

Mòbà Nasal Harmony

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0. Introduction

This paper is a case study of nasality in Mòbà, a dialect of Yorùbá. Nasality in Mòbà is of interest for various reasons. In particular, it illustrates how a local and highly restricted pattern of assimilation can develop into a more general pattern of ‘harmony’ and it demonstrates the interaction of conditions on locality and similarity.

The properties of nasal harmony in Standard Yorùbá are quite well understood (Awobuluyi 1990, Clements & Şonaiya 1990, Awobuluyi & Oyebade 1995, Oyebade 1985). In contrast, the pattern of nasal harmony in the Yorùbá dialect, Mòbà, is virtually untreated in the literature. Works such as Bamisile (1986) and Ajiboye (1991, 1997, 1999) have treated some aspects of the phonology of Mòbà, but this is the extent of the work on the dialect’s phonology. In this paper, we show that Mòbà exhibits a robust pattern of nasal harmony that is significantly different from that of Standard Yorùbá, though clearly related to it.

Mòbà nasal harmony will be shown to have several significant properties. Harmony is unbounded, with all eligible targets to the left of a harmonic source undergoing harmony. It will be shown that there are two classes of ineligible targets and that these ineligible segments differ in their behaviour: voiced and voiceless obstruents may not undergo harmony and are transparent to harmonic propagation; nonhigh vowels may not undergo harmony and block harmonic propagation. Harmony crosses morpheme boundaries and applies strictly from right to left.

In the following sections, we begin by presenting basic background facts concerning consonant and vowel inventories of both Standard Yorùbá and Mòbà, focussing on nasality (§1). We go on to sketch properties of syllable-internal harmony (§2), this pattern being shared by the two dialects. In §3, we show that Mòbà differs from Standard Yorùbá in having word-level harmony which extends beyond the syllable: we discuss transparency (§3.1, §3.2), properties of harmonic targets (§3.3), opacity (§3.4), limitations on harmonic triggers (§3.5), and directionality (§3.6). We show that harmony in Mòbà cannot be the result of a “syllable-to-syllable” process (§4), and that both Standard Yorùbá and Mòbà exhibit evidence of a stringent harmonic requirement on adjacent moras (§5). We propose an analysis of harmony based on a conceptually simple class of sequential feature cooccurrence conditions (§6).

1. Background

In order to understand nasal harmony in Mòbà, it is crucial to consider the function of nasality in the Yorùbá segmental inventory. Like Standard Yorùbá, Mòbà has seven oral vowels and three basic nasal vowels.¹

(1) Standard Yorùbá & Mòbà: Vowel inventory

a. oral vowels

i u
e o
ɛ ɔ
 a

b. nasal vowels

ĩ ù
 ã

As indicated, the distinction between oral and nasal vowels is contrastive in Mòbà. This can be seen in minimal and near-minimal pairs such as the following:

(2) Standard Yorùbá & Mòbà: Vowels contrasting in nasality

	<i>oral</i>		<i>nasal</i>	
a.	dì	<i>bound/tie</i>	dí	<i>fry</i>
b.	dù	<i>scramble for</i>	dù	<i>sweet</i>
c.	tà	<i>sell</i>	tã	<i>deceive</i>

It is important to note that both high vowels and low vowels exhibit oral and nasal pairs, while mid vowels cannot be nasalised.

¹ Nasalisation on vowels in Yorùbá is indicated orthographically in two ways. If the consonant preceding the nasalised vowel is itself nasal, then nasalisation on the vowel is not indicated; if the preceding consonant is oral, then nasalisation is indicated by the inclusion of 'n' after the relevant vowel. To avoid potential confusion, and since the topic of this paper is nasality, we give all data in a minimally modified IPA transcription rather than in orthography. We use a modified IPA in only one respect. Rather than use [j] for a palatal glide, we use 'y': (i) Yorùbá has no rounded vowels, (ii) this prevents visual confusion with [ɟ], a voiced palatal stop, and (iii) it brings our transcriptions closer to the orthography where a palatal glide is represented by 'y'.

