, *-ti-is-*, and *-is-y-aa*, a strict allomorph approach would have to set up /-aa/ and /-iis-/ allomorphs which would occur only after another vowel. Proliferating allomorphs in such a way is highly unmotivated, given that a more insightful analysis that distinguishes between prefix and stem vowel sequences is available. This is taken up in the following section.

5. A stratal analysis

In the preceding section we explored the possibility of accounting for the vowel length alternations by manipulating underlying representations, specifically by recognizing some or all vocalic prefixes as underlyingly /VV-/. This proposal does run into the problem that in other cases input long vowels are never shortened, e.g. the long root vowels in (1b). For this reason I suggested earlier that if there is a VV → V shortening process, it applies only in derived environments. In this section I argue instead that all of the above observations can be appropriately derived if we distinguish three domains—the prosodic stem, the prosodic word, and the phonological phrase—which correspond roughly to stratum 1, stratum 2 and postlexical phonology within the lexical morphology and phonology model (Kiparsky 1982 et seq). The basic distinction we have to make is between vowel sequences that arise by concatenating prefixes vs. those which arise between a prefix and the stem or within the stem. The former are realized short, unless the V-V sequence is in penultimate position, while V-V sequences involving the stem are realized long. In what follows I will return to the original (and general Bantu) position that prefixal, suffixal, and root-initial vowels are underlyingly short. The proposal is the following:

(i) Within the stem domain (stratum 1), V-V sequences are realized long. There is no rule or input-output requirement of mora deletion. In an OT approach, this can easily be accounted for by ranking MAX(μ) higher than *VV, *Struc or whatever constraint is responsible for mora deletion, when it occurs at later strata.

(ii) Within the word domain (stratum 2), all moras that serve as input from stratum 1 are grandfathered in: the mora of a vowel initial root is never deleted, nor are stem-internal or

stem-final V + V sequences shortened. The only affected moras are those that come in within this domain, i.e. prefixal moras. Specifically, any prefixal V + V sequence that occurs prepenultimately will be shortened. In addition, a word-initial V- is lengthened if it is in penultimate position.

(iii) At the phrasal (postlexical) level, final vowel shortening applies, as does a process of V#V truncation to be illustrated below. In addition, any trimoraic sequence of V + V + V will be shortened to bimoraic VV. Otherwise, any length inputted from stratum 2 is preserved. Sample derivations are shown in (25).

(25)	URs:	/ti/ 'fear'	/βal/ 'count'	/agal/ 'search'
	stratum 1:	ty-aa	βal-a	-agal-a
	stratum 2:	tú-a- [ty-aa]	tú-a-e- [βal-a]	tú- [agál-a]
		tw-áá-ty-aa	tw-é-βal-a	tw-aagál-a
	postlexical:	tw-áá-ty-a	tw-é-βal-á	tw-aagál-a
		'we will fear'	'we will count ourselves'	'we search'

Stratum 1 is where the stem is built up, which in each of the above cases consists of a root + FV suffix /-a/.[15] As shown, prefixes enter at stratum 2. The phonological processes shown above are coalescence (a + e → ee), gliding + compensatory lengthening (tu + e → twee) and prefix vowel shortening in prepenultimate position (*tw-é-βal-a* is thus derived instead of **tw-éé-βal-a*). At the postlexical level FVS applies to 'we will fear', as does the assignment of a final H% boundary tone in 'we will count ourselves' (see Hyman 2014).

With the above analysis there is no need for prefixes to have an underlying long vowel. However, there is reason to propose that monosyllabic stems and enclitics are underlyingly bimoraic. The examples in (26a,b) show that an enclitic preserves the final length on a monosyllabic (and monomorphemic) noun stem:

(26)					
a.	mu-sú	'(it's a) squirrel'	mu-súú = kí	'which squirrel?'
b.	ma-jí	'(it's) eggs'	ma-jíí = go	'your (sg.) eggs'
			ma-jíí = ge	'his/her eggs'
c.	kí-tábo	'(it's) a book'	kí-tábo = kí	'which book?'
			kí-tábo = có	'your (sg.) book'
			kí-tábo = cé	'his/her book'

