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12 The syllable in Luganda phonology and morphology

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> "The composition of the syllable in LuGanda, and the rules for syllable
> length are so aesthetically satisfying that there is a danger
> in supposing them to hold for Bantu languages in general."
> (Tucker 1962: 122)

1. Introduction

Thus observes the author of one of the major works, among many, treating the structure of the Luganda syllable. The Luganda syllable has been the subject of inquiry within a number of frameworks during the past forty years (Ashton et al. 1954, Cole 1967, Stevick 1969, Katamba 1974, Herbert 1976, Halle & Vergnaud 1980, Heny & Wheeler 1982, Borowsky 1983a,b, Katamba 1985, Clements 1986, Hyman & Katamba 1990, Wiltshire 1992). Directly or indirectly these studies draw heavily on Tucker's original analysis and hence on the 'aesthetics' that he highlighted. As shall be exemplified below, Tucker's 'rules' conspire to guarantee that a Luganda syllable will be maximally bimoraic and that this bimoricity will be preserved even if the first of a sequence of vowels loses its syllabicity or is deleted. While these rules are well-founded and aesthetically pleasing, we shall show that the situation is considerably more complex than Tucker or other scholars have indicated. The basic question that has not been addressed is how the syllabification process is to be effected within a morphological context. Each study has been presented as if one could do a one-time (non-cyclic) mapping from an underlying representation to a surface target. As we shall demonstrate, there are important cyclic effects in Luganda syllabification: Stratum 2 prefixes appear to be added one at a time to the verb stem[1], with syllabification checked in a step-wise fashion. This finding, which potentially bears on the question of whether step-by-step derivations are justified in phonology (Bromberger & Halle 1989, Coleman 1995), is however contradicted by an 'anti-stratal' effect: The stratum 1 (stem-level) phonology cannot be correctly derived without peeking ahead to see what will happen at stratum 2 (word-level). This paradox, we argue, is best resolved if we adopt a 'direct mapping' approach to both stratified and cyclic phonology such as in

Orgun (1996). Instead of ordered rules, there would be analogous output constraints which could apply in parallel rather than one after the other.

The purpose of this chapter is thus twofold. First, as a descriptive goal, we shall provide an account of the syllable-related phonology of a wider range of phenomena in Luganda than heretofore considered. Second, as a theoretical goal, we shall provide evidence for a particular view of the phonology-morphology interface based on Luganda syllabification. Despite previous grammar-free accounts, Luganda syllabification is intimately tied to the morphology. In some cases, the parsing and allocation of segments to syllables does take into account grammatical considerations. Of particular importance in this regard is our treatment of the y/Ø alternations that characterize root morphemes. While we present much of our analysis in derivational terms for expository reasons, the obvious relation to constraint-based phonology, specifically certain ideas within Optimality Theory (Prince & Smolensky 1993), will be evident. We first present the basic properties of syllabification in Luganda followed, progressively, by elaborations and refinements. Finally, the 'derivation' of geminate consonants is treated in an Appendix.

2. The bimoraic syllable

We begin by schematizing the possible syllable types in Luganda in (1), where C represents an onset consonant (which may be prenasalized and/or followed by a glide), VV indicates a long vowel, and C_i stands for the first half of a geminate consonant:

(1) a. Utterance-Internal		b. Utterance-Initial		c. Utterance-Final	
Monomoraic	Bimoraic	Monomoraic	Bimoraic	Monomoraic	Bimoraic
CV	CVV	CV	CVV	CV	CVV
	CVC_i	V	CVC_i		
		N	VC_i		
		C_i			

As seen in (1a), all utterance-internal syllables have an onset position which is filled by a single consonant. Such syllables may be monomoraic (CV) or bimoraic (CVV, CVC_i). In utterance initial position in (1b), monomoraic syllables may be CV or lack an onset, consisting either of a single vowel (V), a syllabic nasal (N), or the first half of a geminate (C_i). (There are two reasons for regarding the first half of a geminate as moraic: the first is that it is a tone-bearing unit; the second is that it counts towards the 'bimoraic maximum' for syllables as we shall show below.) As also seen, an utterance-initial bimoraic syllable may consist of a vowel followed by the first half of a geminate consonant (C_i).[2] It should be noted that there are no VV syllables in Luganda, a fact which will be crucial in our analysis (see section 3). In addition, there are no syllables containing more than two moras (e.g.*CVVV). Lastly, only open syllables occur in word- or utterance-final position and they tend to have a short vowel because one of the moras of a CVV syllable is suppressed in that position (cf. Hyman & Katamba 1990).

As indicated in (1), bimoraic syllables may consist either of a long vowel nucleus or of a vowel followed by the first half of a geminate consonant. Examples contrasting such syllables with corresponding monomoraic ones are given in (2).[3]

(2)	a. $[\mathrm{CV}]_\sigma$ vs. $[\mathrm{CVV}]_\sigma$	ku-lim-a	[ku.li.ma]	'to cultivate'
		ku-liim-a	[ku.lii.ma]	'to lie in wait for'
	b. $[\mathrm{CV}]_\sigma$ vs. $[\mathrm{CVC_i}]_\sigma$	ku-ket-a	[ku.ke.ta]	'to cut off'
		ku-kett-a	[ku.ket.ta]	'to spy'

In (2a) the verb root *-liim-* 'lie in wait for' contains an underlying long vowel, while in (2b) the verb root *-kett-* 'spy' contains a phonological geminate. Because of the bimoraic maximum, there are no verb roots such as **-liiim-* or **-keett-*. Concerning CVV syllables, we note that vowel length may come from four sources in Luganda. We consider three of these here.[4]

First, a long vowel may be underlying, as in the case of *-liim-* 'spy'. Other examples include *-léet-* 'bring', *-saab-* 'smear', *-lóot-* 'dream', and *-túuk-* 'arrive'.

Second, a long vowel automatically results when two identical vowels occur in succession across morpheme breaks: either within words, as in (3a), or across words, as in (3b).

(3) a.	bâ-agal-a	[báà.ga.la]	'they want'	(bâ- 'they', -agal- 'want')
	ku-se-ebu-a	[ku.see.bwa]	'to be ground'	(-se- 'grind', -ebu- 'passive')
	ku-lî-ir-a	[ku.líì.ra]	'to eat at'	(-lî- 'eat', -ir- 'applicative')
b.	a-lâb-a a-ba-kâzi	[a.lá.baa.ba.ká.zi]	's/he sees women'	
	e-n-te e-mû	[e.ntee.mû]	'one cow'	
	o-no o-mu-genyi	[o.noo.mu.ge.nyi]	'this visitor'	

Third, a long vowel may result from the compensatory lengthening (CL), which accompanies the gliding of a high vowel before another vowel:

(4) High Vowel Gliding + CL:	/CiV, CuV/	→	[CyVV, CwVV]	
a. Within morpheme:	ku-kîal-a	→	[ku.kyáà.la]	'to visit'
	ku-tûal-a	→	[ku.twáà.la]	'to take'

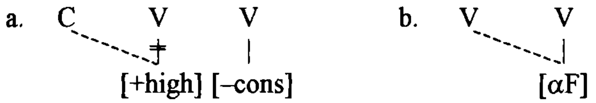
b. Across morphemes: ku-lî-a → [ku.lyàà...][5] 'to eat'
[lexical] ku-gu-a → [ku.gwaa...] 'to fall'

c. Across words: mu-limi + o-mû → [mu.li.myoo.mû] 'one farmer'
[postlexical] n-fûdu + e-mû → [n.fû.dwèè.mû] 'one tortoise'

As seen in (4a), gliding + CL applies morpheme-internally. It also applies within a word across morpheme breaks, as in (4b), and across words, as in (4c). The reason for positing underlying forms such as /-kîal-/ and /-tûal-/ is that there are otherwise no underlying consonant + glide sequences in the language: all CG sequences come from the gliding of a vowel[6]. Besides having to complicate the inventory of permissible underlying forms, if the glide were underlying, we would have no explanation as to why the following vowel is normally long.[7]

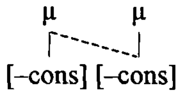
The assumption of all previous researchers is that gliding applies whenever a high vowel is followed by another vowel. Using the CV framework of Clements & Keyser (1983), Clements (1986) formalizes the gliding rule as in (5a).

(5)



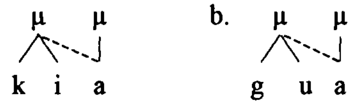
The rule in (5a) delinks a high vowel from its V slot and relinks it to the preceding C slot, when it is followed by another (non-identical) vowel. Then (5b) applies to spread the second vowel onto the preceding free V slot. The effect of these two rules taken together is that the second vowel is compensatorily lengthened to fill the vacated position of the first vowel.[8] Previous researchers had all assumed that /Ci/ and /Cu/ sequences become [Cy] and [Cw] before another vowel (e.g. Tucker 1962, Cole 1967 etc.), i.e. that consonant clusters are created. Clements' rule in (5a), however, represents these as $[C^y]$ and $[C^w]$, i.e. as single consonants with a palatal or labial offglide. This appears to be necessitated by the theory: the way to get CL is by transferring a vowel from a V to a C, which it will share with the preceding consonant. Hyman's (1985: 80) moraic analysis of Luganda is perhaps appropriately ambiguous with respect to this issue, and has the advantage of producing the gliding plus compensatory lengthening effects by a single rule, which we term Leftward Vowel Spread (LVS):

(6) Leftward Vowel Spread:



The effect of this rule is to lengthen the second of two vowels in sequence. In case the first vowel is [+high], LVS will produce representations such as in (7).

(7) a. b.



Following Hyman (1985), we interpret syllabicity in terms of relative sonority. In (7a) the first mora dominates the segments /k/, /i/ and /a/, while in (7b) the first mora dominates the segments /g/, /u/ and /a/. In both examples the most sonorous segment is /a/, which therefore is syllabic. In both cases the second mora dominates only /a/, which again is syllabic. The result is the long vowel [aː] preceded by a non-syllabic high vowel, i.e. a glide.

It has been generally noted that gliding (or LVS in our analysis) applies only when the first of two vowels in sequence is [+high]. The examples in (8) show that when the first vowel is non-high, it does not glide. Instead, it is subject to elision accompanied by compensatory lengthening:

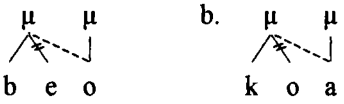
(8)	a.	mu-sibê + o-mû	→	[mu.si.bóò.mû]	'one prisoner'
		mu-walâ + o-mû	→	[mu.wa.lóò.mû]	'one girl'
	b.	m-bogô + e-mû	→	[m.bo.géè.mû]	'one buffalo'
		n-diga + e-mû	→	[n.di.gee.mû]	'one sheep'
	c.	ba-sibê + a-ba-o	→	[ba.si.báà.bo]	'those prisoners'
		ba-kô + a-ba-o	→	[ba.káà.bo]	'those in-laws'

The examples in (8) show elision of a word-final /e o a/ followed by a non-identical /e o a/ across a word boundary.[9] In each case the first vowel is lost, and the second vowel is lengthened but there are no palatalization or labialization effects ever associated with /e/ and /o/ in this context. Clements (1986) represents this process as in (9a).

(9) a. b.

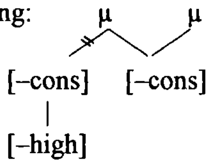
A [–high] vowel is delinked from its V slot, which is filled by a leftward spreading of the features of the second V in (9b) (= (5b)). In the moraic framework LVS first applies to these vowel sequences, followed by the delinking of the [–high] vowel:

(10) a.



The rule of Non-High Delinking (NHD) is formulated in (11).

(11) Non-High Delinking:



In this framework, all sequences undergo LVS, but only [–high] vowels delink.[10]

Let us consider other environments where NHD might potentially apply. All of the examples in (8) showed the delinking of a [–high] vowel when followed by another vowel across a word boundary. It is thus clear that NHD applies postlexically. The examples in (12) show that it also applies between a prefix of the shape Ca- and a stem:

(12) a.	ba-ogezi	→	[boo.ge.zi]	'speakers'	(cf. sg. [mwoo.ge.zi])
	ma-envû	→	[mee.nvû]	'ripe bananas'	(cf. sg. [lyee.nvû])
	ka-âna	→	[káà.na]	'small child'	(cf. [mwáà.na] 'child')
b.	bâ-er-a	→	[béè.ra]	'they sweep'	(cf. [twéè.ra] 'we sweep')
	bâ-ôt-a	→	[bóò.ta]	'they bask'	(cf. [twóò.ta] 'we bask')

The examples in (12a) involve the class 2 *ba-*, class 6 *ma-* and (diminutive) class 12 *ka-* noun class prefixes followed by a noun stem, while those in (12b) have the class 2 subject marker (SM*)* *bâ-* followed by a verb stem. In each case the /a/ is elided and the following /e/ or /o/ is lengthened.[11] NHD thus appears to apply lexically, at least across the prefix-stem boundary.

There is, however, a complication. Within the verb stem, there is evidence that /e/ and /o/ undergo LVS but are not subject to NHD. In (13) we provide a complete list of the 18 verb roots in Luganda which have the underlying shape -CV-:

(13) a.	-lî-	'eat'	[ku.lyáà...]	'to eat'	[a.lîd.dè]	'he has eaten'
	-tî-	'fear'	[ku.tyáà...]	'to fear'	[a-tîd.d.è]	'he has feared'
	-gi-	'fit in'	[ku.gyaa...]	'to fit in'	[a-gíd.dè]	'he has fit in'
	-yî-	'be burnt'	[kûg.gyaa...]	'to be burnt'	[e.yîd.dè]	'it is burnt'

b.	-gu-	'fall'	[ku.gwaa...]	'to fall'	[a-gúd.dè]	'he has fallen'
	-lu-	'delay'	[ku.lwaa...]	'to delay'	[a.lúd.dè]	'he has delayed'
	-fû-	'die'	[ku.fáà...]	'to die'	[a.fûd.dè]	'he has died'
	-vu-	'come from'	[ku.vaa...]	'to come from'	[a.vúd.dè]	'he has come from'
c.	-ke-	'dawn'	[ku.kyáà...]	'to dawn'	[lú.kêd.dè][12]	'it has dawned'
	-se-	'grind'	[ku.saa...]	'to grind'	[a.séd.dè]	'he has ground'
	-ne-[13]	'defecate'	[ku.nyaa...]	'to defecate'	[a-nyéd.dè]	'he has defecated'
d.	-mo-	'shave'	[ku.mwaa...]	'to shave'	[a-mwéd.dè]	'he has shaved'
	-ɲô-	'drink'	[ku.ɲwáà...]	'to drink'	[a-ɲwêd.dè]	'he has drunk'
	-cô-	'abscond'	[ku.cwáà...]	'to abscond'	[a-cwêd.dè]	'he has absconded'
	-wô-	'be exhausted'	[kûg.gwaa...]	'to be exhausted'	[a.wêd.dè]	'he is exhausted'
e.	-bâ-	'be'	[ku.báà...]	'to be'	[a.bâd.dè]	'he has been'
	-tâ-	'let go'	[ku.tâa...]	'to let go'	[a.tâd.dè]	'he has let go'
	-wâ-	'give'	[ku.wâa...]	'to give'	[a.wâd.dè]	'he has given'

The infinitive forms marked by the prefix *ku-* all show the vowel of the -CV- root fusing with the final vowel (FV) suffix *-a*. As expected, the high root vowels /i u/ in (13a,b) are realized as [y w] and the FV is lengthened by LVS. In two of the examples, the glide [w] is absorbed into a preceding labiodental consonant: We thus obtain [faa] and [vaa] rather than *[fwaa] and *[vwaa]. This follows from the general prohibition in the language of labiodental fricatives [f v] occurring before [w]. Also as expected, the root vowel /a/ and FV /-a/ fuse as a long [aa] in (13e). What is not expected is the gliding of the root vowels /e/ and /o/ in (13c,d). (In the case of [ku.saa...], the [y] of the intermediate representation [syaa] is always absorbed into the preceding alveolar fricative. This too follows from the general prohibition of coronal fricatives [s z] occurring before [y].) It is clear from the perfective forms in the right hand column that the underlying vowels are as indicated. The perfective ending which surfaces here as *-dde* is preceded by the underlying vowel in all cases except (13d), where /Co/ for some reason is realized as [Cwe].[14]

What is clear is that stem-level mid-vowels glide when followed by a (non-identical) vowel. In our analysis, this means that they do not undergo NHD. Luganda has no *Co-* prefixes and only one *Ce-* prefix, negative *te-*, whose behavior is irregular, and which has the allomorph *t-* before vowels (see section 4.2). We therefore do not know whether word-level sequences of /e+V/ and /o+V/ would undergo NHD or not.[15] It is thus possible to say that mid-vowels do not undergo NHD lexically, but do undergo NHD postlexically. The vowel /a/, on the other hand, undergoes NHD both lexically and postlexically. The coalescence of unlike vowels can now be summarized as in (14).

(14) a. $Ci+V_i$ → CyV_iV_i c. $Ca+V_i$ → CV_iV_i
$Cu+V_i$ → CwV_iV_i
b. $Ce+V_i$ → CyV_iV_i [lexical] $Co+V_i$ → CwV_iV_i [lexical]
CV_iV_i [postlexical] → CV_iV_i [postlexical]

In order to obtain this result, if we were to postulate a single 'input-output' application of LVS, NHD would have to apply differentially to the output, sensitive to the lexical/postlexical distinction. In a derivational approach, one might apply LVS first lexically, followed by NHD applying only to /a/, and then postlexically, with NHD applying to /i/ and /e/, as well as /a/.[16]

In all of the relevant examples, the rule of LVS assures that no Luganda syllable will surface with two non-identical vowels. Whether NHD applies or not, the bimoricity of the input is preserved. However, when morphemes are concatenated, it is possible for a string to have up to five vocalic moras in sequence. As the literature has repeatedly established, Luganda syllables are maximally bimoraic. The examples in (15) and (16) respectively show three and four vocalic moras occurring in the underlying representation being reduced to a single bimoraic syllable on the surface:

(15) tû-eê-lâb-a → [twéé.là.ba] 'we see ourselves'
we-refl-see-FV

(16) a. tû-nâa-eê-lâb-a → [tú.néé.là.ba] 'we will see ourselves'
we-F_1-refl-see-FV (F_1 = today future)
b. tû-â-eê-lâb-â → [twéé.làb-à] 'we saw ourselves'
we-P_2-refl-see-FV (P_2 = general past)

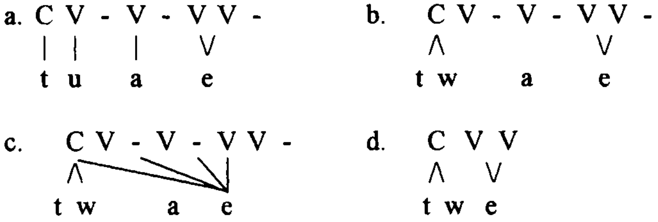
It should be noted that the reflexive morpheme and the F_1 'today future' both have underlying long vowels. They appear not only in the above examples but also elsewhere in preconsonantal environments where length is unconditioned cf. [n.tém.à] 'I cut' vs. [nn.éé.tèmà] 'I cut myself, pres.'; [tú.tèm.à] 'we cut, pres.' vs. [tu.náá.tém.à] 'we will cut'.

In (15) the first person plural SM *tû-* and the reflexive prefix *-eê-* provide three moras in sequence. LVS spreads the /e/ of the reflexive onto the mora of *tû-*, thereby producing surface trimoraic **twêeê-*. In (16a), the F_1 today future marker *-nâa-* is followed by the reflexive prefix -eê, thereby creating a sequence of four vocalic moras. LVS spreads the /e/ of the reflexive into both moras of the F_1 prefix, producing the unacceptable quadrimoraic output **neeee*. In the input in (16b) there are two opportunities for LVS to apply: the /a/ of the P_2 past tense spreads leftwards onto the mora of the first person plural SM *tû-*, and the /e/ of the reflexive prefix spreads onto the mora of the P2 marker *-a-*. With NHD of the /a/, this yields the unacceptable sequence **tweeee*. As indicated in the outputs in (16), the moraic lengths of /e/ in each case must be pared down to two. For this purpose, Clements (1986) proposes the rule of V-trimming in (17).

(17) Clements' 'V-trimming': $V_Q \rightarrow Ø$ / ___ V V

Recall that in Clements' CV framework, vocalic moras are represented as V slots. The rule in (17) deletes all V slots that precede a VV sequence. The derivation in (18) shows how Clements' rules would apply to the relevant part of the form in (16b).