(3) Prohibition on nasalised mid vowels²

*Mid/Nas: *[+nasal, -high, -low]

There is typological motivation for such a constraint. Ruhlen (1975) reports on the patterning of nasal vowels in a sample of 100 languages; 47 languages in the sample have fewer nasal vowels than oral vowels, and of that set, 20 languages lack mid nasal vowels. This is the largest class in the 47 vowel set, the next most common being languages without high nasal vowels (15/47). Hyman (1972) suggests that the impossibility of nasalised mid vowels is a common property of Kwa languages.³ On the basis of such work, we assume here that a constraint such as *Mid/Nas can be plausibly motivated, and that in Yorùbá it outranks MaxNas, giving the result that nasality is not preserved if the alternative is to have a nasalised mid vowel:

(4) *Mid/Nas >> MaxNas

MaxNas: A nasal specification in the input must have a correspondent nasal specification in the output.

This is illustrated by considering a putative morpheme with a mid vowel and a nasal specification. As seen in (5) for *ɲɛ* 'eat', an oral output is preferred to a nasalised one no matter what the input.

(5) Standard Yorùbá & Mòbà: Impossibility of nasalised mid vowels

/ɲɛ/ or /ɲɛ̃/	*Mid/Nas	MaxNas
⇒ a. [ɲɛ]		(*)
b. [ɲɛ̃]	*!	

² Nothing crucial depends on the precise choice of distinctive features. The use of [nasal], [high] and [low] is for the purposes of being explicit but other feature systems could achieve the desired effect.

³ Williamson (1973) points out that numerous Kwa languages exhibit equal numbers of oral and nasal vowels, including mid vowels, and that there are also numerous examples of languages allowing retracted mid nasal vowels ([ɛ̃, ɔ̃]) but not advanced mid nasal vowels (*[ē, õ]).

Whether a nasal specification is postulated underlyingly (in which case there is a faithfulness violation in the optimal output) or whether no nasal specification is postulated underlyingly, an oral mid vowel surfaces.⁴

The consonant inventory of Mòbà is given in (6):

(6) Mòbà: Consonant inventory

	labial	alveolar	palatal	velar	labial- velar	glottal
voiceless stops		t		k	kp	
voiced stops	b	d	ɟ	g	gb	
Fricatives	f	s				h
Nasals	m	[n]				
Liquids		r [r̄]				
		l				
Glides			y [ỹ]		w [w̃]	

Two segments found in Standard Yorùbá are absent in Mòbà. As with certain other dialects of Yorùbá, the distinction between /s/ and /ʃ/ has been neutralised in Mòbà, with only /s/ found (Ajiboye 1991, Bamisile 1986). With respect to the nasalisation of sonorants, Standard Yorùbá exhibits a nasalised variant of [h], namely [h̃] (Owólabí 1989). In Mòbà, [h̃] is not attested, as it seems that /h/ has disappeared in morphemes where it would precede a nasalized vowel. For example, the Mòbà counterparts of Standard Yorùbá [oḥũ] ‘thing’ and [mo ḥũ akpèrè] ‘I weaved a basket’ are [oũ] and [mĩ ã akpèrè] respectively. This issue does not bear on the treatment of nasal harmony and will not be addressed here. It should also be noted that Mòbà appears to have only one phonemic nasal consonant, namely the bilabial nasal /m/. Whether Standard Yorùbá has one phonemic nasal (/m/) or two (/m, n/) is a matter of some debate (Owólabí 1989, Clements & Şonaiya 1990, Awobuluyi 1992), hinging on the analysis of alternations between [l] and [n]. We do not address this issue here. Finally, although we tone-mark our data throughout,

⁴ Standard Yorùbá has two words involving the same morpheme that surface with a nasalised mid vowel: [ỹḗ] ‘that’, [iỹḗ] ‘that thing’. Mòbà appears to have no such exceptional morphemes. Indeed, a speaker of Mòbà is likely to denasalise such exceptional morphemes if speaking Standard Yorùbá, e.g. [ye] instead of the exceptional [ỹḗ].

we note that a number of issues require investigation in the analysis of tone in Mòbà, particularly in cases of tone sandhi involving vowel deletion.

