

Some vowel harmonies in West Africa

What harmonises, what blocks?

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1 Preamble

This paper reviews various types of distant assimilations of vowels found in some West African languages and attempts to point out some regularities, not only in the assimilations themselves, but also in the blocking of assimilation, which has previously not received much attention. The distant assimilations that have been called vowel harmony (hereafter: VH) are often once-only assimilations affecting only a single vowel; I will adhere to this terminology, but will point out true VH (involving 3 or more vowels) as it arises.

Our itinerary is given in (1).

(1) Itinerary of this paper

- a. Harmony that is not blocked: Yukuben I/U-harmony. (Local A-assimilation, but no A-harmony.)
- b. Harmony that is blocked by (elements attached to) vowels: Mòoré ATR.
- c. Harmony that is blocked by (elements attached to) consonants: Mòoré I/U/A umlaut.
- d. Harmony that is initiated by (elements attached to) consonants: Koromfe “Phrase-Final Filling”.

2 Distant vowel assimilations

2.1 Phonological theory

The theoretical background to this paper is the theory of Government Phonology (GP) (Kaye, 2000; Kaye et al., 1985, 1990; Lowenstamm, 1996), as defined in Rennison & Neubarth (2003). Here, vowel quality consists of combinations of the elements¹ I, U, A and ATR, plus the elements H and L for tones and nasality. For consonants additional elements or theoretical devices are needed. I have not come across any vowel-harmony process that is sensitive to tone; nevertheless I have marked tones in the data given here.

The elements are arranged on lines, called tiers, and are associated to the skeleton with lines, in the usual manner of autosegmental phonologies. The skeleton is simply a sequence

¹ An element can be considered, for our present purposes, as a monovalent distinctive feature. The notations “A” and “ATR” are simplified representations used here for expository purposes only.

of points (denoted with small x's) which have a relative temporal² order and which interpret phonetically all the elements that are attached to them.

3 Yukuben

In Yukuben distant assimilation affects both noun-class prefixes and pre-verbal tense/aspect particles. The former have only single assimilations, the latter can have multiple assimilations. There is no blocking of these distant assimilations. Yukuben has a classic 5-vowel inventory /i, e, a, o, u/ and there is no ATR harmony. Stem vowels are often reduced to schwa. The Government Phonology representations of the vowels are given in (2).

(2) GP representations of the vowels of Yukuben (Rennison, 2014)

I,U line	I	I	U	U		
skeleton	x	x	x	x	x	x
A line		A	A	A		
phonetic	i	e	a	o	u	ə

The elements I and U are quite clearly transmitted in distant assimilations. The element A is not itself transmitted to non-local positions, but assimilates only locally.

3.1 Assimilations affecting noun-class prefixes

3.1.1 Harmonisation of the elements I and U in Yukuben

An /a/ of a noun-class prefix becomes /e/ or /o/ before a stem whose (first) vowel is front (i/e) or back (u/o) respectively. This is shown schematically in (3).

(3) Schematic representation of I and U harmony in Yukuben (cf. Rennison, 2014)

<i>“Lexical”</i>		<i>“Phonetic”</i>
<i>NCl prefix</i>	<i>Stem</i>	<i>Harmonised</i>
(C)a	+ Ci(C)	→ (C)e + Ci(C...)
(C)a	+ Ce(C)	→ (C)e + Ce(C...)
(C)a	+ Cu(C)	→ (C)o + Cu(C...)
(C)a	+ Co(C)	→ (C)o + Co(C...)
	<i>no change:</i>	
(C)a	+ Ca(C)	→ (C)a + Ca(C...)

Thus, for example, [kēlēm] ‘grass’ is lexically /ka+lēm/, and is harmonised as shown in the left part of (4). How do we know the lexical shape of the noun-class prefix? Agreement is a very good test. Thus we have [kēlēm kóru] ‘fresh grass’ (which is also the term for the colour green), as shown in (4).

