Revised - September 1997

Positional Prominence and the "Prosodic Trough" in Yaka

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1. Introduction

The issue of Bantu vowel height harmony is one that most serious theories of phonology have addressed at one time or another. 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. In this paper I have three goals. First, I present a comprehensive treatment of the unusual vowel harmony system in (ki-)Yaka, a Western Bantu language spoken in ex-Zaire, designated as H.31 by Guthrie (1967-1971). Second, I introduce the notion of the prosodic trough (τ), a domain which is needed in order to state important phonological generalizations 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 organized as follows. In §2 I establish the general nature of the Yaka harmony system, reanalyzing 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.[1]

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,[2] I illustrate the latter from Kisa E.32 (Sample 1976) in (1).

(1) Vowel height harmony in Eastern Bantu, i → e / {e, o} __, u → o / o __, 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'
	-″is-il-a	'hide + appl'		-″is-ul-a	'reveal'
	-fu:ng-il-a	'lock + appl'		-fu:ng-ul-a	'unlock'
	-″a:mb-il-a	'spread out fasten down'		-″a:mb-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

[1]This paper was presented at the Southwest Optimality Theory workshop at U.C.L.A. on June 1, 1997 and in a phonology seminar at U.C. Berkeley on September 18, 1997, participants at which I would like to thank for their helpful comments. I am particularly endebted to Sharon Inkelas, who has continually provided valuable input, and in whose seminar in I was inspired to produce this study. I am also grateful to Karel van den Eynde, Claire Grégoire and Lukowa Kidima for their written correspondences with me on Yaka. This study was greatly faciliated by the transfer of the Yaka-French part of the Ruttenberg (1971) dictionary into database form by John Lowe (co-PI) as part of the Comparative Bantu On-Line Dictionary (CBOLD) project, funded in part by National Science Foundation Grants #SBR93-19415 and #SBR96-16330.

[2]For example by Archangeli & Pulleyblank (1994): "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...." (p.443).

"asymmetric" pattern of VHH (Hyman 1997). This pattern is widely attested throughout Eastern Bantu and is well established in the literature.[3]

However, the earliest attestation of Bantu vowel harmony, in S. Kongo H.16 (de Gheel 1652 [translated by van Wing & Penders 1928]) and illustrated in (2), comes from *Western* Bantu:

(2) Vowel height harmony in Western Bantu, i, u → e, o / {e, o} __, e.g. S. Kongo H.16

a.	-somp-el-a	's'attacher à'	b.	-tomb-ol-a	'faire monter'
	-leng-el-a	'dépérir, languir'		-lemb-ol-a	'barrer, effacer'
	-sik-il-a	'soutenir, fortifier'		-vil-ul-a	'mouvoir, remuer'
	-vur-il-a	'surpasser, l'emporter'		-bub-ul-a	'corrompre'
	-land-il-a	'suivre'		-bang-ul-a	'faire violence, violer'

These 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 1997 for further discussion).

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

(3) VHH of the perfective suffix in Yaka

a.	kik-idi	'barrer'	kin-ini	'danser'
	kud-idi	'chasser qqn'	kún-ini	'planter'
	kas-idi	'lier'	kan-ini	'proposer'
b.	keb-ele	'faire attention'	kém-ene	'gémir'
	sol-ele	'déboiser'	són-ene	'colorer'

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 M(id) feature.

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[3]The earliest explicit reference to it that I have found comes from Bleek (1862:62): "The rule of vowel harmony is in a very restricted manner carried out in the termination of inversive verbs, -ura or -una, which become -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."

[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.

(4) Apparent spreading of "mid" feature (M) from left to right

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 harmonizing Bantu languages, the presence of a preceding M vowel is neither sufficient nor necessary to get height harmony in Yaka. The verb forms in (5), for example,

(5) No VHH on the usual verb suffixes ("extensions"): applicative, causative, reversive

	Applicative -il-			Causative -is-	
a.	kik-il-a	'barrer pour'	b.	kik-is-a	'faire barrer'
	kud-il-a	'chasser pour'		kud-is-a	'faire chasser'
	kas-il-a	'lier pour'		kas-is-a	'faire lier'
	keb-il-a	'faire attention pour'		keb-is-a	'faire faire attention'
	sol-il-a	'déboiser pour'		sol-is-a	'faire déboiser'
	Reversive intransitive -uk-			Reversive transitive -ul-	
c.	zib-uk-a	'être ouvert'	d.	zib-ul-a	'ouvrir'
	hul-uk-a	'être sauvé'		hul-ul-a	'sauver'
	bal-uk-a	'être renversé' (camion)		bal-ul-a	'renverser'
	yek-uk-a	'être séparé'		yek-ul-a	'séparer'
	tob-uk-a	'être percé'		tob-ul-a	'percer'

show that high vowel suffixes other than the perfective do not by themselves undergo height harmony after a mid vowel. Thus, both the applicative suffix -il- in (5a) and the causative suffix -is- in (5b) fail to harmonize after /e/ and /o/. Similarly, the reversive suffixes -uk- and -ul- do not harmonize 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 morphologized, 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 *-ɟd-e is reconstructed with a high tense vowel *ɟ, while the vowels of the suffixes in (5) are reconstructed with the lower lax vowel *i. It is this latter "degree 2" vowel that harmonized historically (Meeussen 1967). Thus, in many Bantu languages such as Haya E/J.22 the applicative harmonizes (e.g. a-kom-él-a 'he ties for/at'), while the perfective does not harmonize (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":

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[6]A rather complex but logical diachronic explanation (which I reject) begins by first generalizing left-to-right VHH to perfective *-ɟd-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 morphologization 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 notably exceptions (Leitch 1996, Hyman 1997).

(6) VHH would have to target the perfective suffix "at a distance"

a.	hit-ik-a	/	hit-ik-idi	'envoyer'	b.	zib-uk-a	/	zib-uk-idi	'être ouvert'
	fut-ik-a	/	fut-ik-idi	'plier'		hul-uk-a	/	hul-uk-idi	'être sauvé'
	kab-ik-a	/	kab-ik-idi	'étendre'		bal-uk-a	/	bal-uk-idi	'être renversé'
c.	yed-ik-a	/	yel-ek-ele	'gouter'	d.	yek-uk-a	/	yek-ok-ele	'être séparé'
	kos-ik-a	/	kos-ek-ele	'ajouter'		tob-uk-a	/	tob-ok-ele	'être percé'
e.	bet-idik-a	/	bet-elek-ele	'abaisser'	f.	kel-umuk-a	/	kel-omok-ene	'faire volteface'