2. Basic syllable-internal harmony

Just as in Standard Yorùbá, Mòbà exhibits nasal agreement within the syllable: adjacent sonorants within a syllable must be either both oral or both nasal. (A class of exceptions to this statement is discussed below.)

(7) Standard Yorùbá & Mòbà: Syllable-internal sonorant harmony

	<i>oral</i>		<i>nasal</i>	
a.	rì	<i>drown</i>	ṛì	<i>walk</i>
b.	rù	<i>carry</i>	ṛù	<i>smell</i>
c.	yà	<i>draw/comb</i>	ṽà	<i>choose</i>
d.	rà	<i>buy</i>	ṛà	<i>spread</i>

In all relevant respects, the facts of contrast and syllable-internal sonorant harmony are comparable in Standard Yorùbá and Mòbà. Indeed, the forms in (2) and (7) are the same in the two dialects.⁵

These reasonably straightforward facts form the starting point for our analysis. Though this initial pattern is amenable to a variety of treatments, we anticipate properties to be discussed below and propose an analysis of harmony based on sequential cooccurrence constraints (Smolensky 1993, Pulleyblank 2002, in press). We propose two constraints to drive

⁵ We have not included examples with [w] or [w̃] in (7) for reasons that have nothing to do with harmony. In Standard Yorùbá, the glide [w] is nasalised before a nasal vowel exactly as expected. Compare, for example, [wà] ‘drive (vehicle)’ with [w̃ǒ] ‘measure’. The rounding of the low vowel in ‘measure’ reflects a predictable allophonic pattern whereby low nasal vowels are rounded after labial consonants; this allophonic rule does not apply in Mòbà. In Mòbà, nasalisation of the glide [w] can be seen in a pair like [uwá] ‘in front of’ vs. [ũw̃á] ‘lies (n.)’. Direct counterparts of Standard Yorùbá verbs are not found because the glides tend to have disappeared in such cases. For example, the cognate of Standard Yorùbá [w̃ǒ] ‘measure’ in Mòbà is [ǎ].

harmony. The first constraint requires that a sonorant to the *left* of a nasal segment be nasal; the second constraint requires that a sonorant to the *right* of a nasal segment be nasal.

(8) Nasal harmony constraints

- a. $*[\text{Oral/son Nas/son}]_{\sigma}$: an oral sonorant incurs a violation if immediately preceding a nasal sonorant within a syllable ($*[\text{O N}]_{\sigma}$)
- b. $*[\text{Nas/son Oral/son}]_{\sigma}$: an oral sonorant incurs a violation if immediately following a nasal sonorant within a syllable ($*[\text{N O}]_{\sigma}$)

By ranking both of these constraints above the relevant faithfulness constraints, the pattern of agreement observed in (7) results.⁶ We illustrate this with *rã* ‘spread’.

(9) Standard Yorùbá & Mòbà: syllable-internal agreement

<i>/rã/ or /rã/</i>	*Mid/Nas	MaxNas	*[O N] _σ	*[N O] _σ	DepPath[nas]
a. [rã]			*!		
⇒ b. [rã]					(*)
c. [ra]		*!			

Nothing so far indicates the internal ranking of MaxNas, $*[\text{O N}]_{\sigma}$, and $*[\text{N O}]_{\sigma}$.

This syllable-internal agreement is arguably the synchronic core of the nasality patterns of Yorùbá, and plausibly also the diachronic core. Of interest, we see in the following sections that assimilation extends beyond the core in interestingly restricted ways. We structure the following discussion by considering gradually larger domains, showing how such domains differ in their properties and therefore analysis in the two dialects. Three variables are crucial to a detailed understanding of harmonic properties: (i) domain size, (ii) degree of similarity between trigger and target, (iii) segmental nature of potentially affected consonants and vowels.