(18)



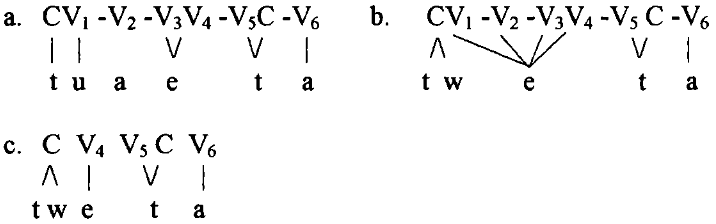
The input in (18a) shows three vowels linked to four V slots. In (18b) the /u/ relinks to the preceding C slot by Clements' rule in (5a), while the /a/ delinks by his rule in (9a). This is followed in (18c) by the leftward spreading of the vowel /e/ (Clements' rule in (5b)). Finally, V-trimming (17) applies in (18d), removing the first two V slots.[17]

In a moment we will reformulate V-trimming in moraic terms. But first let us consider how it is possible to get five V slots in a row. In order to demonstrate this, we need to consider geminate consonants. We saw in the examples in (2b) that the first half of a geminate counts as a mora. Thus, any long vowel that precedes a geminate consonant will be automatically shortened, as seen in (19).

(19) a.	tû-a-ˆtt-a we-P_2-kill-FV	→	[twát.tà]	'we killed'
b.	tû-ee-ˆtt-a we-refl-kill-FV	→	[twét.tà]	'we are killing ourselves'
c.	tû-a-ee-ˆtt-a we-P_2-refl-kill-FV	→	[twét-tà]	'we killed ourselves'

In (19a) the geminate of *-ˆtt-* 'kill' is preceded by two vocalic moras. After LVS applies, the intermediate representation is **tw-áá-tt-à*. As Tucker (1962), Clements (1986), and others have pointed out, the first half of a geminate is tone-bearing, hence moraic and joins a preceding vowel to form a syllable. Thus, the syllabification of this intermediate string would be *[twáát.tà] with an unacceptable trimoraic syllable. The vowel preceding the geminate thus shortens. The same results are obtained in (19b), where there are three vocalic moras preceding the geminate, and in (19c), where there are four. A derivation of (19c) in Clements' framework is provided in (20).

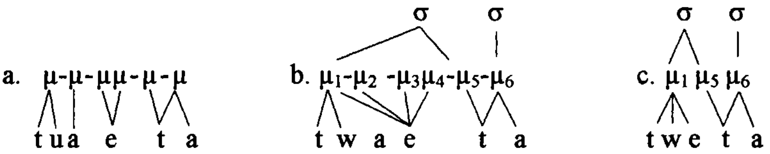
(20) *'V-trimming' from left to right (Clements 1986)*



As seen, Clements represents a geminate as a consonant linked to a VC sequence on the CV tier. Example (20a) shows the relinking of /u/ to the preceding C slot by (5a), and the delinking of /a/ by (9a). In (20b) the vowel /e/ spreads by (5b) to the preceding two V slots, and in (20c) V-trimming (17) removes the first three of the five successive V slots. Thus, five vocalic moras (V slots) are reduced to two.

The moraic analysis could in principle proceed in similar fashion, with excess moras being trimmed from the left. We will, however, depart from Clements' V-trimming in two ways. First, we shall assume that the 'trimmed' moras are not the leftmost ones, but rather excess internal ones. And second, we will assume that the reason they are trimmed is that they fail to be parsed into the syllable. As shown in (21), we will adopt an 'edge-in' association of moras to syllables.[18]

(21) *Edge-in syllabification of moras + stray erasure: (some tonal evidence)*



The input form is given in (21a). In (21b), LVS has applied, followed by NHD, which delinks the /a/. This creates a form in which the /e/ of the reflexive morpheme is linked to four moras. As also seen, only the first and fifth moras are syllabified by the edge-in algorithm. As a result, moras 2, 3 and 4 are stray erased in (21c).

The evidence for this departure from Clements' view is tonal. As background, consider the two geminate-initial verbs in (22).

(22) a.	ku-ggul-a	[kug.gu.la]	'to open'
	ku-ˆdduk-a	[kúd.dù.ka]	'to run'
b.	bâ-ggul-a	[bâg.gul.a]	'they open'
	bâ-ˆdduk-a	[bád.dù.ka]	'they run'

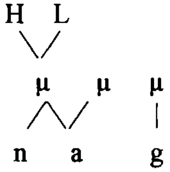
The verb root *-ggul-* 'open' is underlyingly toneless, while the verb root *-ˆdduk-* has an underlying HL contour on its first (=geminate) mora. As seen in (22a), the H of the HL contour is realized on the underlyingly toneless infinitive prefix *ku-*, while the L of the contour is realized on the next syllable. In (22b), the class 2 SM *bâ-* 'they' has an underlying HL contour. When followed by the toneless root *-ggul-*, the contour surfaces on the vowel of the first syllable. When tonic *bâ-* is followed by tonic *-ˆdduk-*, the two HL contours simplify on their one syllable, and the same surface realization is obtained as in [kúd.dù.ka] in (22a).[19]

With this background, we are now ready to consider cases that involve stray-erasure of excess moras. Consider the forms in (23).

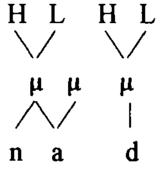
(23) a.	a-nâa-ggul-a	[a-nâg.gu.la]	'he will open'
b.	a-nâa-ˆdduk-a	[a-nád.dù.ka]	'he will run'

In each form the geminate-initial verb root is preceded by the F$_1$ future prefix -*nâa-*.[20] As seen, the output in (23a) is with a falling tone on the syllable [nâg], while the output in (23b) has a H tone on [nád] followed by a L tone on [dù]. Consider in (24) what would happen if the leftmost of the three moras were trimmed:

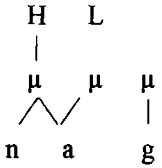
(24) a.i.



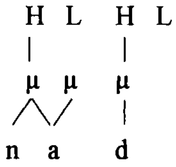
a.ii.



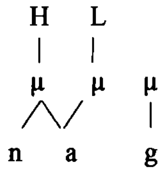
b.i.



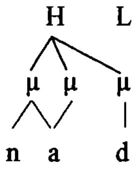
b.ii.



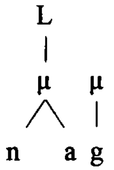
c.i.



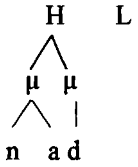
c.ii.



d.i.



d.ii.



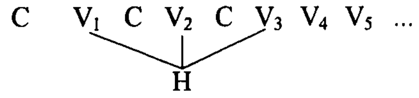
Although this does not affect the argument about to be made, the derivation in (24) follows the analysis of Hyman & Katamba (1993a). As seen in (24a), underlying tonicity consists of a HL contour. In (24b) the rule of *Contour Simplification* (CS) has applied, which delinks the L of a HL contour from its mora when followed by another mora. This L links to the following mora in (24c.i). In (24c.ii), where the L is wedged between two H tones, it is deleted, and the two H's fuse into a single H by a process of H tone plateauing[21]. Following Clements' proposal of V-trimming from the left, (24d) shows the structure that results if we delete the leftmost mora.[22] Initial mora-deletion creates no difficulty in (24d.ii), where the correct bimoraic H tone syllable is derived. However, with the first mora deleted in (24d.i), its H is now floating and a L is linked to the now initial mora, thereby incorrectly deriving a L tone bimoraic syllable. We know that H tones never spread to the right in Luganda (and except for a very specific phrasal phenomenon, they do not dislodge L tones). Instead, such free H tones, when they are realized, always link to the *preceding* mora. In this example, the preceding mora is a word-initial vowel, which cannot be H in Luganda. The expected result, then, would be for the H either to be passed onto the preceding word or to be stray erased. Since this does not happen, we assume that the first mora is not deleted in (24).[23]

Of course Clements' V-trimming rule can be reformulated as in (25).

(25) V-trimming revised: $V_Q \rightarrow \varnothing \ / \ V \_\_\_ \ V$

Or, one could revise (25) to adopt our claim that the excess moras (V slots) are stray-erased because they fail to be syllabified, as in (21). Either way it would still be useful to have more empirical evidence distinguishing leftmost V-trimming vs. internal stray erasure. It would be critical for this purpose, if Luganda, for example, provided an input of the form in (26).

(26)



(if V_3 is 'trimmed', the H will be lost in its CVV syllable)

In this case a H is linked to V_1, V_2 and V_3, which are in three different syllables, the last of which has the problematic input of more than two moras. As seen, the H is linked only to V_3, i.e. the first V in the third syllable. If this V_3 were 'trimmed', the H would thus be lost on the third syllable by the general principles of autosegmental phonology.[24] Unfortunately, the morphology of the language seemingly conspires against providing a relevant sequence of formatives that would produce this output. The best case we have come up with concerns the WH-*yet* tense illustrated in (27).

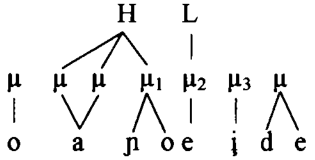
(27) a. o-âa-sib-ɪ-e = ki [wáà.si.byee.ki] 'what have you tied yet?'
b. o-âa-lâb-ɪ-e = ki [wáá.lá.byèè.ki] 'what have you seen yet?'

The only underlying contour in (27a) occurs on the first mora of the tense marker *-âa-* in (27a). In (27b), there is a second contour on the verb root *-lâb-* 'see'. By the regular tone rules of Luganda, a H plateau surfaces from the first mora of *-âa-* to the tonic mora of -lâb-. Now consider the corresponding forms that are obtained when a -Co- verb root from (13d) is substituted for the above -CVC- roots:

(28) a. o-âa-mo-e-ɟd-e = ki [wáà.mwed.de.ki] 'what have you shaved yet?'
b. o-âa-ɲô-e-ɟd-e = ki [wáá. ɲwêd.de.ki] 'what have you drunk yet?'

A comparison of these forms with those in (27) reveals that the perfective ending is *-ɟ-e* following a consonant, but -ɟd-*e* following a vowel, the latter being converted by rule to *-dd-e* (cf. Appendix).[25] In order to get the [e] of the surface syllables [mwed] and [ɲwêd], we have placed an additional morph *-e-*. Now, if this vocalic morph is moraic, as it is everywhere else in the language, we have the input we seek:

(29)



It should be clear that if $μ_1$ were to be trimmed in (29), the incorrect tonal output *[wáá. ɲwèd.de.ki] would be obtained. As indicated in note 14, there are however other interpretations of the $μ_2$ vowel formative -e-. In addition, even if the vowel sequence /o-e-į-/ is trimoraic, it is possible that it has been trimmed at the stem level before the prefix *-âa-* is added. While the tonal facts suggest that stray erasure should apply to medial moras, a stronger argument will be made from the perspective of the syllabification process itself. As we shall see in sections 4.2 and 4.3, syllabification is cyclic in Luganda. That fact plus the preference for CV syllables will automatically result in the retention of the first and last moras of vocalic sequences.

3. The optimal syllable

Taking our inspiration from *Optimality Theory* (OT) (Prince & Smolensky 1993), we present in this section evidence in favor of the following surface syllable preferences in Luganda:

(30) a. CV >> V
b. V >> VV
c. CVV >> CVCV

(30a) states that Luganda disprefers syllables lacking an onset, which can occur only after pause. This then is strong instantiation of Itô's (1989) constraint Avoid σ[V.[26] According to (30b), syllables with simplex (monomoraic) nuclei are preferred. Although Luganda allows CVV (30c), i.e. a syllable with a complex bimoraic nucleus, which goes against the preferred choice in (30b), rarely does it allow an onsetless syllable with a bimoraic nucleus which violates both constraints (30a) and (30b). Finally, as we argue below, where it has a choice, Luganda prefers to build a single CVV syllable rather than two CV syllables (30c). This minimization of the number of syllables constructed, which can be attributed to Prince & Smolensky's (1993) constraint *STRUC(σ) (avoid structure with respect to syllables), is the one place where a VV nucleus is preferred to V nucleus.

In this section we shall exemplify the validity and see the utility of the three preference statements in (30). In (31) we summarize the syllable-related phenomena that are related to or are at least in part motivated by (30), particularly by the need to avoid VV syllables:

(31) *Motivation for the hierarchy in (30)*
a. the occurrence of V (and syllabic N) syllables only after pause
b. the near non-existence of $[\mathrm{VV}]_\sigma$
c. the lack of root morphemes that begin +VVC (or $\mathrm{VC_iC_i}$)
d. the replacement of class 1 SM *a-* by *e-* when followed by a V
e. the lack of CL when onsetless /e-, o-/ are followed by a V
f. y/Ø alternations at the beginning of root morphemes
g. the non-tone-bearing status of the moraic nasal 'N' in onsetless $[\mathrm{VN}]_\sigma$

We begin by considering the status of V-initial syllables.

3.1. V-initial syllables

We have already established that onsetless syllables can only appear after a pause. In all other positions the vowel that begins a word joins the preceding syllable (recall the examples in (3b), (4c) and (8)). This is true even if there is an assertion break (%) occurring between two words, as in a right dislocation, as in (32).

(32) /tû-mu-lâb-a % ô-mu-âna/ → [tú.mú.lá.bòò.mwáà.na]
we-him-see-FV aug-cl.1-child 'we see him, the child'

In addition, we have asserted that Luganda has no VV syllables. As pointed out by a number of scholars (e.g. Tucker 1962, Cole 1967, Stevick 1969), the one exception to this statement is that post-pausal vowels actually vary in duration. Thus, the augment vowels /e o a/ may be short or long when followed either by a plain consonant in (33a) or by a preconsonantal nasal in (33b).[27]

(33) a.	e-bi-tabo	'books'	[e.bi.ta.bo]	~	[ee.bi.ta.bo]
	o-mu-limi	'farmer'	[o.mu.limi]	~	[oo.mu.limi]
	a-ba-limi	'farmers'	[a.ba.li.mi]	~	[aa.ba.limi]
b.	e-n-jovu	'elephant'	[en.jo.vu]	~	[ee.njo.vu]
	o-n-sib-a	'you sg. tie me'	[on.si.ba]	~	[oo.nsi.ba]
	a-n-sib-a	'he ties me'	[an.si.ba]	~	[aa.nsi.ba]

What we propose is that the VV realization is stylistic or expressive and, as is often the case, intonational features produce a structure that would not normally occur in the output of the phonology proper. In terms of OT we can say that stylistic initial lengthening is optional, but outranks the prohibition against VV syllables. As seen in (33), this variation is categorical: Independent of whether a NC sequence follows, there is a clear distinction between a short vs. long realization of the initial vowel. The vowel duration that is optionally observed in (33b) is thus due to intonation, rather than to lengthening before preconsonantal nasals (see sec. 5.1).[28]

3.2. Lack of root morphemes that begin +VVC

The second property that is explained by the prohibition against VV syllables is the non-occurrence of root morphemes that begin VVC. Limiting our attention to verbs, there are roots of the shape -al- 'spread' and -er- 'sweep'. However, no roots exist such as *-aal- and *-eer-. Two kinds of evidence unambiguously establish that the initial vowel of verb roots is underlyingly short. The first of these can be seen from the forms in (34), where verb stem reduplication adds the meaning of 'to X here and there':

(34)	a.	(ku-) al-a	'to spread'	→	(ku-) al-aa - yal-a	[kwaa.laa.ya.la]
		(ku-) er-a	'to sweep'	→	(ku-) er-aa - yer-a	[kwee.raa.ye.ra]
	b.	(ku-) lim-a	'to cultivate'	→	(ku-) lim-aa - lim-a	[ku.li.maa.li.ma]
		(ku-) gul-a	'to buy'	→	(ku-) gul-aa - gul-a	[ku.gu.laa.gu.la]
	c.	(ku-) saab-a	'to smear oneself, refl. '	→	(ku-) saab-a - saab-a	[ku.saa.ba.saa.ba]
		(ku-) siig-a	'to smear s.o./s.th.'	→	(ku-) siig-a - siig-a	[ku.sii.ga.sii.ga]

(34a) shows that the first FV is lengthened following a -VC- root in reduplication. A comparison with (34b) and (34c) shows that this lengthening applies only when the FV is preceded by exactly one mora. Further complications involving this construction are discussed in section 5. For our present purposes, it should simply be noted that the initial [y] that occurs on the second stem in reduplication is followed by a short vowel in these examples. Given the appearance of this [y], it would have been logically possible for Luganda to have an opposition between root initial /V/ vs. /VV/. A hypothetical underlying representation such as /-aal-/ would not only require that the first FV be short, but also that the second part of the reduplicated stem surface as [yaa.la], with a perfectly fine CVV initial syllable. Since no such alternations exist in the language, we conclude that Luganda roots may not begin with an underlying long vowel.

The second piece of evidence for this conclusion is tonal. The forms in (35) show the tonal realization of vowel-initial stems in the non-subject cleft construction:

(35) a.	(ènó gyè tu-) al-â[29]	'it's this that we spread'	[twàà.lâ]
	(ènó gyè tu-) er-â	'it's this that we sweep'	[twèè.râ]
	1 2		
b.	(eno gye tù-) lìm-â	'it's this one that we cultivate'	[tù.lì.mâ]
	(ebyo bye tù-) gul-â	'it's these that we buy'	[tù.gù.lâ]
	1 2		
c.	(guno gwe tu-) saâb-a	'it's this that we smear'	[tù.sáá.bà]
	(zino ze tu-) siîg-a	'it's these that we smear'	[tù.síí.gà]
	12		

In this construction[30] a HL contour is assigned to the second mora (M2) of the stem. In (35a) we see that the stem-initial vowel is counted as one TBU for this purpose. In this regard it behaves identically to the CVCV stems in (35b) rather than the CVVCV stems in (35c).[31] If the stem-initial vowel were bimoraic, we would have obtained outputs such as *[twáá.là] and *[twáá.gà.là]. Both reduplication and tonal evidence thus point towards root-initial vowels as being short.

Recall that while roots may not begin +VVC, they may begin +VNC. We attribute this to the [+cons] specification of the nasal. It is important to note in this context, however, that roots beginning $+VC_iC_i$ are also not found.[32] Since the first half of the geminate is phonetically a consonant, one might expect to find such roots, just as one finds roots such as *-anj-* 'spread out' which begin with a +VNC sequence. We can explain this gap by treating the first half of the geminate as a vowel (cf. Clements' 1986 representation of Luganda geminates as VC). Specifically, in our analysis we would have to derive $+VC_iC_i$ from underlying /V¡C/ which clearly violates the prohibition against root initial +VVC. At a later stage in the derivation /V¡C/ is converted to $[VC_iC_i]$.

What this means is that roots may not have the structure [VV, i.e. a branching nucleus following a left bracket. We believe that this is related to the prohibition of VV syllables in general in the language. The output of stratum 1 (stem-level) phonology must not therefore contain such a sequence. While root morphemes may not begin with a long vowel, a small number of grammatical morphemes do, e.g. the reflexive prefix *-eê-* seen in many of the examples. Since it is not unusual for affixes to escape root-structure constraints, we needn't be concerned.

3.3. Replacement of class 1 subject marker *a-* by class 9 *e-*

Another property of Luganda that we believe to be related to the avoidance of bracket-initial VV and VV syllables concerns the allomorphy of the class 1 (singular human) SM. As seen in (36a), the regular allomorph of the class 1 SM is *a-*:

(36) a.	a-láb-à	'he/she sees'	a-kyáá-láb-à	'he/she still sees'
	a-ki-láb-à	'he/she sees it'	a-náá-láb-à	'he/she will see'
b.	e-láb-à	'it sees'	e-kyáá-láb-à	'it still sees'
	e-ki-láb-à	'it sees it'	e-néé-láb-à[33]	'it will see'
c.	y-a-láb-à	'he/she/it saw'		
	y-aaka-láb-à	'he/she/it has just seen'		
	y-éé-làb-a	'he/she/it sees self'		

The forms in (36a) show *a-* followed by a verb root, an object marker (OM), and two tense markers (TM's), all of which begin with a consonant. In (36b) we see that the class 9 (singular animal) SM has the shape *e-* in the same preconsonantal environments. In (36c), however, where the SM's are directly followed by the reflexive OM or a TM that begins with a vowel, the two noun classes merge. Earlier analyses of Luganda or closely related languages have occasionally accounted for this fact by positing a peculiar phonological rule by which /a-/ glides to [y] before a vowel.

We shall depart from this interpretation and suggest that the class 1 SM *a-* is replaced by the class 9 SM *e-* before a vowel by a morphological rule. The class 9 *e-* then glides to [y] by the regular phonological rule in (14b). Such a process whereby one morpheme is replaced by another in a specific phonological (or grammatical) context has been called a 'rule of referral' (Zwicky 1987, Stump 1993) or 'take-over' (Carstairs 1987). The rule of referral in Luganda is expressed as in (37a) and is responsible for the first step of the derivations in (37b).[34]

(37) a.	a-	→	e-	/	___ V
	[class 1 SM]		[class 9 SM]		

b.	/a-a-lâb-â/	→	/e-a-lâb-â/	→	[ya.lá.bà]	'he saw'
	/a-aaka-lâb-a/	→	/e-aaka-lâb-a/	→	[yaa.ka.lá.bà]	'he has just seen'
	/a-eê-lâb-a/	→	/e-eê-lâb-a/	→	[yéé.là.ba]	'he sees himself'

Once class 1 *a-* has been taken over by class 9 *e-*, gliding applies to create the [y]. The reason, we suggest, for this take-over is to avoid an initial VV syllable. When *a-* is replaced by *e-*, this sets up the possibility of deriving a [yV] or [yVV] initial syllable. The last example in (37b) shows that *e-* glides to [y] even before another /e/. We have seen in other cases that sequences of identical vowels are realized as a single long vowel. In our view, this latter option is blocked here, because a VV syllable would result. Instead, a more optimal realization is obtained by allowing /e-/ to glide before another /e/.[35] In case *e-* is followed by a short vowel, the output is monomoraic for reasons to which we now turn.