These data show that vowels that occur between the root and the perfective suffix potentially harmonize. 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 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 and the 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 Mid 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) No VHH on the final vowel -i used in conditional

a.	tu-kik-í	'si nous barrons'	c.	tu-kik-id-í	'si nous barrons pour'
	tu-kud-í	'si nous chasser qqn'		tu-kud-id-í	'si nous chassons qqn pour'
	tu-kas-í	'si nous lions'		tu-kas-id-í	'si nous lions pour'
b.	tu-keb-í	'si nous faisons attention'	d.	tu-keb-id-í	'si nous faisons attention pour'
	tu-sol-í	'si nous déboisons'		tu-sol-id-í	'si nous déboisons pour'

(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 harmonize after root /e/ and /o/. In (7c,d) I have added the applicative suffix -il-, pronounced [-id-] before [i], which also fails to harmonize 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) No VHH of -iCi or -uCi in derived nouns:

a.	n-són-ík-í	'écrivain'	<	son-ik-a	'écrire'
	ma-lók-ís-í	'bruit, chahut'	<	lok-a	'ensorceler'

[7]Within Bantu, the verb stem must end with one of a small number of inflectional endings. In Yaka these include perfective -ile, 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 realization 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 *ɟd-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 proably 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'."

b.	n-téém-ún-í	'civilisateur'	<	teem-un-a	'civiliser'
	n-yék-úd-í	'traître'	<	yek-ul-a	'trahir'
	n-lóng-úk-í	'élève, apprenti'	<	long-uk-a	'apprendre, étudier'

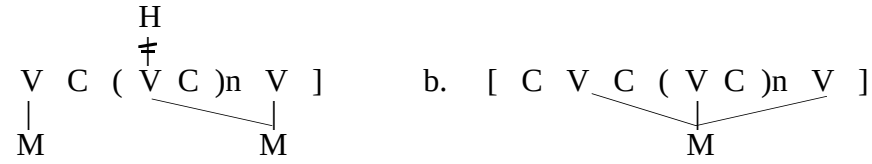
These nouns in fact contrast with others such as those in (9), which end in front mid vowels:

(9) Nouns may end -eCe (13 out of 16 examples end in -ele/-ene)

a.	phélékélé	'ombrage'	b.	khélénge	'souffrance'
	kéngele	'bloc de sel'		khékhékhe	'petitesse'
	yi-séngele	'hache'		yi-kwéléte	'boîte à poudre (pour fusil)'

On the basis of these facts, I would like now to argue for a quite different anlysis. 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 M's. [8]

(10) a. [C V C (V C)n V] b. [C V C (V C)n V]



(11) a. [... V] b. V]

Where plateauing is not possible, the M feature of /-ile/ is deleted. In the formulation in (11a) I exploit Hayes' (1986) linking convention. This formulation thus stands for the more awkwardly stated rule in (12b). 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.

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. The table in (11) summarizes the distribution of vowels in (native) bisyllabic noun stems, based on Ruttenberg (1971):

[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 generalizations that characterize the remainder of the stem. In §4, where the "prosodic trough" is introduced, I will explicitly exclude the first syllable from the harmony domain.

(11) Vowel distributions in native CVCV noun stems

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

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 generalization 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 generalization is that a monomoraic /e/ may not occur outside the first syllable of a noun stem. Let us consider the effect of extending this generalization 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 a monomoraic (i.e. if it fails to spread right-to-left).

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 a monomoraic.

Further evidence that a final /e/ must be multiply linked is seen from the French borrowings in (13).

(13) Borrowings from French that end in /e/ in Yaka

a.	bélée	'béret'	kuphée	'culotte'	b.	m-félélé	'frère' (rel.)
	búlée	'bleu'	lábée	'abbé'		kómélése	'commerce'
	kálée	'calé'	phínée	'pneu'		phéengele	'épingle'
	káyée	'cahier'	yi-zámée	'examen'		-ofélée	'offert'

Of the 20 French borrowings ending in Yaka [e] in Ruttenberg (1971), only 1 (búse 'bougie') 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 'Pâques', káafi 'café' 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 (14).

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[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 'linge, étoff, tissu'; n-yénde 'esp. de panier'; (ii) -bóte in both m-bóte 'bonté, honnêté' and di-mbóte 'bienfait'; (iii) w-áándzyo 'ange' (borrowed from French?). Another CeCe form, mbele 'celui qui, quiconque' might be mentioned, but may be a grammatical item. Finally, it is not clear whether the five CoCu noun stems are "in" the system vs. exceptional. They are: b-óoku 'champignon'; khókú 'premier chant du coq'; thótú 'esp. de lapin'; yi-zóombu 'gibicière'; wóólu 'or' [borrowed from English *gold*?].

[10]The nouns in (13a) 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 (13b), final epenthetic [e] does not develop into [ée]. Also, I assume that kuphée in (13a) derives from French *coupé* 'cut'.

(14) Delinking of M of /o/ if not preceded by V1 M vowel also explains the following alternations:

a. dí-ísú 'oeil' /li-iso/ pl. m-éésó /ma-iso/ < PB *-jɟco 'eye'
dí-ínú 'dent' /li-ino/ pl. m-éénó /ma-ino/ < PB *-jɟno 'tooth'

b. cf. /ba-ifi/ 'voleurs' → bééfi (var. bíífi) *bééfe̲

The vowel height of both syllables of these nouns differ 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 (14b), where the class 2 prefix /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 that 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 reconstructoins to the right in (14a), as well as reflexes in order 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:

(15) This first source of right-to-left VHH results from the interaction of three constraints

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

[11] Meinhof and 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 generalized 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 in §1.7 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|)" (p.84). In Yaka, which has merged *ɟ/*i and *ɯ/*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 optimality theoretic work on positions of relative prominence, see Casali (1996), Zoll (1996), Beckman (1997) and the references cited therein.

vowel (FV). The tableaux in (16) and (17) show how these three constraints derive the correct outputs of /kik-ile/ and /keb-ile/, respectively:[13]

(16)

	/kik-ile/	IDENT V_1	PLATEAU	IDENT FV
	kik-ile		*	
	kik-ele		*!	
	kik-ele			
	kik-idi			*

In (16) the input vowel of the root /kik-/ is high, therefore the perfective suffix must be realized -idi. The form kik-ile is ruled out in (16a) 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 (16b), PLATEAU is still violated.[15] To avoid violating PLATEAU in (16c), 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 (16d), where only the lower ranked IDENT FV is violated.

Now compare the tableau in (17), where the root vowel is mid.

(17)

	/keb-ile/	IDENT V_1	PLATEAU	IDENT FV
	keb-ile		*!	
	keb-ele			
c.	keb-idi			*!
d.	kib-idi	*!		*

In (17a) we again obtain a PLATEAU violation when the M feature remains on the FV. This is fixed up in (17b) by right-to-left M spreading. Had we instead delinked the M feature of the FV, as in (17c), a violation of IDENT FV would have occurred. Finally, we obviously would have the worst possible outcome if, as in (17d), 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.