⁶ For concreteness, we assume in (9) that the relevant faithfulness constraint violated by harmony is DepPath[nasal]: Any path between [nasal] and a root node in the output has a correspondent path between [nasal] and a root node in the input. Nothing here depends on this choice of faithfulness constraints. For example, assuming an Ident[nasal] constraint would work equivalently. We omit DepPath[nasal] from subsequent tableaux since it plays no crucial role.

3. Word-level harmony: Mòbà

Unlike in Standard Yorùbá, Mòbà routinely extends the domain of nasality to the high vowels that precede a nasalised vowel.

(10) Mòbà: nasal harmony

a.	ũĩĩ	<i>iron</i>	e.	ĩyǎ	<i>argument</i>
b.	ĩwĩ	<i>spirit</i>	f.	ĩyĩ	<i>feces</i>
c.	ũyǎ	<i>famine</i>	g.	ũwǎ	<i>lie</i>
d.	ĩyǎ	<i>pounded yam</i>			

While the forms in (10) are all monomorphemic, such nasal harmony is also observed in polymorphemic cases. Compare the examples in (11) with those in (12).

(11) Mòbà: polymorphemic words, oral roots

	<i>Verb</i>		<i>Nominal</i>	
a.	ɟɛ	<i>eat</i>	ùɟɛ	<i>bait</i>
b.	fé	<i>like</i>	ùfé	<i>love</i>
c.	kó	<i>pack</i>	ùkó	<i>basket</i>

The examples in (11) illustrate that the nominalising prefix is oral when the root to which it attaches is oral; the examples in (12) show that the same prefix is nasal when the root to which it attaches is nasal.

(12) Mòbà: polymorphemic words, nasal roots

a.	ĩĩ	<i>walk</i>	ũĩĩ	<i>walk</i>
b.	yĩ	<i>praise</i>	ũyĩ	<i>praise</i>
c.	nĩ	<i>have</i>	ũnĩ	<i>possession</i>
d.	ǎ	<i>measure</i>	ũǎ	<i>measurement</i>

Word-level harmony requires some generalisation of the *[Oral/son Nas/son]_σ constraint (8a). Not only is an oral sonorant prohibited before a nasal sonorant within the syllable, such an oral segment is also prohibited even across syllables. The precise formulation of the word-level

harmony constraint is the topic of the next several sections. To start with, we give a simple illustration without yet defining the constraint (labelled here as ‘Wd Harmony’) and without motivating its ranking relative to other constraints.

(13) Mòbà: word-level nasal harmony, first approximation

/uwá/	*Mid/Nas	MaxNas	*[O N] _σ	*[N O] _σ	Wd Harmony
a. [uwá]			*!		*
b. [uŵá]					*!
⇒ c. [ũŵá]					

To move towards an adequate formulation of the harmonic constraint, we now consider several properties of word-level harmony.

3. 1 Transparency

As seen in (14), a high vowel before a nasalised vowel must itself be nasalised, even if an obstruent intervenes between the two vowels. Note that the transparent obstruent is itself oral, not nasal.

(14) Mòbà: transparency of obstruents

a.	ìdũ	<i>bed bug</i>	f.	ìfũ	<i>intestine</i>
b.	ũgũ	<i>corner (of a house)</i>	g.	ìtà	<i>story</i>
c.	ìsì	<i>worship</i>	h.	ìdĩ	<i>maggot</i>
d.	ĩkĩ	<i>mucus</i>	i.	ũkpĩ	<i>KIND OF INSECT</i>
e.	ĩká	<i>termite</i>			

3. 2 Representations: no gap

Assuming some version of autosegmental representations (Goldsmith 1979, etc.) and assuming some version of the Obligatory Contour Principle (OCP: McCarthy 1986, etc.), syllable-internal nasal agreement would uncontroversially be represented as a single nasal autosegment linked to both the consonant and vowel of a relevant form. Schematically, this means that (15a) would be preferred to (15b), where ‘V’ represents any vowel, ‘w’ represents any sonorant consonant, and ‘n’ represents a nasal specification, whether unary or binary.