3.4. Lack of CL when onsetless /e o/ are followed by a vowel

In (3), (8), (12) and elsewhere we have seen examples where a vowel either glides or is deleted, with compensatory lengthening of the following vowel. Additional examples are given in (38a).

(38) a. kî-â-lâb-â ‘it saw’ → [kyáá.là.bà] (cl. 7)
tû-â-lâb-â ‘we saw’ → [twáá.là.bà]
bâ-â-lâb-â ‘they saw’ → [báá.là.bà]
b. e-â-lâb-â ‘he/she/it saw’ → [ya.lá.bà] (cl. 1, 9)
o-â-lâb-â ‘you sg. saw’ → [wa.lá.bà]

As seen in (38b), however, CL is not observed when the gliding vowel is not itself preceded by a consonant. Further examples of this contrast are seen in (39).

(39) a. ky-ee= ki-kópò ‘it’s the cup’ b. y-e= loolê ‘it’s the lorry’ [cl.9]
lw-ee= lu-ggí ‘it’s the door’ y-e= mw-áàna ‘it’s the child’ [cl.1]
b-ee= b-áàna ‘it’s the children’ (< ba-e-)

In this construction the copula is expressed by the morpheme /-e/ which combines with the appropriate noun class prefix. In (39a) we see that when this prefix is of the underlying shape CV-, gliding or deletion applies, accompanied by CL. The resulting length surfaces because length is preserved on proclitics (Hyman & Katamba 1990). In (39b), on the other hand, the vocalic class 9 prefix *e-* glides to [y] without CL. (We also see that class 1 *a-* is again replaced by class 9 *e-* by the rule of referral in (37a).) One solution, suggested by Clements (1986), would be to introduce a mora truncation rule which can be informally stated as in (40a) or (40b).[36]

(40) a. $\begin{array}{cc} \mu & \mu \\ | & | \\ [\text{e,o} & \text{V} \end{array} \rightarrow \begin{array}{c} \mu \\ \wedge \\ \text{e,o}\ \ \text{V} \end{array}$ b. $\mu \rightarrow \emptyset \;/\; \begin{array}{cc} \underline{\quad} & \mu \\ | & | \\ [\ \text{e,o} & \text{V} \end{array}$

The mora of an initial /e/ or /o/ is deleted before another vowel but the vowel itself survives and gets realized as a (non-moraic) glide. As a result, underlying /e+V/ and /o+V/ sequences are realized as short [yV] and [wV]. What is crucial is that the V in (40a) does not simply spread onto the preceding mora by the LVS rule in (6). Our contention is that this would be the equivalent of a VV syllable, which is prohibited on the surface in Luganda.

Now it turns out that, in other cases, these same morphemes glide and we observe [yVV] and [wVV] syllables. As seen in (41), however, this only arises when the following morpheme has an underlying long vowel:[37]

(41) a.	y-éé-làb-a	'he/she/it sees self'	<	e-eê-lâb-a
	w-éé-làb-a	'you sg. see self'	<	o-eê-lâb-a
b.	y-aa= mulondo	'the one of Mulondo' [cl. 9]	<	e-aa= mulondo
	w-aa= mulondo	'the one of Mulondo' [cl. 1]	<	o-aa= mulondo[38]
c.	mw-áánà y-ee= y-a-gw-â	'it's a child that fell'	<	mu-âna e-ee= e-â-gu-â
	m-bwá y-ee= y-a-gw-â	'it's a dog that fell'	<	m-buâ e-ee= e-â-gu-â

In (41a) *e-* and *o-* glide before the reflexive OM -eê- yielding surface [yéé] and [wée] syllables. This is because the reflexive morpheme has an underlying long vowel. We similarly obtain the surface syllables [yaa] and [waa] in (41b), because of the underlying length of the genitive morpheme *-aa* (which is preserved in the examples because *y-aa=* and *w-aa=* are proclitics). Example (41c) shows that the subject cleft marker *-ee* is also underlyingly long.[39]

The preceding subsections have shown that VV syllables are prohibited in Luganda. We propose, in addition, that the present section points to the need for an additional constraint presented in (42a).

(42) a. Avoid $\begin{array}{l}\sigma\\ |\\ [\text{V}\end{array}$ b. $\begin{array}{l}\sigma\\ |\\ [\text{VVC}\end{array}$ c. $\begin{array}{l}\ \ \sigma\\ \ \ |\\ [\text{VVC}\end{array}$

A V-initial syllable is to be avoided at the left edge of a constituent, i.e. in addition to the avoidance of onsetless syllables, which are dispreferred in general. We take this to mean that in Luganda, as in many languages, constituents should begin with a CV syllable, e.g. words, stems and roots (possibly other morphemes as well).[40] This constraint motivates the non-existence of +VVC+ in roots in the following way: If there were such an input, we could not syllabify both V's to obtain a disallowed VV syllable. Hence both VV's of a [VV input cannot syllabify. Without the constraint in (42a), there would be two equally well-formed syllabifications of one of the two vowels: the first V in (42b) and the second V in (42c). With the constraint in (42a), (42c) 'wins out' over (42b). Now, if we add the proposal that non-syllabified moras are stray-erased at the end of the stem level (stratum 1), the long vowel in (42c) would automatically shorten to V before moving on to prefixation at stratum 2.

It can now be noted that (42a) will also obviate the mora truncation rule in (40). In this case as well, only the second of the two V moras *e-a-* and *o-a-* of (38b) can be syllabified, while the other is stray-erased. The difference is that stray-erasure occurs at the end of the word (stratum 2) phonology rather than the stem (stratum 1). In addition, the constraint in (42a) explains the y/Ø alternation which we address in the following section.

4. y/Ø alternation

The take-over of class 1 *a-* by class 9 *e-* and the moraic loss and gliding of *e-* and *o-* before another vowel indicate that much of the syllable phonology of Luganda centers around the analysis of glides. In this section, we present an analysis of the y/Ø alternation that occurs in vowel-initial roots.

4.1. Stable- vs. unstable-*y*

As seen in the examples in (43), there are clearly verb roots which begin with an underlying /y/.

(43) *'Stable-y' at the beginning of root morphemes*

a.	ku-yíg-à	'to learn'	a-yíg-à	n-jíg-à	'he, I learn'
	ku-yuz-a	'to tear'	a-yuz-a	n-juz-a	'he, I tear'
b.	ku-yéyùk-a	'to be poor' [< Swahili]	a-yéyùk-a	n-jéyuk-a	'he, I am poor'
	ku-yoy-a	'to hanker after'	a-yoy-a	n-joy-a	'he, I hanker after'
	ku-yab-a	'to be weak'	a-yab-a	n-jab-a	'he is, I am weak'
c.	ku-yíìy-a	'to invent'	a-yíìy-a	n-jíìy-a	'he, I invent'
	ku-yéèy-a	'to crumble'	a-yéèy-a	n-jéèy-a	'he, I crumble'
	ku-yúùg-a	'to vacillate'	a-yúùg-a	n-júùg-a	'he, I vacillate'
	ku-yool-a	'to pick up in hands'	a-yool-a	n-jool-a	'he, I pick up'
d.	ku-yîgg-a	'to hunt'	a-yîgg-a	n-jîgg-a	'he, I hunt'
	ku-yôtt-a	'to make off, go away'	a-yôtt-a	n-jôtt-a	'he, I make off'
	ku-yagg-a	'to lament'	a-yagg-a	n-jagg-a	'he, I lament'
e.	ku-yíìmb-a	'to sing'	a-yíìmb-a	ɲ-ɲíìmb-a	'he, I sing'
	ku-yeeng-a	'to stir and dissolve'	a-yeeng-a	ɲ-ɲeeng-a	'he, I stir, dissolve'
	ku-yuunj-a	'to cut down (plantains)'	a-yuunj-a	ɲ-ɲuunj-a	'he, I cut down'
	ku-yoond-a	'to twist, twine together'	a-yoond-a	ɲ-ɲoond-a	'he, I twist, twine'
	ku-yaamb-a	'to help'	a-yaamb-a	ɲ-ɲaamb-a	'he, I help'

The forms in (43) are arranged by what follows the initial /y/ of the verb root: high short vowels (43a), non-high short vowels (43b), long vowels (43c), vowel + geminate (43d), and, finally, vowel+NC (43e), where we have also transcribed the redundant vowel length obtained before a preconsonantal nasal (see sec. 5.1). These roots are preceded by a CV- prefix (infinitive class 15 *ku-*) in the first column, by a V- prefix (class 1 SM *a-*) in the second column, and by the first person singular moraic *n-* prefix in the third column. As seen, a [y] is realized throughout the first two columns. In the third column of (43a-d), the /y/ hardens after the nasal prefix to the alveopalatal affricate [dʒ] transcribed as *j*. In (43e), a process known as Meinhof's Rule (also known as the Ganda Law) converts the derived *n+j* to *ɲɲ* when the next syllable begins with a nasal (cf. also *ku-yím-à* 'to take up position' vs. *ɲ-ɲímà* 'I take up position', where the following syllable begins with a simple nasal consonant, rather than NC).

Using Meeussen's (1955) terminology, we can refer to such cases of root-initial /y/ as 'stable': In all environments these roots show either a phonetic [y] or its hardened or nasalized counterparts. Roots with stable /y/ initials are particularly common when followed by /i/ or when occurring in a bimoraic syllable, i.e. preceding a long vowel or a vowel + NC cluster.[41] By contrast, unstable-*y* (and its hardened and nasalized counterparts) is found only before roots that begin with /e/, /o/ or /a/:

(44) *'Unstable-y' at the beginning of root morphemes*

a.	ku-er-a	[kwee.ra]	'to sweep'	a-yer-a	n-jer-a	'he, I sweep'
	ku-ôl-a	[kwóò.la]	'to carve'	a-yól-à	n-jól-à	'he, I carve'
	ku-oger-a	[kwoo.ge.ra]	'to speak'	a-yoger-a	n-joger-a	'he, I speak'
	ku-al-a	[kw-aal-a]	'to spread out'	a-yal-a	n-jal-a	'he, I spread out'
b.	ku-êng-a	[kwéè.nga]	'to despise'	a-yéèng-a	ɲ-ɲ-éèng-a	'he, I despise'
	ku-end-a	[kwee.nda]	'to c. adultery'	a-yeend-a	ɲ-ɲeend-a	'he, I c. adultery'
	ku-onger-a	[kwoo.nge.ra]	'to increase'	a-yoonger-a	ɲ-ɲoonger-a	'he, I increase'

As seen in the infinitives in (44), these are the forms we have referred to as 'vowel-initial roots'(cf. sec. 3.2). When preceded by the class 1 *a-* SM, they begin with [y] and are thus indistinguishable from the stable-*y* roots. Similarly, when preceded by the first person sg. *n-* prefix, the [y] hardens to [j] and Meinhof's Rule converts *nj* to [ɲɲ] when the next syllable begins with a nasal. The question, then, is how to analyze this alternation between Ø and [y].

The forms in (45) reveal the correct generalization: the Ø-initial form is used when the root is preceded by a CV- prefix; the y-initial form is used elsewhere:[42]

(45) *Generalization: no [y] if the root is preceded by a CV prefix;* otherwise *a [y]*

a.	ku-er-a	[kwee.ra]	'to sweep'	(infinitive)
	tû-er-a	[twéè.r-a]	'we sweep'	(subject)
	ku-gî-er-a	[ku.gyéè.ra]	'to sweep it'	(object)
	a-lî-er-a	[a.lyéè.ra]	'he/she will sweep'	(tense)
b.	a-yer-a	[a.ye.ra]	'he/she sweeps'	(subject)
	o-yer-a	[o.ye.ra]	'you sg. sweep'	(")
	e-yer-a	[e.ye.ra]	'it sweeps'	(")
	tû-â-yêr-â	[twáá.yè.rà]	'we swept'	(tense)
c.	ku-eê-yer-a	[kwéé.yè.ra]	'to sweep oneself'	(reflexive)
	a-nâa-yer-a	[a.náà.ye.ra]	'he/she will sweep'	(tense)
	a-kîa-yer-a	[a.kyáà.ye.ra]	'he/she still sweeps'	(aspect)
d.	n-yer-a	[n.je.ra]	'I sweep'	(subject)
	a-n-yer-er-a	[an.je.re.ra]	'he/she sweeps for me'	(object)
e.	yer-a	[ye.ra]	'sweep!'	(Ø)
	yer-aa - yer-a	[ye.raa.ye.ra]	'sweep here and there'	
	a-yer-aa - yer-a	[a.ye.raa.ye.ra]	'he/she sweeps here and there'	
	tû-er-aa - yer-a	[twéè.raa.ye.ra]	'we sweep here and there'	

(45a) shows the vowel-initial realization *-er-* of 'sweep' when preceded by a variety of CV- prefixes: infinitive class 15 *ku-*, first person pl. SM *tû-*, class 9 OM *-gî-*, and the general future (F_2) prefix *-lî-*. (45b) shows the *y*-initial realization *-yer-* after the three vocalic SM's: *a-* (class 1), *o-* (second person sg.) and *e-* (class 9), as well as after the general past (P_2) TM -â-. [y] is also obtained in (45c) after long vowel prefixes: reflexive *-eê-*, today future (F_1) *-nâa-*, and persistive *-kîa-*. In (45d) we again have *-yer-*, although with hardening after a nasal. Finally, (45e) shows that [y] appears when there is no prefix, i.e. either word-initially or at the beginning of the second stem in verb stem reduplication. As seen, the second stem begins with [y] independent of how the first stem is realized (e.g. without [y] in the fourth example) and independent of whether the preceding syllable is CV or CVV.[43]

There are four logical analyses of unstable *y*-stems, which we will treat in turn:

(a) underlying /y/ gets deleted; (b) /y/ is epenthetic; (c) a ghost /y/ without a root node, and (d) extraprosodic /y/.

The first analysis proposes forms such as /-yer-/, i.e. with an underlying /y/ which deletes by rule (46) whenever preceded by a CV- prefix:

(46) $$y \rightarrow Ø \ / \ C \ \ V \ + \ \_\_\_$$

There are two problems with this analysis. First, as we saw in (43), there are many verbs whose initial /y/ does not delete. There are even some minimal or near-minimal pairs, e.g. *ku-ab-a* [kwaa.ba] 'to come to an end' vs. *ku-yab-a* 'to be weak', *ku-êng-a* [kwéè.nga] 'to despise' vs. *ku-yeng-a* [ku-yeeng-a] 'to stir and dissolve'. If unstable-*y* roots are analyzed with /y/, we will thus have to invent some way to distinguish stable and unstable /y/, e.g. a diacritic or rule exception feature. This seems an unsatisfactory solution, since stable-*y* and unstable-*y* appear with almost equal frequency in the lexicon (87 vs. 85 verb roots, respectively, in Snoxall 1967). The second problem is that unstable-*y* is invariably followed by one of three morpheme-initial short vowels in the language: /e/, /o/ and /a/. That is, stable- and unstable-*y* contrast only when the following vowel is [–high] and short. This vowel may not be followed by a geminate, but it may be followed by a NC cluster.[44] If unstable-*y* is underlying, how do we relate its distribution to the generalization that morphemes must not begin with a high vowel? We might therefore reformulate the rule as in (47).

(47) $$y \rightarrow \emptyset \ / \ C \ V + \_\_ \ \begin{matrix}[-\text{high}] \\ V\end{matrix} \ C$$

However, even with the short [–high] vowel environment being stipulated, as in (47), there would be many lexical exceptions to the rule.[45]

This problem is automatically taken care of in the second logical analysis: unstable-*y* is epenthetic. In this case, we set up underlying forms such as /-er-/ 'sweep', /-oger-/ 'speak' etc. Since such roots are entered in the lexicon as vowel-initial, they meet the general morpheme structure condition of the language that prohibits words and root morphemes beginning with /i/ and /u/.[46] The first problem with this analysis, however, is how to formulate the rule. As was seen in (45b-e), the left hand environments in which unstable-*y* appears are quite varied: after a -V- morpheme, a long vowel, a nasal, or Ø. Not only would it be difficult to conflate the preceding environment of the rule, one would also have to build into it that the [y] is inserted only at the beginning of a root (or stem). As seen in (48), a [y] is not inserted between vocalic prefixes:

(48) a.	o-a-lâb-â	[wa.lá.bà][47]	'you saw'	*[o.ya.lá.bà]
b.	o-eê-lêet-a	[wéé.lèè.ta]	'you bring yourself'	*[o.yéé.lèè.ta]

In (38a) [y] is not inserted when the 2 sg. SM *o-* is followed by the P_2 TM *-a-*, and in (48b) it is not inserted between the *o-* SM and the reflexive prefix *-eê-*.[48] A second potential complication involves the interaction of *y*-insertion with the takeover rule in (37a). Consider the input in (49), which meets the structural description of both the takeover rule in (37a) and *y*-insertion.

(49) a. ([y]-epenthesis)
/a + er-a / → a-yer-a → [a.ye.ra] 'he sweeps'
b. (takeover + gliding)
/a + er-a / → e + er-a → *[ye.ra], *[e.ye.ra]

The correct output is seen in (49a), where *y*-insertion precedes (and hence bleeds) the takeover rule responsible for replacing class 1 *a*- with class 9 *e*-. If takeover were to apply first, the incorrect output would be derived in (49b).[49] Although both rules are in part phonologically conditioned, takeover is a morphological process establishing allomorphy, while *y*-insertion is a phonological rule. One would normally assume that allomorphy would be established before the application of a phonological rule.[50]

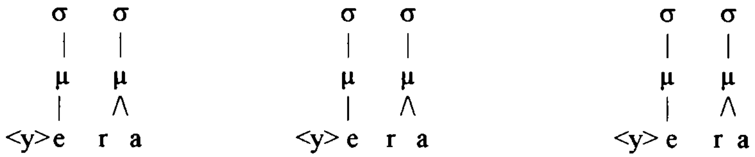
First, however, let us consider a phonological strategy which appears to us to be less problematic than the foregoing – and which derives the correct result from the syllable hierarchy in (30). The solution is to give special status to unstable-*y*. One possibility raised by Peterson (1993) is to represent unstable-*y*'s as 'ghost consonants'. Following the work of Zoll (1993, 1996) one could represent unstable-*y* as an /i/ lacking a root node. In the right context, a root node would be supplied so that the segment could be syllabified as [y]. If not supplied a root node, the rootless /i/ would be stray erased. The drawback of this solution is that we have no explanation for why unstable-*y* appears only at the left edge of a root morpheme.

Our own preference is to view unstable-*y*'s as extraprosodic /y/ that is invisible at the stem level. This makes two correct predictions. First, because of the peripherality condition (Hayes 1982), extrametricality accounts for why unstable-*y* is found only at the beginning of a domain. Second, if we adopt Inkelas' (1989) account of extrametricality, unstable-*y* cannot be seen by virtue of its being external to the stem domain. This explains why the visible part of the stem must meet the general condition that the initial vowel of a morpheme is limited to short /e/, /o/ or /a/.

Our analysis can be illustrated by means of the derivations in (50).

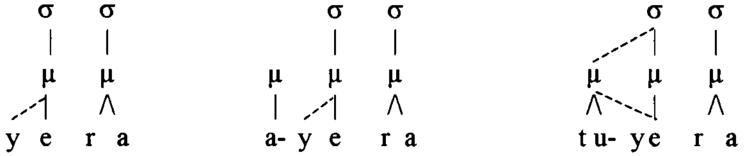
(50) a. [ye.ra] b. [a.ye.ra] c. [twéè.ra]

i.



ii.

iii.