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[13]While the three constraints in (15) 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 and Kisseberth (1997).

[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 intepretation 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 V1 would violat 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.

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 in (18a,b).

(18) Second source of -ele from "imbrication" (fusion) of the perfective

a.	zib-uk-a	/ zib-uk-idi	'être ouvert'	c.	zib-ul-a	/ zibwel-e	'ouvrir'
	hul-uk-a	/ hul-uk-idi	'être sauvé'		hul-ul-a	/ hulwel-e	'sauver'
	bal-uk-a	/ bal-uk-idi	'être renversé'		bal-ul-a	/ balwel-e	'renverser'
b.	yek-uk-a	/ yek-ok-ele	'être séparé'	d.	yek-ul-a	/ yekwel-e	'séparer'
	tob-uk-a	/ tob-ok-ele	'être percé'		tob-ul-a	/ tobwel-e	'percer'

These forms show the reversive intransitive suffix -uk- followed by the perfective suffix. Plateauing harmony applies in (18b), as expected, but not in (18a), where the root vowel is /i/, /u/ or /a/. Compare now the data in (18c,d), where the verb bases end in the reversive transitive suffix -ul-. Here the perfective, which has been analyzed 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/). Had there been no imbrication, we would have expected the forms in (19a), parallel to those in (18a,b):

(19) Expected realizations of -ul- + -ile suffixes in (18c,d):

a. If not imbricated: *zib-ud-idi, *hul-ud-idi, *bal-ud-idi, *yek-ol-ele, *tobol-ele,
b. If imbricated: *zibwid-i, *hulwid-i, *balwid-i, yekwel-e, tobwel-e

In many other Bantu languages (e.g. neighboring 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 (19b). While the [e] of the penultimate syllable in (18d) can be attributed to plateauing, the [e] in (18c) 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.

In Yaka, imbrication, and its corollary of unexpected right-to-left spreading of the FV, is not limited to the perfective suffix. The forms in (20a,b) document an uneventful appearance of the applicative suffix -il- after the reversive intransitive suffix -uk-:[17]

(20) Imbrication of applicative -il-

a.	zib-uk-a	/ zib-uk-il-a	'être ouvert'	c.	zib-ul-a	/ zibwal-a	'ouvrir'
	hul-uk-a	/ hul-uk-il-a	'être sauvé'		hul-ul-a	/ hulwal-a	'sauver'
	bal-uk-a	/ bal-uk-il-a	'être renversé'		bal-ul-a	/ balwal-a	'renverser'

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

[17]Some of the examples in (20) 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.

b. yek-uk-a / yek-uk-il-a ‘être séparé’
tob-uk-a / tob-uk-il-a ‘être percé’

d. yek-ul-a / yekwal-a ‘séparer’
tob-ul-a / tobwal-a ‘percer’

In (20c,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. 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 (21).

(21) Expected realizations of -ul- + -il- suffixes in (20c,d):

a. If not imbricated: *zib-ud-il-a, *hul-ud-il-a, *bal-ud-il-a, *yek-ud-il-a, *tobud-il-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 (21a), parallel to the forms in (20a,b) which end in /k/. Since we know that imbrication does take place, the expected forms in (21b) should have had the penultimate vowel [i], as in Kongo and other Bantu languages, not [a].

This same penultimate [a] is also observed in (22) when the causative suffix -is- imbricates:[19]

(22) Imbrication of causative -is-

a. zib-ul-a / zibwas-a ‘ouvrir’
hul-ul-a / hulwas-a ‘sauver’
bal-ul-a / balwas-a ‘renverser’

b. yek-ul-a / yekwas-a ‘séparer’
tob-ul-a / tobwas-a ‘percer’

The expected realizations are shown in (23).

(23) Expected realizations of -ul- + -is- suffixes in (22a,b):

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

Again, (23a) shows how the causative would have been realized if there had not been imbrication, while the expected imbricated forms in (23b) show the vowel [i] in their penultimate syllable. Finally, note the right-to-left spreading of the final vowel /a/ in the triplets in (24a,b) from Ruttenberg (1971):

(24) Triplets attested in Ruttenberg (1971)

a. kabula ‘retourner’
kabwala ‘retourner pour’ (appl)
kabwasa ‘faire retourner’ (caus)

b. koombula ‘balayer’
koombwala ‘balayer pour’ (appl)
koombwasa ‘faire balayer’ (caus)

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 (25), 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 (25a,b).

[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 nasalized counterpart [un]).
[19]As in (20), 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) Right-to-left spreading of FV -e/-a is motivated by the phonotactic constraint: *[wi]

a. ...Cwile → ...Cwele = (18c,d)

b. ...Cwila → ...Cwala = (20c,d; 22a,b)

The spreading of the FV can in fact take place at-a-distance. Thus consider the forms in the table in (26).

(26) **Perfectives of Imbricated Applicatives**

a. verb	b. applicative	c. applicative +perf	d. gloss
butul-a	butwal-a	butwelel-e	commencer (par)
kabul-a	kabwal-a	kabwelel-e	retourner (pour)
kakul-a	kakwal-a	kakwelel-e	marchander (pour)
katul-a	katwal-a	katwelel-e	enlever (pour)
leengul-a	leengwal-a	lengwelel-e	polir (pour)
taambul-a	taambwal-a	taambwelel-e	accepter (pour)
timbul-a	timbwal-a	timbwelel-e	jeter (à)
yubul-a	yubwal-a	yubwelel-e	rappeler (pour)

The input verb bases in (26a) all have the shape CVCul-, which permits imbrication of the applicative in (26b). When these applicativized verbs are in turn perfectivized, we obtain the forms in (26c), 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 (27) has become Mid at a distance from the final vowel -e of the perfective:

(27) Derivational account of applicative +perfective VHH at a distance:

butul-il-	→	butwil-	→	butwil-ile	→	butw<u>e</u>l-ele
root+app		imbrication		base+perf		VHH at distance (to repair *[wi])

The examples in (28) show a similar at-a-distance spreading of the final vowel -a:[22]

(28) Lexicalized cases of R → L spreading of L of -a at a distance

	Underlying	**Surface**		**Related verbs**	
a.	/kabul-is-il-a/	kabw<u>a</u>sal-a	'répondre, refrapper'	kabul-a	'retourner'
				kabwal-a	'retourner pour'
				kabwas-a	'faire retourner'
b.	/mokul-ilil-a/?	mokw<u>a</u>nan-a	'supplier, demander pardon'	mok-a	'bavarder'
c.	/yakul-is-an-a/	yakw<u>a</u>san-a	's'interpeller'	yakul-a	'aborder, interpeller
d.	/yekul-is-an-a/	yekw<u>a</u>san-a	'se séparer, divorcer'	yekul-a	'séparer, écarter'
				yekwas-a	'séparer, diviser'
e.	/ziimbul-is-an-a/	ziimbw<u>a</u>san-a	'se raconter'	ziimbul-a	'expliquer, exposer'

[21]It is noted in (26c) and the derivation in (27) that perfective imbrication does not apply. This is because an output such as *butwel-e would be a MAX violation (applicative -il- is not realized in the output), and would, in fact, be identical to the realization obtained from the input /butul + ile/, which lacks the applicative. See below.