- (15) a. $\begin{array}{c} n \\ / \quad | \\ w \quad V \end{array}$ b. * $\begin{array}{c} n \quad n \\ | \quad | \\ w \quad V \end{array}$

Similarly, in the cases where harmony involves an intervocalic sonorant (12), the same considerations would argue in favour of (16a) over (16b) and (16c), since both (16b) and (16c) involve gratuitous violations of the OCP.

- (16) a. $\begin{array}{c} n \\ / \quad / \quad | \\ V \quad w \quad V \end{array}$ b. * $\begin{array}{c} n \quad n \quad n \\ | \quad | \quad | \\ V \quad w \quad V \end{array}$ c. * $\begin{array}{c} n \quad n \\ | \quad / \quad | \\ V \quad w \quad V \end{array}$

Such sequences of sonorants, therefore, suggest representations that are consistent with ‘assimilation by spreading’ (Goldsmith 1979, Clements 1981, Hayes 1986, etc.). The situation is different, however, when we consider the data involving transparent obstruents (14). Since the intervocalic obstruents in such forms are oral, not nasal, it cannot be the case that they are linked to a nasal feature. This means that two representations are conceivable. On the one hand, having two nasal vowels flanking an oral consonant (schematically represented as ‘d’) means having two nasal specifications (17a); on the other hand, it might be proposed that a single nasal value skips over the transparent obstruent (17b).

- (17) a. $\begin{array}{c} n \quad n \\ | \quad | \\ V \quad d \quad V \end{array}$ b. * $\begin{array}{c} n \\ / \quad | \\ V \quad d \quad V \end{array}$

While proposals have differed as to precisely how to impose locality conditions on phonological representations, the gapped representation in (17b) is widely rejected. If phonological specifications are to map straightforwardly onto phonetic targets (Keating 1988, Cohn 1990, and so on), then the representation in (17b) must be rejected since the phonetic implementation involves a nasal-oral-nasal sequence, not a single nasal target that is maintained through multiple segments. For Gafos (1999), Ní Chiosáin & Padgett (2001), Rose & Walker (2004) and so on, the representation in (17b) would be ruled out because all assimilation is required to obey a *strict segmental locality* principle whereby multiply linked features can only exist on segments whose root nodes are adjacent. Even with a slightly less restrictive notion of adjacency such as in Archangeli & Pulleyblank (1994), the representation would violate a general precedence condition since both consonants and vowels are anchors for nasality in Mòbà and no eligible anchor may be skipped. Our conclusion is that the representation in (17a) is to be preferred to the representation in (17b).

Overall we propose that the surface representation of a harmonic sequence is a multiply-linked nasal specification in cases involving an intervocalic sonorant (data in (10)/(12); structure in (16a)) and that it is a sequence of two nasal specifications in cases involving an intervocalic obstruent (data in (14); structure in (17a)).

3. 3 Mid and low vowels are not targets

As noted above, nasal harmony in Mòbà targets high vowels. As can be seen in (18) and (19), this targetting of high vowels must be interpreted strictly: nonhigh vowels are not targetted by harmony.

(18) Mòbà: mid vowels are not nasal harmony targets

a.	oĩ	<i>song</i>	g.	eĩ	<i>elephant</i>
b.	èsĩ	<i>reproach</i>	h.	ènĩ	<i>bonus</i>
c.	õřà	<i>matter</i>	i.	ẽřã	<i>meat</i>
d.	èkà	<i>NAME OF TOWN</i>	j.	èfã	<i>mosquito</i>
e.	ẽřũ	<i>mouth</i>	k.	omã	<i>child</i>
f.	ogũ	<i>war</i>	l.	odú	<i>festival</i>

In the case of mid vowels (18), this immunity to harmony is not surprising since we have already seen that Mòbà is like Standard Yorùbá in not allowing mid vowels to be nasalised. For low vowels (19), however, the same failure to undergo nasalisation is perhaps surprising since low vowels are otherwise perfectly good nasalised vowels.