² The skeletal points relate only to sequential ordering, and not to the actual phonetic length of segments.

- (4) GP representation of Yukuben **kēlām** ‘grass’ from lexical /ka+[̄]līm/ and **kóru** ‘fresh’ from lexical /ka+[̄]ru/ (tones omitted)

I,U line		I		U							
skeleton	x	x	+	x	x	x	x	x	x		
A line		A		A							
phonetic	k	e	+	l	ə	m	k	o	+	r	u

The I and U elements do not harmonise one another (in contrast, say, with German, where umlaut involving an I element can attach to a position that already has a U element, giving the vowels ⟨ü⟩ and ⟨ö⟩). This difference can be captured by a parameter allowing or banning attachments from more than one element on a shared tier to the skeleton (Rennison, 1990).

The net effect of the harmonisation of the elements I and U is to eliminate the vowel /a/ from noun-class prefixes. But this effect is circumvented by the local assimilation of the A element.

3.1.2 Local assimilation of the A element in Yukuben

By A-assimilation, a high vowel of a noun class prefix becomes mid if the noun stem to which it attaches has an (abstract) initial floating A element (marked here with a small capital A). This assimilation process is strictly local. It is a fusion of elements across the morpheme boundary between noun class prefix and stem; unfortunately (conspiratively) there is never an independent realisation of the assimilating A element – indeed, there is never any independent realisation of any noun stem in Yukuben.³ A typical word with this abstract stem-initial A element is **kēwūn** ‘nose’ from /ki-**A**wūn/, shown in (5).

- (5) GP representation of Yukuben **kēwūn** ‘nose’ from lexical /ki-**A**wūn/ (only the vowels are shown)

I,U line		I		U		
skeleton	x	x		x	x	x
A line			A			
phonetic	k	e	+	w	ū	n

- (6) GP representation of how Yukuben **kēwūn** ‘nose’ would turn out as **kīwūn** from hypothetical lexical /ki-**w**ūn/ without a stem-initial A (only the vowels are shown)

I,U line		I		U		
skeleton	x	x		x	x	x
A line (empty)						
phonetic	k	i	+	w	ū	n

The floating A melody has no position in syllable structure. Apart from these cases, there are no word stems of Yukuben that begin with a vowel. Also, word stems are typically monosyllabic.

Only this floating /a/ can transmit the element A from the stem to the prefix; there is no such thing as A-harmony between a stem vowel containing the element A and a prefix vowel – in particular, none parallel to the type described above for the elements I and U. One might

³ Except, of course, for loan words that take no noun-class prefix.

ask why the U element in (5) does not attach to the prefix vowel. This is banned by the parameter mentioned above, which allows only one element from the I,U line to be attached to the skeleton.

The net effect of the local assimilation of the A element is to lower all high vowels of the noun-class prefixes attached to a particular stem to mid. In other words, there are two sets of phonetic vowels in noun-class prefixes, and the choice of the set depends on whether there is a floating A element at the left edge of the stem or not. This is shown in (7).

- (7) The two sets of phonetic noun-class prefixes in Yukuben and the sources of their mid vowels

Before plain C-initial stems

i u
e o

a

Mid vowels always derived from /a/ by I/U harmony

Before stems with a floating initial A element

e o

a

Mid vowels always derived from /i/ or /u/ by local assimilation of a floating stem-initial A

Now we turn to the assimilation of preverbal tense/aspect particles.

3.2 Assimilations involving the preverbal T/A particle /ā/

In contrast with the noun-class prefixes, the preverbal particles are separate morphological words and therefore are subject to sociolinguistic variability of the well-known type: Careful and/or slower speech reduces the number and scope of assimilations, whilst casual and/or faster speech increases the number and scope of the assimilations. Nevertheless, the same process of I/U-harmony that affects noun-class prefixes also regularly targets the preverbal TAM particle /ā/, producing [o] in (8b) and [e] in (8c).

