http://www.jstor.org

Positional prominence and the 'prosodic trough' in Yaka*

Larry M. Hyman
University of California, Berkeley

1 Introduction

The issue of vowel height harmony – relatively rare in the world's languages – is one that most serious theories of phonology have addressed at one time or another, particularly as concerns its realisation in Bantu (e.g. Clements 1991, Archangeli & Pulleyblank 1994, Beckman 1997). As is quite well known, the majority of an estimated 500 Bantu languages exhibit some variant of a progressive harmony process by which vowels lower when preceded by an appropriate (lower) trigger. (Ki)-Yaka, a Western Bantu language spoken in ex-Zaire, designated as H.31 by Guthrie (1967–71), has a height harmony system which has been analysed as having a similar left-to-right lowering process. In this paper I argue against the general analysis given for Yaka, showing that this language differs in a major way from the rest of Bantu. The goals of the paper are threefold. First, I present a comprehensive treatment of the unusual vowel harmony system in (ki-)Yaka. Second, I introduce the notion of the 'prosodic trough' (τ), a domain which is needed in order to state important phonological generalisations in Yaka and in Bantu in general. Finally, I show the relevance of the Yaka facts for the study of positional prominence in phonology. A (partial) analysis is offered within optimality-theoretic terms, particularly as developed by McCarthy & Prince (1995). Although superficially resembling the vowel height harmony found in most Bantu languages, the Yaka system will be shown to differ from these latter in major ways. The paper is organised as follows. In §2 I establish

the general nature of the Yaka harmony system, reanalysing previous accounts in terms of 'plateauing'. In §3 I turn to the process of 'imbrication', which introduces a second motivation for vowel harmony: the avoidance of the sequence [wi]. A third source of vowel harmony is presented in §4, which also introduces the notion of the 'prosodic trough'. The study ends with a brief conclusion in §5 and an appendix that discusses outstanding problems.

2 PLATEAU and vowel height harmony

Since the Yaka system has been compared to the standard kind of vowel height harmony (VHH) found elsewhere in Bantu,[1] I illustrate the latter from Kisa E.32 (Sample 1976):

(1) *Vowel height harmony in Eastern Bantu* (e.g. Kisa E.32)

a.	-tsom-el-a	'pierce+APPL'	b.	-tsom-ol-a	'pull out'
	-rek-el-a	'set trap+APPL'		-rek-ul-a	'spring trap'
	-βis-il-a	'hide+APPL'		-βis-ul-a	'reveal'
	-fuːng-il-a	'lock+APPL'		-fuːng-ul-a	'unlock'
	-βaːmb-il-a	'spread out, fasten down'		-βaːmb-ul-a	'spread apart, open up'

As seen in (1a), the /i/ of the applicative suffix lowers to [e] after /e/ and /o/. On the other hand, (1b) shows that the /u/ of the reversive transitive suffix lowers to [o] only after /o/. This is what I call the 'asymmetric' pattern of VHH (Hyman in press). This pattern is widely attested throughout Eastern Bantu and is well established in the literature.[2]

However, the earliest attestation of Bantu vowel harmony comes from *Western* Bantu, e.g. in S. Kongo H.16 (de Gheel 1652):[3]

(2) *Vowel height harmony in Western Bantu* (e.g. S. Kongo H.16)

a.	-somp-el-a	'become attached to'	b.	-tomb-ol-a	'raise'
	-leng-el-a	'wilt, languish'		-lemb-ol-a	'strike out, erase'
	-sik-il-a	'support'		-vil-ul-a	'move, stir'
	-vur-il-a	'surpass, win'		-bub-ul-a	'corrupt'
	-land-il-a	'follow'		-bang-ul-a	'violate'

[1] For example by Archangeli & Pulleyblank (1994: 443): 'Schlindwein (1989) makes exactly the same point [as A&P do for Haya] with respect to a comparable process of post-root harmony in Yaka. Versions of the same harmony process are found in other Bantu languages as well.'

[2] The earliest explicit reference to it that I have found comes from Bleek (1862: 62): 'this rule of vowel harmony is in a very restricted manner carried out in the termination of inversive verbs, *-ura* or *-una*, which becomes *-ora* or *-ona* after a preceding *o*, but retains its sharp [high–LMH] vowel after all other vowels, even after the flat [non-high–LMH] *a* and *e*'.

[3] Glosses here and elsewhere have been translated from the French originals.

These 350-year-old data come from a southerly dialect of (ki-)Kongo, which borders with Yaka, the language I will be discussing in some detail. As seen in (2), /i/ and /u/ lower, respectively, to [e] and [o] after *both* mid vowels. This 'symmetric' pattern of height harmony is almost exclusively limited to Western Bantu.[4] It is generally assumed that the two systems are related and that the asymmetric pattern is older (but see Hyman in press for further discussion).

In this context, it is natural to assume that the Yaka examples in (3), containing the perfective suffix, derive from the same proto harmony system.[5]

(3) a. kik-idi 'erase'   kin-ini 'dance'
       kud-idi 'chase someone away' kun-ini 'plant'
       kas-idi 'bind'   kan-ini 'propose'
    b. keb-ele 'pay attention to'   kem-ene 'moan'
       sol-ele 'deforest'   son-ene 'colour'

The forms on the left show that the perfective suffix is -*idi* after the vowels /i/, /u/ and /a/, but -*ele* after /e/ and /o/. The forms on the right are identical except that the consonant of the suffix becomes [n] when a nasal consonant occurs in the preceding syllable (van den Eynde 1968, Kidima 1991, Hyman 1995a). It should be noted that the perfective suffix can be set up either with an underspecified /D/ or with an underlying /l/, which is regularly pronounced [d] when it is followed by [i].

Based on the data and discussion in van den Eynde (1968), Goldsmith (1985) proposed a rule of left-to-right spreading of [−high] as in (4), where I have represented [−high] with a Mid (M) feature.

(4) [C V C − I D I]
         |
         M

Though changed in details, Goldsmith's proposal of a progressive height harmony rule in Yaka has been accepted by all subsequent scholars who have commented on it, e.g. Schlindwein (1989), Goad (1993) and Archangeli & Pulleyblank (1994).

Despite its superficial attractiveness, there are, however, serious problems with this analysis. As I shall show, unlike most other harmonising Bantu languages, the presence of a preceding M vowel is neither sufficient nor necessary to get height harmony in Yaka. The verb forms in

---

[4] The only cases of symmetric VHH in Eastern Bantu are found in the Luhya E.40 group, e.g. Gusii E.42 (Whiteley 1960) and Kuria E.43 (Cammenga 1994), which have also extended the process to prefixes. Except for the Kongo H.10 group and Yaka H.31, which have five-vowel systems, all of the symmetric cases of VHH occur in languages which have preserved a seven-vowel system from Proto-Bantu.

[5] All data cited in this study are taken from Ruttenberg (1971) unless otherwise noted and are cited without tones, since there is no lexical opposition in verb roots.

(5), for example, show that high vowel suffixes other than the perfective do not by themselves undergo height harmony after a mid vowel.

(5) a. APPLICATIVE -*il*-

kik-il-a	'strike out for'
kud-il-a	'hunt for'
kas-il-a	'bind for'
keb-il-a	'pay attention for'
sol-il-a	'deforest for'

b. CAUSATIVE -*is*-

kik-is-a	'make strike out'
kud-is-a	'make hunt'
kas-is-a	'make bind'
keb-is-a	'make pay attention'
sol-is-a	'make deforest'

c. REVERSIVE INTRANSITIVE -*uk*-

zib-uk-a	'be open'
hul-uk-a	'be saved'
bal-uk-a	'be overturned (of a truck)'
yek-uk-a	'be separated'
tob-uk-a	'be pierced'

d. REVERSIVE TRANSITIVE -*ul*-

zib-ul-a	'open'
hul-ul-a	'save'
bal-ul-a	'overturn'
yek-ul-a	'separate'
tob-ul-a	'pierce'

Thus, both the applicative suffix -*il*- in (5a) and the causative suffix -*is*- in (5b) fail to harmonise after /e/ and /o/. Similarly, the reversive suffixes -*uk*- and -*ul*- do not harmonise in (5c) and (5d). The question is why not?

The simplest and perhaps most obvious step to take in response to these facts would be to stipulate that height harmony is simply morphologised, targeting only the perfective suffix. First, as a Bantuist, I note as a diachronic aside that this solution is the exact opposite of what is expected from Proto-Bantu. The perfective suffix *-ɪd-e is reconstructed with a high tense vowel *ɪ, while the vowels of the suffixes in (5) are reconstructed with the lower lax vowel *i. It is this latter 'degree 2' vowel that harmonised historically (Meeussen 1967). Thus, in many Bantu languages, such as Haya EJ.22, the applicative harmonises (e.g. *a-kom-él-a* 'he ties for/at'), while the perfective does not harmonise (e.g. *a-kom-íl-e* 'he tied (YESTERDAY PAST)').[6]

Besides being diachronically anomalous, notice in (6) that VHH would in certain cases have to target the perfective suffix 'at a distance':

(6)
a.	hit-ik-a	hit-ik-idi	'send'
	fut-ik-a	fut-ik-idi	'fold'
	kab-ik-a	kab-ik-idi	'spread out'
b.	zib-uk-a	zib-uk-idi	'be open'
	hul-uk-a	hul-uk-idi	'be saved'
	bal-uk-a	bal-uk-idi	'be overturned'
c.	yed-ik-a	yel-ek-ele	'taste'
	kos-ik-a	kos-ek-ele	'add'
d.	yek-uk-a	yek-ok-ele	'be separated'
	tob-uk-a	tob-ok-ele	'be pierced'
e.	bet-idik-a	bet-elek-ele	'lower'
f.	kel-umuk-a	kel-omok-ene	'turn round'

[6] A rather complex but logical diachronic explanation (which I reject) begins by first

These data show that vowels that occur between the root and the perfective suffix potentially harmonise. There is no harmony in (6a, b), where the first vowel is /i/, /u/ or /a/. The examples in (6c, d), on the other hand, show that (frozen) derivational suffixes such as *-ik-* and *-uk-do* lower when wedged between a mid root vowel and the perfective suffix. Finally, the forms in (6e, f) demonstrate that *more* than one intervening vowel may undergo height harmony (see also §3, Appendix).

In response, we might modify our first hypothesis such that VHH still applies from left to right but only when it can reach the final vowel, i.e. only when the M feature can be aligned with the right edge of the stem. This modification, however, has problems of its own. First, as seen in (7), there is no height harmony on the final vowel *-i* used in the conditional:[7]

(7) a. tu-kik-í   'if we strike out'
     tu-kud-í   'if we chase someone away'
     tu-kas-í   'if we bind'
   b. tu-keb-í   'if we pay attention'
     tu-sol-í   'if we deforest'
   c. tu-kik-id-í   'if we strike out for'
     tu-kud-id-í   'if we chase someone away for'
     tu-kas-id-í   'if we bind for'
   d. tu-keb-id-í   'if we pay attention for'
     tu-sol-id-í   'if we deforest for'

(7a) shows verb roots with /i/, /u/ and /a/ immediately followed by the conditional suffix *-i*. We see in (7b) that final *-i* does not harmonise after

---

generalising left-to-right VHH to perfective *id-e. Speakers subsequently would then have had to identify VHH with the perfective and suppress it on all other suffixes – a rather roundabout way to get morphologisation *vs.* the proposal I will make below. Finally, another anomalous fact worth noting about the perfective data is that the final vowel of the verb stem is exempt from height harmony in most Bantu languages, however, with notable exceptions (Leitch 1996, Hyman in press).