As seen in (26c), an enclitic does not lengthen a preceding vowel. Monosyllabic stems such as /-súú/ 'squirrel' and /-jíí/ 'eggs' therefore have to be set up with an underlying long vowel which undergoes FVS, but is preserved before an enclitic. By this reasoning, given forms such as in (27b), enclitics themselves must also have an underlying long vowel:

(27)				
a.	/a-ta-a/	→ aa-t-â		's/he puts'
b.	aa-ta-a	= múú = kúú = ki		'what does s/he put a little of in?'
	3sg-put	in	a little what	

[15] Although not essential to the analysis, I show /ti-a/ undergoing gliding + compensatory lengthening at stratum 1.

In (27a) the prefix /a-/ 's/he' undergoes penultimate lengthening at stratum 2, while the stem /-ta-a/ undergoes postlexical FVS. In (27b) not only the verb stem /-ta-a/, but also the enclitcs /=múú/ 'in' (class 18) and /=kúú/ 'a little' (class 17) are realized long. The length of each monosyllabic stem or enclitic is preserved by the following enclitic, the last of which, /=kii/ 'what', undergoes FVS. The fact that an enclitic both can save the final length of the lexical word as well as have its own length saved by another enclitic suggests that there is a postlexical clitic group domain. While enclitics must be underlyingly bimoraic, in Lulamogi, as well as in Luganda, proclitics can be mono- or bimoraic:

(28) a.	monomoraic:	mu= nyuumbá	'(it's) in the house'
		ku= saabóòni	'(it's) on the soap'
b.	bimoraic:	byaa= mú-límí	'(it's) the ones of the farmer' (from /bi-a/)

This too follows from the decision to recognize as a domain any lexical word plus its proclitics and enclitics.[16] Besides FVS, the same V + V coalescences occurs postlexically. As in stratum 2, the result will be a short vowel, as in (29a), unless the initial V of the second word is penultimate, as in (29b).

(29) a.	ó-mú-límí	+	ó-mú-sa	→	ó-mú-límy' ó-mú-sa	'good farmer'
	ó-mu-sahú	+	ó-mú-sa	→	ó-mu-sah' ó-mú-sa	'good healer'
	ó-mu-saizá	+	ó-mú-sa	→	ómusaiz' ó-mú-sa	'good man'
b.	ó-mú-límí	+	oonó	→	ó-mú-límy' oonó	'this farmer'
	ó-mu-sahú	+	oonó	→	ó-mu-sah' oonó	'this healer'
	ó-mu-saizá	+	oonó	→	ó-mu-saiz' oonó	'this man'

This works out fine as long as shortening continues not to apply penultimately in the postlexical phonology.[17]

6. Residual cases

While the above distribution of vowel length is extremely general in the language, I have found two morpheme-specific exceptions in verbs. In addition, a few more words need to be said about initial vowel length on nouns. The first exception concerns the immediate past prefix *-aaka-*, whose first vowel is always long, even though it never appears in penultimate position:

(30) a.	tw-aaká-gw-á	'we have just fallen'
b.	tw-aaká-βál-á	'we have just counted'

[16] See however Hyman & Katamba (1990) for complications which arise from determining what is a phonological vs. syntactic clitic.

[17] Finally, note that a vowel is always long before a nasal + consonant (NC) sequence. Although the nasal is moraic, it does not condition truncation, even pre-penultimately: /βá-n-lingil-a/ → *βáá-n-diingíl-á* 'they look at me'. In terms of the above analysis we can say that an input nasal mora is always realized in the output, i.e. MAX(μ_{nasal}) is high-ranked.