[22]The suffix divisions in (28) are included for clarity only. It is likely that -is-an-, for instance, should be analyzed as a single reciprocal suffix, not two suffixes (cf. §4).

These all involve the imbrication either of the causative morph -is- or the first -il- of the -ilil- suffix. A derivational account of (28a) is shown in (29).

(29) Derivational account of -isil- VHH at a distance:

kabul-is-il-	→	kabwisil-	→	kabwisil-a	→	kabwasal-a
root-caus-app		imbrication		base+FV		VHH at distance (to repair *[wi])

In both (27) 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. 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-kwíikílú ‘foi’. This form is most likely a borrowing from the Kongo form lu-kwikilu ‘credulité’ (de Gheel 1652), derived from the verb kwikila ‘croire’. Interestingly, the corresponding Yaka verb kuukila ‘croire’ 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 (30).

(30) a.	/ba-ífi/	→	béefi, bíifi	‘voleurs’	
b.	/mu-ífi/	→	múúfi	‘voleur’	cf. Kongo [mwíifi]
c.	/ú-is-ilí/	→	wúús-idi	‘il est venu’	
	/tu-is-ilí/	→	thuus-idí	‘nous sommes venus’	

I have already cited the two plural forms of /bá-ífi/ ‘thieves’ in (14b), repeated here in (30a). The corresponding singular, however, has the prefix /mu-/ followed by a root-initial /i/. In order to avoid the expected output [mwíifi], as it is pronounced in certain Kongo dialects, a long [uu] is obtained in Yaka in (30b), rather than, say, a change in the height of the vowel to obtain *mwéefi. The verb forms in (30c) show the realization 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 (30c), a long [uu] is obtained. The same loss of /i/ with lengthening of the stem V_1 is seen in the suffixed forms of the CV verb roots in (31), which lists all of the CV verbs and suffixed forms that appear in Ruttenberg (1971):

(31) **Table of CV- verb roots + suffixes**

	root	root + -a	perfective -ile	applicative -il-a	causative -is-a	gloss
a.	di-	dy-a	di-idi	di-il-a	di-is-a	‘manger’
	hi-	hy-a	hi-idi	hi-il-a	hi-is-a	‘brûler’ (intr.)
	si-	sy-a	si-idi	si-il-a	si-is-a	‘placer’
b.	ti- (~ te-?)	ty-a	ti-idi	ti-il-a / tye-el-a		‘aimer’
c.	khe-	khy-a	khye-ele	khye-el-a		‘faire jour’
d.	bu-	bw-a	bu-udi	bu-ul-a	bu-us-a	‘tomber’
	fu-	fw-a	fu-udi	fu-ul-a		‘mourir’
	hu-	hw-a	hu-udi	hu-ul-a		‘finir’
	nu-	nw-a	nu-uni	nu-un-a	nu-us-a	‘boire’
	tsu-	tsw-a	tsu-udi	tsu-ul-a		‘manquer’
	tu-	tw-a	tu-udi	tu-ul-a		‘être aiguisé’
	vu-	vw-a	vu-udi	vu-ul-a		‘posséder’
	wu-	w-a	wu-udi	wu-ul-a		‘entendre’
e.	ta-	t-a	te-ele	te-el-a	te-es-a	‘frapper’

As seen, in suffixed forms such as the applicative column of (31d), 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 V_1 vowel /u/ of -bu-, -fu-, etc.

Finally, consider the forms in (32), where imbrication is responsible for the truncation of the -il- part of the the perfective suffix -ile.[23]

(32) Only "plateauing" VHH with imbrication when coronal C is preceded by /i/

a.	yimbil-a	→	yimbid-i	'chanter'	b.	keembil-a →	keembel-e 'faire volteface'
	kuukil-a	→	kuukid-i	'croire'		boondil-a →	boondel-e 'se desagréger'
	yambil-a	→	yambid-i	's'éveiller'			

Without imbrication, the perfective of yimbil-a in (37a) would have been *yimbid-idi, while that of keembil-a in (37b) would have been *keembel-ele, etc. Plateauing vowel height harmony applies in (32b), but there is no height harmony in (32a). We can explain why Mid does not spread with imbrication in (32a) 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 (16b).

The question we must now address is how imbrication should be analyzed. 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/ 'commencer + 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 imbrication as the spreading of the -e or -a features of the FV, i.e. without having to recognize an -il- sequence in such forms (cf. the Appendix).

In the present analysis I shall assume what I consider to be the traditional account of imbrication as documented in Bastin (1983), Hyman (1995) 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 F(ront) feature.[24] 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 (32). (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).[25] 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 realized:

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

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

[25]I assume that the inputs to the forms in (32a) 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).

(33)

	/butu-i-l-e/	IDENT V_1	*[wi]	MAX	PLATEAU	IDENT FV
a.	butwil-e		*!			
b.	butul-i			*!		*
☞	butwel-e				*	
d	bwet(w)el-e	*!				

We begin with /butu-i-l-e/ the perfective of /butul-/ 'commencer'. Candidate (33a) is ruled out by virtue of its violating *[wi], while candidate (33d) violates even higher-ranked IDENT V_1. Candidate (33b) is rejected on the basis that the infix -i- has no surface correspondent.[26]

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 nasalized derivative [n]). (iii) The vowel that precedes the final /l/ must be /u/.[27] Starting with /butu-i-l-a/ 'commencer par', the imbricated applicative form of /butul-/, the tableau in (34) shows that the same ranked constraints produce the correct output derivation of butwal-a 'commencer par' is rather straightforward:

(34)

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

Candidate (34a) is ruled out by the *[wi] constraint, while the candidates in (34b) and (34c) are blocked because of their violation of MAX. As seen, the correct output, butwal-a, in (34d) does not violate any of the five constraints considered. Finally, (34e) 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 summarized again in (35a,b).

(35) FV-spreading to avoid [wi] produced in imbrication (butul- 'commencer')

		root		*imbrication*		*output*
a.	perfective with FV -e	butul-	→	butwil-e	→	butwel-e
b.	applicative with FV-a	butul-	→	butwil-a	→	butwal-a
c.	applicative with FV-i	butul-	→	butwid-i	→	butwad-i (!)