[7] Within Bantu, the verb stem must end with one of a small number of inflectional endings. In Yaka these include perfective *-idi/-ele*, conditional *-i* and the 'default' FV *-a*. Kidima (1991) reports that the final vowel of the conditional is *-e* on monosyllabic verbs, citing, *tu-dy-é* 'if we eat'. Van den Eynde (1968: 87, 89) gives the corresponding conditional stems of the root *-w-a* 'hear' and *-t-a* 'say' as varying between *w-e* ~ *w-i* and *t-e* ~ *t-i*. (The variant *w-i* in fact violates a constraint against the sequence [wi] which we discuss in §3.) Given this variation we would ideally like to study the realisation of the conditional FV across different dialects and speakers. Finally note that although we shall point out later that stems do not otherwise end in a single vowel [e], the final *-e* on *dy-e*, *w-e* and *t-e* can be preserved by the fact that it appears in the *first* stem syllable (cf. below). More problematic, perhaps, would be explaining why the mid feature of *-e, which occurs frequently in the subjunctive in other Bantu languages, does not spread leftwards, as we argue below for the *-e of the perfective ending *id-e. Concerning the proto situation, Meinhof & van Warmelo (1932: 168) state re Kongo: 'the *-i* of the optative form is derived from original *-e*, and though probably first assimilated only after *i* and *u*, *-i* has now become general, and has only been retained as *-e* in a few forms and dialects. It produces no change in the stem, e.g. *-kangi* from *-kanga* 'bind', *-vedisi* from *-vedisa*; cf. *-fwasabale* from *-fwasabala* 'rustle'.'

root /e/ and /o/. In (7c, d) I have added the applicative suffix -*il*-, pronounced [-id-] before [i], which also fails to harmonise after /e/ and /o/ in (7d).

In addition to these facts involving conditional -*i*, there is no VHH on derived nouns ending in the final vowel -*i* in (8):

(8) a. n-sónîk-í   'writer'   < son-ik-a   'write'
       ma-lókís-í   'noise, row'   < lok-a   'bewitch'
    b. n-téém-ún-í 'civiliser'   < teem-un-a 'civilise'
       n-yék-úd-í   'traitor'   < yek-ul-a   'betray'
       n-lóng-úk-í 'pupil, apprentice' < long-uk-a 'study, learn'

These nouns in fact contrast with others such as those in (9), which end in front mid vowels (13 out of 16 examples end in -*ele*/-*ene*):

(9) a. phélékélé   'shade'   b. khélénge   'suffering'
       kéngele   'block of salt'   khékhékhe 'meanness'
       yi-séngele 'axe'   yi-kwéléte 'powder box'

On the basis of these facts, I would like now to argue for a quite different analysis. I propose, first, that the underlying representation of the perfective suffix is /-ile/ (as in the reconstruction *-ɟd-e) and, second, that VHH applies *from right to left*. In other words, as seen in (10a), I propose that VHH in Yaka is a bridging or *plateauing* process: H vowels become M when surrounded by Ms.[8]

(10) a.
$$\begin{array}{c} \text{H} \\ \nparallel \\ [\ \text{C V C (V C)}_n \text{V}\ ] \\ |\quad\quad\quad | \\ \text{M}\qquad\quad \text{M} \end{array}$$

b.
$$\begin{array}{c} [\ \text{C V C (V C)}_n \text{V}\ ] \\ \diagdown\!\diagup \\ \text{M} \end{array}$$

(11) a. $\begin{array}{c} [\ \dots \text{V}\ ] \\ \nparallel \\ \text{e} \end{array}$ b. $\begin{array}{c} [\ \dots \text{V}\ ] \\ \diagup\!\!\diagdown\!\!\nparallel \\ \text{e} \end{array}$

Where plateauing is not possible, the M feature of /-ile/ is deleted. In the

---

[8] One might propose that we simplify the representation of (10a) to that in (10b), in which case plateauing would result in the *fusion* of two M features into one multiply linked one. As we see throughout this study, however, the first stem syllable does not participate in the generalisations that characterise the remainder of the stem. In §4, where the 'prosodic trough' is introduced, I will explicitly exclude the first syllable from the harmony domain.

formulation in (11a) I exploit Hayes' (1986) linking convention. This formulation thus stands for the more awkwardly stated rule in (11b). When the mid feature of the /e/ is delinked, the perfective suffix surfaces with /i/, possibly by default. Thus, in order for a final /e/ to survive, its mid feature *must* spread to the left. Right-to-left spreading of M, in turn, occurs (thus far) only when the preceding root vowel is Mid.

By positing a final M feature on /-ile/ we are able to avoid having to make diacritic reference to this morpheme in the statement of VHH. The evidence for this final /e/ and for right-to-left VHH is substantial, the full force of which will not be appreciated until §3, where the final /e/ is involved in a second VHH process. In this section the evidence is distributional – and largely circumstantial.

V1/V2	i	e	u	o	a
i	41	—	51	—	66
e	32	(2)	14	56	112
u	61	—	123	—	140
o	55	(1)	5	102	93
a	121	—	126	(1)	204

[Table I. Vowel distributions in native CVCV noun stems]

To this end, consider the status of final /e/ (and /o/) in Yaka in general. In verbs it is found only in the perfective and on monosyllabic verbs in the conditional (cf. note 7). In nouns there also are restrictions. Table I summarises the distribution of vowels in (native) bisyllabic noun stems, based on Ruttenberg (1971). Here we see, first, that /o/ can appear only after /e/ or /o/. However, this cannot be the result of progressive vowel harmony, since /u/ also appears after /e/ and /o/.[9] The generalisation thus goes from right to left: final /o/ is possible only if preceded by a mid vowel. This is as expected from the plateauing analysis of VHH in verbs: a mid stem-vowel can occur only if preceded by a mid vowel.

Turning to final /e/, this vowel cannot appear as the second vowel of a bisyllabic noun stem at all. The generalisation is that a monomoraic /e/ may not occur outside the first syllable of a noun stem. Let us consider the effect of extending this generalisation to verb stems. In this case, assuming /-ile/ as the underlying form of the perfective suffix, the mid feature of /e/ would be lost if it is monomoraic (i.e. if it fails to spread right to left).

---

[9] Numbers that I indicate in parentheses refer to combinations that are rare enough to be considered exceptions. These refer to the following forms: (i) CeCe: *n-léle* 'material', *n-yénde* 'type of basket'; (ii) *-bóte* in both *m-bóte* 'goodness, honesty' and *di-mbóte* 'benefit'; (iii) *w-áándzyo* 'angel', a borrowing. Another CeCe form, *mbele* 'whoever', might be mentioned, but may be a grammatical morpheme. Finally, it is not clear whether the five CoCu noun stems are 'in' the system *vs.* exceptional. They are: *b-óoku* 'mushroom', *khóku* 'cockcrow', *thótu* 'sort of rabbit', *yi-zóombu* 'shoulder bag' and *wóólu* 'gold' (a borrowing).

What I am suggesting is that Yaka does not like monomoraic final /e/'s. As we saw in (9), it does allow final /e/ on longer noun stems. In this case, the /e/ can be interpreted as linked also to the penultimate vowel, and hence is not monomoraic.

Further evidence that a final /e/ must be multiply linked is seen from the French borrowings in (12).

(12) a. bélée   Fr. béret   'beret'
          búlée   bleu   'blue'
          kálée   calé   'stuck'
          káyée   cahier   'exercise book'
          kuphée   culotte   'shorts'
          lábée   abbé   'abbot'
          phínée   pneu   'tyre'
          yi-zámée   examen   'exam'
      b. m-félélé   frère   'brother'
          kómélése   commerce   'commerce'
          phéengele   épingle   'pin'
          -ofélée   offert   'offered'

Of the 20 French borrowings ending in Yaka [e] in Ruttenberg (1971), only one (*búse*, Fr. *bougie* 'candle') occurs without the preceding vowel also being [e]. In other words, even in borrowings, the /e/ is always branching. Since borrowings that end in other vowels do not have this restriction (e.g. *pháki*, Fr. *Pâques* 'Easter'; *káafi*, Fr. *café* 'coffee', etc.), I take this fact to be significant.[10]

The plateauing analysis also nicely handles the two anomalous pairs of noun forms in the language seen in (13a), where the M of /o/ is also delinked when not preceded by V_1 M vowel.

(13) a. dí-ísú 'eye'   /li-iso/   PL m-éésó /ma-iso/   < PB *-jɉco
          dí-ínú 'tooth' /li-ino/   PL m-éénó /ma-ino/   < PB *-jɉno
      b. /ba-ifi/ 'thieves' → bééfi (*var*. bíífi, *not* bééfe)

The vowel height of both syllables of these nouns differs between their class 5 singular, where the vowels are [+high], and their class 6 plural, where both vowels are [−high]. Superficially, it again appears that there is a left-to-right height harmony. Under the left-to-right analysis the roots would be underlyingly /-isu/ and /-inu/. When the class 6 prefix *ma-* fuses with the root-initial vowel /i/ to produce [e], the M feature would then spread to the right. However, this would predict that the same should happen in the noun /ba-ifi/ 'thieves' in (13b), where the class 2 prefix

---

[10] The nouns in (12a) end in a long vowel [ée] with falling tone, which apparently does not otherwise exist in the language, but which presumably imitates a perceived final accent in French. Except for the last form in (12b), final epenthetic [e] does not develop into [ée]. Also, I assume that *kuphée* in (12a) derives from French *coupé* 'cut'.

/ba-/ also fuses with the initial /i/ of the root. Since this does not happen, the left-to-right analysis must be wrong. As shown, I propose instead that these roots are /-iso/ and /-ino/ underlyingly, and the M feature of the final /o/ is preserved only when preceded by a M vowel (just as in the case of perfective /-ile/). This /o/ will of course be preceded by a M vowel only when the /a/ of the noun-class prefix fuses with the root-initial /i/, a process to which we return in §4. This shows that the *ma-* prefix becomes part of the stem. On the other hand, when the prefix is the class 5 singular /li-/, the M feature of /-iso/ and /-ino/ is delinked by the rule in (11).[11] These underlying forms directly reflect Meeussen's (1967) Proto-Bantu reconstructions in (13a), as well as reflexes in other languages, e.g. Yao P.21 *dí-ísó/m-éésó* 'eye(s)' and *dí-ínó/m-éénó* 'tooth/teeth'. We thus see that there never was a left-to-right height harmony in the history of these forms in Yaka – nor, I would claim, in the synchronic analysis either.

To translate into optimality-theoretic (OT) terms (Prince & Smolensky 1993), particularly as developed by McCarthy & Prince (1995), right-to-left vowel height harmony results from the interaction of the following (streamlined) subset of constraints:

(14) a. IDENT V_1 (i.e. preservation of the mora and features of the first stem vowel)
      b. PLATEAU: *HM, *LM (i.e. a vowel preceding a M vowel must be M)
      c. IDENT FV (i.e. preservation of the features of the final vowel)

The constraint IDENT V_1 is designed to preserve the mora and features of the first stem syllable, which is known to be prominent in Bantu languages.[12] The constraint PLATEAU says that a M vowel must be preceded by another M vowel. Finally, IDENT FV refers to the preservation of the features of the final vowel (FV). The tableaux in (15) and (16) show

---

[11] Meinhof & van Warmelo (1932: 168) make similar observations about the corresponding forms in certain dialects that show the same alternations in the Kongo H.10 group. The same observations are found in Laman (1936).

[12] The IDENT V_1 and IDENT FV constraints are generalised from Beckman (1995, 1997), who ranks the preservation of input height features on the initial stem syllable in Shona higher than the preservation of the same features on subsequent (stem-internal) syllables. The greater prominence or 'strength' of both the consonants and vowels of stem-initial syllables is quite widespread in Benue-Congo languages (Hyman 1990). For example, the first syllable is the only position in the Proto-Bantu verb stem where all seven vowels clearly contrasted. Thus, Meeussen (1967: 92) states: 'the absence of morphophonemes |e| and |o| in suffixes is worth noticing; this gives free space to the rule stated in 1.7'. The rule to which Meeussen refers is the Eastern Bantu vowel harmony system illustrated earlier in (1): '|i| appears as /e/ after either |e| or |o|... Similarly, |u| appears as /o/ after |o| (but not after |e|)' (167: 84). In Yaka, which has merged *i/*i and *ʉ/*u to yield the five-vowel system /i e u o a/, only /i u a/ contrast stem-internally, i.e. within what I shall refer to as the 'prosodic trough' (cf. §4). For other OT work on positions of relative prominence, see Steriade (1994, 1995), Zoll (1996), Beckman (1997), Casali (1997), and the references cited therein.

how these three constraints derive the correct outputs of /kik-ile/ and /keb-ile/, respectively:[13]

(15)

/kik-ile/	IDENT V$_1$	PLATEAU	IDENT FV
a. kik-ile		*!	
b. kik-ele		*!	
c. kek-ele	*!		
☞ d. kik-idi			*

In (15) the input vowel of the root /kik-/ is high, therefore the perfective suffix must be realised *-idi*. The form *kik-ile* is ruled out in (15a) by PLATEAU, since the final /e/ is not preceded by a mid vowel.[14] Although right-to-left spreading of M has applied to the preceding vowel in (15b), PLATEAU is still violated.[15] To avoid violating PLATEAU in (15c), M might spread into the first syllable. However, as shown, this would cause a violation of higher-ranked IDENT V$_1$. Finally, the right output is obtained in (15d), where only the lower-ranked IDENT FV is violated.