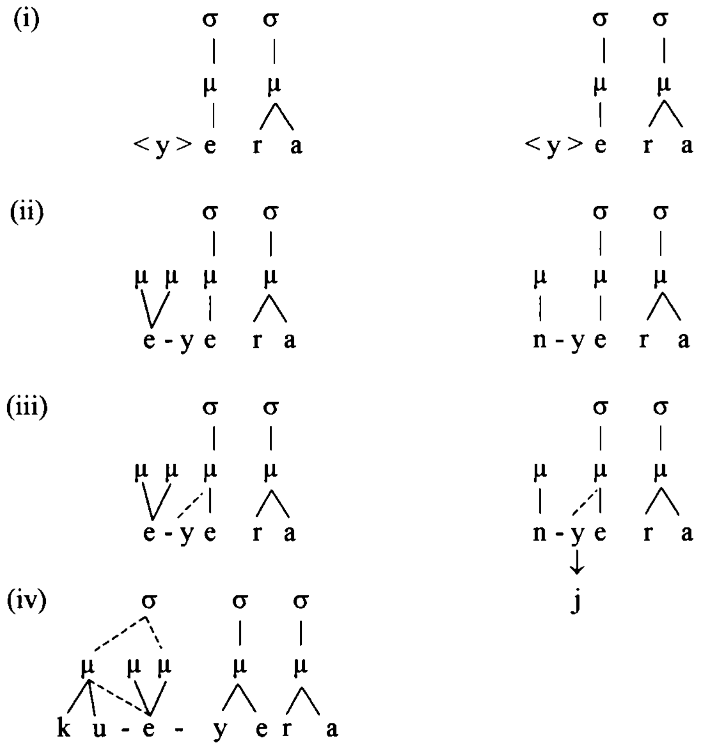
All examples begin with the representation in (50i): The initial /y/ of the root *-yer-* is extrametrical at the left edge of the stem. Despite the constraint in (42a), one forms a V syllable after the left stem bracket so as to avoid stray-erasure of the initial [e] at the end of the stem phonology. In (50ii), the /y/ becomes visible when a subject prefix is added in (50b, c), or in the case of the imperative in (50a), which has no prefix, the /y/ becomes visible at the word level. At this point the preferences in (30) come into play. The question in each derivation is whether to syllabify the /y/ as an onset or to leave it unparsed. In (50a.iii), the /y/ syllabifies because the resulting CV syllable is preferred over the initial V syllable that would otherwise result. In (50b.iii) the /y/ syllabifies for the same reason. In (50c.iii), on the other hand, the /y/ is not parsed. Instead, the mora of the SM *tû-* joins with the initial vocalic mora /e/ of the verb root to form a bimoraic syllable. If the /y/ had been parsed we would have obtained *[tú.yè.ra], i.e. two CV syllables. As we indicated in (30c), a single CVV syllable is preferred over two CV syllables. When given a choice, the language will first construct a CVV syllable before considering other options. Getting the CVV syllable is thus ranked higher than parsing the /y/. This stands in contrast with the results in (50b): Here parsing the /y/ was ranked higher than forming a V or VV syllable. These outputs thus result from the interaction of constraints, ranked in the following order:

(51) a. Avoid σ[V[51]
b. Minimize structure
c. Principle of preservation ('parse')

The first constraint due to Itô (1989) states that onsetless syllables are to be avoided. The second constraint says that structure should be minimized (cf. the constraint *STRUC of Prince & Smolensky 1993). Finally, borrowing the principle of preservation from Paradis & LaCharité (1993) or the notion of 'parse' from OT, the constraint in (51c) says that features in the input should be realized in the output.

Now consider how this hierarchy works when the same verb is preceded by a long vowel or by a moraic nasal, as in (52).

(52) a. [kwéé.yè.ra] b. [n.jer.a]



We again begin in (52i) with stems whose initial /y/ is extrametrical. In (52a.ii) the reflexive prefix *-eê-* is added, while in (52b.ii) the 1 sg. SM *n-* is added. (52iii) shows that the /y/ is parsed to create a [ye] syllable in both cases. The alternatives include either not building any additional syllables at all, which is unacceptable, given that [ye] is perfectly well-formed, or building one or more onsetless syllables. In (52a.iii) the reflexive morpheme cannot itself be syllabified, since that would require creating an onsetless syllable. *-eê-* thus remains unsyllabified until another prefix is added, e.g. infinitival *ku-* in (52a.iv).[52] As seen, the first and third available moras link to this syllable by the edge-in process referred to in section 2. In the case of (52b.iii), the nasal mora cannot begin a syllable (by itself or with the vowel /e/) because it would create an onsetless (i.e. non-branching) mora. Instead, the /y/ must be parsed and, as indicated, will strengthen to [j] because of the preceding nasal.[53]

While such hierarchies are common (see Prince & Smolensky 1993 and the growing literature on OT), what makes Luganda unusual is that it can put off syllabification of vowels until a later stage in the 'derivation'. Consider, in this light, what the alternatives are in realizing the representation in (50b.ii):

(53) a. The mora of *a-* is linked to a syllable with /e/, and the /y/ is not parsed.
b. The mora of *a-* and the following /e/ are linked to their own syllables, and the /y/ is not parsed.
c. The /y/ is parsed with the following /e/ as a CV syllable, and the mora of *a-* is linked to a newly constructed syllable.
d. The /y/ is parsed as an onset to the next syllable, and the *a-* is moraically licensed at the left edge of the form.

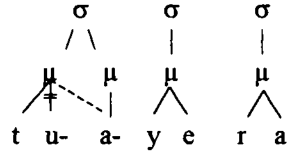
Assuming that the unparsed /y/ does not block NHD (11), the first two choices result in the same surface output *[ee.ra]. (53a) creates an initial VV syllable, while (53b) creates two V syllables in succession. The correct form [a.ye.ra] is produced by (53c): The CV syllable is formed with the visible /y/ followed by a new syllable being formed with the mora of *a-*. This output is preferable to the two earlier ones because it both avoids VV (the least preferred syllable) and has the two syllables V and CV rather than two V syllables. The last possibility in (53d) differs only slightly from (53c): this variant allows the *a-* to remain unsyllabified, a vowel being moraically licensed at left edge of its domain.[54] (53d) has the advantage of not constructing lexical syllables in excess of what is needed postlexically. Recall that all Luganda words end in a vowel, and that this vowel is always tautosyllabic with an immediately following vowel in the next word.[55] Assume that an initial vowel syllable *a-* is constructed by (53c). If another word is placed before it at the phrase level, its final CV syllable will have to combine with the initial *a-* syllable. In other words, one of the syllable nodes would have to be removed. If we wish Luganda syllabification to be strictly structure building, and never structure changing, we must not allow *a-* to become a syllable. This can only be accomplished by prohibiting onsetless syllables except when preceded by pause.[56]

4.2. Cyclic syllabification

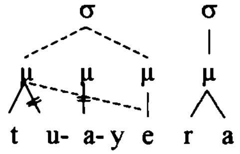
We have thus far established that the hierarchy in (51) is responsible for y/Ø alternation in Luganda, and that the ranking proposed guarantees that unstable-*y* will be taken only if it is needed to avoid an onsetless syllable. We have also demonstrated that syllabification cannot be done in one step at the phrasal level, as implicitly assumed by previous researchers, but rather must proceed in stages. The question is whether syllabification is cyclic, i.e. applying every time a morpheme is added, or whether it is non-cyclic. The y/Ø alternation suggests that syllabification is cyclic. The argument is seen from a comparison of the correct vs. incorrect realizations of the input *tû-a-<i>er-a* 'we swept' in (54).

(54) *Sensitivity to single prefix = cyclic syllabification?*

a. [twáá.yè.rà]

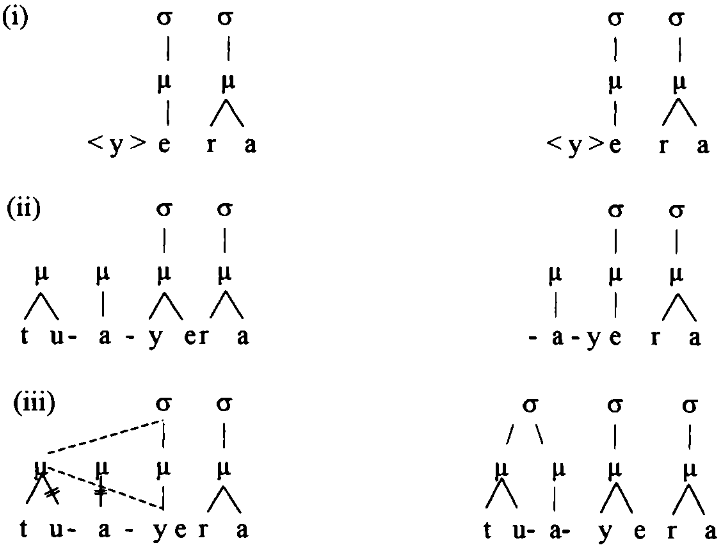


b. *[twéèrà]



In (54a) we see that unstable-*y* must be parsed to obtain surface [tw-áá-yèr-à]. However, why don't we obtain (54b) instead? We saw in (50c) that a CVV output is preferable to a CVyV one (where the [y] is from unstable-*y*). So why shouldn't the CVV output of **twéèrà* be preferred to the CVVyV output of *twááyèrà*?[57] The answer is that it should be, but is not available because syllabification is not non-cyclic, as in (55a), but rather cyclic, as in (55b).

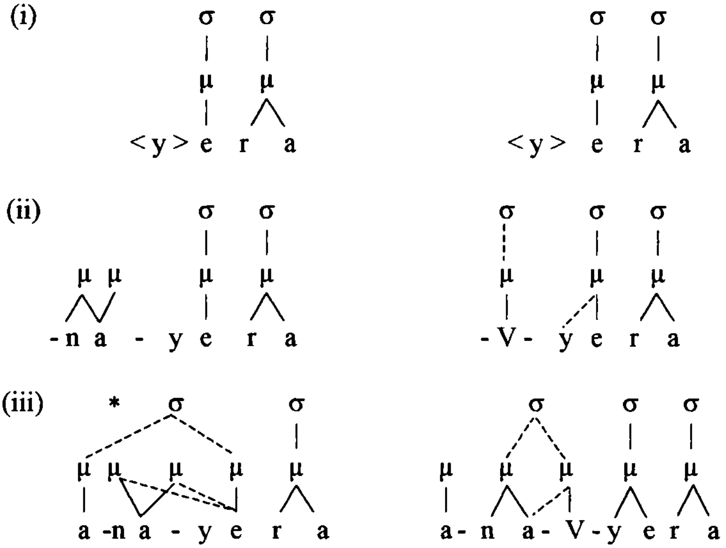
(55) (a) non-cyclic: *[twéè.rà] (b) cyclic: [twáá.yè.rà]



The assumption in Bantu phonological studies, if any, has been that the prefixal (stratum 2) phonology is non-cyclic, as in (55a). Here all prefixes are brought in at the same time, in (55ii). With this assumption, however, edge-in association of moras into syllables produces the wrong output in (55iii). The correct output is seen in (55b), where the past tense prefix *-a-* is brought in first in (55ii), thereby causing now visible unstable-*y* to link to the following mora. The subject prefix is then brought in and syllabified separately in (55iii).

The argument for cyclicity is that the y/Ø alternation is determined locally with respect to the shape of the preceding *morpheme*. In order for this to go through we must, however, have a clear notion of the morphemic structure of prefixes. One potential problem concerns prefixes that appear to have the shape CVV-. There appear to be two of these in the language: near future (F_1) *-nâa-* and persistive ('still') *-kîa-*, two tense markers, which were both illustrated in (45c). Compare the derivations in (56).

(56) (a) cyclic *-nâa-*: *[a.néè.ra] (b) cyclic *-V-*: [a.náà.ye.ra]



The extrametrical /y/ in (56a.i) becomes visible when the F_1 TM *-nâa-* is added in (56a.ii). As seen, however, in (56a.iii), the first (CV) mora of *-nâa-* potentially syllabifies with the vocalic mora /e/ of the root. The incorrect output *[a.néè.ra] is produced instead of the correct [a.náà.ye.ra] 'he will sweep'. If persistive *-kîa-* were treated the same way, we would likewise derive *[a.kyéè.ra] instead of the correct [a.kyáà.ye.ra]. The correct outputs thus require that /y/ be parsed when preceded by CVV. (56b) shows how this can be done by treating these two prefixes as bimorphemic *-nâ-V-* and *-kî-a*. In (56b.ii) the empty vocalic mora -V- is prefixed on its own cycle. At this stage the /y/ links to the mora of the following /e/ and a CV syllable is correctly derived. In later cycles the F_1 morph *-nâ-* and the class 1 SM *a-* are added. As seen in the output in (56.b.iii), syllabification proceeds without complication. (Rightward vowel spreading observed in 56b occurs elsewhere in Luganda and will be dealt with in sec. 5.1 below.)

The decision to treat F_1 *-nâ-V-* as bimorphemic is easily justified by comparing the affirmative and negative forms of the F_1 tense in (57):

(57)	a.	tû-nâ-V-yer-a	[tú.nàà.ye.ra]	'we will sweep'
		bâ-nâ-V-yer-a	[bá.nàà.ye.ra]	'they [class 2 human] will sweep'
		kî-nâ-V-yer-a	[kí.nàà.ye.ra]	'it [class 7] will sweep'
	b.	te-tû-V-yer-ê	[té.túú.yé.rê]	'we will not sweep'
		te-bâ-V-yer-ê	[té.báá.yé.rê]	'they [class 2] will not sweep'
		te-kî-V-yer-ê	[té.kíí.yé.rê]	'it [class 7] will not sweep'

The affirmative F_1 is marked by [nàà], while the corresponding negative is marked by the lengthening of the vowel of the SM. Our analysis is that the formative *-nâ-* appears only in the affirmative F_1, while the underspecified vocalic mora -V- occurs in both affirmative and negative forms. Since only *-nâ-* can precede the empty -V- in the affirmative, one can mistakenly conclude that there is a single *-nâa-* formative. We instead set up two formatives *-nâ-V-* in order to account both for the length alternations in the F_1 in (57) as well as to account for the realization of unstable-*y* in (56). Concerning *-kîa-*, while there is no evidence from Luganda specifically, other nearby languages have *-ki-* as their persistive, e.g. in relative clauses in Kirundi (Meeussen 1959). It is clear that two formatives *-kî-a-* were involved historically – and, if we are correct, still function as such in synchronic Luganda.

With the potential problematic cases of -CVV- prefixes analyzed as bimorphemic CV-V-, we now seek to test the cyclic hypothesis with the reverse situation: a CV prefixal syllable that has the bimorphemic structure C-V-, i.e. a C- prefix followed by a V- prefix. The one possible case of this in the language is not unambiguous, but it is instructive. It concerns the negative prefix, which, as seen in (58a) precedes the SM:

(58) *What if a C-V- sequence of prefixes precedes a root?*

a.	te-bâ-lâb-â	[te.bá.là.bà]	'they do not see'
	te-tû-lâb-â	[te.tú.là.bà]	'we do not see'

b.	t-ê-lâb-â	[té.là.bà]	'it [cl. 9] doesn't see'	(?< /te-ê-/)
	t-ô-lâb-â	[tó.là.bà]	'you sg. don't see'	(?< /te-ô-/)
	t-â-lâb-â	[tá.là.bà]	'he/she doesn't see'	(?< /te-â-/)

Where preceding a -CV- SM in (58a), the main clause negative prefix is *te-* and two CV syllables are realized without event. In (58b), where the SM has the shape -V-, however, we observe that the resulting coalesced syllable is unexpectedly monomoraic. If we assume the underlying representations shown in parentheses to the right in (58b), this would be the only place in the language where a prefixal CV-V- sequence surfaces as short. In addition, the negative prefix *te-* in (58a) is the only CV prefix that has the vowel [e]. Recall from earlier discussion that the only shapes of CV- prefixes in Luganda are *Ci-*, *Cu-*, and *Ca-*. What we would like to suggest is that the negative prefix has the vowelless allomorph /t-/ in prevocalic position. This would then be the only case in the language a C-V- prefixal sequence occurs – and, as we have, the result is a CV syllable coming from two different morphemes.

With this assumption we are now ready to consider the realization of -*<y>er-* 'sweep' in the present negative:

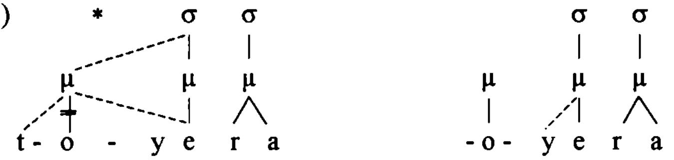
(59) a.	te-bâ-er-â	[tè.béé.râ]	'they do not sweep'
	te-tû-er-â	[tè.twéé.râ]	'we do not sweep'
b.	t-ô-yer-â	[tó.yé.râ]	'you sg. don't sweep'
	t-â-yer-â	[tá.yé.râ]	'he/she doesn't sweep'
	t-ê-yer-â	[té.yé.râ]	'it [cl. 9] doesn't sweep'

In (59a), the [y] of -*<y>er-* is not parsed. Since the root is preceded by the SM's *-bâ-* and *-tû-*, which have the shape CV-, these latter then syllabify with the following vocalic mora of the verb root, as expected. Turning to (59b), it is noted that the [y] of -*<y>er-* is parsed even though it is preceded by one of three phonetic CV syllables: [tó], [tá], [té]. As seen in (60a), if this C-V- prefixal sequence had been available all at once, we would have expected the [y] of -*<y>er-* not to parse, and instead get realizations such as *[twéé.râ], *[téé.râ] and *[tyéé.râ].

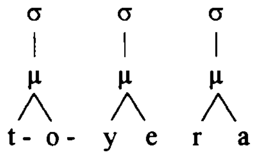
(60) (a) non-cyclic: *[twéé.râ] (b) cyclic: [tó.yé.râ]

(i)

(ii)



(iii)



In a non-cyclic analysis such as (60a), this incorrect result would be obtained whether one recognized underlying /t-/ or /te-/.[58] This is because the extrametrical /y/ of the verb root would be able to see the whole prefix string at once. Since either *te-V-* or *t-V-* begin with a consonant, the /y/ would not parse and instead a CVV syllable would be formed.

Our analysis, then, is that prefixation is cyclic. As a result, as seen in (60b), the extrametrical /y/ will become visible when the SM's *o-*, *a-* and *e-* are added alone. This is exactly what is also needed for sequences such as o-â-(y)er-a to be realized as [wa.yé.rà] 'you swept', rather than *[wéé.rà]. Each formative is thus introduced on a separate cycle at which point the constraints in (51) determine whether unstable-*y* will be parsed.

Before we leave this subject, let us consider a few other relevant facts from the negative paradigm. The relative clause forms in (61) and (62) correspond to the main clause negatives seen earlier in (58) and (59).

(61) a.	by-e	bâ-tâ-lâb-â	[bye.bá.tà.là.bà]	'the ones they don't see'
	by-e	tú-tâ-lâb-â	[bye.tú.tà.là.bà]	'the ones we don't see'
b.	by-e	ô-tâ-lâb-â	[byóó.tò.là.bà]	'the ones you don't see'
	by-e	â-tâ-lâb-â	[byáá.tà.là.bà]	'the ones he doesn't see'
	by-e	ê-tâ-lâb-â	[byéé.tè.là.bà]	'the ones it doesn't see'
(62) a.	by-e	bâ-tâ-yer-â	[bye.bá.tá.yé.râ]	'the ones they don't sweep'
	by-e	tú-tà-yer-à	[bye.tú.tá.yé.râ]	'the ones we don't sweep'
b.	by-e	ô-tâ-yer-â	[byóó.tó.yé.râ]	'the ones you don't sweep'
	by-e	â-tâ-yer-â	[byáá.tá.yé.râ]	'the ones he doesn't sweep'
	by-e	ê-tâ-yer-â	[byéé.té.yé.râ]	'the ones it doesn't sweep'

As seen, in relative clauses, the negative relative marker *-tâ-* occurs after the SM. The vowel of *-tâ-* assimilates to the preceding *o-* or *e-* SM (cf. also note

33). Surprisingly, the /y/ of *-<y>er-* 'sweep' parses in (62), even though it is preceded by a CV morpheme. This is the sole exception to the generalizations we have outlined above. The only solution to it that has occurred to us would be to treat *-tâ-* as the combination of two formatives *-t-â-*, i.e. the main clause negative marker followed by an *-â-* formative.

Consider, finally in this connection, the forms in (63):

(63) a. sî-lâb-â [sí.là.bà] 'I don't see' *t̲e̲-n-n̲̂-lâb-â
b. by-e sî-lâb-â [bye.sí.là.bà] 'the ones I don't see' *bye n̲̂-t̲â̲-lâb-â
c. [1 sg. SM + negative] → si-

The data in (63a, b) show that both in main clauses and in relative clauses the combination of a 1 sg. SM and a negative TM is realized with the portmanteau morph *si-* by the spell-out rule in (63c). In other words, the formative *si-* overrides the expected sequences **te-n̲̂-* in (63a) and *n̲̂-tâ-* in (63b). What this means for the cyclic account of Luganda prefixation that we propose is that *si-* preempts whichever of the two morphemes [1 sg. SM] or [neg] it first encounters: in the main clause, where NEG comes outside the SM, *si-* will be spelled out in place of the 1 sg. SM *-n̲̂-*. In the relative clause, where the SM comes outside NEG, *si-* will be spelled out in place of NEG *-tâ-*.[59] With this in mind, now consider the realization of -<y>er- in (64).