Given that [wi] is avoided by spreading the M or L of the FV in (35a,b), what should be expected to happen when applicative (or causative) imbrication co-occurs with the conditional FV -i? It is clear that the sequence [wi] in butwid-i in the intermediate form in (35c) cannot be fixed by spreading the [i] of the FV to the left. Neither van den Eynde (1968) nor Ruttenberg (1971) indicate 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 characterized as infixation of -i-, this form would be derived

[26]This of course would have to be made more precise, since one could assume that the underlying mora of -i- is the one preserved in the output.

[27]The same conditions hold of causative imbrication except that the /s/ of -is- overwrites the final /l/ (recall the examples in (22) above).

as indicated in (40c): butul- → butwil- → butwid-i → butwad-i, where the [a] would have to be epenthesized into the form in order to prevent [wi].[28]

The tableau in (36) shows, however, that butwad-i is the best candidate of the most likely alternatives:[29]

(36)

/butu-i-l-i/	IDENT V_1	*[wi]	MAX	PLATEAU	IDENT [L]	IDENT FV
butwid-i		*!				
butud-i			*!			
butwed-i				*!		
but(w)od-i				*!		
butwad-i					*	

In this tableau I have added the constraint, DEP [L], designed to assess the cost of acquiring a L feature that is not present in the input. As seen, (36a) is barred because it violates the high ranking *[wi] constraint. MAX rules out (36b), which, since it does not have an overt realization of -i-, is in fact identical to the non-applicative form. As seen, PLATEAU rules out candidates (36c,d). As seen, the candidate in (36e) violates only IDENT [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.[30]

Returning to the Constraint MAX, we have rejected the outputs butud-i in (33b) and (36b) and butul-a in (34b) 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 realized. 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 (32). 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- 'prendre', is perfectivized, 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- 'réprimander', whose perfective is bakid-i. This fact provides further evidence that Yaka speakers also do not allow the applicative allomorph -il- to get totally lost.[31]

Finally, let us consider how to achieve the correct output when the verb root has the shape -Cu-, as the input /bu-il-a/ 'tomber + appl' in (37).

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[28]Another possibility in a derivational approach would be to recognize an intermediate representation butwal-a. One could then replace the FV -a with -i (or perhaps even recognize 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.

[29]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 and Sprouse, to appear). As seen, Yaka instead prefers to epenthesize [a].

[30]Many thanks to Eric Bakovic for pushing me to explore this strategy for explaining the occurrence of epenthetic [a].

[31]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)."

(37)

	/bu-il-a/	IDENT V_1	*[wi]	MAX	PLATEAU	IDENT FV
a.	bv-il-a	*!	*!			
b.	bv-al-a	*!				
c.	bu-ul-a			?		

Both (37a) and (37b) violate IDENT V_1 and hence are rejected, whether or not we consider (37c) to violate MAX (since the mora of -i- is realized).

In the next section we shall see the need to refine IDENT V1 slightly.

4. TROUGH [V-V] and vowel height harmony

In previously 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/ and /i/. We now consider the third vowel /a/ which allows imbrication only in the perfective. The data in (38) show that when the pre-coronal vowel is /a/, imbrication produces [e] from /a+i/:

(38) Perfective imbrication with the pre-coronal vowel /a/

a.	timan-a	→	timen-e	'se débattre'	b.	kweelan-a	→	kweelen-e 'se marier'
	sundal-a	→	sundel-e	'dormir'		zoondan-a	→	zoonden-e 's'arranger'
	zakal-a	→	zakel-e	's'éveiller'				

A standard derivational account such as documented in Bastin (1983) and Hyman (1995b) would be as in (39).

(39) Derivational account of imbrication

CV_1CV_2C	→	$CV_1CV_2V_3C$-V	→	CV_1C	V_3C-V	→	CVCVC-V
| | | | |		| | | | | | |		| | |	| | |		| | | | |
z a k a l		z a k a i l e		z a k a i l e			z a k e l e

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 in the plural noun forms in (14a) above: /ma+iso, ma+ino/ → meeso 'eyes', meeno 'teeth'. The correct output is obtained as in (40).

(40)

	/zaka-i-l-e/	IDENT V_1	*[wi]	MAX	PLATEAU	IDENT FV
a.	zakid-i			*!		*
b.	zakad-i			*!		*
c.	zakel-e				*	
d	zekel-e	*!				

(40a,b) are ruled out as violations of MAX, and (40d) as a violation of IDENT V1. (40c) is the correct output, even though it violates PLATEAU. As seen, however, (40a), in which the second /a/ of /zaka-i-

l-e/ is not realized violates only low-ranked IDENT FV. In order to obtain the correct output, we assume in just this case that both vowels of an /ai/ input can correspond to an input [e].[32]

As a result of imbrication, we thus can derive a penultimate [e] from the coalescence of a+i. However, nothing we have seen thus far would explain why the (non-imbricated) perfective ending is -ene in (41).

(41) -ene is required when a polysyllabic verb base ends in /am/

a.	yilam-a	→	yilam-ene	'se préparer'	CiCamene 13	CiCemene Ø
	bukam-a	→	bukam-ene	'se coucher'	CuCamene 15	CuCemene Ø
	lakam-a	→	lakam-ene	'insister'	CaCamene 21	CaCemene 1
b.	zetam-a	→	zetam-ene	'être tordu'	CeCamene 8	CeCemene 12
	kolam-a	→	kolam-ene	'désobéir'	CoCamene 10	CoCemene 3

Recall from forms such as kas-idi 'lier' and kan-ini 'proposer', seen earlier 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 (41), right-to-left spreading of M does occur if the preceding /a/ is not stem-initial.[33] We thus obtain yilam-ene instead of *yilam-ini (etc.). The question is why?

The answer comes from an examination of the prosodic structure of the stem (root + suffixes). As shown, in (42), I propose that verb stems in Yaka (and in Bantu generally), divide into the following subcomponents for prosodic purposes:

(42) The prosodic trough (τ) as a harmony domain (vs. "perimeters")

General Bantu Trough: < CV(V)C > τ < V > (where τ = $(VC)^n$)

In Yaka:	a.	<CV(V)C>	<V>	τ = Ø
	b.	<CV(V)C> VC	<V>	τ = VC
	c.	<CV(V)C> VCVC	<V>	τ = VCVC

As indicated, the stem contains a "prosodic trough" obtained by exbraciating the two perimeters: (i) the initial CV(V)C and (ii) the final V of the stem. In (42a), Yaka verb stems of the shape CV(V)C-V have no trough, while those in (42b) and (42c) have -VC- and -VCVC- troughs, respectively. It is crucial that phonological restrictions often hold only within the trough, as thus defined. While the

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[32]This also applies to the nouns meeso and meeno in (14a). It is, however, not clear how these surface realization survive, given that they violate IDENT V1. There are a number of strategies that might be followed, one of which is to redefine IDENT V1 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.