Now compare the tableau in (16), where the root vowel is mid.

(16)

/keb-ile/	IDENT V$_1$	PLATEAU	IDENT FV
a. keb-ile		*!	
☞ b. keb-ele			
c. keb-idi			*!
d. kib-idi	*!		*

In (16a) we again obtain a PLATEAU violation when the M feature remains on the FV. This is fixed up in (16b) by right-to-left M spreading. Had we instead delinked the M feature of the FV, as in (16c), a violation of IDENT FV would have occurred. Finally, we obviously would have the worst

---

[13] While the three constraints in (14) are sufficient for the present purposes, as these tableaux show, clearly other constraints will be needed, some of which are introduced in §3 and §4. One of these will be the general IDENT V, which makes no reference to position and which is ranked below IDENT FV.

[14] Given the failure of final /e/ to appear even after /e/ and /o/ in bisyllabic noun stems in (10), I also propose a constraint *MONO [e], which rules out singly linked /e/. Of course this will not affect a monomoraic /e/ in the first syllable of the stem, which must be preserved because of the higher-ranked constraint IDENT V$_1$. For other discussion of the MONO as well as PLATEAU families of constraints, see Cassimjee & Kisseberth (1998).

[15] As far as I can tell, there does not appear to be any reason for PLATEAU to be gradient. If M-spreading doesn't apply, *MONO [e] will also come into play, but spreading once *vs.* twice when both are inappropriate seems not to matter. Note that we could slightly revise our interpretation of PLATEAU to say that any M vowel that is not preceded by a M vowel is a PLATEAU violation. In this case a M V$_1$ would violate PLATEAU, but would be saved, since the higher-ranking IDENT σ_1 requires the M feature to surface. In §4, however, I argue that the first syllable essentially falls outside the purview of these constraints, which explains in part why assimilation is right-to-left rather than left-to-right.

possible outcome if, as in (16d), the M feature of the stem vowel were not retained.

The above concludes the treatment of vowel height harmony in Yaka, as motivated by PLATEAU. In the next section we turn to a second, unrelated case where right-to-left vowel-height spreading is required.

3 *[wi] and vowel height harmony

In the preceding section we observed via the process of plateauing that it is not *sufficient* to have a preceding Mid vowel for a stem-internal High vowel to become Mid. In this section we turn to a second source of height harmony, which shows that having a preceding Mid vowel is not even *necessary*.

Recall the data in (6b, d), repeated here as (17a, b).

(17) a. zib-uk-a   zib-uk-idi   'be open'
      hul-uk-a   hul-uk-idi   'be saved'
      bal-uk-a   bal-uk-idi   'be overturned'
    b. yek-uk-a   yek-ok-ele   'be separated'
      tob-uk-a   tob-ok-ele   'be pierced'
    c. zib-ul-a   zibwel-e   'open'
      hul-ul-a   hulwel-e   'save'
      bal-ul-a   balwel-e   'overturn'
    d. yek-ul-a   yekwel-e   'separate'
      tob-ul-a   tobwel-e   'pierce'

These forms show the reversive intransitive suffix *-uk-* followed by the perfective suffix. Plateauing harmony applies in (17b), as expected, but not in (17a), where the root vowel is /i/, /u/ or /a/. Compare now the data in (17c, d), where the verb bases end in the reversive transitive suffix *-ul-*. Here the perfective, which has been analysed underlyingly as /-ile/, has *fused* with the stem. This process is generally known as 'imbrication' in the Bantu literature.[16] In Yaka, imbrication of the perfective suffix occurs if two conditions are met: (i) the base has to have at least two syllables, i.e. be of the shape CV(V)CVC- or longer; (ii) the base has to end in a coronal consonant such as /l/ (*vs.* non-coronal consonants such as/k/). (For exceptions, see the Appendix.) Had there been no imbrication, we would have expected the forms in (18a), parallel to those in (17a, b):

(18) *Expected realisations of* -ul- + -ile *suffixes in* (17c, d)
    a. If not imbricated:
       *zib-ud-idi, *hul-ud-idi, *bal-ud-idi, *yek-ol-ele, *tob-ol-ele
    b. If imbricated:
       *zibwid-i, *hulwid-i, *balwid-i, yekwel-e, tobwel-e

---

[16] For general statements on imbrication, which is frequently triggered by the perfective ending *-jd-e, see Bastin (1983), Hyman (1995b) and references cited therein.

In many other Bantu languages (e.g. neighbouring Kongo), imbrication transparently consists of the infixation the [i] of perfective /-ile/ before the final consonant of the base, followed by the application of vowel coalescence rules. This would lead one to expect the penultimate vowel [i] in the first three examples of (18b). While the [e] of the penultimate syllable in (17d) can be attributed to plateauing, the [e] in (17c) cannot be. Why has the /e/ of the FV apparently spread to the left in these forms? In order to better explain the appearance of this penultimate [e], let us also consider the applicative in this context.

The forms in (19a, b) document the uneventful appearance of the applicative suffix *-il-* after the reversive intransitive suffix *-uk-*:[17]

(19) *Imbrication of applicative* -il-

a.	zib-uk-a	zib-uk-il-a	'be open'
	hul-uk-a	hul-uk-il-a	'be saved'
	bal-uk-a	bal-uk-il-a	'be overturned'
b.	yek-uk-a	yek-uk-il-a	'be separated'
	tob-uk-a	tob-uk-il-a	'be pierced'
c.	zib-ul-a	zibwal-a	'open'
	hul-ul-a	hulwal-a	'save'
	bal-ul-a	balwal-a	'overturn'
d.	yek-ul-a	yekwal-a	'separate'
	tob-ul-a	tobwal-a	'pierce'

In (19c, d), on the other hand, where applicative *-il-* has been added after reversive transitive *-ul-*, imbrication applies with the FV spreading into the penultimate syllable. In Yaka, imbrication, and its corollary of unexpected right-to-left spreading of the FV, is thus not limited to the perfective suffix. The only difference in this case is that the FV is /-a/ (*vs.* the FV /-e/ used in the perfective).[18] The expected forms are indicated in (20).

(20) *Expected realisations of* -ul- + -il- *suffixes in* (19c, d)
  a. If not imbricated:
     *zib-ud-il-a, *hul-ud-il-a, *bal-ud-il-a,
     *yek-ud-il-a, *tob-ud-id-a
  b. If imbricated:
     *zibwil-a, *hulwil-a, *balwil-a,
     *yekwil-a, *tobwil-a

If there had not been imbrication, the applicative forms would have surfaced as in (20a), parallel to the forms in (19a, b) which end in /k/.

---

[17] Some of the examples in (19) are extrapolated on the basis of Ruttenberg (1971) in order to keep the verb roots constant. Note that the glosses should include a further precision 'for/at' to express one or another function of the applicative suffix.

[18] Compared to the perfective, imbrication of applicative *-il-* (as well as causative *-is-*) is more restricted: the base must again be polysyllabic, but it must specifically end in the sequence [ul] (or its nasalised counterpart [un]).

Since we know that imbrication does take place, the expected forms in (20b) should have had the penultimate vowel [i], as in Kongo and other Bantu languages, not [a].

This same penultimate [a] is also observed in (21) when the causative suffix -*is*-, seen earlier in (5b), imbricates:[19]

(21) *Imbrication of causative* -is-

    a. zib-ul-a   zibwas-a   'open'
       hul-ul-a   hulwas-a   'save'
       bal-ul-a   balwas-a   'overturn'
    b. yek-ul-a   yekwas-a   'separate'
       tob-ul-a   tobwas-a   'pierce'

The expected realisations are shown in (22).

(22) *Expected realisations of* -ul- + -is- *suffixes in* (21a, b)

    a. If not imbricated:
       *zib-ud-is-a, *hul-ud-is-a, *bal-ud-is-a,
        *yek-ud-is-a, *tob-ud-is-a
    b. If imbricated:
       *zibwis-a, *hulwis-a, *balwis-a,
        *yekwis-a, *tobwis-a

Again, (22a) shows how the causative would have been realised if there had not been imbrication, while the expected imbricated forms in (22b) show the vowel [i] in their penultimate syllable. Finally, note the right-to-left spreading of the final vowel /a/ in the triplets in (23a, b), from Ruttenberg (1971):

(23) a. kabula   'return'   b. koombula   'sleep'
       kabwala 'return for'   koombwala 'sleep for'
       kabwasa 'make to return'   koombwasa 'make to sleep'

The question that we need to address is why the /e/ or /a/ of the FV spreads to the penultimate syllable in cases of imbrication. As stated in (24), this spreading of -*e* and -*a* is motivated by a phonotactic constraint barring the sequence [wi].[20] When the sequence [wi] arises through imbrication, it is repaired by spreading the feature Mid or Low of the final vowel to yield the changes in (24a, b).

(24) a. ...Cwile → ...Cwele (17c, d)
     b. ...Cwila → ...Cwala (19c, d; 21a, b)

The spreading of the FV can in fact take place at a distance. Thus consider the forms in (25):

---

[19] As in (19), some of the forms are extrapolated in order to keep the roots constant.
[20] This is known in French as the '*Non* (*oui*)' constraint.

(25) a. *verb*   b. APPL   c. APPL + PERF

butul-a	butwal-a	butwelel-e	'begin (by)'
kabul-a	kabwal-a	kabwelel-e	'return for)'
kakul-a	kakwal-a	kakwelel-e	'haggle (for)'
katul-a	katwal-a	katwelel-e	'remove (for)'
leengul-a	leengwal-a	lengwelel-e	'polish (for)'
taambul-a	taambwal-a	taambwelel-e	'accept (for)'
timbul-a	timbwal-a	timbwelel-e	'throw (to)'
yubul-a	yubwal-a	yubwelel-e	'remind (for)'

The input verb bases in (25a) all have the shape CVCul-, which permits imbrication of the applicative in (25b). When these applicativised verbs are in turn perfectivised, we obtain the forms in (25c), where the Cwi → Cwe repair is found in the antepenultimate syllable.[21] In other words, the underlined vowel in the output of the derivational account in (26) has become Mid at a distance from the final vowel -*e* of the perfective:

(26)   butul-il-   ROOT + APPL
    → butwil-   imbrication
    → butwil-ile   BASE + PERF
    → butwel-ele   VHH at a distance (*to repair* *[wi])

The examples in (27) show a similar lexicalised at-a-distance spreading of the final vowel -*a*:[22]

(27)   *underlying*   *surface*   *related verbs*

a. /kabul-is-il-a/   kabwasal-a   kabul-a   'return'
    'answer, strike again'   kabwal-a 'return for'
                kabwas-a 'make return'
b. /mokul-ilil-a/   mokwanan-a   mok-a   'chatter'
    'beg, ask for pardon'
c. /yakul-is-an-a/   yakwasan-a   yakul-a   'accost,
    'call to each other'   question'
d. /yekul-is-an-a/   yekwasan-a   yekul-a   'separate, split'
    'separate, divorce'   yekwas-a 'separate, divide'
e. /ziimbul-is-an-a/ ziimbwasan-a ziimbul-a 'explain, show'
    'tell each other'

These all involve the imbrication either of the causative morph -*is*- or the first -*il*- of the -*ilil*- suffix. A derivational account of (27a) is shown in (28).

---

[21] Note in (25c) and the derivation in (26) that perfective imbrication does not apply. This is because an output such as *butwel-e would be a MAX violation (applicative -*il*- is not realised in the output), and would, in fact, be identical to the realisation obtained from the input /butul + ile/, which lacks the applicative. See below.