(64) a. sî-er-â [séé.râ] 'I don't sweep' *sí-yér-â
*t̲e̲-̲n̂-jer-â
b. by-e sî-er-â [bye.séé.râ] 'the ones I don't sweep' *by-e sí-yér-â
*by-e n̂-t̲â̲-yer-â

The non-parsing of <y> is as expected, since *si-* is a single formative, i.e. since it comes in on one cycle. In this sense it differs from the forms in (59b), where the combinations of NEG + vocalic SM have the shape CV (e.g. [tó]), but come in two cycles, i.e. [t- [o-.

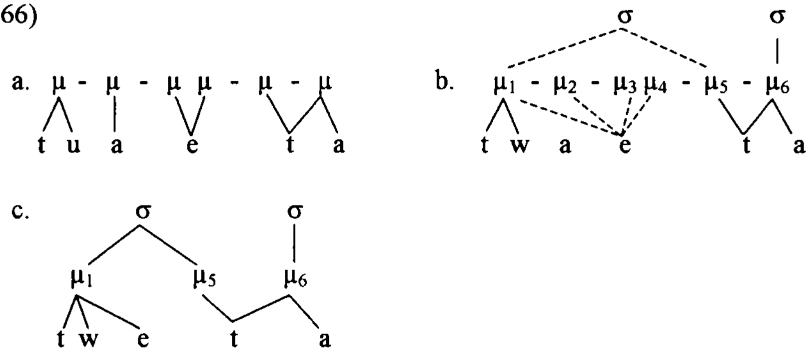
4.3. Edge-in syllabification is cyclic syllabification

To summarize, the preferred syllable types in (30) are predicted on the basis of the ranked constraints in (51). With cyclicity and these constraints established, we are now in a position to address the edge-in syllabification of overloaded moraic sequences. Recall the example in (19c), repeated in (65).

(65) tû-a-ee-ˆtt-a → [twét-tà] 'we killed ourselves'
we-P_2-refl-kill-FV

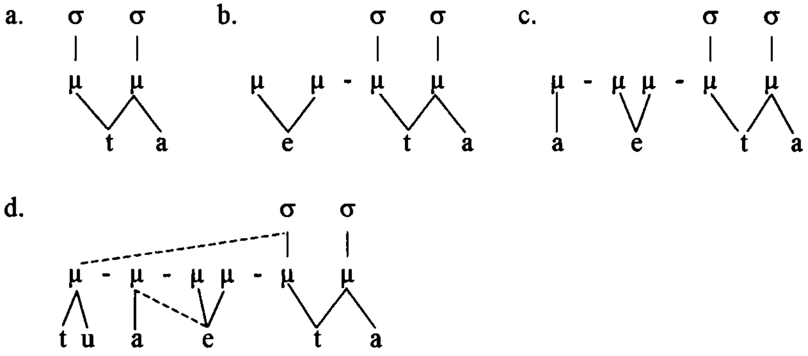
The underlying form in (65) has a CVVVVV sequence which must be 'trimmed' into a single bimoraic syllable.[60] In section 2 we discussed Clements' V-trimming rule that removes V slots from the left. Tonal evidence was adduced for internal stray erasure to trim excess *medial* V slots. In our moraic account, we proposed that if syllabification proceeded in an edge-in fashion, the excess medial moras of a CVVVVV sequence would fail to be syllabified and would be stray-erased, as shown in (66).

(66)



It may seem unfortunate, however, that we have had to invoke edge-in assignment of moras to syllables, rather than the more usual left-to-right linking. However, we suggest that this edge-in effect may only be an artifact. Once we recognize the syllable preferences in (30) and the constraints in (51) and (42a), we can derive this edge-in effect by our demonstration that syllabification is cyclic in Luganda. The cyclic analogue to non-cyclic edge-in syllabification in (66) is given in (67).

(67)



We begin in (67a) with both moras of the stem /ˆtta/ syllabified. When the reflexive prefix /-eê-/ is added in (67b), the prohibition against a VV syllable (including VC_i) blocks the syllabification of either of its moras. The same is observed in (67c) when the P_2 tense marker /-â-/ is added. It is not until the CV mora *tû-* 'we' is added in (67d) that syllabification can proceed: as seen, the CV mora joins with the V (=C_i) mora to form a bimoraic syllable. The intervening moras are then stray-erased.[61]

In (67) we thus derive the edge-in nature of syllabification by a combination of two formal devices: (i) the constraints in (51) and (42a); and (ii) cyclic syllabification. While V syllables are permitted, VV syllables are avoided at all stages of the derivation. When a -VV- prefix such as reflexive /-eê-/ is involved, one of two things happens: first, neither mora may be syllabified, as (67c), because to do so would create a VV syllable. Or, in the case of an input such as /tû-eê-lâb-a/ 'we see ourselves', its second mora is syllabified (rather than its first) because this satisfies the constraint against bracket-initial V syllables in (42a). In such a form, the mora of /tû-/ will also be syllabified so as to create a CVV syllable, and the medial mora (= the first mora of /-eê-/ is stray-erased.[62] Thus, the syllable hierarchy in (43) – coupled with cyclicity – yield the apparent edge-in association.

5. A problem for level-ordered phonology

In the preceding sections we have thus motivated a cyclic process of syllabification which starts internal to the stem and then moves progressively outward, taking in one prefix at a time. The effect, as we have just seen, is an edge-in association of moras in case more than two must be squeezed into a bimoraic syllable. We have also seen that stem-initial y/Ø alternation is conditioned by optimizing the syllable outputs relative to the principles in (30), (42) and (51). The analysis we have presented would lead one to conclude that one can proceed derivationally to effect all of stratum 1 (stem-level) phonology 'before' going on to stratum 2 (word-level) phonology. In this section we show that a rule application paradox arises if we interpret the strata as domain-ordered, i.e. if we insist on completing the stem-level phonology before moving out to consider the prefixes at stratum 2. In order to appreciate the problem we first introduce the moraic nasal in section 5.1.

5.1. The moraic nasal

In the preceding sections we saw that a hierarchy of constraints determines which moras will be syllabified vs. stray-erased. An additional element figuring in the moraic equation, but not yet treated, is the preconsonantal moraic nasal. Just as a vowel or a geminate consonant contributes a mora to a syllable to its left, so does a nasal that is immediately followed by a homorganic oral consonant.[63] The major difference between such NC sequences and geminates is the vowel lengthening that applies before the former. As seen in (68), vowel-lengthening before a NC sequence is pervasive:

(68) a. Within morpheme: ku-gend-a → [ku.gee.nda] 'to go'
ku-bing-a → [ku.bii. ŋga] 'to chase'

b. Across morphemes: ku-n̂-sib-a → [kúú.nsì.ba] 'to tie me'
[lexical] ku-n̂-tûm-a → [kúú.ntù.ma] 'to send me'

c. Across words: bu-tâ-lâb-â + n-te → [bu.tá.là.bàà .nte]
[postlexical] 'to not see cows'
bu-tâ-lâb-â + n-go → [bu.tá.là.bàà .ŋgo]
cl.14-neg-see 'to not see leopards'

In (68a) the moraic nasal /n/ is tautomorphemic with the following oral consonant, while in (68b) the N+C cluster occurs as the result of prefixation of the first person singular object prefix /-n-/.[64] In (68c) the nasal is the class 9/10 prefix which comes in contact with the preceding vowel across a word boundary.

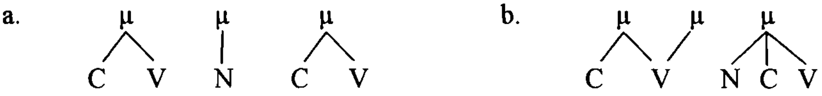
As seen in (68), whatever the source of the VNC sequence, in all cases the preceding vowel is lengthened. Clements (1986) accounts for this in the two-step fashion seen in (69).

(69)

As in the case of geminate consonants, which Clements set up as VC on the CV tier, the moraic nasal is linked to a V slot and forms a VC with the following consonant. In (69a) the nasal both delinks from its V slot and relinks to the following C. This creates a vacant V slot to which the features of the preceding vowel spread. In this fashion, Clements is able to view the increased vowel duration as a case of compensatory lengthening. As was true of his gliding rule in (5a), Clements' rule in (69a) creates a single segment, a prenasalized consonant. There is good durational evidence for this view, since the vowel lengthening is quite considerable in Luganda, even greater than that in closely related languages (Hubbard 1994, 1995, Maddieson & Ladefoged 1993). Clements' rightward spreading rule in (69b) is the mirror image of his leftward spreading rule in (5b).

Converting Clements' insights into our moraic framework, what we need is a process that will convert the input in (70a) into the output in (70b).

(70) *Rightward vowel spreading (RVS)*



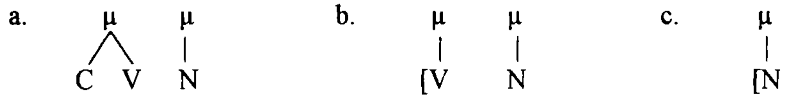
As seen, the nasal in (70a) relinks to the following mora in (70b). The mora of the preconsonantal nasal is filled by a process of rightward vowel spreading (RVS) which is analogous to the LVS process seen in (6). If done in two steps, this input-output relation of nasal relinking with compensatory lengthening can logically be effected in one of the two ways in (71).

(71) *'Push' vs. 'drag' versions of the CL trigger*

In (71a) RVS has applied, 'pushing' the nasal off of its mora. The freed nasal then relinks to the following mora, which now has the shape NCV. In (71b) the nasal first delinks from its mora and relinks to the following mora. This then 'drags' the preceding vowel onto the freed mora by RVS.

Either of these conceptions will work, as will a non-ordered, input-output relation. What must be recognized in either case is a crucial condition on RVS: the vowel that spreads must be in a CV mora. Of the three distributions of the moraic nasal in (72), RVS will apply only in (72a), where the preceding mora is CV:

(72)



RVS and delinking will not apply to a VN sequence in (72b), which recall occurs only bracket-initially in Luganda, because a VV syllable that would result fatally violates the highest ranked constraint on syllable structure in this language and so, when it is generated by the grammar, it is screened out and fails to surface (see 30, 31). Finally, note that delinking does not apply to a string-initial moraic nasal in (72c), which will be moraic (and syllabic) if occurring after pause.

Evidence for the failure of RVS to apply to the structure in (72b) comes from tone. Consider the forms in (73), which correspond to those cited earlier in section 3.2:

(73) a.	(eno gye tù-)	lìm-â	'it's this one that we cultivate'	[tù.lì.mâ]
	(ebyo bye tù-)	gul-â 1 2	'it's these that we buy'	[tù.gù.lâ]
b.	(ono gwe tu-)	lagîr-a	'it's this one that we command'	[là.gí.rà]
	(ono gwe tu-)	sasûl-a 1 2	'it's this one that we pay'	[sà.sú.là]
c.	(guno gwe tu-)	saâb-a	'it's this that we smear'	[tù.sáá.bà]
	(zino ze tu-)	siîg-a 12	'it's these that we smear'	[tù.síí.gà]

As indicated, in the non-subject cleft construction, a HL contour is assigned to the M2 (second mora) of underlyingly toneless verb stems. All preceded moras are realized with surface L tone. By the regular tone rules, the M2 is realized H, while the following moras, if any, are realized L. In case the M2 is the second mora of a CVV syllable, as in (73c), the whole syllable is realized H. This is because Luganda does not permit rising tones.

Now compare the analogous forms in (74) involving NC sequences:

(74)	a.	(ono gwe tu-)	lin̂d-a	‘it’s this one that we wait for’	[tù.líí.ndà]
		(zino ze tu-)	bin̂g-a	‘it’s these that we chase’	[tù.bíí.ŋgà]
			12		
	b.	(guno gwe tu-)	anj-â	‘it’s this that we spread out’	[twàà.nj-â]
		(tutyo bwe tu-)	end-â	‘it’s thus that we commit adultery’	[twèè.nd-â]
			1 2		
	c.	(zino ze tu-)	ambâl-a	‘it’s these that we wear’	[twàà.mbá.là]
		(eno gye tu-)	ongêr-à	‘it’s this that we increase’	[twòò.ŋgé.rà]
			1 2		

The forms in (74a) show that -CVNC- roots act the same way as the -CVVC- roots in (73c): The HL is assigned to the second mora which, as indicated, belongs underlyingly to the preconsonantal nasal. On the surface, the preceding vowel is of course lengthened and, since rising tones are not permitted in Luganda, the whole syllable is pronounced on a H pitch. This situation contrasts with the tones observed on the vowel-initial verbs in (74b,c). In these examples, the HL contour is assigned to the second syllable – as if the initial VN sequence counted as one mora. Evidence that this sequence cannot be monomoraic comes from the verb stem reduplication process also seen in section 3.2. The reduplicated verb forms in (75) have a frequentative (‘again and again’) or distributive meaning (‘here and there’):

(75)	a.	(ku-) lim-a	‘to cultivate’	→	(ku-) lim-aa - lim-a	[ku.li.maa.li.ma]
		(ku-) gul-a	‘to buy’	→	(ku-) gul-aa - gul-a	[ku.gu.laa.gu.la]
	b.	(ku-) saab-a	‘to smear’	→	(ku-) saab-a - saab-a	[ku.saa.ba.saa.ba]
		(ku-) siig-a	‘to smear’	→	(ku-) siig-a - siig-a	[ku.sii.ga.sii.ga]
	c.	(ku-) lagir-a	‘to command’	→	(ku-) lagir-a - lagir-a	[ku.la.gi.ra.la.gi.ra]
		(ku-) sasul-a	‘to pay’	→	(ku-) sasul-a - sasul-a	[ku.sa.su.la.sa.su.la]

As seen in (75a), if the verb root is monomoraic, the FV that links the two stems is lengthened. However, as shown in (75b,c), the FV does not lengthen if it is preceded by two (or more) moras. In other words, the FV is lengthened just in those cases where it is in M2 position in a stem. Now consider the verb stems with NC in (76).

(76)	a.	(ku-) lind-a	‘to wait’	→	(ku-) lind-a - lind-a	[ku.lii.nda.lii.nda]
		(ku-) bing-a	‘to chase’	→	(ku-) bing-a - bing-a	[ku.bii.ŋga.bii.ŋga]
	b.	(ku-) anj-a	‘to spread out’	→	(ku-) anj-a - yanj-a	[kwaa.nja.yaa.nja]
		(ku-) end-a	‘to fornicate’	→	(ku-) end-a - yend-a	[kwee.nda.yee.nda]

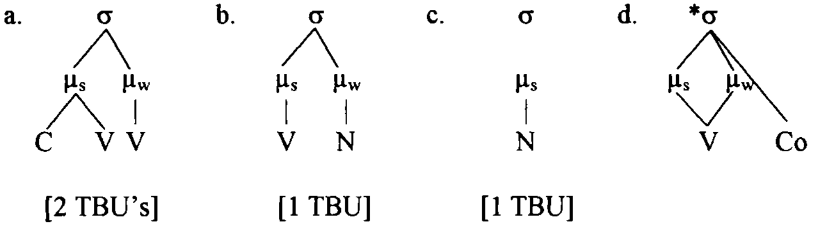
c. (ku-) ambal-a 'to wear' → (ku-) ambal-a-yambal-a [kwaa.mba.la.yaa.mba.la]

(ku-) onger-a 'to increase' → (ku-) onger-a - yonger-a [kwoo.nge.ra.yoo.nger.a]

As seen, there is no lengthening of the first FV in any of these forms. What this means is that the -VNC- roots in (76b) must not be monomoraic. The nasal counts as a mora in determining that the following FV will be short.

Given this fact, there must be another explanation as to why in (74b,c) the M2 tones are assigned to the second syllable of stems beginning with VNC. Somehow verb roots such as *-anj-* and *-end-* must be bimoraic (because of FV non-lengthening in (76)), but have only one tone-bearing unit (TBU). As argued by Hyman (1992), TBU's are defined in Luganda and several other Bantu languages as either (a) the first mora of a syllable, or (b) the second mora of a syllable if it dominates a [–cons] root node. Adopting Zec's (1988) strong/weak labeling of the moras, we thus have the mora/TBU counts in (77).

(77)



As indicated in (77a), a syllable will be bimoraic and consist of two TBU's only if it is CVV. This includes cases where the second mora is the first half of a geminate consonant, and it includes CVN syllables which have undergone the RVS.[65] What it excludes is the configuration in (77b): a bimoraic VN syllable will count as one TBU, because RVS does not apply to it. Consequently, the second mora in (77b) is [+cons] and fails to meet either of the conditions for being a TBU.[66] The nasal in (77c), on the other hand, is a TBU, because it is the first (hence strong) mora of its syllable – and thus escapes the condition on consonantality, which applies only to the second (weak) mora.

The question to be addressed now is why RVS should be sensitive to whether a trigger syllable has an onset. The answer to this question is that Luganda has the constraint in (77d): a bimoraic, bivocalic syllable that lacks an onset is prohibited. We thus add the above facts to the list of phenomena motivated by the *σ[VV(C) constraint in Luganda.

5.2. A problem

Now that we have analyzed the moraic nasal and determined that a bimoraic VN sequence constitutes a single TBU, we return to our analysis of the y/Ø alternation. Recall that we have assumed in this analysis that unstable-*y* is extrametrical at the left edge of a stem (=stratum 1) and thus does not become visible until word level (stratum 2), when either a prefix is added or there is no prefix in the case of the bare imperative. In this stratally segregated approach, the stratum 1 phonology takes place prior to the introduction of information from stratum 2. That is, we have thus far followed the classical model of lexical phonology (Kiparsky 1982).

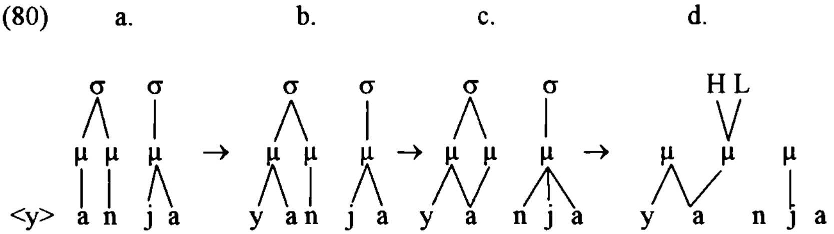
In this section, we show that this model cannot be maintained. Specifically, a problem arises in the tonal realization of roots that alternate between -VNC... and -*y*VNC.... Compare the forms in (78) with those in (79).

(78)	a.	(guno gwe tu-)	anj-â	'it's this that we spread out'	[twàà.nj-â]
		(tutyo bwe tu-)	end-â	'it's thus that we commit adultery'	[twèè.nd-â]
			1 2		
	b.	(zino ze tu-)	ambâl-a	'it's these that we wear'	[twàà.mbá.là]
		(eno gye tu-)	ongêr-à	'it's this that we increase'	[twòòŋgé.rà]
			1 2		
(79)	a.	(guno gwe a-)	yan̂j-a	'it's this that he spreads out'	[gwàà.yáánj-à]
		(bwatyo bwe a-)	yen̂d-a	'it's thus that he commits adultery'	[bwàà.yéénd-à]
			12		
	b.	(zino ze a-)	yam̂bal-a	'it's these that he wears'	[zàà.yáámbà.là]
		(eno gye a-)	yon̂ger-à	'it's this that he increases'	[gyàà.yóóŋgè.rà]
			12		

In all of these verb forms, a HL contour is assigned to the second TBU of the verb stem, which is always the second mora (M2). In (78), repeated from (74b, c), the HL is assigned to the second syllable because the initial VN counts as a single TBU. In the forms in (79), which involve the same verb stems, the HL is assigned to the nasal since it is preceded by a CV mora and thus counts as a TBU.

These data demonstrate that the realization of unstable-*y* has an important effect on the tonology. If it is preceded by a CV- prefix, e.g. *tu-* 'we' in (78), it will not be realized and the initial VN will count as one TBU. If it is preceded by a V- prefix, e.g. *a-* 'he/she' in (79), unstable-*y* will surface, and the *y*VN sequence will count as two TBU's.

(80)



As shown in the derivation in (80), unstable-*y* must be syllabified prior to RVS and M2 stem-tone assignment. The representation in (80a) shows the extrametrical unstable-*y* in angled-brackets, as we have thus far assumed. Hence the first syllable has the shape VN. In (80b), the unstable-*y* becomes visible and joins the first mora of the initial syllable. This is followed in (80c) by RVS and relinking of the nasal to the next mora. Finally, the HL contour is assigned to the second TBU in (80d), which, as seen, is the M2 of the first syllable. Had unstable-*y* continued to be extrametrical throughout the steps in (80), RVS would not have applied to VN, and the M2 HL would instead have been assigned to the second stem syllable.

The problem of course is that one doesn't know if unstable-*y* will surface, as it does in (80), until leaving stratum 1, i.e. until knowing what the shape will be of the preceding prefix (if any). We assume that the assignment of HL to the second mora of the stem is a stratum 1 rule, since it makes specific reference to the stem domain. We thus appear to have a situation where stratum 1 M2 tone assignment must look ahead to see what will happen at stratum 2.