- (8) Some Yukuben examples from the Vienna corpus. 1st line = phonetic, 2nd line = morphemes. The shaded cells illustrate I/U harmony in noun classes (left) and in the preverbal particle /ā/ (right). e

a.	ábà	ēdīŋ	ókùb	ā̄	bā̄	jíròb	múnŋ	kénəŋ	
	a-ábà	a-đīŋ	a-kùb	ā̄	bā̄	jíròb	múnŋ	kénəŋ	
	SG.-father	SG.-good	SG.-old	NON-PRES.	come	Europe	now	NEG.	
	The old man has not yet come to Europe.								
b.	ábà	ēdīŋ	ókùb	ā̄	bā̄	jíròb	múnŋ	ō̄	fú
	a-ábà	a-đīŋ	a-kùb	ā̄	bā̄	jíròb	múnŋ	ā̄	fú
	SG.-	SG.-	SG.-	NON-	come	Europe	now	NON-	not_do
	father	good	old	PRES.				PR.	
	The old man has not yet come to Europe.								
c.	ábà	ēdəŋ	ókùb	ā̄	ŋbā̄	bàkṗarūbā̄	ē	hí	kénəŋ
	a-ábà	a-đīŋ	a-kùb	ā̄	ŋbā̄	bàkṗarūbā̄	ā̄	hí	kénəŋ
	SG.-father	SG.-good	SG.-old	NON-PR.	drink	MASS-beer	NON-PRES	be	NEG.
	The old man no longer drinks beer.								

4 Mòoré

Some questions that I hope this paper will help to answer are given in (9).

(9) Some questions about Mòoré phonology

Why do only **high** +ATR stem vowels ATR-harmonise their suffix vowels? (Conversely:

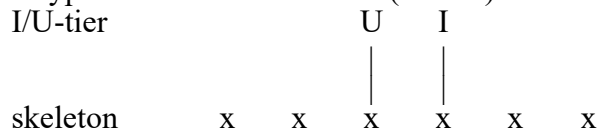
Why do mid +ATR stem vowels never harmonise their suffix vowels?

Why do +ATR high vowels never get an A element from A-umlaut (although –ATR high vowels do)?

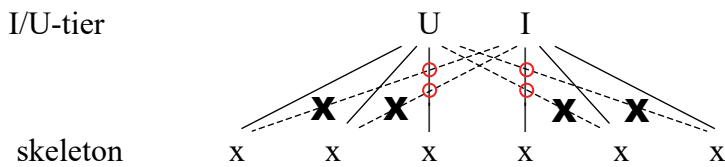
Why are +ATR mid vowels never involved in ATR harmony or by A-umlaut?

In (10) I show only the vowel positions on the skeleton for ease of recognition. Blocking arises when two elements share a tier and cannot both be associated to all skeletal points in the harmony domain, as illustrated in (10).

(10) a. A hypothetical unharmonised (lexical) harmony domain



b. Possible harmonisations of (10a)



Thus the element U can potentially spread to the first two V positions, but never to the last two, and the I element could not possibly associate to the first two vowels. We can say that in (10) the U element blocks the leftward spreading of the I element, and the I element blocks the rightward spreading of the U element.

This formalism, at the moment, does little more than can be captured with traditional analyses. However, the arrangement of elements on tiers is fixed for any individual variety of a language (again, see Rennison (1996) for details). So, if we discover that two elements share a tier, they must share that tier in **every** phonological process, and if more than one element from the same tier are associated to a skeletal position, the elements must also have a fixed sequential order.

One case in point involves the ATR harmony of Mòoré and its interaction with A-umlaut (also known as vowel capture).

4.1 ATR harmony in Mòoré

For reference, the representations of vowels that I assume are given in (11).