[22] The suffix divisions in (27) are included for clarity only. It is likely that -*is-an*-, for instance, should be analysed as a single reciprocal suffix, not as two suffixes (cf. §4).

(28) kabul-is-il- ROOT + CAUS + APPL
  → kabwisil-   imbrication
  → kabwisil-a BASE + PERF
  → kabwasal-a VHH at a distance (*to repair* *[wi])

In both (26) and (28) the penultimate vowel *-i-* is also modified (to [e] and [a], respectively), as a result of its appearing between the targeted [wi] sequence and the FV.

It would be hard to account for such data without invoking this prohibition against [wi], which is quite strongly felt in Yaka.[23] Besides the verb form [wi] mentioned in note 7, there is exactly one exceptional case of [wi] in the entire 3900+ entry Ruttenberg dictionary, *lu-kwiíkílú* 'faith'. This form is most likely a borrowing from the Kongo form *lu-kwikilu* 'credulity' (de Gheel 1652), derived from the verb *kwikila* 'believe'. Interestingly, the corresponding Yaka verb *kuukila* avoids [wi] by a second strategy, loss of [i] with compensatory lengthening, implemented only in stem-initial position. In this context, compare the noun forms in (29).

(29) a. /baífi/   → bééfi, bíífi 'thieves'
  b. /muífi/   → múúfi   'thief' (cf. Kongo [mwíífi])
  c. /ú-is-ilí/ → wúús-idi 'he has arrived'
    /tu-is-ilí/ → thuus-idí 'we have arrived'

I have already cited the two plural forms of /baífi/ 'thieves' in (13b), repeated here in (29a). The corresponding singular, however, has the prefix /mu-/ followed by a root-initial /i/. In order to avoid the expected output [mwíífi], as it is pronounced in certain Kongo dialects, a long [uu] is obtained in Yaka in (29b), rather than, say, a change in the height of the vowel to obtain *mwééfi*. The verb forms in (29c) show the realisation of the vowel-initial verb root *-is-* 'come' in the '*passé actuel absolutif*' (van den Eynde 1968: 83). When the preceding prefix has the vowel /u/, as in (29c), a long [uu] is obtained. The same loss of /i/ with lengthening of the stem V₁ is seen in the suffixed forms of the CV verb roots in Table II, which lists all of the CV verbs and suffixed forms that appear in Ruttenberg (1971).

As seen, in suffixed forms such as the applicative column of (d), we obtain *buul-a*, *fuul-a*, etc., instead of *bwiil-a* and *fwiil-a*, as these forms are pronounced in certain Kongo dialects. What this represents is another instance of the preservation of the V₁ vowel /u/ of *-bu-*, *-fu-*, etc.

Finally, consider the forms in (30), where imbrication is responsible for the truncation of the *-il-* part of the perfective suffix *-ile*.[24]

---

23 A similar constraint exists in Nupe (Hyman 1970), which forbids [w] followed by either [i] or [e]. (Symmetrically, [y] may not appear before [u] or [o].) I thus assume that *[wi] is part of a family of constraints which may be invoked in individual languages to rule out *w* + front vowels and *y* + rounded vowels. As Yaka shows, the constraint may target only high vowels, where the sequencing of round and front is most strongly felt.

24 In §4 we shall see that the perfective imbricates also when the pre-coronal vowel is /a/. By contrast, applicative *-il-* imbricates only if the preceding sequence is

	root	root + -a	PERFECTIVE -ile	APPLICATIVE -il-a	CAUSATIVE -is-a	
a.	di-	dy-a	di-idi	di-il-a	di-is-a	'eat'
	hi-	hy-a	hi-idi	hi-il-a	hi-is-a	'burn (INTR)'
	si-	sy-a	si-idi	si-il-a	si-is-a	'place'
b.	ti- (~te-?)	ty-a	ti-idi	ti-il-a/ tye-el-a		'love'
c.	khe-	khy-a	khye-ele	khye-el-a		'dawn'
d.	bu-	bw-a	bu-udi	bu-ul-a	bu-us-a	'fall'
	fu-	fw-a	fu-udi	fu-ul-a		'die'
	hu-	hw-a	hu-udi	hu-ul-a		'finish'
	nu-	nw-a	nu-uni	nu-un-a	nu-us-a	'drink'
	tsu-	tsw-a	tsu-udi	tsu-ul-a		'lack'
	tu-	tw-a	tu-udi	tu-ul-a		'be sharp'
	vu-	vw-a	vu-udi	vu-ul-a		'possess'
	wu-	w-a	wu-udi	wu-ul-a		'hear'
e.	ta-	t-a	te-ele	te-el-a	te-es-a	'hit'

[Table II. CV- verb roots + suffixes]

(30) a.   yimbil-a → yimbid-i   'sing'
          kuukil-a → kuukid-i   'believe'
          yambil-a → yambid-i   'awake'
     b.   keembil-a → keembel-e 'turn round'
          boondil-a → boondel-e 'disintegrate'

Without imbrication, the perfective of *yimbil-a* in (30a) would have been **yimbid-idi*, while that of *keembil-a* in (30b) would have been **keembel-ele*, etc. Plateauing vowel height harmony applies in (30b), but there is no height harmony in (30a). We can explain why Mid does not spread with imbrication in (30a) by noting that there is no *[wi] problem and hence no *need* for the final vowel *-e* to spread leftwards. In fact, an output such as **yimbel-e* would have been ruled out as a PLATEAU violation, exactly as in the tableau in (15b).

The question we must now address is how imbrication should be analysed. There are at least three logical possibilities. The first is to posit underlying /-ile/ and /-il-/ suffixes on all perfective and applicative forms, respectively, whether they imbricate or not. Imbrication would then be handled by somehow converting /butul-ile/ 'begin + PERF' to [butwele]. A second possibility is to treat imbrication as the infixing of *-il-* (or perhaps just *-i-*) before a final coronal consonant (cf. Hyman 1995b, where base-final consonants are prosodically circumscribed to allow infixation). Finally, we can adopt Goldsmith's (1985) analysis and treat

_____

specifically /ul/, exactly as in distant Bemba M.42 (Hyman 1995b). I assume that these differences simply have to be stipulated.

imbrication as the spreading of the *-e* or *-a* features of the FV, i.e. without having to recognise an *-il-* sequence in such forms (cf. Appendix).

In the present analysis I shall assume what I consider to be the traditional account of imbrication, as documented in Bastin (1983), Hyman (1995b) and elsewhere. The non-imbricated perfective and applicative allomorphs are underlyingly /-ile/ and /-il-/, respectively, where both the /i/ and the /l/ could be default. The imbricated representations are *-i-e* and *-i-*, respectively, where *-i-* is an infix consisting of a mora and a Front (F) feature.[25] Considering the perfective first, the imbricated allomorph will be assigned if two conditions are met: (i) the base has to have at least two syllables, i.e. be of the shape CV(V)CVC- or longer; (ii) the final consonant has to be coronal. We have seen that the vowel preceding the consonant can be either /u/ or /i/, as in (30). (This will be extended to /a/ in §4.) For such forms that imbricate, the perfective allomorph consists of the FV /-e/, the infix /-i-/ *and* a relatively high constraint MAX, which requires that each input segment have an overt expression on the surface (i.e. short of violating a higher-ranked constraint).[26] The desired effect is that the M or L of the final vowels *-e* and *-a* spread right to left in order to avoid [wi], sometimes at a distance.

With these assumptions, the following tableau shows how perfective imbrication can be appropriately realised:

(31)

/butu-i-l-e/	IDENT V$_1$	*[wi]	MAX	PLATEAU	IDENT FV
a. butwil-e		*!		*	
b. butud-i			*!		*
☞ c. butwel-e				*	
d. bwet(w)el-e	*!				

We begin with /butu-i-l-e/, the perfective of /butul-/ 'begin'. Candidate (31a) is ruled out by virtue of its violating *[wi], while candidate (31d) violates even higher-ranked IDENT V$_1$. Candidate (31b) is rejected on the basis that the infix *-i-* has no surface correspondent.[27]

Now let us consider applicative imbrication, which is more restricted than in the perfective: (i) the base has to have at least two syllables, i.e. be of the shape CV(V)CVC- or longer; (ii) the final consonant has to be /l/ (or its nasalised derivative [n]); (iii) the vowel that precedes the final /l/ must be /u/.[28] Starting with /butu-i-l-a/ 'begin by', the imbricated ap-

---

[25] The infixed variants can in fact be considered to be 'enriched inputs' in the sense of Sprouse (1997).

[26] I assume that the inputs to the forms in (30a) will be *yimbi-i-l-e*, *kuuki-i-l-e* and *yambi-i-l-e*, even though *-i-* does not surface. Although MAX is thus violated, an output such as **yimbiid-i* would violate an even higher-ranked constraint that forbids long vowels except in stem-initial syllables (see §4).

[27] This of course would have to be made more precise, since one could assume that the underlying mora of *-i-* is the one preserved on the vowel [u] in (31b).

[28] The same conditions hold of causative imbrication, except that the /s/ of *-is-* overwrites the final /l/ (recall the examples in (21) above).

plicative form of /butul-/, the tableau in (32) shows that the same ranked constraints straightforwardly produce the correct output [butwal-a].

(32)

/butu-i-l-a/	IDENT V_1	*[wi]	MAX	PLATEAU	IDENT FV
a. butwil-a		*!			
b. butul-a			*!		
c. butil-a			*!		
☞ d. butwal-a					
e. bwat(w)al-a	*!				

Candidate (32a) is ruled out by the *[wi] constraint, while the candidates in (32b) and (32c) are blocked because of their violation of MAX. As seen, the correct output, *butwal-a* in (32d), does not violate any of the five constraints considered. Finally, (32e) is the worst candidate, since the L of -*a* has spread also onto the stem-initial syllable, thereby violating IDENT V_1.

In these tableaux we have observed the desired spreading of the FV -*e* or -*a* triggered by imbrication, as summarised again in (33a, b) for /butul-/.

(33)   *root*   *imbrication*   *output*

     a.   perfective with   butul- → butwil-e   → butwel-e
          FV -*e*

     b.   applicative with   butul- → butwil-a   → butwal-a
          FV -*a*

     c.   applicative with   butul- → butwid-i   → butwad-i (!)
          FV -*i*

Given that [wi] is avoided by spreading the M or L of the FV in (33a, b), what should be expected to happen when applicative (or causative) imbrication cooccurs with the conditional FV -*i*? It is clear that the sequence [wi] in *butwid-i* in the intermediate form in (33c) cannot be fixed by spreading the [i] of the FV to the left. Neither van den Eynde (1968) nor Ruttenberg (1971) indicates what the output would be in such a case. Thanks to Lukowa Kidima (personal communication), we are able to establish that it would be as indicated: *butwad-i*. The natural question is: where does the [a] come from? In a derivational account where imbrication is characterised as infixation of -*i*-, this form would be derived as indicated in (33c): *butul-* → *butwil-* → *butwid-i* → *butwad-i*, where the [a] would have to be epenthesised into the form in order to prevent [wi].[29]

---

[29] Another possibility in a derivational approach would be to recognise an intermediate representation *butwal-a*. One could then replace the FV -*a* with -*i* (or perhaps even recognise a sequence of FV's -*a-i* which are spelled out cyclically). In the absence of more information on the conditional FV we will not explore these options further here.