This would appear to create a paradox: The fate of unstable-*y* must await the syllabification of the preceding prefix, and if the assignment of the stem M2 HL tone must also await the fate of the unstable-*y*, it would appear that stem level HL is assigned *after* prefixation, i.e. after we have passed from stem to word level in the derivation. Consequently, the derivation would have to keep track of what is within vs. outside the stem, even after the addition of a prefix, since the latter is not calculated in the mora count. Also, we would have to make sure that word-level RVS and prenasalization do not precede the assignment of the M2 HL tone.

One way to maintain the lexical model and independent stratal morphology and phonology would be to abandon a strictly phonological analysis in favor of one in terms of allomorphy. In this analysis, we would assume that every so-called vowel-initial verb root would have an alternate form with initial /y/ conditioned by the subcategorization illustrated by means of the verb roots in (81).[67]

(81) a. 'sweep' : -er- / + C V + ___
-yer-
b. 'spread out' : -anj- / + CV + ___
-yanj-

As before, the vowel-initial allomorphs are restricted to occurring in a single frame: when immediately following a CV prefix (informally represented by the + boundaries). By choosing the stem alternant that is appropriate, we can immediately determine what will be the second TBU for the assignment of M2 tone. We will assume that the phonological conditioning of allomorphy proposed in (81) can still be motivated by the syllable structure considerations for which we have argued above. This analysis, however, has several undesirable consequences:

First, since the advent of generative phonology, other things being equal, phonological analyses have been preferred over morphological ones. In this case every root that begins with unstable-*y* will have to be entered with two allomorphs. We have considered only verb roots thus far, but the same issues pertain to noun roots as well (cf. sec. 5.3).[68]

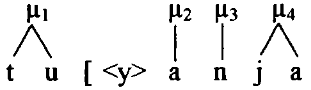
Second, both allomorphs of these roots would have to be extended by derivational suffixes and the FV morpheme before determining which 'allomorph' is used with which preceding prefix. In other words, this is not a case of allomorphs but rather 'allostems', forms which consist of at least two, and potentially many more morphemes. We know of no precedent for such a phenomenon.

Finally, there is a potential third problem, depending on the validity and interpretation of Carstairs' (1987) peripherality principle by which the shape of inner morphemes cannot depend on the presence of outer morphemes. It is expected that when there is allomorphy, the shape of an affix depends on the base to which it is attached, not the reverse. In this allomorphy interpretation of y/Ø alternation, the root allomorph (or allostem) is inserted on the basis of a prefix, which appears to be quite unusual across languages.

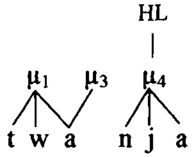
We, therefore, disprefer an analysis with allomorphy and instead opt for one where the strata are more integrated than usually assumed.[69] Specifically, we propose that the rules we have presented in this study are input-output relations, some of which have specific requirements based on the domain of application. For example, we summarized in (14) a difference in the gliding of mid-vowels that was dependent on lexical vs. postlexical domains. In such a case, the input-output relation must also be checked against whether a mid-vowel comes to be followed by another vowel within the same word or across words.

Such input-output conditions are, of course, the cornerstone of non-derivational approaches to phonology such as optimality theory (Prince & Smolensky 1993, McCarthy & Prince 1993, 1994). Returning to the problem at hand, we can say in this theory that the M2 HL must be assigned *to the second stem TBU of the output.*[70] Specifically, we don't count the vocalic mora that results from RVS at stratum 2. Thus, the verb form [twaa.njâ] in (78a) has the input structure in (82a).

(82) a.



b.



Because the second stem mora (μ_3) dominates a nasal and is not a TBU, the HL tone is assigned to the FV in (82b). If we had counted the vocalic shape of μ_3 in the output in assigning the stem tone, then the HL would have been assigned to it (and we would have obtained *[twáá.njà]). In the account proposed thus far we have blocked this by referring to the input nasal that constitutes μ_3. In our earlier terms, μ_3 is not a TBU. Note, however, that reference to the output sponsoring of moras by domains allows a different interpretation. If we maintain co-indexing of μ_3 and μ_4 with the stem, then we can revise our account and say that the HL must be assigned to the second stem mora *of the output*. This is made possible by the fact that μ_2 is stray-erased as per our proposed edge-in syllabification of moras. So, in just the case where unstable-*y* is not syllabified and a stem begins with two non-branching moras, only one of these stem moras will survive into the output.

We, therefore, assume stem-licensing of moras which carries through to the output. The price we pay is having to identify which moras are sponsored by the stem and which are not. However, the other pay-off, as we have seen, is that we may be able to avoid having to refer to the nasal '...μ_w...' in (77b) as different from other moras. In this revised account all moras are TBU's that make it into the output.

5.3. A true case of allomorphy

In the preceding section we rejected an analysis with allomorphy to account for y/Ø alternations. However, there is a clear case of allomorphy that intersects with these alternations in an interesting way. This concerns the class 5 noun prefix which Meeussen (1967) reconstructs as **į*- in Proto-Bantu (PB). We have mentioned in passing (cf. also the Appendix) that PB **į* has a geminating effect on following consonants. This effect is evidenced in the class 5 nouns in (83a).

(83)	a.	p-péèsà	'button' (< Sw.)	b.	*pl.*	ma-péèsà
		t-támà	'cheek'		*pl.*	ma-támà
		c-cúpà[71]	'bottle'		*pl.*	ma-cúpà
		k-kúbò	'road'		*pl.*	ma-kúbò
		b-bálà	'stain'		*pl.*	ma-bálà
		d-díbà	'skin, hide'		*pl.*	ma-líbà
		j-joola	'length of cloth'		*pl.*	ma-joola
		j-jibâ	'dove'		*pl.*	ma-yibâ
		g-gúùmbà	'bone'		*pl.*	ma-gúùmbà
		g-gwáàgi	'centerpost of house'		*pl.*	ma-wáàgi
		f-fúmù	'spear'		*pl.*	ma-fúmù
		v-víívî	'knee'		*pl.*	ma-víívî
		s-sávù	'fat, lard'		*pl.*	ma-sávù
		z-zíkè	'chimpanzee'		*pl.*	ma-zíkè
		j-jubâ	'dove'		*pl.*	ma-yubâ

The geminate is not present in the corresponding plurals in (83b), which are marked by the prefix ma-. These plurals also show that /l y w/ geminate as [dd jj ggw], respectively.

Now consider the class 5 nouns in (84a-c).

(84)	a.	ly-ááto	'canoe'	d.	*pl.*	má-àto
		ly-eenvû	'ripe banana'		*pl.*	m-eenvû
		ly-óóvù	'acne'		*[no plural]*	
		ly-anda	'piece of charcoal'		*pl.*	mà-nda
	b.	li-ggwâ	'thorn'	e.	*pl.*	ma-ggwâ
		lí-ǹnya	'name'		*pl.*	má-ǹnya
		lí-ǹnyo	'tooth'		*pl.*	má-ǹnyo
	c.	lí-ìso	'eye'	f.	*pl.*	má-àso

In these forms, the class 5 prefix is /li-/, which corresponds to PB **di-*.[72] This allomorph of class 5 is used when the root begins with a vowel, as in (84a). It is also used when the root begins with a geminate consonant in (84b). This follows from the fact that geminates derive from **ɟ*, which is still possible as a synchronic analysis, hence /ɟgwá/ 'thorn', etc. (cf. Clements' 1986 VC representation of geminates; also Borowsky 1983a). The one noun in (84c) reconstructs as **-ɪcò* and should therefore have produced *[lís̩̀so], but geminate [ss] is avoided here (also in the plural in (84f)), although it is found elsewhere in the language (cf. *s-sávù* 'fat, lard' in (83a)).

Comparing the class 5 nouns in (83) with those in (84) we discover that there is a completely general allomorphy: the geminator *ɟ-* is used if the noun stem begins with a consonant, the prefix *li-* is used if the noun stem begins with a vowel (or geminate, which functions like a vowel). The relevance of the data in (84) to our study is that these vowel-initial noun stems all derive from the unstable-*y* phenomenon. Since there are no noun class prefixes of the shape V-, this can only be shown when such stems are preceded by the N- prefix of singular class 9 or plural class 10. Thus, consider the following nouns which are marked by class 11 *lu-* in the singular in (85a) and class 10 N- in the plural in (85b):

(85)	a.	lw-áàla	'fingernail'	b.	*pl.*	n-jálà	
		lw-eeyo	'broom; brush'		*pl.*	n-jeyo	
		lw-óoka	'internal pain'		*pl.*	n-jókà	
		lw-ookyo	'red-hot iron'		*pl.*	n-jokyo	'tribal body marks'
	c.	lú-ùso	'long glance'	d.	*pl.*	n-zísò	

As seen, the unstable-*y* fails to appear after the CV prefix *lu-* in (85a), but appears in hardened form [j] after the prefix N- in (85b). In other words, unstable-*y* fails to appear in classes 5/6 in (83) because the prefixes *li-* and *ma-* have the shape CV-. However, if one compares the stem in (84c,f) with its related realization in (85c,d) one observes that in the latter the underlying unstable-*y* of *-<y>V̂ so-* is realized as [z] in (85d). In addition, for reasons outlined in the Appendix, unstable-*y* may not be realized before the vowel [i]. We can thus assume that all of the roots in (83) begin with an unstable-*y* which does not surface in classes 5 and 6.

The question is: why doesn't it surface in class 5? Or, put slightly differently, given the two allomorphs of class 5, gemination (/i̧-/) and *li-*, why is it the latter that is chosen for stems beginning with unstable-*y*? As seen in (86), stems that begin with stable-*y* undergo the same gemination as other stems that begin with a consonant:

(86)	a.	j-jamba	'small fish (sp.)'	b.	*pl.*	ma-yamba
		j-jêmbe	'horn, charm'		*pl.*	mà-yêmbe
		j-jibâ	'dove'		*pl.*	ma-yobâ
		j-jinja	'stone, rock'		*pl.*	ma-yinja
		j-jútè	'boil'		*pl.*	ma-yútè
		j-júùga	'projecting jaws'		*pl.*	ma-yúùga

What is lacking is a single case in the language where a class 5 noun with initial *j-jV...* obligatorily alternates with *ma-V...*, as would be expected of an unstable-*y*. The only nouns that even hint at this possibility are the three indicated in (87).

(87) a.	j-jano (< Nyoro *i-hano*, /i-pano/)	'wonder, marvel'	*pl.*	ma-wano or ma-ano
b.	j-jayo (cf. lw-aayo = j-jayo)	'mouldy, musty smell'	*pl.*	ma-yayo or ma-ayo
c.	j-jebe	'dried fruit of a tree'	*pl.*	ma-yébè or m-éèbe

The example in (87a) is a borrowing from Nyoro, where /p/ is realized as [h] unless preceded by a homorganic nasal, in which case one obtains [mp]. As seen in the plural, the [h] is interpreted in Luganda either as [w], the normal reflex of /p/ in this context, or is deleted, since Luganda doesn't have [h]. We can thus dismiss this example. The noun *j-jayo* in (87b) shows a variation in its plural. However, the singular also exists equivalently as class 11 *lw-aayo*. Since some class 11 nouns have a plural in class 6, it is possible that *ma-yayo* is the plural of *j-jayo*, while *ma-ayo* is the plural of *lw-aayo*. This leaves only (87c) whose variation in the plural we cannot explain.

What we can explain is why the class 5 allomorph *li-* is chosen with <y>-initial nouns rather than *j*-: By choosing *li-* one obtains forms such as [líì.so] 'eye', [lyáà.to] 'canoe' etc. Had *j*- been chosen instead, such nouns would have been realized *[j.jí.sò], *[j.játò], etc. As seen, the choice is thus between a single CVV syllable vs. two syllables C.CV. In (30c) we proposed a constraint according to which a single CVV syllable is preferred over two CV syllables. If we interpret this constraint in terms of moras we discover that it also covers the current situation: A bimoraic syllable is preferred over two monomoraic syllables (other things being equal). Thus this class 5 allomorphy, rather than being a problem, provides additional support for the approach taken here.[73]

6. Summary

In the preceding sections we accomplished the following: first, we expanded the empirical base for the study of the syllable in Luganda. Second, we provided a characterization of Luganda syllabification within the context of the morphological structures that affect the phonology of the language. We saw that syllable-related phenomena may differ in their word-internal vs. word-external manifestations (e.g. the gliding vs. deletion of mid-vowels when followed by another vowel). We also saw that syllabification is edge-in and cyclic in Luganda. We also proposed that the sponsoring of moras by the stem (=stratum 1) be globally encoded in the output in order to handle a sticky problem involving unstable-*y* and the assignment of M2 stem tone. Finally, we saw that the choice of the class 5 allomorph *li-* before unstable-*y* roots is predicted by our analysis. Despite the fact that we have shown Luganda syllabification to be considerably more intricate than Tucker (1962) and subsequent scholars have described it, we believe (or at least hope) that we have not detracted from the pleasing aesthetics that so inspired Tucker in the opening quotation.[74]

Appendix

In the above discussion we have had occasion to mention the role of geminate consonants (henceforth geminates) in Luganda syllabification. What is lacking from our study is a thorough study of gemination. In order to limit the length of our study we shall provide only a schematic statement concerning geminates, which, although usually functioning as vowels, do not always behave as expected. As we shall show, bimoraic VC_i sequences behave slightly differently from either VV or VN ones. But first, as an attempt to understand their behavior, it is constructive to consider the various sources of geminate consonants.

As has been pointed out in the literature (Meeussen 1955, Tucker 1962, Clements 1986), a major source of geminates is from PB ***įC* sequences. Some geminates in Luganda can be argued to have the synchronic representation /įC/. In order to appreciate the full situation, we briefly list the seven sources of gemination in Luganda:

(i) Tauto-morphemic geminates: e.g. *ku-tippa* 'to tie tightly', *ku-kk-a* 'to descend', *n-tugga* 'giraffe' etc.

(ii) 'C_i prefixes' such as class 5, as we saw in (83), e.g. *t-táma* 'cheek', *f-fúmù* 'spear', as well as some class 9 nouns, including borrowings such as *b-bású* 'bus', *s-saffáàli* 'safari'.

(iii) Nasal prefix + root-initial nasal consonant, e.g. class 9 *m-mésè* 'rat(s)', *n-nákù* 'trouble(s)' and first person singular subject and object prefixes on verbs, e.g. *m-manyi* 'I know', *a-n-nenya* 'he blames me'.

(iv) Meinhof's rule, whereby a N-DVN sequence generally becomes N-NVN (where D = a non-strident oral voiced consonant), e.g. m-máànja 'I demand payment' (cf. *ku-báànj-a*), a-n-númà 'he bites me' (cf. *ku-lúma*), *n-nímì* 'tongues' (cf. sg. *lu-límì*) (see Katamba & Hyman 1991).

(v) Perfective allomorph *-įl-* after a CV verb roots (e.g. *a-gu-į̂l-e* < *a-gú-dd-è* 'he has fallen') and fused or 'imbricated' allomorph *-ɨ̧* before polymoraic stems ending in /l/, e.g. *a-sasûl-į-e* → *a-sasûįl-e* → *a-sasûddè* 'he has paid' (cf. *a-sâl-į-e* → *a-sáz-è* 'he has cut').

(vi) Optional infinitival *ku-* truncation (Katamba 1977), e.g. *ku-pákàs-a* ~ *p-pákàsa* 'to work for hire', *ku-bala* ~ *b-bala* 'to count' etc.

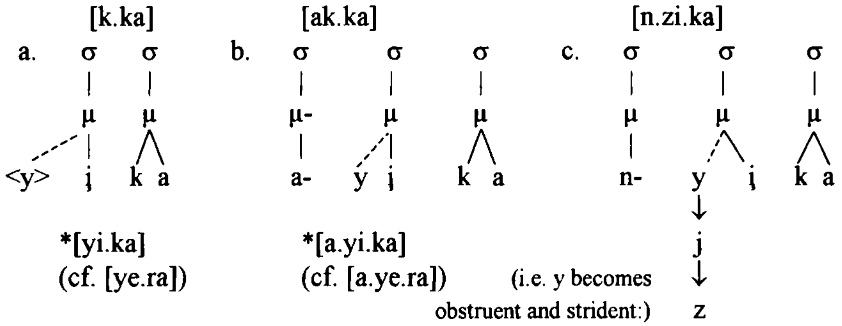
(vii) ‘Prothetic gemination’ (see below).
In cases (i)-(vi), consonant gemination results from either the concatenation of like or near-like consonants or from the leftward spreading of a consonant onto an available vocalic mora (either from Proto-Bantu **į* or from the deletion of the infinitive prefix *ku-*). The seventh and last source of gemination is quite different and problematic. However, before dealing with it, it will be necessary to consider the interaction of gemination with unstable-*y*.

Compare the imperative and present tense paradigms of the two verbs ‘sweep’ and ‘descend’ in (88).

(88)	a.	yer-a	‘sweep!’	kk-a	‘descend!’
	b.	n-jer-a	‘I sweep’	n-zik-a	‘I descend’
	c.	o-yer-a	‘you sg. sweep’	o-kk-a	‘you sg. descend’
		a-yer-a	‘s/he sweeps’	a-kk-a	‘s/he descends’
	d.	tw-éèr-a	‘we sweep	tû-kk-a	‘we descend’
		mw-éèr-a	‘you pl. sweep’	mû-kk-a	‘you pl. descend’
		b-éèr-a	‘they sweep’	bâ-kk-a	‘they descend’

In the case of -<y>er- ‘sweep’ the unstable-*y* surfaces in the imperative in (88a), after the first person singular prefix *n-* in (88b), and after the vocalic prefixes *o-* and *a-* in (88c). Unstable-*y* fails to surface after the CV prefixes *tû-*, *mû-* and *bâ-* in (87d). Now consider the *-kk-* ‘descend’. In the right hand column we see that this verb surfaces with a geminate in all forms except after the nasal prefix in (88b). As mentioned, such verbs historically had the vowel **į*. Thus compare Luganda *ku-kk-a* with Rukiga *kw-ika*, both meaning ‘to descend’. Now, we have pointed out that all vowel-initial roots have an unstable-*y*. What this means is that the underlying representation of root-initial C_iC_i should be *-<y>į C*. The <y> surfaces after *n-*, but not as [j], rather as [z], the expected ‘fricated’ reflex before *į.This latter vowel of course also surfaces as the [i] in *n-zik-a* ‘I descend’. But why don’t we obtain the form *-zik-* in the imperative (**zik-a*) or after the vocalic prefixes *o-* and *a-*? It is clear that we have a parallel representation with -<y>er-, but with a different output, as indicated in (89).

(89) *Parallel representation of* C_iC_i *as /<y>į C/, but with different output*



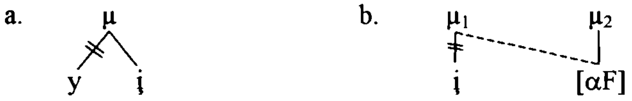
As indicated, if the input of the imperative in (89a) were to follow the same principles as we invoked for [ye.ra] 'sweep!' in (50a), 'descend!' would incorrectly surface as *[yi.ka]. Similarly, the input in (89b) would incorrectly surface as *[a.yi.ka]. In (89c), however, the unstable-*y* does surface. In order to see why, let us first consider a possible serial solution in (90).

(90) *A serial solution*

a. a- <y> er-a	b. a- <y> įt-a	c. n- <y> įt-a	UR
a-yer-a	a-yįt-a	n-yįt-a	Link <y>
		n-jįt-a	C-hardening
		n-zįt-a	C-frication
	a-įt-a		y-absorption
	a-tt-a		Gemination

Each of the inputs show unstable-*y* as <y>. The first step in the derivation is to link unstable-*y*, since it is preceded by either a vowel or nasal prefix. This produces *a-yer-a* in (90a). In (90c) /y/ hardens to [j] and then 'fricates' to [z] before /į/. This frication process applies to all lingual consonants in the language except /y/.[75] It therefore does not apply in (90b). Instead [y] deletes before /į/ by an OCP-related process of absorption, formalized in (91a).

(91)



Finally, as schematized in (91b), /į / delinks from its mora μ_1 and the following consonant is compensatorily lengthened (Clements 1986) by leftward spreading.[76] Note, however, that μ_1 must not be branching, as it is in (90c), or we would obtain something like **nzta* or **ntta*, depending on the ordering of hardening with respect to (91a) and (91b). What this means is that gemination will occur either after a vowel or after pause.

Within a direct mapping approach such as the one we advocate, instead of the rules in (92), we would introduce the analogous constraints in (92).