(11) GP representations of the vowels of Mòoré (from Rennison, 1996)

I,U line	I	I	I	I		
skeleton	x	x	x	x	x	x
			/ \		/ \	
A,ATR line	ATR		ATR A	A	ATR A	A
phonetic	i	ɪ	e	ɛ	ʌ	a

I,U line	U	U	U	U	
skeleton	x	x	x	x	x
	/ \				
A,ATR line	ATR A	A	ATR		
phonetic	o	ɔ	u	ʊ	ə

Consider the word forms in (12). Here we see a remarkable distribution of ATR in the vowels. The suffixes above the triple line receive ATR from the stem vowel; all the others do not. In other words, only two stem vowels, /i/ and /u/, ever trigger ATR harmony in Mòoré.

(12) ATR harmony in Mòoré (Gur)

<i>phonetic</i>	<i>lexical</i>	<i>gloss</i>	<i>stem vowel</i>	<i>suffix vowel</i>
túsí	tús -rí	thousand	/u/	/i/ → [i]
túsá	tús -a	thousands	/u/	/a/ → [ʌ]
wúlgú	wúl -gʊ	fog	/u/	/ʊ/ → [u]
bíísí	bí -sɪ	fruits	/i/	/i/ → [i]
bíigá	bí -ga	fruit	/i/	/a/ → [ʌ]
siilfú	siil -fu	grain of sesame	/i/	/ʊ/ → [u]
<hr/>				
bòosí	bò -sɪ	goats	/o/	/i/ remains [i]
bòogá	bò -ga	goat	/o/	/a/ remains [a]
kómbdù	kómb -dʊ	leaves of eggplant	/o/	/ʊ/ remains [ʊ]
tèesí	tè -sɪ	trees	/e/	/i/ remains [i]
tèegá	tè -ga	tree	/e/	/a/ remains [a]
beto	béd -dʊ	sorrel (pl.)	/e/	/ʊ/ remains [ʊ]
búusrí	búus -rí	viper (large)	/ʊ/	/i/ remains [i]
búaasá	búus -a	vipers (large)	/ʊ/	/a/ remains [a]
wúbgú	wúb -gʊ	elephant	/ʊ/	/ʊ/ remains [ʊ]
jíllí	jíl -rí	problem	/i/	/i/ remains [i]
jélá	jíl -á	problems	/i/	/a/ remains [a]
déend'ú	déel -dʊ	eels	/i/	/ʊ/ remains [ʊ]
láasí	lása -sɪ	plates	/a/	/i/ remains [i]
láagá	lása -ga	plate	/a/	/a/ remains [a]
lagdú	lag -dʊ	containers	/a/	/ʊ/ remains [ʊ]

For reasons of space, nasal stem vowels and diphthongs have been omitted here; their suffixes behave exactly as those of the corresponding oral stem vowels.

The vowels [ɛ, ɔ, ʌ] do not occur in the lexicon (and therefore *a fortiori* in underlying word stems).

Why does ATR from a mid vowel never trigger an ATR vowel in a suffix? Because the configuration in (13a) is the only permissible one. Structure (13b) is banned, whether lexically or as the result of a phonological process.

(13) The permitted and banned orders of ATR and A

a. ATR/A-tier	ATR A	b. ATR/A-tier	A ATR
	/ \		/ \
skeleton	x	skeleton	x
	permitted		banned

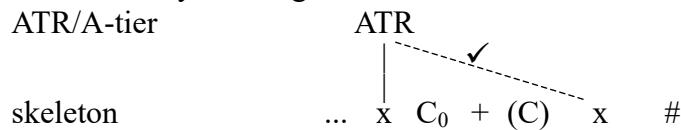
In Mòoré, as in many other Niger-Congo languages, the noun-class suffixes have only 3 lexical vowels to choose from: *i*, *ʊ* and *a*. Moreover, their vowel may not be long. The stem

vowels, on the other hand, can choose from 7 oral and at least 5 nasal vowels,⁴ plus various diphthongs, and all of these vowels can be short or long. The behaviour of the noun-class suffixes exemplified in (12) holds for all last vowels of word stems.