This marker is also unique in being the only prefix that has such a complex structure: Except for numeral prefixes (see (31) below), all other prefixes have the shapes V-, N- or CV-. However, analyzing the immediate past as two prefixes in sequence, i.e. *-a-ka-*, does not explain the invariant length on *-aaka-*. One possibility is to recognize forms with *-aaka-* as having the compound word structure [tu-aká]$_{w}$ [βal-a]$_{w}$. The first syllable, here [tw-aa] would then be penultimate and not subject to shortening. Since there is otherwise no evidence for this boundary, a natural alternative is to assume that the prefix has exceptional underlying length, i.e. /-aaka-/, which is subject to the same high ranked Max(μ) constraint proposed to preserve tautomorphemic vowel length on roots. As was seen in the examples in (5), tautomorphemic vowel length is preserved in the output, even when pre-penultimate. Although there are no CVV- prefixes in the language, some support for this analysis can be derived from numerals which, as seen in (31), are unique in the language in having long vowel (or nasal) prefixes:

(31)

numeral		*noun/verb*	
ii-βírí	'two'	í-βúga	'(it's a) gourd'
aa-βírí	'twenty'	a-βál-a	's/he counts'
ŋŋ-káagá	'sixty'	ŋ-kín-a	'I dance'

At the same time, numerals provide evidence that other V- (and N-) prefixes should be underlyingly short. Had we followed the analysis suggested in (20b), we would have had to say that VV- prefixes shorten in prepenultimate position, except for numerals. It seems more straightforward to analyze the prefixal length contrast in (31) as underlying.

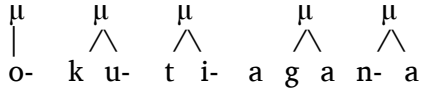
The second exception concerns the reciprocal suffix *-agan-*. As seen in (32), when preceded by an underlying vowel, the gliding process is not accompanied by compensatory lengthening:

(32)

a.	/ó-ku-ti-agan-a/	→	ó-ku-ty-agán-á	'to fear each other'
b.	/ó-ku-ti-is-i-agan-a/	→	ó-ku-ti-is-y-ágán-á	'to frighten each other'
	AUG-INF-fear-CAUS-CAUS-RECIP-FVS			

To account for this one might propose that the initial /a/ of /-agan-/ is exceptional in not having an underlying mora, rather is a floating vowel, as in (33).

(33)



With such a representation the initial /a/ of /-agan-/ would join the preceding mora of /ti-/ and a short vowel would result. However, this would not account for the prefixal length observed in (34a,b).

(34)

a.	/tu-a-ti-agan-a/	→	tw-áá-ty-agan-á	'we will fear each other'
b.	/tu-e-ti-agan-a/	→	tw-ee-ty-ágán-a	'we fear ourselves'.
c.	/tu-a-ti-is-i-agan-a/	→	tw-á-ti-is-y-ágán-á	'we will frighten each other'
	1PL-FUT-fear-CAUS-CAUS-RECIP-FV			

As seen, the prefix sequences /tú-a-/ and /tú-e-/ are realized with a long vowel in (34a,b), even though the reciprocal suffix places it in pre-penultimate position. It is as if these words have the internal compound structures $[\text{tu-a-ti-a}]_w\,[\text{gan-a}]_w$ and $[\text{tu-e-ti-a}]_w\,[\text{gan-a}]_w$, in which case prefixal length would be preserved because it is penultimate within the first word constituent. While such an internal word division makes no sense from a morphological point of view, as the historical structure of the reciprocal suffix is *-ag-an-*, it does receive some support from variations such as the following:

(35) a. a-ták-a mú-ty-agan-é 'he wants you (pl.) to fear each other'
b. a-ták-a mú-ty-egan-é (idem)
c. a-ták-a mú-βon-agan-é 'he wants you (pl.) to see each other'
d. a-ták-a mú-βon-egan-é

As seen, the subjunctive form of the verb takes the FV *-e*. (35a) and (35c) show the expected realization of the subjunctive clause. However, as an alternative, the forms in (35b) and (35d) were offered, where the reciprocal suffix appears to be *-egan-*. It is thus, as if the structure of (35b) is $[\text{mú-ti-e}]_w\,[\text{gan-e}]_w$, each word taking the same FV *-e*. As now predicted, when the reciprocal prefix *-e-* is optionally added, the prefixal sequence is realized long:

(36) a. a-ták-a mw-éé-ty-ágán-é 'he wants you (pl.) to fear each other'
b. a-ták-a mw-éé-ty-égán-é (idem)
3SG-want-FV 2PL-REFL-fear-RECIP-FV

As further evidence that [gan-a] may be becoming a restructured constituent, a number of examples have been elicited where it follows the inflectional verb ending *-ire*:

(37) a. tw-a-kub-again-é =ku 'we beat each other a little bit'
b. tw-a-kub-ire-gan-á =ku (idem)
c. tw-a-kub-ire-gain-é =ku (idem)

The expected form is (37a), where the [ir] of *-ire* has fused or "imbricated" with *-agan-* to produce *-again-*. In (37b), *-ire* precedes *-gan-á*, while in (37c) *-ire* is marked twice: once after the verb root *-kub-* 'beat', once imbricated into *-agan-*. There clearly appears to be a restructuring of *-agan-* that accounts for its variant and exceptional behavior.[18]

Except for the above complications posed by the *-aaka-* prefix and *-agan-* suffix, initial vowel length is completely regular in verbs. The third residual problem concerns V-CV nouns, where a significant amount of variation was found. As was seen in (3a), class 5 nouns have an *i-* prefix, while classes 1, 9 and 10 have an *N-* prefix. When occurring with the augment vowel /é-/ or /ó-/, their tone is always H-L:

[18] As an aside, note that the accentual solution of Hyman & Katamba (1993:51-2) concerning the failure of *-agan-* to condition compensatory lengthening in Luganda cannot work here.

(38)

class 5		*class 1*		*class 9*	
é-í-ji	‘egg’	ó-m-bwa	‘dog’	é-n-si	‘country’
é-í-hwa	‘thorn’	ó-n-te	‘cow’	é-n-swa	‘white ant’
é-í-je	‘army’	ó-n-go	‘leopard’	é-n-za	‘outside’

As has been discussed, diphthongs such as /ei/ do not undergo penultimate lengthening on either vowel, while a vowel is automatically lengthened before an NC sequence, e.g. /ó-m-bwa/ → [óómbwa] ‘dog’, /ó-m-bulí/ → [óómbulí] ‘goat’. While nouns occur with their augment vowel in isolation and in many, if not most environments, there are certain grammatical contexts where the noun occurs without its augment. One of these, the presentative ‘it is X, they are X’ has been seen in many of the examples. In such cases the above and similar nouns begin either with an *i-* or N- prefix:

(39)

class 5		*class 1*		*class 9*	
ii-jí	‘it’s an egg’	mm-bwá	‘it’s a dog’	nn-sí	‘it’s a country’
ii-hwá	‘it’s a thorn’	nn-té	‘it’s a cow’	nn-swá	‘it’s a white ant’
ii-jé	‘it’s an army’	nn-gó	‘it’s a leopard’	nn-zá	‘it’s outside’

As seen, the V- or N- prefix is lengthened, as expected, in penultimate position (vs. *ḿ-bulí* ‘it’s a goat’, *í-sumó* ‘it’s a spear’ (cf. *é-í-sumó* ‘spear’)). While some such nouns have been produced instead with L-HL tone, e.g. *ii-jê* ‘it’s an army’, *mm-bwâ* ‘it’s a dog’, this is of less concern than the variations in vowel length which occur when an enclitic such as *=kí* ‘which’ is added.[19]

(40)

	‘which egg?’	‘which dog?’
a.	ii-jíí =ki	mm-bwáá =ki
b.	ii-jí =ki	mm-bwá =ki
c.	íí-jii =kí	ḿḿ-bwaa =kí
d.	íí-ji =kí	ḿḿ-bwa =kí
e.	ii-jîì =ki	mm-bwáà =kí

In all of the above variants the V- or N- prefix is long, but there is variation not only in tone but also in whether the enclitic saves the final length of the noun stem. Recall the discussion of the bimoraic minimum of monosyllabic stems and the examples in (26). Somehow when the prefix is bimoraic the monosyllabic stem can be optionally realized as monomoraic, as if it is the full word that is being calculated to determine minimality. It is not acceptable for both syllables to be short: **i-jí =ki*, *m-bwá =ki*. Clearly this is an area where a fuller survey with more speakers would hopefully shed light on what exactly is motivating the above variants.