[33]As seen in the following distributions, Ruttenberg's perfective entries for CVCam- verb stems are somewhat inconsistent:

CiCamene 13	CiCemene Ø	
CuCamene 15	CuCemene Ø	
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 on-going changer 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].

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.[34]

(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 'ressusciter (tr.)', 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-perfectivized) verbs that have five syllables: One is the applicative fikukidila from fikuka (or fikukila) 'pleurnicher, sangloter'. The other two are reduplications: baaka-(ku)baaka 'déchirer plusieurs fois' and beeta-beeta 'frapper plusieurs fois'.

(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 generalizations 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 (42) rather than *yilam-ini. As seen in the table in (44),

(43) Possible V-V Trough Sequences in Quadrisyllabic Verb Stems (CVCVCVCV)

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

[34]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- 'grimper' → meet-e.

-aCiC- is not a possible trough sequence, while -aCeC- is. Hence one cannot obtain -ini after verb bases of the shape CVCa-. I thus suggest that this right-to-left VHH is trigger by a *third* factor (in addition to PLATEAU and *[wi]: namely, to avoid an unacceptable trough sequence (TROUGH). The table in (44) shows that the correct output is obtained if TROUGH is ranked above PLATEAU:

(44)

	-ilam-ile	IDENT V_1	*[wi]	TROUGH	PLATEAU	IDENT FV
a	-ilam-ini			*		*
b	-ilam-ni				*	*!
	-ilam-ene				*	

The account in (44) thus crucially depends on recognizing the trough as a prosodically weak sequence occurring between two peaks of prominence. The data in (45) confirm that the constraint against *-aCiC-, among others, pertains specifically to the trough as the relevant domain:

(45) -aCiC- sequences are prohibited only within the trough

a.	CVC-VCVC-V	:	*kab-amin-i	‘être divisé’ (perfective)
b.	CVC-VC-V	:	kab-ik-a	‘étendre’
c.	CVC-VC-V	:	kab-am-i	‘être divisé’ (conditional)
d.	CVC-Ø-V	:	kab-i	‘diviser’ (conditional)

Since the -amin- sequence is fully contained within the trough in (45a), this form is impossible (and is modified to kab-amen-e as a result). Forms such as kab-ik-a in (45b) show that 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 (45c,d) further show that the FV -i also does not figure in the constraint: In kab-am-i in (45c), the /a/ is in the trough, while the /i/ is in the second perimeter, while in (45d), 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/. In (46) I present the specific -VCVC- trough sequences that confirm these observations:

(46) 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)

The number in parentheses after each sequence indicates how many entries appear with this form in the Ruttenberg dictionary of 1781 verb forms. In (47) I indicate selected historical developments which show how some of these sequences arose from concatenations of Proto-Bantu suffixes:

(47) Selected historical developments yielding trough properties

a.	-umuk-, -umun-	<	*-am-uk-, *-am-ud-	(positional + reversive)
b.	-asan-, -akan-	<	*-is-an-, *-ik-an-	(causative/impositive + reciprocal)
c.	-amas-/-aman-	<	*-am-is-, *-am-id-	(positional + causative/applicative)

As seen, the *a of -am- has assimilated to the following *u of the reversive suffixes *-uk- and *-ud- in (47a), while the *i of the causative and impositive suffixes has assimilated to the *a of the reciprocal

suffix *-an- in (47b). Finally, in (47c) we see that the *i of the causative and applicative suffixes assimilate to the preceding *a of the positional suffix *-am-.[35]

We thus see that Yaka gives evidence of a prosodic trough of easily identifiably properties, one of which is to motivate VHH of CVC-amin-e to CVC-amen-e. Other Bantu languages fall within a wide range. At one extreme a language may have relatively free trough properties (though cf. the quote from Meeusen 1967 in note 12). At the other end of the spectrum a language can have even greater 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 E./J.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 summarize 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 M feature should be immediately preceded by another Mid. Second, *[wi] which rules out such sequences. And third, TROUGH, a family of constraint 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.[36] Although other patterns are also attested in Bantu, one prosodic organization of vowel harmony in these languages is for the trigger to be in the perimeter and the target in the trough, as we have seen in Yaka. However, the *directionality* of vowel height harmony is not predictable from the number or nature of contrasts alone: 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 CVC perimeter or from the final vowel. In this sense directionality still needs to be stipulated.[37]

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[35]Ruttenberg (1971) includes examples like fukamana 's'agenouiller pour adorer' (< fukama 's'agenouiller') and sikamana 'se réveiller à cause de quelque chose' (< sikama 'se réveiller'), which are clearly applicatives. Lukowa Kidima (personal communication) informs me that he usually applicativizes CVCam- verb bases as CVCam-an-, but that CVCam-in- is possible in another dialect area.

[36]Although not developed in this paper, another conclusion to draw from Yaka is that a number of its constraints are language-specific, i.e. arbitrary from a synchronic point of view. There is, for example, no general linguistic reason why the sequence -uCiC- should be permitted in the prosodic trough while the sequence *-iCuC- is disallowed. There is, however, a good historical explanation: 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-ɨd-e and *CVC-uk-is-a, where the applicative, perfective and causative suffixes with *ɨ or *i follow the reversive intransitive suffix *-uk-. The opposite is quite impossible, since *-uk- and *-ud- attach normally only directly to the verb radical. While some Bantu languages allow -iCuC- sequences, many others 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, vol. 1, pp.640-641). In this language, trough /u/ must precede trough /a/ and both /u/ and /a/ must precede /i/ and its harmonized variant /e/. That is, the trough vowels must occur in the fixed order u-a-{i,e}.

[37]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/ nasalizes 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.

APPENDIX : Shorter and Longer Imbricated Forms

The process of imbrication was illustrated and analyzed 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 characterizing 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 (48).

(48) Imbrication of /i/ also found with some bisyllabic verbs with V1 /a/

a.	CaaT-a:	kyaat-a	kyeet-e	'se mettre en rang'	?< *ki-at-
		nwaan-a	nween-e	'se battre, combattre'	PB *du-an-
		haan-a	heen-e	'donner, fournir, confier qqch à qqn'	PB *pa-an-
b.	CaaP-a:	syaam-a	syeem-e	'être confirmé' (sen. relig.)	?< *ci-am-
		swaam-a	sweem-e	'se cacher, s'abriter'	?< *cu-am-
		yaab-a	yeeb-e	'savoir, connaître'	?< *ji-ab-
c.	CaT-a	kal-a	kel-e	'être'	
		man-a	meen-e	'finir, épuiser; être fini épuisé'	PB *mad-
		mat-a	meet-e	'grimper'	PB *mat-
		nat-a	neet-e	'porter, supporter, transporter'	
d.	CoT-a	mon-a	mween-e	'voir'	PB *bón-

The verbs in (48a) have a coronal (T) second consonant, normally required for imbrication, while those in (48b) have a non-coronal (P) second consonant. The four verbs in (49c) have a short vowel, though only the first one fails to acquire length in the perfective.[38] 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 'to see' in (48d) irregularly imbricates, as it does throughout much of the Bantu zone (Meeussen 1967, Bastin 1983). The corresponding Proto-Bantu reconstructions are provided in the right column.