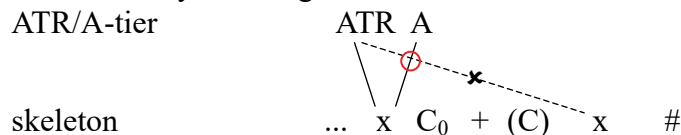
Other researchers have sought to explain the unusual ATR-harmony system of Mòoré by various *ad hoc* means, such as a language specific hierarchy of vowel strength (Nikiema, 1989). I claim that the present analysis is a principled one because it depends on parameters of the element tiers which have to be set in every human language. More on this later.

The only stem vowels which trigger ATR harmony are /i/ and /u/. Both of these have an ATR element, and both of them can associate this element to the right **because there is no intervening A element**. This is shown in (14). All the other stem vowels either have no ATR element, or they are mid vowels like /e/ and /o/, and therefore have an A element which blocks the association of their ATR element to the right, as shown in (15).

(14) ATR harmony with high stem vowels

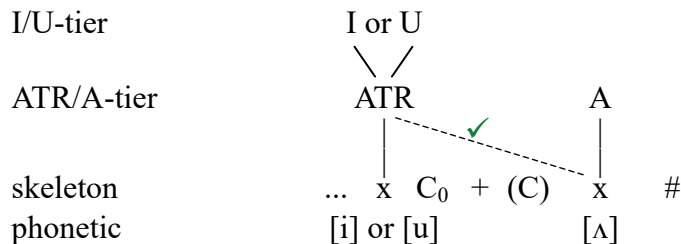


(15) ATR harmony blocking with mid stem vowels



Notice that there is nothing in the formulation of ATR harmony in (14) which restricts the association of the ATR element to **any** suffix vowel. Previously it was thought that Mòoré had only one low vowel, /a/. This analysis allows for two low vowels. Given the ordering ATR-A, nothing prevents ATR from spreading to an /a/ in the noun-class suffix, as in (16).

(16) ATR harmonisation of /a/



It turns out that Mòoré does indeed have this second low vowel, as was recognised, though not implemented, in Kaboré (1994). Incidentally, I do not advocate including this vowel in the orthography,⁵ but it would be nice if phonologists used it.

⁴ The precise number of lexical nasal vowels is still a matter of debate, but it is clear that there are at least five.

⁵ Nevertheless, eventually the official national alphabet of Burkina Faso will have to be changed to allow a second (“+ATR”) low vowel because in Koromfe this vowel is lexical.

4.2 Umlaut⁶ im Mòoré

All vowels of noun-class suffixes can trigger umlaut in Mòoré, provided that the consonants intervening between the (last) stem vowel and the trigger do not prohibit the assimilation (see below on intervening consonants).

The umlaut processes are responsible for transmitting an element to the left; but they are not responsible for what happens to the stem vowel once it has received extra melody. Sometimes the old and new elements combine, sometimes they remain separate.

4.2.1 A-umlaut

(17) Examples of Mòoré A-umlaut. Only /i/ and /o/ can be harmonised; the vowels affected by A-umlaut are bold and underlined.

<i>sg.</i>	<i>pl.</i>	<i>gloss</i>
b <u>è</u> ndá	bìndsí	‘loincloth’
ku <u>á</u> adà	ku <u>á</u> adbá	‘farmer’
b <u>ì</u> ngri	b <u>è</u> nga	‘bean’
n <u>ó</u> bri	n <u>ó</u> aba	‘nut’
lu <u>á</u> nga	lúmsi	‘frog’

The facts of ATR harmony in Mòoré show that whenever the elements ATR and A are attached to a single skeletal point, they are ordered ATR-A on their tier. Whatever other processes may occur, this relative ordering of ATR and A is fixed.