7. Summary and conclusion

[19] Occasionally it appeared that the L-HL realization was a question or perhaps more emphatic. While it is possible that there are pragmatic conditions on the tonal (and vowel length) variations, it is likely that the language is undergoing change in this area which should be further investigated. Some of the other variations are due to a tendency for enclitics to have opposite tone. Thus, in addition to the =H =H =L enclitic sequence in *aa-ta-a =múú =kúú =ki* ‘what does s/he put a little of in?’ from (27b), the sequence can alternatively be realized =H =L =H, where *=kí* now has a H tone: *aa-ta-a =múú =kuu =kí*.

In the preceding sections we have established the following:

(41) a. a V- prefix must surface with length in penultimate position
b. a V-V- prefix sequence surfaces with length in penultimate position
c. a V-V- prefix sequence surfaces short in pre-penultimate position

The alternatives we considered to account for the above were cyclicity vs. global reference to the prefix-stem distinction. Opting for the latter, a stratal analysis was outlined in §5. We therefore can conclude that the kind of cyclic analysis considered in (9) above is not needed or the surface output-output correspondence approach that has been proposed to capture alleged cyclic effects. The stratal analysis explicitly recognizes that the stem, word, and phrasal domains may have different properties, in the present case concerning the number of moras that will surface from input V-V sequences. These properties are as follows in Lulamogi:

(42) Stem level: all moras in V-V sequences are preserved in the output
Word level: all stem moras are grandfathered in; prefixal moras in V-V sequences are preserved only in penultimate position; a word-initial V- prefix must be long in penultimate position
Phrase level: word final V-V sequences are shortened by FVS; V # V sequences that arise across words are shortened to one mora unless the word-initial VV- is long by virtue of being in penultimate position

It may be possible to conflate the phrase level properties by recognizing the constraint in (43), where ## represents the end of a clitic group:

(43) * μ ##
|
V

The domain we have identified with the postlexical word or clitic group must not end in a vocalic mora. The repair is to delete the mora. This process will apply in all cases unless the result would be a final syllable closed by a consonant, since a higher constraint prohibiting closed syllables will dominate vocalic mora deletion. Thus, prepausally or pre-consonantally, CVV ## will become CV, while CVCV ## will be unaffected. When followed by a vowel, CV(V) ## V becomes C ## V, and CV(V) ## VV becomes C # VV. In cases where the final syllable has a long vowel, both moras will be delete. Thus, it may be that FVS and word-final vocalic mora deletion are the same process.

While I believe this is a viable analysis of the vowel length properties of Lulamogi, the mystery still remains as to why only V- prefixes are subject to length alternation—particularly why a word-initial V- prefix should have to lengthen to VV- in penultimate prosition. We can stipulate as Odden (2006) that a short V- cannot begin a phonological word, or that it cannot head a trochee at the stem level, as I have hypothesized. In the absence of further evidence, neither seems totally compelling to me, although this appears to be the best we can do at this point. Perhaps future comparisons with closely related dialects and languages will ultimately provide important clues as to how the Lulamogi prefixal vowel length alternations originated.

Although, none have been thus far described with the exactly properties of Lulamogi, past researchers have commented on the uncertain length of initial vowels in Luganda:

> "As pointed out by a number of scholars (e.g. Tucker 1962, Cole 1967, Stevick 1969)... post-pausal vowels actually vary in duration. Thus, the augment vowels /e o a/ may be short or long when followed by either a plain consonant... or by a preconsonantal nasal...." (Hyman & Katamba 1999:363)

While Hyman & Katamba go on to propose that the realization of post-pausal V ~ VV is "stylistic or expressive", we have seen that there is a definite contrast between initial V- and VV- prefixes which is not present in Luganda or Lutenga (Standard Lusoga). Perhaps such variation occurred in pre-Lulamogi and became phonologized with the current distribution. Only more work on Lulamogi and other nearby Bantu language communities will provide a definitive answer.

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