(92) a. Avoid [yi]$_\sigma$
b. Avoid [i

The first says that one should avoid [yi] syllables. Since stable-*y* may surface before [i], e.g. *ku-yíìmb-a* 'to sing', this constraint is violable. The constraint in (92b), which prohibits bracket-initial [i], is however undominated, and counter-evidenced only by a handful of exceptions (see note 11). Returning to the input of (89b) unstable-*y* fails to link because of (92a) and *į* is delinked because of (92b). In fact, we can propose one amendment which may have value in explaining why Luganda has consonant gemination. Recall that the 'geminator' *į*, is an /i/ that causes gemination or frication, depending on the context. Our proposal is that it is an /i/ which is not pre-linked to its mora. Because of the constraints in (92), it will fail to link (and hence be stray-erased) if preceded by a vowel or null, but will otherwise be reassigned to a preceding consonant to cause frication. The reason why an empty mora is preferentially filled by the consonant to its right rather than by the vowel to its left is that right-to-left directionality takes precedence over left-to-right directionality in Luganda. In other words, we don't think the language prefers geminate consonants to long vowels, other things being equal.

With this treatment of geminates, we are now ready to consider what we have termed 'prothetic gemination'. This concerns the development of [ggw] and [ggy] geminates from PB **-pó-* and **-pí-*. The two verbs in (93), originally cited in (13a,d), illustrate this phenomenon:

(93) a. Infinitives

i.		ii.	
kû-ggw-a	'to be exhausted'	kû-ggy-a	'to get burnt'
kú-ggw-aa=kô	'... a little'	kú-ggy-aa=kô	'... a little'

b. Present tense (habitual)

i.		ii.	
n-zígwà	'I am exhausted'	n-zígyà	'I get burnt'
ó-ggwà	'you (sg.) are exhausted'	ó-ggyà	'you (sg.) get burnt'
á-ggwà	's/he is exhausted'	á-ggyà	'he/she gets burnt'
tú-ggwà	'we are exhausted'	tú-ggyà	'we get burnt'
mú-ggwà	'you (pl.) are exhausted'	mú-ggyà	'you (pl.) get burnt'
bá-ggwà	'they are exhausted'	bá-ggyà	'they get burnt'

c. Perfect tense

i.		ii.	
m-pwêddè	'I have become exhausted'	n-jîddè/m-pîddè	'I have got burnt'
o-wêddè	'you (sg.) have bec. exhausted	o-yîddè	'you (sg.) have got burnt'
a-wêddè	's/he have bec. exhausted	a-yîddè	'he/she has got burnt'
tú-wèddè	'we have bec. exhausted'	tú-yìddè	'we have got burnt'
mú-wèddè	'you (pl.) have bec. exhausted'	mú-yìddè	'you have got burnt'
bá-wèddè	'they have bec. exhausted'	bá-yìddè	'they have got burnt'

As seen in the infinitives in (93a), the two verbs have a geminated [ggw] or [ggy]. The second line shows that the FV of these verbs is long, but undergoes FVS when not followed by an enclitic, here class 17 *=kô* 'a little'. The same geminates are found in the present tense in (93b), except when the subject is first person singular. From the first person singular subject forms in the perfect tense in (93c), we can see evidence that the initial consonant was **p* (although there is variation in (93c.ii.)). We also see from the vowel that precedes perfective *-dde* that 'become exhausted' has an underlying /o/ (cf. (13) and note 14), while 'get burnt' has an underlying /i/. As mentioned in note 40, when not preceded by [m], PB **p* weakens to [w] in Luganda, which then assimilates to [y] before front vowels. In an abstract analysis we can thus can set up /-pi-/ and /-po-/.

We now are ready to show in (94) how the geminates [ggw] and [ggy] arise in these forms:

(94) a. /po-a/ → wo-a → ww-aa → ggwaa
b. /pi-a/ → wi-a → yy-aa → ggyaa

First /p/ weakens to [w] or [y], as appropriate. Then /o/ and /i/ glide to [w] and [y], respectively, with compensatory lengthening of the FV. (Recall from (13) and (14) that mid-vowels glide before another vowel lexically.) As seen, this produces [ww] and [yy] sequences. The final step is for these to undergo hardening to [ggw] and [ggy].[77] What is of concern in the derivation in (94) is that the input contains two moras, while the output contains three! That is, assuming that the [wwaa] and [yyaa] stage can be treated the same as other *Cwaa* and *Cyaa* bimoraic syllables, when [ww] and [yy] harden to [ggw] and [ggy], an additional mora has to be inserted to carry the first half of the geminate. For this reason, we view this mora as 'prothetic' and the resultant hardened consonants as 'prothetic gemination'. That the first half of the geminate is moraic is seen in the following derivatives of these verbs:

(95)	a. kw-é-ggw-èès-a	'to exhaust oneself'	<	ku-eê- [wô-es-į-a]
	b. kw-é-gg-ììr-a	'to be burnt for oneself'	<	ku-eê- [yî-ir-a]

The verb *-wô-* 'become exhausted' is causativized in (95a), while the verb *-yî-* 'be burnt' is applicativized in (95b). In both cases, the three vocalic moras of the *ku-ee-* infinitive prefix + reflexive sequence are pared down to one. This of course is the result of the edge-in syllabification of the first and last of the four moras in sequence, the last being that of geminate *-ggw-* and *-ggy-*.

In the interest of space we will refrain from providing a fancy synchronic account of this essentially diachronic problem. We note that this is an area where the language is in flux (note the two possible forms of 'I have got burnt' in (93.c.ii)). Also note in (93b) that the forms obtained with a first person singular subject are not **m-pw-â* and **m-py*-â, but rather *n-zígw-à* and *n-zígy-à* – as if their underlying representations should be *-<y>įgo-* and *-<y>įgi-*, like other initial geminates. Finally, note that we do not obtain geminates in the perfect tense in (93c). We can explain the non-gemination in (93c.ii.): The development of the geminate *-dd-* from an input such as *o-yi-įl-e* bleeds the environment for the gliding of the preceding /i/. Hence there is no [yy] stage to produce the geminate. However, in (93c.i), there is an extra *-e-*, as we noted in note 14. Thus, even when an input such as *o-wo-e-įl-e* becomes *o-wo-e-dd-e*, this still should become *o-ww-e-dd-e*, which should then become **o-ggw-e-dd-e*, which it doesn't (cf. [o.wêd.de]). This too we will leave for further research.

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Notes

1. In this study we use the term ‘stem’ in the traditional Bantu sense to include a root plus any suffixes. Prefixes, however, fall outside the stem, with which they combine at the word level.
2. Though phonologically the two parts of a geminate consonant belong to separate syllables, phonetically a geminate consonant is a single unit which differs crucially in length from its non-geminate counterpart. Geminates are normally between one and half to two times longer than their non-geminate counterparts (cf. Katamba 1974).
3. The tone marking conventions used here follow Hyman and Katamba (1993). In lexical (underlying) representations Luganda contrasts tonic moras, which bear a HL (^) melody, and toneless moras which have no underlying tone. We interpret underlying tonicity as HL complex with geometry depicted below:

μ	(Tone Bearing Unit = mora)
|	
o	(Tonal Root Node)
Λ	
o o	(Tonal Nodes)
| |	
H L	(Tones H, L)

The assumption that underlying tonic syllables have HL melodies simplifies the analysis of Luganda tonology considerably.

In surface representations the language has H(igh) (´), L(ow) (`) as well as F(alling) (^) tones. All surface moras have one of these tones but only high and falling tone are always marked. Low tone is only shown where it is especially helpful to do so.

4. The fourth source is the rule of lengthening that applies to a vowel that is followed by a nasal + consonant cluster (cf. sec. 5.1).

5. In (4b) and elsewhere below, three dots (...) indicate that this vowel length is maintained before an enclitic, e.g. [ku.lyàà =kô] 'to eat a little'. When an appropriate enclitic does not follow, the form is subject to a rule of final vowel shortening (FVS), e.g. [ku.lyâ] 'to eat' (cf. Hyman & Katamba 1990).
6. Also possible is an alternative Government Phonology inspired analysis where one assumes that there is a floating underlying I (palatality) melody or U (labiality) melody which ultimately attaches to the consonant preceding it.
7. Where the gliding vowel is preceded by a consonant in the syllable onset, as in all the examples in (4), compensatory lengthening is mandatory. The one exception from Snoxall (1967) is [kwété] 'beer made from maize meal', a drink (and hence a word?) which is borrowed from Northern Uganda. Note, however, that there are two complications. First, compensatory lengthening is absent when the gliding vowel is syllable-initial (cf. the examples below in (48)). Second, in stems, compensatory lengthening is accent sensitive. Hyman & Katamba (1993) have shown that heteromorphemic stem vowel sequences yield a long vowel ONLY if the second vowel – the one that surfaces – is in an accented position (marked by ' ^{x}'):

(a) (*ku-)gu-*$\overset{x}{i}$ *r-*$\overset{x}{a}$ → *ku-gw-iir-a* 'to fall for/at' (*-ir-/-er-* 'for at')

(b) (*ku-)tá-*$\overset{x}{e}$ *r-*$\overset{x}{a}$ → *ku-t-éèr-a* 'to let go for/at'

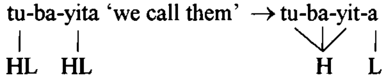
(c)(*ku-)wá-*$\overset{x}{e}$ *bu-agan-*$\overset{x}{a}$ → *ku-w-éèbw-agan-a* 'to be given (to) each other'
(*-ebu-*'passive', *-agan-* 'reciprocal')

In all these examples, the expected compensatory lengthening of the accented second mora of the stem is observed. By contrast, in (c) the first /a/ vowel of the reciprocal suffix which follows the /u/ of the passive fails to undergo compensatory lengthening because it is in an unaccented position.

8. Clements (1986) actually views (5b) as a result of a 'linking convention' which guarantees that all empty V slots will be targeted by spreading from an adjacent vowel.
9. These represent the only possibilities of [–high] # V, since words cannot begin with a high vowel in Luganda. The examples in (8c) also show word-internal deletion of the /a/ of /a-ba-o/. The resulting vowel is short because of a rule of final vowel shortening (Hyman & Katamba 1990).
10. This naturally follows from our assumption that onset consonants link to the first mora of a syllable. If instead we followed Hayes' (1989) proposal that onset consonants link directly to the syllable node, then all vowel sequences could be said to undergo LVS *and* delinking of the first vowel. In cases where the delinked vowel is [+high], it would relink as part of the onset to the syllable node. Delinked [–high] vowels would not relink as onsets (but cf. below). This alternative analysis within moraic theory mirrors the approach taken by Halle & Vergnaud (1980) within the CV framework.
11. These are the only relevant combinations, since other than the exceptional negative prefix *te-* (see sec. 4.2), prefixes cannot have the shape *Ce-* or *Co-*. In addition, morphemes cannot begin with high vowels. There are a very few noun roots which exceptionally begin (or appear to begin) with a high vowel. We know of only four: *mu-îko* [mwíì.ko] 'trowel', *bu-ûgi* [búù.gi] 'maize meal', *ki-ûma* [kyúù.ma] 'iron' and *lu-ûyî* [lúú.yì] 'side', the first three of which are borrowed from Swahili. A different kind of exception is the class 5 noun [líì.so] 'eye', whose class 6 plural is [máàso]. In this case we can factor out the *li-/ma-* singular/plural prefixes and establish the root as /μ̂so/, i.e. beginning with a HL tone empty mora to which the vowel of the prefix spreads.

12. The lack of gliding in [lú.kêd.dè] 'it has dawned' (*[lú.kyêd.dè]) in (13c) is unexpected. It seems the pressure to follow the broader surface pattern of having gliding and palatalization only before [i] overrides the gliding and palatalization rules that would otherwise apply here.
13. We tentatively recognize 'defecate' as *-ne-*, because it takes an [e] in its perfective form. In order to predict the /ny/ sequence, however, we would either need to set up *-nie-* instead, or else consider that the /e/ of a *-Ce-* root glides in the prefective if the C is coronal. (In the case of *-se-*, the *y* of intermediate *-syedde* would undergo regular absorption after /s z c j y/.) Guthrie's (1967-71) starred form for this root is **nį-* (here *-į* = a tense high front vowel), while Meeussen (1980) reconstructs it as **-ne-*. The underlying vowel cannot be /į/ in Luganda, because this vowel automatically mutates /n/ to [ɲ], e.g. *-fûn-* 'get' vs. /mu-fûn-į/ [mu.fu.ɲi /'rich person' (i.e. a getter). It is possible that it was /-ne-/ in Luganda, but that the *ny* sequence that one gets in the infinitive and elsewhere was analogized into the perfective. As pointed out by Katamba (1980), the sequence *ny*, written *nÿ* (as opposed to the palatal nasal [ɲ], written *ny*) is used exclusively in words relating to relieving the bowels, e.g. *ki-nÿago* 'rectum'. Also noteworthy is the gemination obtained in the infinitives of the last forms in (13a) and (13d). These are treated in the appendix.
14. Whether an additional suffix of the form *-e-* is involved here, e.g. *-mo-e-dde*, as we believe, or /o/ undergoes an otherwise unattested 'breaking' process to become [we] before *-dde*, what is important for us is that the following vowel is [e], rather than [i]. This follows from the height harmony conditions in Luganda which disallow [i] from following the mid-vowels /e/ and /o/ (see Katamba 1984).
15. As seen in (38b) below, the onsetless subject prefixes *e-* 'class 9' and *o-* '2 person sg.' do glide to [y] and [w] before a vowel, suggesting word-level gliding of mid-vowels. However, since Luganda morphemes do not begin with [i] or [u], these prefixes can equally well be set up as /i-/ and /u-/ with an initial vowel lowering rule, or as underspecified /I-/ and /U-/ with morpheme-initial [–high] redundant specification.
16. A possible consequence of this analysis is that morpheme-internal [Cwee] can be set up with an underlying /oe/ sequence, e.g. /ku-koek-a/ [ku.kwee.ka] 'to hide'. If we set up /ue/, the sequence would be disharmonic. There are two caveats, however. First, there are few sequences of morpheme-internal /ui/ in the language, e.g. no verbs of the shape -CuiC- that would surface with a [Cwii] syllable. Second, the normal rule of height harmony operates differently when two vowels are in direct sequence. While a suffix such as the applicative appears as *-ir-* after -CiC-, -CaC- and -CuC-, and as *-er-* after -CeC- and -CoC-, it appears as *-er-* when preceded not only by -Ce-, and -Co- but also by -Ca-. Similarly, for the causative morph *-is-/-es-*, one might consider an alternative by which root /e/ and /o/ first raise to [i] and [u] before another vowel and then glide by the general rule that affects only high vowels. In this case it would first be necessary to spread their [–high] onto the following applicative or causative suffix and then delink the [–high] from the root vowel, thereby bleeding the NHD rule. (The [+high] specification of the resulting glide would presumably be supplied by default.)
17. Since all but the last two V slots will ultimately be 'trimmed', a variant on this analysis would be to restrict Clements' leftward vowel spreading to apply only to the preceding V slot. If we assume that V-trimming applies to non-syllabified V slots, and that it is only the last two V's that are syllabified, LVS could be said to apply only when the landing site is prosodically licensed by a syllable.
18. The notion of edge-in association is due to Yip (1988) and it has been applied to syllabification by Macken (1990). In section 4.3 below we suggest that edge-in association is an automatic consequence of the cyclic nature of syllabification in Luganda.

19. Interestingly, this is the one case where Meeussen's Rule (MR) does not apply in Luganda. MR delinks a H from a mora that is immediately preceded by a HL contour (Hyman & Katamba 1993a). As seen in the second example of (22b), this fails to apply when the H in question is in the same syllable as the preceding HL. If MR had applied, we would have obtained *[bâd.du.ka].
20. The HL melody is definitely associated with the first rather than the second mora of *-nâa-*. This is clear when we consider a verb with a non-tonic root e.g., *-som-* 'read' whose first person singular future form is *anáàsoma* 'he will read'. If the HL melody were underlyingly associated with the second mora of *-naâ-*, the surface form would be the incorrect **anaásoma* (or **anáásoma* after the simplification of a rising tone to H; rising tones are strictly disallowed and typically simplify to H, cf. /mu-âmi/ [mwá:mì] (*[mwǎ:mì]) 'chief').
21. High tone plateauing is motivated by the OCP. It converts adjacent HL contours on the tonal tier into a single HL melody with a multiply linked H as depicted below:



A detailed justification of this analysis is to be found in Hyman & Katamba (1993a).

22. In both examples we show /n/ linked to the following mora. This can be seen either as a relinking process, or can be avoided altogether if one assumes, contra our view, that onsets link directly to the syllable node as discussed by McCarthy & Prince (1986) and Hayes (1989). In our analysis, where there is stray-erasure of medial non-syllabified moras, this onset-relinking problem does not arise.
23. For evidence of free H tones linking to the left, consider the fate of the H tone that delinks from its prefix in demonstratives as when *kâ-no* → *ˆka-no* 'this' (class 12). A sequence such as *a-ka-sâale* 'arrow' + ˆ *ka-no* 'this' is pronounced *a-ka-sáàlé kàno* 'this arrow', with the H linking to the left.
24. See especially Kenstowicz & Kidda (1987) for an explicit discussion of this prediction, based on Tangale.
25. The symbol /ι/ indicates the historical tense high front vowel which in Luganda either (a) geminates a following consonant (as in (28)) or (b) mutates a preceding consonant (obstruents → s, z; n →ɲ). When realized as [i] it is otherwise non-distinguishable from instances of /i/ which do not have these effects.
26. In a moraic framework what this means is that you cannot begin a syllable with a non-branching mora. This also rules out a syllable consisting of a syllabic nasal. As in the case of V syllables, a syllabic nasal syllable is only tolerated after pause in Luganda.
27. As we discuss in section 5.1, vowels are otherwise automatically long before NC.
28. There is considerable confusion in the literature on this subject. Cole (1967: 5), for instance, speaks of word-initial vowels: "In word-initial position (except when preceding geminate consonant clusters) vowels appear always to be phonetically longer than medial single vowels. We tentatively assume therefore that, except when preceding CC, all word-initial vowels are phonemically double (VV)." Tucker (1967: xvi), on the other hand, seems to imply that such vowels are short, but that initial vowels followed by a NC cluster are long. It is clear from our investigations that the initial vowels in both (44a) and (44b) have two distinguishable realizations: one where the vowel is relatively short (in fact, sounds exactly like a short vowel to us) vs. one where the vowel is quite long (i.e. having the length of a CVV syllable). It is also occasionally claimed that forms such as the following are distinct for some speakers (cf. Stevick 1969):

(i) /a-lâb-a/ → [a.lá.bà] 'he sees'
(ii) /a-lâb-â/ → [aa.lá.bà] 'he who sees' (< /a-a-lâb-â/?)

In our own investigations with several informants we have found both of the underlying forms in (i) and (ii) to vary between the two outputs. That is, either can be [a-lá.bà] or [aa.lá.bà].

29. Note that *-â* FVs are regular and dealt with in section 5.1.
30. The portion in parentheses is discounted. The mora count starts with the first tone bearing unit not in parentheses; 1 = first mora; 2 = second mora.
31. In the case of CVVCV stems, the HL tonicity is assigned to the second V of the CVV syllable. By the general contour simplification processes, the entire CVV becomes H and the drop to L occurs on the following syllable, as indicated.
32. Snoxall (1967: 269) lists the single potential counterexample *ku-ôtt-a* 'make off, go away', adding, however, that the verb is 'usually' *ku-yôtt-a* (which alone is acceptable to the second author). The only other apparent counterexample in the Snoxall dictionary is ku-aNNang-a 'to approach, accost'. However in this case the root is underlyingly /-angang-/. The geminate velar nasal will be derived by a rule known as either Meinhof's Rule or the Ganda Law (Meeussen 1962, Herbert 1977, Schadeberg 1987, Katamba & Hyman 1991). In Luganda this rule converts sequences of NDVN to NNVN in the relevant domain (where D = a non-strident voiced consonant). Underlyingly the root in question thus begins with initial +VNC, not +VNN.
33. For many speakers, the vowel of this tense prefix may harmonize with the vowel of the pronominal prefix that precedes it where that vowel is mid, resulting in *e-néé-láb-a* 'it will see' (cf. *o-náá-láb-a* = *o-nóó-láb-a* 'you will see').
34. This interpretation also explains why the augment (or initial vowel) in the relative form is pronounced [e]: [e.ya.lá.bà] 'he/she who saw'. Where (37a) does not apply, class 1 surfaces as [a]. If an augment is posited in relative forms such as /a-a-lâb-â/ → [a-láb-à] 'he/she who sees', it too must remain as /a-/ (cf. /a-sib-a/ → [a.sib.a] 'he/she ties' vs. /a-a-sib-â/ → [a.si.bâ] 'he/she who ties', where the main and relative forms differ in tone because the root -sib- is underlyingly toneless). Given the complexity of the realization of the augment in Luganda (see Hyman & Katamba 1993b), it would however also be possible to say that there is a Ø spell-out in this case.
35. There are, however, other possible interpretations of this fact. First, as we have already indicated, the only vowels that appear after a left morphological bracket in Luganda are [e o a], i.e. [–high]. For this reason, it would be possible to represent the class 9 SM as /i-/, which would in fact glide before /e/, but which would lower to [e] in case it didn't glide. To get gliding only before unlike vowels, it would be necessary, however, to keep the representation of the reflexive as *-eê-* and the copula in (39b) as *-e* even though these too could be represented as *-iî-* and *-i-* (with predictable lowering). Or, we could keep /e/ and let it glide by the same lexical rule that we observed in (14b). That the applicative of a verb such as *-kê-* 'dawn' *is -ke-er-*, i.e. without gliding, is no problem. In this case the vowel of *-kê-* is underlyingly [–high], since it contrasts with /i/, but the non-contrastive height of the applicative vowel is underlyingly underspecified (and acquires its [–high] by spreading from *-kê-*). In our view, gliding is not obtained here because it is not needed: a CVV syllable is acceptable in Luganda.
36. An alternative would be to propose that /e-/ and /o-/ are underlyingly non-moraic /i/ and /u/, but acquire a mora when followed by a consonant. This solution, equivalent to the proposal offered in Hyman (1985), will not be pursued here.
37. We assume that the underlying length of a vowel-initial morpheme manifests itself directly on the surface after *e-* or *o-*. This criterion establishes two morphemes as un-

ambiguously short (past tense *-a-* and copular *-e*) and the following as unambiguously long: genitive *-aa*, subject cleft *-ee*, reflexive *-eê-*, WH-*yet* tense *-âa-*, just finished past *-aaka-*, *and -aaku-*, an archaic variant of conditional *-andi-*, whose length cannot be determined because of the NC sequence, which independently conditions CL (see sec. 5.1).