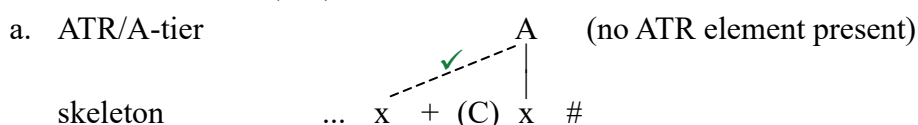
Incidentally my 1996 paper (Rennison, 1996) I show that Yaadre, which is the northern variety of Mòoré, the order of the ATR and A elements on their tier is reversed. This has far-reaching repercussions, for example that mid vowels can trigger ATR harmony. But for reasons of space I will not repeat what is easily available.

The relative priority of phonological processes also seems to be fixed. In Mòoré, ATR harmony takes precedence over A-umlaut. Wherever the context shown in (18b) occurs, ATR harmony is implemented and A-umlaut fails.

The process of A-umlaut involves the leftward attachment of the other element on the ATR/A-tier, i.e. the A element. In fact, A-umlaut can only be detected when the (last) stem vowel has no element on the ATR/A-tier. This is because an ATR element would take precedence, hence no A-umlaut would take place, and because an A element would not be affected by the addition of a further A element from the suffix vowel; phonetically they would be identical.

Clearly, ATR must block A-umlaut as shown in (18c). But there are complications. A-umlaut attaches an A element to its left, as in (18a), but fails if the (last) stem vowel has only ATR on the ATR/A-tier, as shown in (18b). But note that a second attachment of the A element, to a position to the left of the ATR element, is impossible – and indeed does not occur.

(18) A-harmonisation of (last) stem vowels



⁶ Here I use the term umlaut with exactly the same denotation as the term “capture” that is used by other phonologists. I find the term umlaut more exact, since it already implies that a) the process applies only to (final) stem vowels and elements in a monosyllabic suffix, and b) it is motivated by the impending loss of the suffix vowel.

- b. ATR/A-tier ATR A (ATR element in the last stem vowel)
 skeleton ... x + (C) x #
- c. ATR/A-tier ATR A A (ATR and A in the last stem vowel)
 skeleton ... x + (C) x #

The structure in (18b) is illicit because ATR harmony takes precedence over A-umlaut (as in (16) above).

In all of the umlaut processes in Mòoré the newly associated element may fuse with the elements that are already present, or they may form a diphthong. This behaviour is precisely reversed between Mòoré and Yaadre, but at the moment I have no clear idea what lies behind the fusion or non-fusion of elements in these cases.

4.2.2 U-umlaut

(19) Examples of Mòoré U-umlaut. Only /i, ɪ, e, a/ can be harmonised; vowels affected by U-umlaut are shown bold and underlined.

<i>sg.</i>	<i>pl.</i>	<i>gloss</i>
kí <u>u</u> gù	kítù	'moon'
té <u>o</u> gò	téedò	'luggage'
bé <u>o</u> dgu	bétu	'sorrel'
rá <u>o</u> gò	ráadú	'male (animal)'

The process of U-umlaut is parallel to that of A-umlaut, but of course with a U element of a suffix as its trigger. Because it is a different element that is spreading, the possible detectable target vowels are different: they have no U element before U-umlaut gives them one.

4.2.3 I-umlaut

In my (1996) account of umlaut in Mòoré, I discussed U and A-umlaut, but at that time did not notice the I-umlaut process because it is extremely limited and relatively rare. Nevertheless, I-umlaut is responsible for the alternations in (20).

(20) Examples of Mòoré I-umlaut. Only /ĩ/ can be harmonised

<i>sg.</i>	<i>pl.</i>	<i>gloss</i>
bũãṅgá	bũĩsɪ	'donkey'
zũãṅgá	zũĩsɪ	'blind'

4.3 Which consonants block vowel harmony?

A-umlaut is triggered by the suffixes /-a/, /-ba/, /ga/⁷ and can affect only the vowels /i/ and /o/ because /i/ and /u/ trigger ATR-harmony (which blocks A-harmony), and all other vowels already have an A element.