Since the expected perfective forms are kyaat-idi, nwaan-ini etc. , the verbs in (48) must receive special treatment. As shown in (49), 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:

(49) Trough-marking in exceptionally imbricated short-forms

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

[38]This fact is the only indication that the F feature (historically *ị) 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 (48c,d).

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 (49d) is exceptional, as is the /b/ in the last form in (49b). With this exceptional structure, imbrication will appropriately place the infix -i- before the final consonant of the trough, as seen in (50), and surface [e] will be obtained by coalescence.[39]

(50) Trough analysis of imbricated short verbs

a.	b.	c.	d.
<ki> a-i-t <-e>	<si> a-i-m <-e>	<k> a-i-l <-e>	<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 (51).

(51) Plateauing VHH of intervening H vowels

a.	kindumuk-a	→	kindumuk-ini	'être roulé, être déraciné'
	futumuk-a	→	futumuk-ini	'ressusciter (intr.)'
	yandzumuk-a	→	yandzumuk-ini	's'étaler, se détendre, s'ouvrir (fleur).'
b.	kendumuk-a	→	kendomok-ene	'rouler (intr.)'
	wongumuk-a	→	wongomok-ene	'se désagréger, se décomposer'

The examples in (51b) 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 (52), where imbrication takes place:

(52) Imbrication regularly affects entire -VCVC- sequences

a.	kindumun-a	→	kindwemwen-e	'déplacer par moyen d'un lévier (arbre, pierre)'
	futumun-a	→	futwemwen-e	'ressusciter (tr.)'
	yandzumun-a	→	yandzwemwen-e	'étaler, étendre, ouvrir'
b.	kendumun-a	→	kendwemwen-e	'rouler (tr.)'
	wongumun-a	→	wongwemwen-e	'désagreger, décomposer, s' écrouler'

The examples in (52) show imbrication affecting both /u/'s of an -umun- suffix.[40] The expected realizations of the perfectivized forms in (52) are shown in (53).

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[39]In this analysis we avoid the problem of why IDENT V1 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 realized as [ee], IDENT V1 is not really violated, since both the non-high feature of /a/ and the front feature of /i/ are preserved.

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

CVCwemwene	CVCwemene	CVCumwene/CVComwene
CiCwemwene 5	CiCwemene 1	CiCumwene Ø
CuCwemwene 12	CuCwemene 4	CuCumwene 1
CaCwemwene 15	CaCwemene 3	CaCumwene 1
CeCwemwene 10	CeCwemene 1	CeComwene 1
CoCwemwene 3	CoCwemene Ø	CoComwene 1

45 verbs have the double labialized realization -Cwemwen- vs. 9 which have a labialized 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.

(53) Expected forms for (31) ending in ...Cumun-a:

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

(53a) shows how these forms would have been realized without imbrication, i.e. exactly parallel to the forms in (51). The forms in (53b) 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 (52), the forms in (54) show that verb bases which end in the suffix -ulul- 'de nouveau [again]' only retain the labiality of the first suffixal /u/:

(54) Verbs which end in ...Culul-a all become ...Cwelele, never *Cwelwele (-ulul- 'again')

a.	sik-ulul-a	→	sikw-elel-e	'siffler de nouveau'	sik-a	'siffler'
	fuk-ulul-a	→	fukw-elel-e	'recouvrir de nouveau'	fuk-a	'couvrir (toit)'
	bandz-ulul-a	→	bandzw-elel-e	'réflechir de nouveau'	baandz-a	'réfléchir'
b.	beet-ulul-a	→	beetw-elel-e	'frapper de nouveau'	beet-a	'frapper'
	hoy-ulul-a	→	hoyw-elel-e	'parler à nouveau'	hoy-a	'parler'

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 (55).[41]

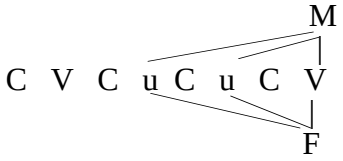
(55) Verbs ending in ...CuCun-a or ...CuCul-a, other than ...Cumun-a and ...Culul-a

a.	buk-unun-a	→	bukw-enen-e	'morceler, recouper'
	hing-unun-a	→	hingw-enen-e	'couper en petits morceaux'
b.	zyok-utun-a	→	zyokw-eten-e	'ronger'

The generalization seems to be that labialization will remain on the penult if the consonant is /m/, otherwise it will be realized only on the antepenult (cf. note 40, however). In other words, labialization will not remain on the penult if its onset is coronal.

Goldsmith's (1985) proposal to handle such facts, modified slightly in (56), involves the right-to-left spreading of [-round], here formalized 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 (56) that I have changed Goldsmith's M height harmony rule also to be right-to-left, as it clearly needs to be.

(56) Goldsmith's proposal: Right-to-left spreading of [-round], and hence frontness (F):



(where last C = coronal)

[41]A fourth verb, bulukut-a 'brouter, broyer', is exceptionally entered in Ruttenberg (1971) as bul-okwet-e. Even if we were to somehow limit imbrication to the penult in this form, we cannot explain the [o] in the antepenult (i.e. we should in that case have obtained *bul-ukwet-e).

To assure 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.[42] The F feature of the perfective thus spreads to the left-most 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 'pleurnicher, sangloter', which, since applicatives don't undergo perfective imbrication, is realized fikukidid-idi in the perfective.[43] So we can't test this hypothesis on longer verbs—specifically on CVCuCuCuC-a verbs, which we hypothesize to imbricate as CVCweCeCeC-e.[44]

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- 'recouvrir de nouveau':[45]

(57)

	/fukulu-i-l-e/	IDENT V_1	*[wi]	MAX	TROUGH	PLATEAU	IDENT FV
	fuk lwil-e		*!			*	
	fuk vilil-e		*!			*	
	fuk lul-e			*!		*	
	fuk lud-i			*!			*
	fuk wel-e				*!	*	
	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 (57a,b) both fail since they contradict the *[wi] constraint. Candidates (57c,d) violate MAX, since neither one has an overt realization of the infix -i-. In addition, (57c) violates PLATEAU, and (57d) violates the IDENT FV constraint, since the latter's M feature is not in the output. The candidates in (57e-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 (57e), where -e spreads to the penult, but not to the antepenult violates TROUGH, since a trough sequence -uCeC- is not permitted (cf. (43)). In the correct output in (57f), -e has spread to both the penult and antepenult. Finally, in (57g), -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- 'parler à nouveau':

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

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

[44]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 'siffler de nouveau' would be sikw-alal-a.