38. Note that the class 1 prefix is the regular *o-* concord in this case. The rule of referral in (37a) only replaces the verbal prefix *a-* with *e-*.
39. The underlying representations given to the right dramatically confirm that syllabification must proceed cyclically, applying first within words, then across. The last example appears to have seven vowels in a row which, however, must be independently syllabified in the three forms /m-bûa/, /e-ee=/ and /e-â-gu-â/.
40. The requirement that constituents should start with a CV syllable is by no means universal. This is an area where cross-linguistic variation can be observed.
41. Only three verbs have been found that have the shape -yVC$_i$C$_i$: *-yîgg-* 'hunt', *-yagg-* 'lament' and *-yôtt-* 'make off'. Concerning the frequency of the sequence [yi], it should be noted that when not preceded by a nasal, Proto-Bantu *p weakens to [w], which then is fronted to [y] before /i/. This creates present alternations such as *ku-yít-à* 'to pass' vs. *m-pít-à* 'I pass' (cf. Proto-Bantu **-pit-*).
42. Cf. Cole (1967:119): "In summary, the *yV* allomorphs occur when there is no prefix, and after all prefixes other than those whose canonical form is CV, i.e. those consisting of N, V, VV, CVV." Borowsky (1983b) and Clements (1986) also deal with some of the issues discussed here.
43. Recall from (34) that the FV of the first stem is long in the second, third and fourth examples in (45e) because it is preceded by exactly one mora. The form *tû-er-aa-yer-a* thus shows that this length must be calculated before the SM *tû-* is prefixed or else two moras will precede the FV. While the second stem in reduplication invariably begins with [y], the forms in (45e) show that the *y vs. Ø* realization of the first stem remains sensitive to the nature of the preceding prefix.
44. Or, put slightly differently, vowel-initial roots may not begin with a long vowel or a vowel + geminate, although they may begin with VNC. We have allowed this by saying that the mora bearing nasal is consonantal and, hence, may be syllabified without violating the constraint against VV syllables. Since we do not have roots beginning -VC$_i$C$_i$, the first half of the geminate functions as a vowel. Discussion of this is presented in the Appendix.
45. Our survey of verb roots in Snoxall (1967) reveals the following statistics:

-yaCV.... 3	-yaaCV... 1	-yaNC... 4	-yaCCV... 1	-aCV... 48	-aNCV... 12
-yeCV.... 4	-yeeCV... 2	-yeNC... 5	-yeCCV... 0	-eCV... 4	-eNCV... 7
-yiCV.... 22	-yiiCV... 8	-yiNC... 11	-yiCCV... 1		
-yoCV... 2	-yooCV... 3	-yoNC... 7	-yoCCV... 1	-oCV... 12	-oNCV... 2
-yuCV... 4	-yuuCV... 5	-yuNC... 3	-yuCCV... 0		

Apart from the many instances of 'unstable-*y*' before /a/, the statistics also show a preponderance of 'stable-*y*' before /i/ that suggests that the missing 'unstable-*y*' before /i/ is (for whatever reason) stable.

46. The name of the country '*Uganda*' looks like a counter-example. But it is not because it is pronounced [yùgáándà], with an initial glide. See the Appendix, however, for the analysis of geminates, where initial superclosed /į/ is proposed.
47. The lack of compensatory lengthening here should be noted. It is normal (cf. 38b) and (39b). Where the gliding vowel is in syllable-initial position there is no compensatory

lengthening. Cf. /tû-â-lâba/ [twáálàbà] 'we saw' vs. /o-â-lâba/ [wàlábà] 'you (sg.) saw'. (See Hyman 1985: 81-83, Clements 1986).

48. Interestingly, close by Haya, which is otherwise virtually identical to Luganda in its unstable-*y* properties, does provide a [y] before the reflexive, e.g. *tu-eê-lêet-â* [twee.léé.ta] 'we bring ourselves' vs. *o-eê-lêet-â* [o.yee.léé.ta] 'you bring yourself'. No other prefix acquires a [y] in this way in Haya. There are at least two ways one could account for this difference. One is to recognize a domain difference, e.g. if [y] depends on stem-initial position in both languages, the reflexive may belong to the stem in Haya, but not in Luganda. Or, perhaps the [y] depends on stem-initial position in Luganda (which would exclude the reflexive) but on macro-stem-position in Haya (which would include the reflexive). Alternatively, one could just give a different underlying representation to the reflexive in Haya vs. Luganda (e.g. initial /y/ vs. ∅). Other languages show considerably different variations, e.g. Olutsootsoo (Dalgish 1974), Kikerewe (Odden 1995), etc.
49. Note that if they applied simultaneously, one would also obtain an incorrect output, *[e.ye.ra].
50. This last point naturally raises the question of whether the y/∅ alternation should be seen as phonological or morphological. As we discuss below, it would be possible to make the alternation one of allomorphy by entering each vowel-initial root with a y-initial allomorph in the lexicon. In this case the conflict in (49) would be over which allomorph takes precedence over the other.
51. In a moraic framework what this means is that one can't begin a syllable with a non-branching mora. As seen in (52b), this also rules out a syllable consisting of a syllabic nasal. As in the case of V syllables, a syllabic nasal syllable is only tolerated after pause in Luganda.
52. Note that reflexive *-eê-*, like other OM's other than the 1sg. OM *n-*, requires the FV *-e* in the imperative. Unlike the other OM's, however, it also requires a 2 pers. SM: /o-eê-er-ê/ → [wee.ye.rê] '(you) sweep yourself!'.
53. As we can tell from forms such as *nn-a-láb-à* 'I saw', for those speakers who geminate the first person morpheme, the 1st person sg. prefix is underlyingly a moraic /n-/ which will be realized as an alveolar before a vocalic prefix. (For other speakers, this morpheme is realized by a non-geminate, non-moraic /n-/ *n-a-láb-a).* We need, therefore, to add to the output in (52b) that we do not obtain **n-nera* (or **nera* in parallel to *nalaba*) because parsing of the underlying extrametrical <y> is preferred to creating an onset from gemination.
54. See Bagemihl (1991) for the notion of moraic licensing.

55 Cf. Tucker (1967: xvii): "Finally, it is important, in reading the examples in the text, to remember that the final vowel of a word is always assimilated by the initial vowel of the following word, which is then pronounced long."

56. Even in this case it is not clear why a post-pausal vowel must be considered a syllable in Luganda. Starting with Hyman (1985) there have been various proposals to recognize syllabicity without having to build a syllable (cf. Bagemihl 1991, Hyman 1985, 1990, Mutaka & Hyman 1990, Downing 1993, 1994). The one awkwardness of this move is that the length observed in reduplications such as *tû-er-aa - yer-a* 'we sweep hear and there' is presumably syllable-related: A perfect iamb [μ μμ] is required if it exactly coincides with the stem. But what does it mean to be a [μ μμ] iamb if not a foot consisting of a light followed by heavy syllable? Finally, in at least one other language, Kinande, an initial vowel must be a syllable. Contrasting with the bare verb stem *tum-à* 'send!', which is the normal realization of the imperative, is the presence of the 2nd sg. subject prefix *u-* whenever the verb stem would otherwise be monosyllabic: *u-sw-à* 'grind!'

Mutaka & Hyman (1990) show that the initial vowels of verb roots such as *-óh-* 'pick' and *-es-* 'play' do not constitute syllables at the stem level. However, their imperatives are oh-à and *es-à*, not **w-oh-à* and **w-es-à* (where the 2nd sg. prefix *u-*, if present, would have glided to [w]). We must conclude from this example at least that an initial vowel counts as a syllable in meeting the bisyllabic minimality of verbs.

57. Disallowing past tense **twéèrà* also has the desirable effect of avoiding homophony with the present tense form *twéèrà* 'we sweep'.

58. Besides the allomorphy account of the irregularity of *te-* we have assumed, one could consider one or another morpheme-specific rule that would apply only to the negative prefix:

    a. te- → t- / ___ V   b. t- → te- / ___ C

    Another possibility is to set up this morpheme with the representation /te/, but without any underlying mora. When followed by a consonant, a mora is inserted to parse the CV sequence. When followed by a vowel, the /t/ joins its mora and the /e/ is stray-erased.

59. Treating similar data in Swahili, Stump (1992) proposes that *si-* is in the pre-SM negative slot, while Stump (1993) presents a reanalysis with *si-* occupying two slots.

60. Recall that a geminate consonant has the structure VC, ultimately /įC/, as discussed in the appendix.

61. Other alternatives such as forming more than one syllable out of the prefixal sequence are blocked by Luganda's lack of C-epenthesis to provide the required onset(s), perhaps also by its preference to minimize structure.

62. One issue not addressed is what to do about a CV # V sequence that come together in the absence of an intervening pause. Recall from the examples in (3b) and (4c) that onsetless moras coalesce into a single bimoraic syllable also across word boundaries, e.g. /o-mu-limi + o-mû/→ [o.mu.li.myoo.mû] 'one farmer'. In an example such as this one, we choose not to assign both the final CV mora /mi/ of the first word and the initial V mora /o-/ of the second word to separate syllables. Otherwise, it would be necessary to undo some of the syllable structure created at an earlier stage of the derivation. An additional constraint would seem to be needed if we insist on keeping all syllabification as structure-building rather than structure-changing. One possibility is to block the formation of a V syllable at the left edge of a word. In this case, we would not invoke stray-erasure but rather we would wait to see if this V joins a preceding CV syllable – or, if occurring instead after pause, forms its own syllable.

63. When the nasal is itself geminate, it behaves exactly as other geminates – e.g. requiring that the preceding vowel be phonetically short. Thus, *tû-eê-m̂m-a* → [twém.mà] 'we begrudge ourselves'.

64. We know that the nasal is underlyingly alveolar, since it surfaces as such when followed by a vocalic prefix, e.g. n-eê-lâb-a [n.néé.là.ba] 'I see myself'. The fact that it surfaces as geminate before a vowel is due to its moraicity (cf. Hyman 1985). We will indicate the moraic nasal as /n/ in all positions, aware however that if coronality is underspecified, this is equivalent to an archiphone /N/.

65. What this automatically implies is that RVS must precede tone rules that need to refer to the second mora of the underlying CVNC sequence. It also is the case that the first half of a geminate is a TBU in the lexical phonology. As will be shown in section 5.3, this follows from our proposal to treat it as an underlying vowel (cf. Clements' VC analysis) which is converted to a consonant postlexically.

66. As discussed in Hyman (1992), this account is preferable to two alternative explanations: (i) that moras are simply counted differently for tone than for quantity, i.e. that there are two different moraic 'projections'; (ii) that initial VN starts out as bimoraic

(e.g. for the purposes of verb stem reduplication), but then undergoes a mora deletion process to become monomoraic.

67. The alternative assumption that unstable-*y* belongs to the prefix rather than the root will not be entertained. Given the structure of Luganda, it is much more plausible to assume that an unstable-*y* is part of the root rather than the prefix. Roots and affixes of various kinds are each restricted to a few canonical phonological shapes. For instance, the canonical shape of verb roots in Luganda, and in Bantu in general, is -CV(V)C- (e.g., *-gul-* 'buy', *-suubir-* 'hope'). Some longer verb roots with frozen suffixes e.g. *-wûlir-* 'hear' are also attested. (There is no related verb **-wûl-* from which *-wûlir-* is derived.) As we noted earlier, -VC- roots are also relatively rare and when they occur after a CV- prefix, they always start with /y/ and thus conform to the -CVC- canonical shape of verbs. The only exception to the requirement that a verb root must minimally contain -CVC-, perhaps followed by a frozen (extension) suffix, is constituted by the 18 -CV- verb roots listed in (13). No less important is the fact that prefixes with the shape CVC- are not found elsewhere in the language. For subject pronouns, for example, the only possibilities are CV-, N-, (N̩) and V-. Nowhere else is a CVC- subject prefix similar to the putative **tuy-* found. It would be an odd coincidence if the only such prefixes that existed happened to be just those that had the unstable-*y*.

68. A relevant comparison with nouns concerns the H of a final HL on nouns with bisyllabic stems such as *ki-sikî* 'log', which is retracted when the augment or initial vowel morpheme is added, hence *e-ki-síkì*. The generalization is that this H falls on the third TBU (=mora) of the noun form in both augmented and non-augmented forms. Now consider a noun such as *n-vubû* 'hippopotamus', which differs from *ki-sikî* only in that its prefix is the class 9 nasal rather than class 7 *ki-*. When these nouns are augmented, an initial V-N- sequence is obtained – and the H is not retracted, hence *e-n-vubû*. This is because the initial VN sequence, although bimoraic, constitutes a single TBU, as in (77b). Similarly, consider a noun such as *li-envû* [lyee.nvû] 'banana' whose stem begins with VN and has a final HL. If the underlying stem /-envû/ counted the nasal as a TBU, the third mora of the noun would be the nasal, and the augmentless form would be pronounced *[lyéé.nvù] (simplified from *lyeê.nvu*). Similarly, the third mora of the augmented form would be vowel /e/, and we should obtain *[e.lyéè.nvù]. Here too, then, the nasal of an initial VNC sequence must not count as a TBU.

69. Odden (1993) discusses other possible cases of cross-stratal reference. However, the model he presents favors complex derivations with apparently any kind of cross-referencing of components and domains. We favor a model that would minimize derivationality, though allowing in at some price the kind of stratal interference we document in this study.

70. Care must be taken to work in the kinds of alternations mentioned in note 67, whereby the H is subsequently retracted one mora to the left. This happens also in verbs, e.g. *a-gul-â* 'he who buys' → *a-bi-gúl-à* 'he who buys them'. Hyman & Katamba (1993a) assume extrametricality of the initial toneless syllable, in which case the H is still on the second TBU of the form. This phenomenon might raise the possibility of another analysis where one starts with V-initial stems, assigns H to their second TBU, and then adjusts this H if and when the unstable-*y* is realized at stratum 2, i.e. *<y>anj-â* → *yaânj-a*. There are two reasons to reject this analysis. First, it is not in fact related to the 'third mora phenomenon' illustrated by *a-bi-gúl-à*. This latter is possible only when all prefixes preceding the verb stem are toneless. Thus, compare *a-bá-gúl-â* 'they who buy' and *a-bá-bi-gúl-â* 'they who buy them' (from *a-bâ-gul-â* and *a-bâ-bi-gul-â* with H tone plateauing), where the HL remains on the FV. In the case of an input form such as *bi-e â-<y>anj-a* 'the ones he spreads out', realized [byá.yáá.njà], the HL must be assigned

to the nasal, *-yañ j-a*. Now if this began as *-anjâ*, the retraction would have to take place despite the fact that the prefix *â-* is tonic. So this is would have to be a unique, hence ad hoc, process of tone retraction conditioned by the introduction of the onset [y]. The second argument against it is that it is not needed: Our input-output analysis produces the same results without having to have an intermediate representation with the HL assigned to the wrong mora.

71. As pointed out by Cole (1967: 31), this noun, from Swahili *chupa*, typically takes class 9 concord rather than class 5.

72. Meeussen (1967) reconstructs the augment as **dí-* and suggests that the augmented prefix for class 5 was therefore **dí-j-*. However, class 5 nouns all take the augment *e-*, hence *e-p-péèsa* 'button', *e-ly-áàto* 'canoe'. It is hard to see how this latter form could derive from **dí-j-játò*, where **j* is the source of the unstable-*y* of our study. Our suggestion is that both *j-deletion and class 5 allomorphy are archaic, **di-* being used before V-initial roots, *j-* before C-initial roots.

73. We of course have not explained – and cannot explain – why *j* (rather than *li*) is used with C-initial stems. This seems to be a historical fact, although we believe that even the diachronic situation is far from clear. Synchronically, there are at least two reasons why a *li-* syllable should be preferred to a C_i- (i.e. geminate) one: (i) As we have argued, geminates are vocalic. Hence, an initial C_iC_i sequence begins with an onsetless syllable. (ii) Geminates are themselves more 'marked' than non-geminates. As shown in the Appendix, however, Luganda has a great affinity toward gemination.

74. One last comment: In some of our presentations of this work we have approached Luganda syllabification as an exercise in how to avoid structure-changing rules (or input-output relations). Whether this is important depends of course on one's theoretical outlook. In the present account, we have attempted to present the syllabification of moras as strictly structure-building. That is, we have had no reason to delink any moras from syllable nodes. In order for this to hold throughout the language, since moras join into a syllable across words, we would have to avoid assigning both a word-final mora and a word-initial vowel or first-half-of-geminate to their own syllables. We also would have to redo gliding and some of the other processes so that instead of being prelinked to their moras, they would be co-indexed with those moras with which they are affiliated. Finally, we have not gone into the consequences that would arise if, as suggested to us by Harry van der Hulst (personal communication), we were to have only moras and no syllables, as in Hyman (1985), or, as he suggested, only syllables and no moras.

75. That is, /t c k/ → [s] and /d l j g/ → [z]. /n/ 'fricates' to [ɲ] (cf. note 25).

76. We assume that all consonants in Luganda are [+cons]. This includes both stable- and unstable-*y*, although Paul Kiparsky (personal communication) suggested to us the possibility that one of them, presumably unstable-*y*, might be identified as [–cons] as a way of distinguishing the two, as has been proposed for French to account for differences such as in *l'hiérarchie* vs. *le yoga*. Alternatively, unstable-*y* could be underspecified for [cons], explaining why it doesn't automatically link as an onset, and why syllabification therefore may occur across it. This seems equivalent to the proposal briefly considered in section 4.1 that unstable-*y* lacks a root node, which we rejected primarily because it did not give us the left-edge property that extrametricality provides.

77. Hardening to [ggw] is completely regular. Thus compare class 5 *g-gwáàgi* 'centerpost of house' with its class 6 plural *ma-wáàgi*. However, as seen in (85), /y/ typically geminates to [jj], e.g. class 5 *j-jibâ* 'dove', class 6 pl. *ma-yibâ*. Diachronically we suspect that **p* > *h* first (as it does in neighboring languages such as Runyankore and Rukiga), possibly [x], which could have voiced to [ɣ]. This then would have produced the intermediate forms *-ɣwaa* and *-ɣyaa*. Now if these were to geminate and harden, *-ggwaa*

and *-ggyaa* would automatically result. In the absence of gemination, [ɣ] is lost. Synchronically what we have to say is that [y] from /p/ geminates as [ggy], while [y] from /y/ geminates as [jj]. Other examples of the former is the adjectival stem *-ggyâ* 'new' from PB **-pia* (cf. class 9/10 realization as *m-pyâ*) and the class 11 noun *lù-ggyâ* 'courtyard', class 10 pl. *`m-pyâ*. Perhaps this is a good place to invoke Kiparsky's suggestion that Luganda might have both a [+cons] and a [–cons] [y] (cf. note 73). Finally, we should perhaps note that there is some confusion in Luganda, a language with velar fronting (and dialectal affrication), between [g] and [j], particularly before high front vowels. Thus Snoxall (1967) gives *gg/jj* variants for the following class 5 nouns: *g-gindù/j-jindù* 'spur of fowl', *g-ginirizi/j-jinirizi* 'hair along spine on back of animals', *g-girì/j-jirì* 'mat with spiral pattern', *g-girikiti/j-jirikiti* 'Red-shot Poker Tree, Uganda Coral'. The last noun has the plural *ma-yirikiti*. Other nouns that are entered solely with initial [gg] in class 5 also have a *y*-initial class 6, e.g. *g-giririzi* 'a skin disease', pl. *ma-yiririzi*. This is clearly an area for further lexicographic research.

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