U-umlaut is only ever triggered by the suffix /-gò/ (and never by suffixes /-fò/, /-dò/ or /-bò/). No consonant seems to block it.

I-umlaut is only triggered by the suffix /-sɪ/.

⁷ The behaviour of /-la/ is unknown for the moment because this suffix occurs only once in my corpus.

Umlaut is therefore always morphologically triggered (by the 6 suffixes mentioned here). There are no blocking consonants, only failures to trigger umlaut because no umlaut-triggering suffix is present.

4.4 Spirantisation of /g/ in Mòoré

It is a well known fact of Mòoré phonology that the voiced velar stop /g/ becomes a fricative after all vowels except the +ATR high vowels /i/ and /u/. Why should this be? In my theory of phonological representations, which will not fit into our present time frame, an ATR element in a vowel is equivalent to a stop element in a consonant. In other words, the ATR element, when it spreads in ATR harmony, also reinforces the velar voiced stop and so prevents it from spirantising **only** in those cases where ATR harmony actually takes place. It is a kind of “anti-intervocalic-spirantisation”.

5 Koromfe

5.1 ATR harmony

ATR harmony in Koromfe is true VH and exceptionless, apart from occasional loan words. It affects all vowels of a phonological word, but stops at word-internal word boundaries (i.e. does not affect compound nouns). Therefore, clearly, the ATR element does not share a tier with any other element.

5.2 I/U-harmony vs. Phrase-Final Filling (Rennison, 1993)

There are two other harmony processes in Koromfe which both involve the I/U tier. Originally I considered these to be a single process, but on closer inspection they have clear differences. I/U Harmony One affects only medial low vowels,⁸ whilst I/U Harmony Two affects only final vowels. Examples are given in (21).

(21) I/U-harmony in Koromfe (Gur). Reversive verb forms with harmonised medial and final vowels.

<i>imperative</i> (<i>phrase-medial</i>)	<i>imperative</i> (<i>phrase-final</i>)	<i>gloss</i>	<i>base verb</i>	<i>gloss</i>
dõnɔt	dõnɔtu	‘take apart, untie’	dõĩ	‘join, tie’
figet	figeti	‘dig up’	fig	‘bury’
kelet	keleti	‘open’	kɛl	‘close’
gãnat	gãnati	‘undo (a bandage)’	gãn	‘bandage’
sumbot	sumbotu	‘take lid off’	sumb	‘put lid on’
tombot	tombotu	‘take off (robe)’	tom	‘put on (robe)’

The harmonisation of medial vowels is exceptionless. But Phrase-final filling will not get us the final /i/ in [gãnati]. And it gets worse. Consider the forms in (22).

(22) I/U-harmony in Koromfe (Gur). Phrase-final filling (all final vowels here are from PFF).

<i>imperative</i>	<i>durative</i>	<i>gloss</i>
hibsu	hibsru	‘fill’
zim	zimmũ	‘extinguish (fire)’

⁸ In verbs with the –V1 suffixoid, these vowels actually appear word-finally because the final /i/ is deleted in the imperative.

A Koromfe word that ends in an obstruent (NB: [r]←/d/) must get an epenthetic final vowel in phrase-final position. In Mòoré, the equivalent vowel is always /ɪ/, but in Koromfe the last vowel is associated to the nearest element on the I/U-tier. This I or U element can be attached to a vowel or to a labial consonant that intervenes between the epenthetic final vowel and the closest vowel to its left. This gives us the final vowels of (22) – and notice that the labial consonant does not even have to be the closest consonant. Only if there is no I or U element available in the whole word does the epenthetic vowel get an I element (e.g. in [gãnatɪ]) – magically, from nowhere, as in Mòoré.

6 Conclusions

Hm. What are the conclusions? – That it's complicated, but I think we're on the right track.

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