(19) Mòbà: low vowels are not nasal harmony targets

a.	àgã	<i>a kind of cult</i>	g.	àkú	<i>KIND OF BEAD</i>
b.	aká	<i>KIND OF PLANT</i>	h.	ãřá	<i>velvet</i>
c.	ãřũ	<i>disease</i>	i.	àdá	<i>bat</i>
d.	àfĩ	<i>albino</i>	j.	àkpá	<i>bachelor</i>
e.	ãřĩ	<i>KIND OF GAME</i>	k.	agbà	<i>basket</i>
f.	àsĩ	<i>KIND OF RAT</i>			

It would seem, therefore, that Yorùbá has a three-way scale as regards the nasalisability of vowels. While high nasalised vowels are both underlying and derived, low nasalised vowels are underlying but not derived, and mid nasalised vowels are neither underlying nor derived.

(20) Nasal scale for vowels: *Mid/Nas >> *Low/Nas >> *High/Nas

- a. *Mid/Nas: *[+nasal, -high, -low] (see (3)) c. *High/Nas: *[+nasal, +high]
 b. *Low/Nas: *[+nasal, +low]

The interaction of this scale with the constraints on faithfulness and harmony is illustrated in (21).

(21) Mòbà: low vowels are not harmonic targets

/àrà/	*Mid/ Nas	Max Nas	*[O N] _σ	*[N O] _σ	*Low/ Nas	Wd Harm	*High/ Nas
a. [àrà]			*!		*	*	
⇒ b. [ãrà]						*	
c. [ãrà]					**!		
d. [àrà]		*!					

Because *Mid/Nas is ranked above MaxNas, nasalised mid vowels are completely ruled out. Nasalised low vowels, on the other hand, are retained if underlying (given MaxNas >> *Low/Nas, Wd Harm) but not derived by harmony (given *Low/Nas >> Wd Harm).⁷ Nasalised high vowels are possible both underlyingly and as a result of harmony given the low ranking of *High/Nas.

3. 4 Opacity

Nasal harmony is blocked by the presence of any vowel that cannot itself undergo harmony. First, note that there is nothing unusual in the basic harmonic patterns seen in trimoraic forms. With high vowels, sequences may be either oral or nasal.

⁷ It is also important to rule out shifts in nasality designed to transfer nasality from a low vowel to a high vowel. For example, ìtá 'story' (14g) surfaces with both vowels nasalised, not with nasality shifting from the low vowel to the high vowel. There are various ways this could be achieved, for example, by reinterpreting MaxNas as MaxPathNas: A path from a nasal specification to a root node in the input must have a correspondent path in the output.

(22) Mòbà: trimoraic sequences of high vowels

- | | | | | | |
|----|-------|-------------------|----|--------|----------------------------|
| a. | isùkù | <i>corn stalk</i> | c. | ùmūmĩ | <i>drinking cup</i> |
| b. | udidì | <i>whole</i> | d. | ìsùgbì | <i>traditional singers</i> |

Similarly, the presence of a mid or low vowel does not prevent harmony from applying to a vowel sequence where a high vowel immediately precedes a nasalised vowel.

(23) Mòbà: trimoraic sequences involving initial nonhigh vowels

- | | | | | | |
|----|---------|-----------------------|----|-------|-------------------------|
| a. | erírú | <i>ashes</i> | i. | enĩnĩ | <i>dew</i> |
| b. | èkíkú | <i>rotten yam</i> | j. | ěřĩřũ | <i>a kind of sponge</i> |
| c. | adití | <i>deaf person</i> | k. | ègĩgũ | <i>KIND OF TREE</i> |
| d. | akúrí | <i>dullard</i> | l. | egĩgũ | <i>masquerade</i> |
| e. | àtùkpà | <i>bush lamp</i> | m. | aĩĩĩ | <i>enjoyable</i> |
| f. | egbìgbò | <i>root</i> | n. | àgùtà | <i>sheep</i> |
| g. | òkìkí | <i>fame</i> | o. | àgùfã | <i>giraffe</i> |
| h. | ètita | <i>flour remnants</i> | p. | egĩgũ | <i>bone</i> |

The presence of a medial nonhigh vowel, however, blocks the transmission of nasality from a final vowel to a vowel preceding the medial nonhigh vowel. That is, nonhigh vowels are opaque.