The tableau in (34) shows, however, that *butwad-i* is the best candidate of the most likely alternatives:[30]

(34)

/butu-i-l-i/	IDENT V$_1$	*[wi]	MAX	PLATEAU	DEP [L]	IDENT FV
a. butwid-i		*!				
b. butud-i			*!			
c. butwed-i				*!		
d. but(w)od-i				*!		
☞ e. butwad-i					*	

In this tableau I have added the constraint DEP [L], designed to assess the cost of acquiring a [+low] feature that is not present in the input. As seen, (34a) is barred because it violates the high-ranking *[wi] constraint. MAX rules out (34b), which, since it does not have an overt realisation of -*i*-, is in fact identical to the non-applicative form. PLATEAU rules out candidates (34c, d). The candidate in (34e) violates only DEP [L]. Epenthesis of a penultimate [a] in *butwad-i* is thus shown not only not to be as surprising as at first blush, but in fact the only reasonable output, given the above system of constraints.[31]

Returning to the constraint MAX, we have rejected the outputs *butud-i* in (31b) and (34b) and *butul-a* in (32b) on the basis of their having no exponent of the input infix -*i*-. In each case the output candidate is identical to how an input without -*i*- would have been realised. Arguments involving the avoidance of homophony are admittedly tricky (cf. Kisseberth & Abasheikh 1974). We have, for instance, already seen a case of paradigmatic merger in the forms in (30). When *yimbil-* 'sing' becomes *yimbid-i* by imbrication in the perfective (rather than **yimbid-idi*), it merges with the conditional, whose final is simply -*i*. On the other hand, applicatives do not permit imbrication in the perfective. Thus, when *bak-il-*, the applicative of *bak-* 'take', is perfectivised, the output is *bak-id-idi*, not **bak-id-i*. This contrasts with forms of the shape CVCil- which are not applicatives, e.g. the minimally contrastive form *bakil-* 'reprimand', whose perfective is *bakid-i*. This fact provides further evidence that Yaka

[30] Among other possibilities would be for imbricated forms to be impossible when the FV is -*i*. In this case speakers might simply block imbrication and use unimbricated allomorphs in their place. Another would be to simply have no way to express APPLICATIVE+CONDITIONAL, where imbrication would have been required, i.e. 'good' isn't 'good enough' (Orgun & Sprouse in press). As seen, Yaka instead prefers to epenthesise [a].

[31] As pointed out by a reviewer, another unsuccessful candidate to consider is **butwudi*, which avoids a violation of *[wi] by rounding the [i] to [u]. This possibility is, however, ruled out by an undominated constraint that forbids *Cwu (and *Cwo) sequences in the language. Concerning the successful candidate, it should be noted that I am not claiming that /a/ is the 'unmarked' vowel in Yaka, only that it will be preferred over other vowels when the latter are ruled out by constraints higher than DEP [L]. (Many thanks to Eric Bakovic for pushing me to explore this strategy for explaining the occurrence of epenthetic [a].) In Yaka, as in Bantu generally, /a/ is, however, the morphologically unmarked FV morpheme – and it is possible to consider this relevant, as in note 29.

speakers also do not allow the applicative allomorph *-il-* to get totally lost.[32]

Finally, let us consider how to achieve the correct output when the verb root has the shape -Cu-, as the input /bu-il-a/ 'fall + APPL' in (35).

(35)

/bu-il-a/	IDENT V$_1$	*[wi]	MAX	PLATEAU	IDENT FV
a. bwi-il-a	*!	*!			
b. bwa-al-a	*!				
☞ c. bu-ul-a			?		

Both (35a) and (35b) violate IDENT V$_1$ and hence are rejected, whether or not we consider (35c) to violate MAX (since the mora of *-i-* is realised).

In the next section we shall see the need to refine IDENT V$_1$ slightly.

4 TROUGH [V-V] and vowel height harmony

In previous sections we have provided evidence that right-to-left VHH is motivated by two independent constraints in Yaka: PLATEAU and *[wi]. In this section we consider a third constraint, TROUGH [V-V], which provides the final motivation for VHH in the language. For this purpose we begin by continuing the discussion of imbrication. In §3 we considered cases of perfective imbrication where the pre-coronal vowel is /u/ or /i/. We now consider the third vowel /a/, which allows imbrication only in the perfective. The data in (36) show that when the pre-coronal vowel is /a/, imbrication produces [e] from /a + i/:

(36) a. timan-a   → timen-e   'struggle'
        sundal-a   → sundel-e   'sleep'
        zakal-a   → zakel-e   'awake'
     b. kweelan-a → kweelen-e 'marry'
        zoondan-a → zoonden-e 'prepare oneself'

A standard derivational account, such as documented in Bastin (1983) and Hyman (1995b), would be as in (37).

(37) *Derivational account of imbrication*

$$
\begin{array}{ccc}
C\ V_1\ C\ V_2\ C \to & C\ V_1\ C\ V_2\ V_3\ C\text{-}V \to & C\ V_1\ C \quad V_3\ C\text{-}V \to C\ V\ C\ V\ C\text{-}V \\
z\ a\ k\ a\ l & z\ a\ k\ a\ i\ l\ e & z\ a\ k\ a\ i\ l\ e \quad z\ a\ k\ e\ l\ e
\end{array}
$$

First the perfective is spelled out by placing the vowel [i] before the /l/ and the vowel *-e* at the end. Since vowel length is possible only in stem-initial position, the first V of a VV bimoraic sequence is deleted – in this example, the V$_2$. At this point /a + i/ fuse into short [e].

In such verb forms we thus have the same fusion of /a + i/ that we saw

---

[32] Cf. Ruttenberg (1971: 15): 'lorsque le suffixe -il- (-in-) est ressenti comme un vrai applicatif... on préfère la forme longue [of the perfective] (-ídí, -íní, -élé, -éné) à la forme courte (-í, -é).

in the plural noun forms in (13a) above: /ma+iso, ma+ino/ → *meeso* 'eyes', *meeno* 'teeth'. The correct output is obtained as in (38).

(38)

/zaka-i-l-e/	IDENT V$_1$	*[wi]	MAX	PLATEAU	IDENT FV
a. zakid-i			*!		*
b. zakad-i			*!		*
☞ c. zakel-e				*	
d. zekel-e	*!				

(38a, b) are ruled out as violations of MAX, and (38d) as a violation of IDENT V$_1$. (38c) is the correct output, even though it violates PLATEAU. As seen, in order to obtain the correct output, we assume in just this case that both vowels of an /ai/ input can correspond to an output [e].[33]

As a result of imbrication, we thus can derive a penultimate [e] from the coalescence of /a+i/. However, nothing we have seen so far would explain why the (non-imbricated) perfective ending is *-ene* in (39), where a polysyllabic verb base ends in /am/:

(39) a. yilam-a → yilam-ene   'prepare oneself'
         bukam-a → bukam-ene 'go to sleep'
         lakam-a → lakam-ene   'insist'
    b. zetam-a → zetam-ene   'be twisted'
         kolam-a → kolam-ene   'disobey'

Recall from forms such as *kas-idi* 'bind' and *kan-ini* 'propose' in (3a) that the form of the perfective suffix is *-idi* or *-ini* after a CaC- root. Thus we know that plateauing does not occur between a first syllable /a/ and the perfective FV *-e*. However, as seen in (39), right-to-left spreading of M does occur if the preceding /a/ is not stem-initial. We thus obtain *yilam-ene* instead of *yilam-ini, etc. The question is why?[34]

---

[33] This also applies to the nouns *mééso* and *mééno* in (13a). It is, however, not clear how these surface realisations survive, given that they violate IDENT V$_1$. There are a number of strategies that might be followed, one of which is to redefine IDENT V$_1$ so that it applies only to stems which begin CV. Another is to seek a coalescence constraint specific to /ai/. I shall unfortunately not be able to resolve this problem here.

[34] As seen in the following distributions, the realisation of the [a] in Ruttenberg's perfective entries for CVCam- verb stems is somewhat inconsistent:
(i) CiCamene 13   CiCemene   0
    CuCamene 15   CuCemene   0
    CaCamene 21   CaCemene   1
    CeCamene   8   CeCemene 12   (= apparent plateauing through /a/)
    CoCamene 10   CoCemene   3
While the majority (67) simply add *-ene*, 16 also change the preceding /a/ to [e] (in violation of MAX [L]). As seen, 15 of these involve a root-initial /e/ or /o/, thus suggesting an ongoing change whereby PLATEAU may ultimately enforce VHH through an intervening /a/. Although an interesting attempt to deal with these forms would be to reverse the ranking of MAX [L] and PLATEAU, I won't address them further here. The important issue for our purposes is simply to account for why the perfective ending is *-ene* when preceded by a non-root-initial [a].

The answer comes from an examination of the prosodic structure of the stem (root + suffixes). As shown in (40), I propose that verb stems in Yaka (and in Bantu generally), divide into the following subcomponents for prosodic purposes:

(40) *general Bantu trough* $\langle CV(V)C \rangle$ τ $\langle V \rangle$
     (where $\tau = (CV)^n$)

     in Yaka a. $\langle CV(V)C \rangle$ $\langle V \rangle$ $\tau = \emptyset$
              b. $\langle CV(V)C \rangle$ VC $\langle V \rangle$ $\tau = VC$
              c. $\langle CV(V)C \rangle$ VCVC $\langle V \rangle$ $\tau = VCVC$

As indicated, the stem contains a 'prosodic trough' (τ), obtained by exbraciating the two 'perimeters': (i) the initial CV(V)C and (ii) the final V of the stem. In (40a), Yaka verb stems of the shape CV(V) C-V have no trough, while those in (40b) and (40c) have -VC- and -VCVC- troughs, respectively. It is crucial that phonological restrictions often hold only within the trough, as thus defined. While the prosodic trough is important in every Bantu language I know, it has a particularly rich set of effects in Yaka, as follows:

(i) The only underlying vowels found in the prosodic trough are /i u a/ *vs.* the full set /i e u o a/ found in the perimeters.

(ii) The only consonants found in the trough are the coronals /t l n s/ and the non-coronals /m k ng/ *vs.* a much larger inventory in the initial CV(V)C perimeter.

(iii) Long vowels are not allowed in the trough (and in fact appear only in the initial perimeter). Among other things, this accounts for why imbrication fails to produce a long vowel in polysyllabic bases as it does in other Bantu languages where vowel length is not restricted to the initial perimeter.[35]

(iv) Only trough vowels are subject to right-to-left VHH, which thus does not affect the vowel in the first perimeter. Thus, root-initial /i/ or /u/ never lowers to [e] or [o] by VHH.

(v) The constraint *[wi] is resolved as [we] or [wa] in the trough, but as [uu] in the first perimeter (σ_1).

(vi) Imbrication targets only polysyllabic verbs, i.e. verb bases which are long enough to have a non-null trough.

(vii) Imbrication affects both vowels of a -uCuC- trough, e.g. *futumun-* → *futwemwen-e* 'resuscitate', but not an /u/ in the first perimeter (see Appendix).

(viii) The trough is virtually limited to a -VCVC- maximum. Ruttenberg (1971) lists only three (non-perfectivised) verbs that have five syllables. One is the applicative *fikukidila* from *fikuka* (or *fikukila*) 'whine, sob'. The other two are reduplications: *baaka-(ku)baaka* 'tear repeatedly' and *beeta-(ku)beeta* 'hit repeatedly'.

---

[35] As will be seen in the Appendix, when imbrication exceptionally occurs in the first syllable (hence first perimeter) of the stem, a long vowel is obtained, e.g. *mat-* 'climb' → *meet-e*.

V2/V3	i	e	u	o	a
i	×				
e		×			
u	×		×		
o		×		×	
a		×			×

[Table III. Possible trough sequences in quadrisyllabic
word stems (CVCVCVCV)]

(ix) The only underlying -VCVC- trough sequences are -iCiC-,
-uCuC-, -aCaC- and -uCiC-.

(x) The only -VCVC- trough sequences with (derived) M vowels are
-eCeC, -oCeC-, -oCoC- and -aCeC-.