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

(58)

	/hoy-u-i-l-e/	IDENT [1]	*[wi]	MAX	TROUGH	PLATEAU	IDENT FV
	hoyulwil-e		*!			*	
	hoywilil-e		*!			*	
	hoylol-e			*!			
	hoylwel-e				*		*
	hoylwel-					*	
	hoywelel-e					*	
g.	hwekelel-e	*!					

As before, (589a,b) are ruled out because they violate *[wi], (58c) violates MAX, and (58d) violates TROUGH (since -uCeC- is not an acceptable trough sequence). Also, (58g) is ruled out because it violates IDENT V1. The problem here, however, is that the incorrect candidate (58e) is not differentiated from the correct output (58f). This is because the -oCeC- of (58e) is not a trough violation. We see this in verb bases such as hemukin- 'haleter', 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 (52) and (54) that CVC-umun- imbricates as CVC-wemwen-e, while CVC-ulul- imbricates as CVC-welel-e. Clearly consonant labialization is an issue here. I shall therefore assume that these distinctions should also be worked into the TROUGH family of constraints.[46]

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 the table in (59).

[46]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-realization 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 (56), 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 assuring that the perfective hemoken-e, from hemukin- 'haleter' does not become *hemweken-e (i.e. spreading of F to the antepenultimate syllable occurs only under imbrication, not under PLATEAU).

(59) **Effects of imbrication on -aCaC- trough (= inconsistent)**

Verb	Perfective	i	u	a	e	o	Totals
...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						

The left-most 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 summarized in (60).

(60) Summary of the imbrication of CVC-aCaC- bases

a.	...CaCeC-e	:	75	9 have M V_1 (4 /e/)	38 have V_1 /a/	28 have H V_1
b.	...CeCeC-e	:	36	19 have M V_1 (12 /e/)	10 have V_1 /a/	7 have H V_1

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 33). 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 stabilized in the case of the imbrication of -uCuC-, the data in (59) and note 33 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, Ma.: M.I.T. Press.

Bastin, Y. 1983. *La finale -IDE et l'imbrication en bantou*. Annales du Musée Royale de l'Afrique Centrale. Série IN-8, Sciences Humaines. N. 114. Tervuren.

Bastin, Y. 1986. Les suffixes causatifs dans les langues bantoues. *Africana Linguistica* 10.55-145. Annales du Musée Royale de l'Afrique Centrale. Série IN-8, Sciences Humaines. N. 121. Tervuren.

Beckman, Jill. 1995. Shona height harmony: markedness and positional identity. In J. Beckman, S. Urbanczyk & L. Walsh (eds), *Papers in optimality theory*, 53-75. Amherst: GLSA.

Beckman, Jill. 1997. Positional faithfulness, positional neutralization and Shona vowel harmony. *Phonology* 14.

Bentley, W. Holman. 1886. *Dictionary and Grammar of the Kongo L anguage.* London: Trübner & Co.

Bleek, W.H.I. 1862. A comparative grammar of South African languages. Part I. Phonology. London: Trübner & Co. Reprinted 1971, Gregg International Publishers.

Casali, Roderic F. 1997. Vowel elision in hiatus contexts: which vowel goes? To appear in *Language*.

Cammenga, J. 1994. *Kuria phonology and morphology*. PhD dissertation. Vrije Universiteit, Amsterdam.

Cassimjee, Farida & Charles W. Kisseberth. 1997. 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 University: C.S.L.I. (in press)

de Gheel, J. 1928 [1652]. *Le plus ancien 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*. Doctoral dissertation, U.S.C.

Goldsmith, John. 1985. Vowel harmony in Khalkha Mongolian, Yaka, Finnish and Hungarian. *Phonology [Yearbook]* 2.253-275.

Guthrie, Malcolm. 1967-1971. Comparative Bantu, vols. 1-4. Farnborough, Hants: Gregg International Publishers Ltd.

Hayes, Bruce. 1986. Inalterability in CV phonology. *Language* 62.321-351.

Hyman, Larry M. 1990. Non-exhaustive syllabification: evidence from Nigeria and Cameroon. In *Papers from the Parasession on the Syllable in Phonetics and Phonology. Chicago Linguistic Society* 26.175-195.

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. 1997. The historical interpretation of Bantu vowel harmony. To appear in J.M. Hombert & L. M. Hyman (eds), *Recent advances in Bantu historical linguistics*. Mouton de Gruyter.

Hyman, Larry M. & Sharon Inkelas. 1997. Emergent templates: the unusual case of Tiene. In Viola Miglio and Bruce Morén, eds. *University of Maryland Working Papers in Linguistics* 5.92-116. ROA-214-0897.

Kidima, Lukowa. 1991. *Tone and accent in Kiyaka.* Ph.D. dissertation, U.C.L.A.

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*. Brussels.

Leitch, Myles. 1996. *Vowel Harmony of the Congo Basin: An Optimality-Theoretic Analysis of Variation in the Bantu C. Zone.* Ph.D. Dissertation, University of British Columbia.

McCarthy, John & Alan Prince. 1993. Generalized alignment. In Geert Booij and Jaap van Marle, eds., *Yearbook of Morphology* 1993. Dordrecht: Kluwer. 79-153.

McCarthy, John & Alan Prince. 1995. Faithfulness and reduplicative identity. In J. Beckman, S. Urbanczyk & L. Walsh (eds), *Papers in optimality theory*, 249-384. Amherst: GLSA.

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

Meeussen, A.E. 1967. Bantu grammatical reconstructions. *Africana Linguistica* 3.81-121. Annales du Musée Royale de l'Afrique Centrale. Série IN-8, Sciences Humaines. N. 121. Tervuren.

Orgun, Cemil Orhan and Ronald Sprouse. To appear. From MParse to Control: deriving ungrammaticality. In *Proceedings of the Western Conference on Linguistics.*

Prince, A. & P. Smolensky. 1993. *Optimality theory: constraint interaction in generative grammar*. Ms. Rutgers & University of Colorado.

Ruttenberg, P. 1971. *Lexique yaka-français, français-yaka*. Kinshasa.

Sample, Ward A. 1976. *The application of rules in the phonology of Olukisa.* Ph.D. 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, University of California, Santa Cruz. ROA-193-0597.

Steriade, Donca. 1994. Underspecification and markedness. In John Goldsmith, ed., A handbook of phonological theory. Cambridge, MA: Blackwell Publishers. 114-174.

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

Whiteley, W.H. 1960. *The tense system of Gusii*. East African Linguistic Studies No. 4. Kampala.

Zoll, Cheryl. 1996. Parsing below the segment in a constraint based framework. Ph.D. dissertation, University of California, Berkeley.