The above generalisations are possible to state and hold true only of the
prosodic trough as I have defined it. By positing the trough and its
limitations, we can explain a number of facts about Yaka, e.g. the
appearance of forms such as *yilam-ene* in (40) rather than **yilam-ini*. As
seen in Table III, -aCiC- is not a possible trough sequence, while -aCeC-
is. Hence one cannot obtain *-ini* after verb bases of the shape CVCam-.
I thus suggest that this right-to-left VHH is triggered by a *third* factor (in
addition to PLATEAU and *[wi]): namely, to avoid an unacceptable trough
sequence (TROUGH). The tableau in (41) shows that the correct output is
obtained if TROUGH is ranked above PLATEAU:

(41)

/yilam-ile/	IDENT V$_1$	*[wi]	TROUGH	PLATEAU	IDENT FV
a. yilam-ini			*!		*
b. yilam-eni				*	*!
☞ c. yilam-ene				*	

It is important to note that the account in (41) crucially depends on
recognising the trough as a prosodically weak sequence occurring between
two peaks of prominence. As suggested by a reviewer, an alternative might
be to positively characterise the properties of the perimeters, i.e. CV(V)C-
and -V, where input features must be preserved *vs.* the 'non-prominent
residue', where this need is less felt. It is, however, not clear how
sequential properties of the trough could be cast in this kind of analysis.
The data in (42) further demonstrate that the constraint against
*-aCiC-, among other sequences, pertains specifically to the trough as the
relevant domain:

(42) a. CVC-VCVC-V   *kab-<u>amin</u>-i   'be divided (PERF)'
     b. CVC-VC-V   kab-<u>ika</u>   'spread out'
     c. CVC-VC-V   kab-<u>am-i</u>   'be divided (COND)'
     d. CVC-∅-V   kab-<u>i</u>   'divide (COND)'

-iC-	312		-uC-	351		-aC-	159	
-ik-	94		-uk-	132 (REVERS INTR)		-al-	23	
-il-	98 (STAT, IMPOS)		-ul-	173 (REVERS TR)		-an-	23 (RECIP)	
-is-	114 (APPL)		-us-	21		-as-	6	
-ing-	1 (CAUS)		-ung-	17		-at-	5	
-it-	5		-ut-	8		-am-	101 (POSITIONAL, PASS?)	
						-amb-	1	

[Table IV. Possible postradical -VC- sequences in
CV(V)CVC verb bases]

Since the *-amin-* sequence is fully contained within the trough in (42a), this form is impossible (and is modified to *kab-amen-e* as a result). Forms such as *kab-ik-a* in (42b) show than an -aCiC- sequence is well-formed if the /a/ is in the first perimeter and the /i/ in the trough. It is therefore necessary to remove the first vowel from consideration of the constraint. The examples in (42c, d) further show that the FV *-i* also does not figure in the constraint: in *kab-am-i* in (42c), the /a/ is in the trough, while the /i/ is in the second perimeter, while in (42d), the /a/ is in the first perimeter, and the /i/ in the second.

As stated above, not only are the underlying trough vowels restricted to /i u a/, but consonants are also restricted to a set of seven: /t l n s m k ng/. The full set of postradical -VC- sequences that can occur in a Yaka CV(V)C-VC- verb base is exhaustively listed, quantified and, where possible, morphologically identified in Table IV. The number after each sequence indicates how many entries appear with this form in the Ruttenberg dictionary of 1781 verb forms.[36] Now if we compare these with the full set of attested -VCVC- trough sequences in (43), we note that although one can derive -uCiC- sequences in (43d), e.g. *-ukil-* from *-uk-*+*-il-*, one cannot derive troughs having the shapes *-iCaC-, *-iCuC-, *-uCaC-, *-aCiC- or *-aCuC- by concatenating the -VC- sequences in Table IV.

(43) *Attested trough* -VCVC- *sequences in verbs*
  a. -ikis- (42), -idil- (10), -ikil- (9), -idik- (5), -inin- (3), -inis- (2)
  b. -umun- (56), -ulul- (36), -umuk- (27), -uluk- (9), -unun- (2)
  c. -asan- (40), -akan- (34), -alal- (17), -aman- (14), -anan- (6),
      -amas- (5), -angan- (4), -asal- (3), -angas- (2), -akas- (1)
  d. -ukil- (6), -ukin- (1), -ukis- (1), -umin- (1)

---

[36] Of the 98 cases of *-il-*, 19 are realised as *-in-* by assimilation to a preceding nasal consonant. Similarly, of the 173 cases of *-ul-*, 21 become nasalised to *-un-* (*vs.* another 21 which have *-un-* without a preceding nasal). In the case of *-al-* and *-an-*, I have counted all cases of phonetic *-an-* as reciprocal /-an-/, even when there is a preceding nasal. For more on *l*-nasalisation in Yaka, see Hyman (1995a).

Given the above limitations, Bantuists will wonder how Yaka treats suffix sequences that would be expected to produce other -VCVC- troughs. The answer is summarised in Table V.

V2/V3	i	u	a
i	iCiC		aCaC
u	uCiC	uCuC	aCaC
a	aCaC	uCuC	aCaC

[Table V. Surface realisation of input
vowel sequences in the trough]

First note that most of the indicated assimilations are regressive, i.e. applying right to left, as we have observed elsewhere. A trough /i/ or /u/ will assimilate to a following /a/, as will a trough /a/ assimilate to a following /u/. On the other hand, assimilation is progressive (left-to-right) in one case: a trough /i/ will assimilate to a preceding trough /a/. (As indicated by the shaded cell, I have not found any convincing cases where I can establish an input sequence of -iC- followed by -uC-.) Representative examples are provided in (44).

(44) a. *-is + an- → -asas-*

kab-a	'give a gift'	hiing-a	'replace'
kab-is-a	'make give a gift'	hiing-is-a	'make replace'
kab-as-an-a	'give each other a gift'	hing-as-an-a	'replace each other'

-ik + an- → -akan-

sweet-ik-a	'make narrow'	kut-ik-a	'group things (TR)'
sweet-ak-an-a	'be narrow'	kut-ak-an-a	'group together (INTR)'

b. *-am + is- → -amas-*

bak-am-a	'be taken'	sik-am-a	'wake up (INTR)'
bak-am-as-a	'get oneself taken'	sik-am-as-a	'wake up (TR)'

-am + il- → -aman- [37]

bak-am-an-a	'be taken for/at'	sik-am-an-a	'wake up because of'

-am + is + il- → -amasan-

bak-am-as-an-a 'get oneself
        taken for/at'

---

[37] Ruttenberg (1971) also provides the example *fukamana* 'kneel in prayer' (< *fukama* 'kneel'), which is clearly an applicative. Lukowa Kidima (personal communication) informs me that he usually applicativises CVCam- verb bases as CVCam-an-, but that CVCam-in- is possible in another dialect area.

c. *-am + ul- → -umun-*

nan-a	'stretch a bow'	tand-a	'stretch (rope)'
nan-am-a	'be stretched'	tand-am-a	'be tight (rope)'
nan-um-un-a	'pull towards oneself'	tand-um-un-a	'unravel (e.g. rope)'

-am + uk- → -umuk-

fut-am-a	'take a jump'	tel-am-a	'stand up straight'
fut-um-uk-a	'resuscitate (INTR)'	tel-um-uk-a	'slip, be slippery'

d. *-uC + aC- → -aCaC- (?)*

beend-ul-a	'do a somersault'	bal-ung-a	'change, turn into'
beend-al-al-a	'bend over'	bal-ang-an-a	'cross, meet someone'

As seen, some of the semantic relationships are more transparent than others. Still others are included only because of their phonological relationship. Thus, the *-ang-* of *-ang-an-* may not be etymologically related to *-ung-*, but the two are in clear complementary distribution in synchronic Yaka: *-ung-* appears only in trisyllabic verb stems (i.e. directly before the FV), while *-ang-* is found only before another trough /a/. The question mark in (44d) therefore indicates that I am not sure of this derivation. Note, finally, in the first set of examples that *-asan-* has developed into a (monomorphemic?) reciprocal suffix, even though it is clear that it derives from *-is- + -an-*. In many cases the trough sequence, although often resembling historical suffixes, will not be synchronically analysable into separate morphemes. For this reason, it seems less satisfactory to pursue a morphological definition of the trough rather than a phonological one.[38]

We thus see that Yaka gives evidence of a prosodic trough of easily identifiably segmental *and* sequential properties. Other Bantu languages fall within a wide range. At one extreme a language may have relatively free trough properties (though cf. the quote from Meeussen 1967 in note 12). At the other end of the spectrum a language can have even greater

[38] One reviewer suggested such a reanalysis, adding that this could have a major effect on the analysis. Let us assume, against the evidence, that all trough elements are identifiable as separate suffixal morphemes. In this case the analysis would be that suffixes are subject to the very restrictions that I have characterised by means of the prosodic trough. These generalisations would still have to be accounted for – and, recall, would still hold only within and between 'internal' suffixes (i.e. excluding the root and the FV). In reality, there are many polysyllabic verb bases in Yaka which do not lend themselves to such a morphological analysis, i.e. where simplex forms do not exist and/or where a -VC- cannot be ascribe any meaning. One such case is postradical -Vt-, whose vowel agrees in frontness and roundness with the root vowel, hence: CiCit-, CeCit-, CuCut-, CoCut- and CaCat-. It has a phonological identity, without a corresponding morphological characterisation.

restrictions on its trough than Yaka. In Tiene B.81, for example, Hyman & Inkelas (1997) propose, based on Ellington (1977), that the prosodic trough is maximally VCVC, where the first C must be coronal and the second C must be non-coronal. In many Bantu languages the trough properties will be limited to vowel distributions and vowel harmony. In others tone may be involved. In this last context, it is interesting to note that the plateauing of Mid in Yaka is quite reminiscent of tonal plateauing, as in Ganda EJ.15, for instance. The constraint against a single final [e] may also be compared to disallowing a single final H tone. Perhaps this similarity to tone is why it has not seemed inappropriate to designate vowel height harmony in terms of H, M and L in Yaka.

5 Summary and conclusion

I shall now summarise what I hope to have achieved in the preceding sections. First, I have shown that vowel height harmony is not progressive in Yaka, as previously believed, but rather operates from right to left. Second, I have shown that mid harmony in Yaka is independently 'enforced' by three different constraints: first, PLATEAU, which says that a [−high] (M) feature should be immediately preceded by another M; second, *[wi], which rules out such sequences; and third, TROUGH, a family of constraints which rules out unlicensed sequences, e.g. -aCiC-, within the prosodic trough. In addition, I have more generally shown that segmental and sequential constraints are more severe between elements that are fully contained within the trough *vs.* partially or totally occurring outside the trough.[39] Although other patterns are also attested in Bantu, one prosodic organisation of vowel harmony in these languages is for the trigger to be in the perimeter and the target in the trough, as we have

[39] Although not developed in this paper, another aspect of the Yaka system to consider is whether all of the constraints are universal, in the OT sense, or whether some may be language-specific, i.e. arbitrary from a synchronic point of view. Is there, for example, a general linguistic reason why the sequence -uCiC- should be permitted in the prosodic trough while the sequence *-iCuC- is disallowed? One reviewer has suggested that Warlpiri has the same prohibition against *iCuC as Yaka, and there might therefore be something universal to this sequential constraint. In my view it has to do with the nature of directionality in assimilation. In some Bantu languages rounding harmony is regressive (as in Yaka), while in others it is progressive (Lengola D.12). It is thus possible to have exactly the opposite prohibition in fact: acceptable [iCu] *vs.* a prohibition on *[uCi]. Whatever the ultimate role of universals, in this case there is a Bantu-specific historical explanation for the instability of trough -iCuC-: Proto-Bantu suffixes with the vowel *u are more tightly bound to the root than suffixes that reconstruct with *i. Thus it is not difficult to obtain sequences such as *CVC-uk-id-a, *CVC-uk-jd-e and *CVC-uk-is-a, where the applicative, perfective and causative suffixes with *j or *i follow the reversive intransitive suffix *-uk-. The opposite is quite difficult to obtain, since *-uk- and *-ud- attach normally only directly to the verb radical. While some Bantu languages allow -iCuC- sequences, many other modify these to -uCuC- or -iCiC- to avoid an earlier /i/ followed by a later /u/. A rather striking case occurs in nearby S. Kongo (Bentley 1886: 640–641). In this language, trough /u/ must precede trough /a/ and both /u/ and /a/ must precede /i/ and its harmonised variant /e/. That is, the trough vowels must occur in the fixed order *u-a-{i,e}*.

seen in Yaka. However, the *directionality* of vowel height harmony is not predictable: vowel harmony can be regressive, as in Yaka, or progressive, as in other Bantu languages – depending on *which* perimeter serves as the trigger. That is, the trough can in principle attract features either from the initial CV(V)C perimeter (as in most of Bantu) or from the final vowel (as in Yaka).[40]

Appendix : Shorter and longer imbricated forms

The process of imbrication was illustrated and analysed in §3 and §4. In all of the examples presented the input verb bases had the shape CV(V)C-VC-, i.e. where the trough is -VC-. In this appendix I discuss how imbrication affects shorter and longer verb bases in Yaka, particularly in light of the analysis presented above. I will restrict myself to the perfective, which is extensively documented in Ruttenberg (1971).

1 Short forms

In characterising imbrication in §3 it was stated that the input must have at least two syllables (CV(V)CVC...). That is, it must have a trough. Normally, CVC-roots do not imbricate, but rather add -*ile* in the perfective, as was seen in the examples in (3). I attribute this to the requirement that only verb bases that have a prosodic trough can imbricate. There are, however, a small number of exceptions where monosyllabic bases undergo imbrication, as seen in (45).

(45) a. CaaT-a kyaat-a kyeet-e 'line up' ? < *ki-at-
nwaan-a nween-e 'fight' PB *du-an-
haan-a heen-e 'give, entrust some-thing to someone PB *pa-an-
b. CaaP-a syaam-a syeem-e 'be confirmed' ? < *ci-am-
swaam-a sweem-e 'hide, be sheltered' ? < *cu-am-
yaab-a yeeb-e 'know' ? < *ji-ab-
c. CaT-a kal-a kel-e 'be'
man-a meen-e 'finish, be finished PB *mad-
mat-a meet-e 'climb' PB *mat-
nat-a neet-e 'carry, transport'
d. CoT-a mon-a mween-e 'see' PB *bón-

The verbs in (45a) have a coronal (T) second consonant, normally required for imbrication, while those in (45b) have a non-coronal (P) second consonant. The

[40] I have not addressed the question of how to make VHH regressive in Yaka. One possibility followed in an earlier version of this paper is to invoke Alignment (McCarthy & Prince 1993). Another is to view the first syllable as 'inert' to certain interactions, as Hyman & Inkelas (1997) suppose for Tiene. The latter approach seems somewhat problematic in Yaka, where, for instance, a trough /l/ nasalises to [n] when preceded by a nasal (which can be in the first perimeter). Whatever the answer, the constant across Bantu languages is the vulnerability of trough elements which may be targeted by perimeter elements on either side.

four verbs in (45c) have a short vowel, though only the first one fails to acquire length in the perfective.[41] It should be pointed out, however, that most such roots do not imbricate: among the CaC- roots in Yaka, 4 imbricate, while 44 do not. Of the CaaC- roots, 16 imbricate, 13 are variable and 40 do not imbricate. Finally, the verb *mon-a* 'see' in (45d) irregularly imbricates, as it does throughout much of the Bantu zone (Meeussen 1967, Bastin 1983). The corresponding Proto-Bantu reconstructions are provided in the rightmost column.

Since the expected perfective forms are *kyaat-idi*, *nwaan-ini*, etc., the verbs in (45) must receive special treatment. As shown in (46), I propose that what is exceptional in these cases is that the initial perimeter has the shape CV or simply C, instead of the canonical shape CV(V)C:

(46) *Trough-marking in exceptionally imbricated short forms*

    a. ⟨ki⟩at⟨-a⟩   b. ⟨si⟩am⟨-a⟩   c. ⟨k⟩al⟨-a⟩   d. ⟨m⟩on⟨a⟩
       ⟨nu⟩an⟨-a⟩   ⟨su⟩am⟨-a⟩   ⟨m⟩an⟨-a⟩
       ⟨ha⟩an⟨-a⟩   ⟨ya⟩ab⟨-a⟩   ⟨m⟩at⟨-a⟩
                              ⟨n⟩at⟨-a⟩

As seen, the trough has the shape VC in all examples. The /a/ of the VC conforms to the trough properties, as do the consonants /t/, /n/, /l/ and /m/. The /o/ in (46d) is exceptional, as is the /b/ in the last form in (46b). With this exceptional structure, imbrication will appropriately place the infix -*i*- before the final consonant of the trough, as seen in (47), and surface [e] will be obtained by coalescence.[42]

(47) *Trough analysis of imbricated short verbs*

    a. ⟨ki⟩a-i-t⟨-e⟩ b. ⟨si⟩a-i-m⟨-e⟩ c. ⟨k⟩a-i-l⟨-e⟩ d. ⟨m⟩o-i-n⟨e⟩
       ⟨nu⟩a-i-n⟨-e⟩   ⟨su⟩a-i-m⟨-e⟩   ⟨m⟩a-i-n⟨-e⟩
       ⟨ha⟩a-i-n⟨-e⟩   ⟨ya⟩a-i-b⟨-e⟩   ⟨m⟩a-i-t⟨-e⟩
                                ⟨n⟩a-i-t⟨-e⟩

2 Long forms

Let us now consider how imbrication affects longer verbs in Yaka. Recall from (6) that a -iC- or -uC- suffix that intervenes between a Mid root vowel and the perfective suffix will undergo plateauing VHH. This plateauing at a distance is further illustrated in (48).

(48) a. kindumuk-a → kindumuk-ini   'be rolled up, uprooted'
        futumuk-a   → futumuk-ini   'resuscitate (INTR)'
        yandzumuk-a → yandzumuk-ini 'spread out, open out'
   b. kendumuk-a → kendomok-ene 'roll (INTR)'
        wongumuk-a → wongomok-ene 'disintegrate'

[41] This fact is the only indication that the F feature (historically *i) may come in with its own mora. Vowel length is allowed only in the initial stem syllable in Yaka, so we could allow imbrication to include an additional mora whose effect is seen only in (45c, d).

[42] In this analysis we avoid the problem of why IDENT V_1 does not preserve the /a/ (or /o/) in the first syllable. Even so, I would like to say that when the combination /a + i/ is realised as [ee], IDENT V_1 is not really violated, since both the non-high feature of /a/ and the front feature of /i/ are preserved.

The examples in (48b) show the lowering of the two intervening vowels of intransitive -*umuk*- caught between the mid vowel of the root and the perfective suffix. Now compare the corresponding transitive -*umun*- forms in (49), where imbrication affects entire -VCVC- sequences:

(49) a. kindumun-a → kindwemwen-e   'move by means of a lever'
         futumun-a   → futwemwen-e   'resuscitate (TR)'
         yandzumun-a → yandzwemwen-e 'spread out, open'
     b. kendumun-a → kendwemwen-e   'roll (TR)'
         wongumun-a → wongwemwen-e   'decompose'

The examples in (49) show imbrication affecting both /u/'s of an -*umun*-suffix.[43] The expected realisations of the perfectivised forms in (49) are shown in (50).

(50) a. *If not imbricated :*
         *kindumun-ini, *futumun-ini, *yandzumun-ini,
           *kendomon-ene, *wongomon-ene
     b. *If imbricated* (*obeying* *[wi]) :
         *kindumwen-e, *futumwen-e, *yandzumwen-e,
           *kendomwen-e, *wongomwen-e

(50a) shows how these forms would have been realised without imbrication, i.e. exactly parallel to the forms in (48). The forms in (50b) are designed to show the expected imbricated forms obeying the *[wi] constraint. Based on what we know about other Bantu languages, we expect imbrication to affect only the penultimate syllable, not also the antepenult.

While both syllables retain the labiality of /u/ in (49), the forms in (51) show that verb bases which end in the suffix -*ulul*- 'again' only retain the labiality of the first suffixal /u/, and all become ...*welele*, never *...*welwele*:

(51) a. sik-ulul-a   → sikw-elel-e   'whistle again' sik-a 'whistle'
         fuk-ulul-a   → fukw-elel-e   'cover again'   fuk-a 'cover (roof)'
         bandz-ulul-a → bandzw-elel-e 'reflect again' baandz-a 'reflect'
     b. beet-ulul-a   → beetw-elel-e   'hit again'   beet-a 'hit'
         hoy-ulul-a   → hoyw-elel-e   'talk again'   hoy-a 'talk'

The same is true of the only three other verbs in Ruttenberg (1971) that have imbricatable internal -uCuC- sequences other than -*umun*- and -*ulul*-, given in (52).[44]

---

[43] As shown in the summary below, the perfective entries for -*umun*- verbs are not consistent in Ruttenberg:

|	(i) *CVCwemwene*	*CVCwemene*	*CVCumwene/CVComwene*
	CiCwemwene 5	CiCwemene 1	CiCumwene 0
	CuCwemwene 12	CuCemene 4	CuCumwene 1
	CaCwemwene 15	CaCwemene 3	CaCumwene 1
	CeCwemwene 10	CeCwemene 1	CeComwene 1
	CoCwemwene 3	CoCwemene 0	CoComwene 1

45 verbs have the double labialised realisation -Cwemwen- *vs.* 9 which have a labialised consonant only in the antepenultimate syllable, i.e. -Cwemen-. Finally, the third column indicates that 4 verbs exceptionally fail to extend imbrication to the antepenult. I shall ignore these differences in the following discussion.

[44] A fourth verb, *bulukut-a* 'browse, crush', is exceptionally entered in Ruttenberg (1971) as *bul-okwet-e*. Even if we were to somehow limit imbrication to the penult

(52) a. buk-unun-a → bukw-enen-e 'divide up'
      hing-unun-a → hingw-ene-e 'cut up into small pieces'
   b. zyok-utun-a → zyokw-eten-e 'gnaw'

The generalisation seems to be that labialisation will remain on the penult if the consonant is /m/, otherwise it will be realised only on the antepenult (cf. note 43, however). In other words, labialisation will not remain on the penult if its onset is coronal.

Goldsmith's (1985) proposal to handle such facts, modified slightly in (53), involves the right-to-left spreading of [−round], here formalised as a front feature F. This spreading of frontness (or lowness in the case of the final vowel -*a*) is of course consistent with my contention that *all* vowel harmony is right-to-left in Yaka. Thus, note in (53) that I have changed Goldsmith's M height harmony rule also to be right-to-left, as it clearly needs to be.

(53)

$$
\begin{array}{c}
\text{M} \\
\text{C V C u C u C V} \quad \text{(where last C = coronal)} \\
\text{F}
\end{array}
$$
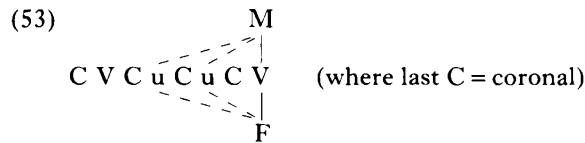
To ensure that both the penultimate and antepenultimate vowels are targeted, one might interpret imbrication as invoking a left-alignment of the FV features with the stem, thereby mirroring Goldsmith's derivational account.[45] The F feature of the perfective thus spreads to the leftmost vowel that it can. Given IDENT V_1, this means as far as the vowel of the second syllable, i.e. only trough vowels are affected. Unfortunately Ruttenberg (1971) gives only one five-syllable verb stem, *fikukidil-a*, said to be the applicative of *fikuk-a* 'whine, sob', which, since applicatives don't undergo perfective imbrication, is realised *fikukidid-idi* in the perfective.[46] So we can't test this hypothesis on longer verbs – specifically on CVCuCuCuC-a verbs, which we hypothesise to imbricate as CVCweCeCeC-e.[47]

In our account of imbrication, we chose however not to invoke alignment, but rather to infix -*i*- before the base-final consonant. The following tableau illustrates how this analysis of imbrication fares with a base such as *fukulul-* 'cover again':[48]

---

in this form, we cannot explain the [o] in the antepenult (i.e. we should in that case have obtained **bul-ukwet-e*).

[45] Alignment is an OT concept developed in McCarthy & Prince (1993) and elsewhere.

[46] Since Ruttenberg also has *fikukila* with a gloss 'cf. *fikuka*', I suspect that *fikukidila* is actually the applicative of *fikukila*, not *fikuka*.

[47] Ruttenberg also does not give any examples of applicatives of CVC-ulul- verbs. My prediction is that the applicative of a verb like *sik-ulul-a* 'whistle again' would be *sikw-alal-a*.

[48] I ignore only the question of why we do not obtain double labialisation, i.e. **fukwelwele*.

(54)

/fukulu-i-l-e/	Ident V$_1$	*[wi]	Max	Trough	Plateau	Ident FV
a. fukulwil-e		*!			*	
b. fukwilil-e		*!			*	
c. fukulul-e			*!		*	
d. fukulud-i			*!			*
e. fukulwel-e				*!	*	
☞ f. fukwelel-e					*	
g. fwekelel-e	*!					

As seen, the input is /fukulu-i-l-e/, where perfective -*i*- has been infixed before the final /l/ of the verb base. Candidates (54a, b) both fail since they contradict the *[wi] constraint. Candidates (54c, d) violate Max, since neither one has an overt realisation of the infix -*i*-. In addition, (54c) violates Plateau, and (54d) violates the Ident FV constraint, since the latter's M feature is not in the output. The candidates in (54e–g) all involve right-to-left spreading of the FV -*e*, differing only by how far left the spreading process extends. As seen, there are two designated winning candidates. Candidate (54e), where -*e* spreads to the penult, but not to the antepenult, violates Trough, since a trough sequence -uCeC- is not permitted (cf. Table III). In the correct output in (54f), -*e* has spread to both the penult and antepenult. Finally, in (54g), -*e* has spread onto the penult and antepenult as well as the stem-initial. This candidate is of course ruled out by the highest-ranked constraint, Ident V$_1$.

While our ranked constraints make the correct prediction for *fukwelel-e*, now consider the corresponding tableau for the input base *hoyulul-* 'talk again':

(55)

/hoyulu-i-l-e/	Ident V$_1$	*[wi]	Max	Trough	Plateau	Ident FV
a. hoyulwil-e		*!			*	
b. hoywilil-e		*!			*	
c. hoyolol-e			*!			
d. hoyulwel-e				*!		*
☞ e. hoyolwel-e					*	
☞ f. hoywelel-e					*	
g. hwekelel-e	*!					

As before, (55a, b) are ruled out because they violate *[wi], (55c) violates Max and (55d) violates Trough (since -uCeC- is not an acceptable trough sequence). Also, (55g) is ruled out because it violates Ident V$_1$. The problem here, however, is that the incorrect candidate (55e) is not differentiated from the correct output (55f). This is because the -oCeC- of (55e) is not a trough violation. We see this in verb bases such as *hemukin-* 'pant', whose perfective is *hem-oken-e* (with imbrication and Plateau harmony). The problem, then, is how to get infixed -*i*- to 'spread' to the antepenultimate syllable.

Although there are several ways one might try to patch this up, it is not clear which is correct. The simplest way to fix things would be to add a constraint to the effect that a sequence -oCweC- is a trough violation (*vs.* -oCeC-, which is acceptable). We have already seen in (49) and (51) that CVC-umun- imbricates as CVC-wemwen-e, while CVC-ulul- imbricates as CVC-welel-e. Clearly,

verb	perfective	i	u	a	e	o	total
...Casana	...Casene	6	5	7	1	2	21
	...Cesene	2		4	5	4	15
...Cakana	...Cakene	3	4	18	3		28
	...Cekene		1	2	2		5
...Calala	...Calele	1		4		1	6
	...Celele	1	2	4	2	2	11
...Camana	...Camene		8	3		2	13
	...Cemene						
...Camasa	...Camese	2		2			4
	...Cemese				1		1
...Canana	...Canene						
	...Cenene	1			2	2	4
...Casala	...Casele		1	1			2
	...Cesele						
...Cangasa	...Cangese			2			2
	...Cengese						
...Cakasa	...Cakese			1			1
	...Cekese						

[Table VI. Effects of imbrication on -aCaC trough]

consonant labialisation is an issue here. I shall therefore assume that these distinctions should also be worked into the TROUGH family of constraints.[49]

Given the fact that imbrication modifies both /u/'s in CVCuCuC- bases, it is natural to ask what happens when the base has the shape CVCaCaC-. The rather skewed answer is shown in Table VI. The leftmost column lists the different -aCaC- sequences that can follow the initial CVC of the stem. The second column distinguishes between two possible imbricated forms: the upper form shows only the penultimate /a/ becoming [e], while the lower one shows both the penultimate and the antepenultimate /a/ becoming [e]. Across the top of the table are the five V_1 vowels that precede the -aCaC- sequence in each case. The results are summarised in (56).

(56) *Summary of the imbrication of* CVC-aCaC- *bases*

    a. ...CaCeC-e: 75   b. ...CeCeC-e: 36

        9 have M V_1 (4 /e/)   19 have M V_1 (12 /e/)

        38 have V_1 /a/   10 have V_1 /a/

        28 have H V_1 7 have H V_1

[49] Many thanks to Donca Steriade, who pushed me in this direction, which I think is essentially correct. Other possible remedies depart more significantly from the general analysis. First, we could, quite ad hoc, modify our view of imbrication to infix -*i*- before each trough consonant. This would yield inputs such as /fuk-u-i-lu-i-l-e/ and /hoy-u-i-lu-i-l-e/. In this case the non-realisation of -*i*- in either trough syllable would be interpreted as a violation of MAX. Or, more drastically, we could introduce some kind of constraint requiring that -*i*- align to the left of the trough – or even give up the infixing analysis of imbrication altogether and adopt Goldsmith's analysis in (53), whereby the F or L feature of the FV has to align at the left edge of the trough in cases of imbrication. Either way we would have to find a means of ensuring that the perfective *hemoken-e*, from *hemukin-* 'pant', does not become **hemweken-e* (i.e. spreading of F to the antepenultimate syllable occurs only under imbrication, not under PLATEAU).

As can be seen in the summary that follows the table, there is a tendency for the plateauing of M to go through an /a/, not just a high vowel (cf. also note 34). Thus, 12 out of 16 verbs with the root-initial vowel /e/ imbricate not only the penultimate /a/ to [e], but also the antepenultimate /a/ to [e]. In addition, there is a weaker tendency, about 1 in 4, for CVCaCaC- bases to become CVCeCeC- when the vowel of the stem-initial syllable is /i/, /u/ or /a/. Though not categorical, this appears related to the modification of both /u/'s of CVCuCuC- bases to [e], and to the tendency noted by Goldsmith (1985: 265) that 'extensions of the form -VC-...agree in vowel quality'. Whereas the situation has stabilised in the case of the imbrication of -uCuC-, the data in Table VI and note 34 suggest that -aCeC- is gradually being replaced by -eCeC-. We thus undoubtedly have a change in progress in the case of the imbrication of -aCaC-, and hence a complexity that with time should work itself out.

REFERENCES

Archangeli, Diana & Douglas Pulleyblank (1994). *Grounded phonology*. Cambridge, Mass.: MIT Press.

Bastin, Y. (1983). *La finale verbale -ide et l'imbrication en bantou*. Tervuren: Musée Royal de l'Afrique Centrale.

Bastin, Y. (1986). Les suffixes causatifs dans les langues bantoues. *Africana Linguistica* **10**. Tervuren: Musée Royal de l'Afrique Centrale. 55–145.

Beckman, Jill N. (1995). Shona height harmony: markedness and positional identity. In Beckman *et al.* (1995). 53–75.

Beckman, Jill N. (1997). Positional faithfulness, positional neutralisation and Shona vowel harmony. *Phonology* **14**. 1–46.

Bentley, W. Holman (1886). *Dictionary and grammar of the Kongo language*. London: Trübner.

Bleek, W. H. I. (1862). *A comparative grammar of South African languages*. Part I: *Phonology*. London: Trübner. Reprinted 1971, London: Gregg.

Cammenga, J. (1994). *Kuria phonology and morphology*. PhD dissertation, Free University, Amsterdam.

Casali, Roderic F. (1997). Vowel elision in hiatus contexts: which vowel goes? *Lg* **73**. 493–533.

Cassimjee, Farida & Charles W. Kisseberth (1998). Optimal domains theory and Bantu tonology: a case study from Isixhosa and Shingazidja. In L. M. Hyman & C. W. Kisseberth (eds.) *Theoretical aspects of Bantu tone*. Stanford: CSLI. 33–132.

Clements, G. N. (1991). Vowel height assimilation in Bantu languages. *BLS* **17**. 25–64.

Ellington, John (1977). *Aspects of the Tiene language*. PhD dissertation, University of Wisconsin, Madison.

Eynde, Karel van den (1968). *Eléments de grammaire yaka*. Kinshasa: Université Lovanium.

Gheel, J. de (1928) [1652]. *Le plus ancient dictionnaire bantu: het oudste Bantu-woordenboek*, translated into French and Dutch by J. van Wing and C. Penders. Leuven.

Goad, Heather (1993). *On the configuration of height features*. PhD dissertation, USC.

Goldsmith, John (1985). Vowel harmony in Khalkha Mongolian, Yaka, Finnish and Hungarian. *Phonology Yearbook* **2**. 253–275.

Guthrie, Malcolm (1967–71). *Comparative Bantu.* 4 vols. London: Gregg.

Hayes, Bruce (1986). Inalterability in CV phonology. *Lg* **62**. 321–351.

Hyman, Larry M. (1970). The role of borrowing in the justification of phonological grammars. *Studies in African Linguistics* **1**. 1–48.

Hyman, Larry M. (1990). Non-exhaustive syllabification: evidence from Nigeria and Cameroon. *CLS* **26:2**. 175–195.

Hyman, Larry M. (1995a). Nasal consonant harmony at a distance: the case of Yaka. *Studies in African Linguistics* **24**. 5–30.

Hyman, Larry M. (1995b). Minimality and the prosodic morphology of Cibemba imbrication. *Journal of African Languages and Linguistics* **16**. 3–39.

Hyman, Larry M. (in press). The historical interpretation of Bantu vowel harmony. In J. M. Hombert & L. M. Hyman (eds.) *Recent advances in Bantu historical linguistics.* Stanford: CSLI.

Hyman, Larry M. & Sharon Inkelas (1997). Emergent templates: the unusual case of Tiene. *University of Maryland Working Papers in Linguistics* **5**. 92–116. (Also available as ROA-214 from the Rutgers Optimality Archive.)

Kidima, Lukowa (1991). *Tone and accent in Ki Yaka.* PhD dissertation, UCLA.

Kisseberth, Charles W. & Mohammad Imam Abasheikh (1974). A case of systematic avoidance of homonyms. *Studies in the Linguistic Sciences* **4**. 107–124.

Laman, K. E. (1936). *Dictionnaire kikongo-français, avec une étude phonétique décrivant les dialectes les plus importants de la langue dite kikongo.* 2 vols. Brussels. Republished 1964, Ridgewood: Gregg.

Leitch, Myles (1996). *Vowel harmony of the Congo basin: an optimality-theoretic analysis of variation in the Bantu C. zone.* PhD dissertation, University of British Columbia.

McCarthy, John J. & Alan Prince (1993). Generalized alignment. *Yearbook of Morphology 1993.* 79–153.

McCarthy, John J. & Alan Prince (1995). Faithfulness and reduplicative identity. In Beckman *et al.* (1995). 249–384.

Meeussen, A. E. (1967). Bantu grammatical reconstructions. *Africana Linguistica* **3**. Tervuren: Musée Royal de l'Afrique Centrale. 79–121.

Meinhof, Carl (1932). *Introduction to the phonology of the Bantu languages.* Translated and revised by N. J. van Warmelo. Berlin: Dietrich Reimer.

Orgun, Cemil Orhan & Ronald Sprouse (in press). From MParse to Control: deriving ungrammaticality. *WCCFL* **16**.

Prince, Alan & Paul Smolensky (1993). *Optimality Theory: constraint interaction in generative grammar.* Ms, Rutgers University & University of Colorado, Boulder.

Ruttenberg, P. (1971). *Lexique yaka–français, français–yaka.* Kinshasa.

Sample, Ward A. (1976). *The application of rules in the phonology of Olukisa.* PhD dissertation, Indiana University.

Schlindwein, Deborah (1989). Context sensitive fill-in rules and underspecification theory. *Linguistic Analysis* **19**. 77–98.

Sprouse, Ronald (1997). A case for enriched inputs. Paper presented at TREND 7, UCSC. (Available as ROA-193 from the Rutgers Optimality Archive.)

Steriade, Donca (1994). Positional neutralization and the expression of contrast. Ms, UCLA.

Steriade, Donca (1995). Underspecification and markedness. In J. Goldsmith (ed.) *The handbook of phonological theory.* Cambridge, Mass. & Oxford: Blackwell. 114–174.

Whiteley, W. H. (1960). *The tense system of Gusii.* Kampala: East African Institute of Social Research.

Zoll, Cheryl (1996). *Parsing below the segment in a constraint-based framework.* PhD dissertation, UCB.