(24) Mòbà: nonhigh vowels are nonundergoers and opaque

- | | | | | | |
|----|-------|----------------------------|----|-------------|--------------------|
| a. | ùrònú | <i>meditation</i> | i. | ùlãĩũ/ùyãĩũ | <i>comb</i> |
| b. | ùròyĩ | <i>news</i> | j. | ùsàmĩ | <i>baptism</i> |
| c. | ìrègũ | <i>reproaching</i> | k. | ìsasũ | <i>KIND OF POT</i> |
| d. | ùsègũ | <i>act of medication</i> | l. | ìtàkũ | <i>root</i> |
| e. | ùkóřũ | <i>thread for plaiting</i> | m. | ùgbádũ | <i>enjoyment</i> |
| f. | ùròřũ | <i>peace of mind</i> | n. | ìkpákũ | <i>climber</i> |
| g. | ilègũ | <i>NAME OF A COMPOUND</i> | o. | ìranũ | <i>unserious</i> |
| h. | ìgósũ | <i>NAME OF A TOWN</i> | | | |

3.5 Nasal consonants are not triggers

An additional point that must be taken into account concerns harmonic triggers. As discussed in some detail in §4 below, both Standard Yorùbá and Mòbà exhibit syllable-internal nasal harmony as a morpheme structure constraint. In derived cases, however, it is possible for a nasal consonant to precede an oral vowel. As seen in (25), such nasal consonants do *not* trigger harmony to their left. Hence the examples in (25a-c) show harmony on the initial high vowel because the following vowel is nasalised, while the examples in (25d-f) show no nasality on the initial high vowel because the following vowel is oral, in spite of the fact that the initial vowels in question are followed by a nasal consonant.

(25) Mòbà: nasal consonants: transmitters/transparent, not triggers

- | | | | | | |
|----|-------|------------------|----|-------|--------------------------|
| a. | ĩmú | <i>nose</i> | d. | ùmojì | <i>NAME OF A VILLAGE</i> |
| b. | ĩmà | <i>palm leaf</i> | e. | ìmélé | <i>laziness</i> |
| c. | ùmálè | <i>light</i> | f. | ùmórù | <i>PERSONAL NAME</i> |

3.6 Directionality

Directionality must also be factored into the analysis. As seen in many examples above, a high vowel must be nasalised if it occurs to the left of a nasalised vowel. This effect is anticipatory only: vowels of any height may be oral when they occur to the right of a nasalised vowel. This can be observed in examples such as the following.

(26) Mòbà: nasalisation does not extend to the right

- | | | | | | |
|----|-------|----------------------|----|-------|-----------------------------------|
| a. | àmàlé | <i>PERSONAL NAME</i> | d. | ùmàsí | <i>having knowledge of an act</i> |
| b. | amàrí | <i>PERSONAL NAME</i> | e. | ùmúra | <i>preparedness</i> |
| c. | ùmálè | <i>light</i> | f. | ùñra | <i>difficulty</i> |

A nasalised vowel in Mòbà never affects a vowel to its right. This failure of rightwards nasalisation is observed whether the vowel is high (26b,d), mid (26a,c), or low (26e,f) and whether the postnasal consonant is an obstruent (26d) or a sonorant (26a,b,c,e,f).

To summarise, a high vowel must be nasalised when it appears to the left of a nasalised vowel. This is true whether an intervening consonant is a sonorant, in which case the consonant too is nasalised, or an obstruent, in which case the obstruent is oral. Nasalisation of a vowel

takes place only when the nasal trigger is itself a vowel; a nasal consonant on its own does not initiate vowel nasalisation to its left.

4 Harmony is not the result of inter-syllable agreement

The formalisation of the rule or constraint that forces harmony is problematic as regards the role of the segment and the role of the syllable. Consider a possible autosegmental representation of the process as expressed as a rule:

(27) Harmony as a spreading rule



Following work such as Anderson (1974), Howard (1972), Jensen & Stong-Jensen (1976), Johnson (1972), Kenstowicz & Kisseberth (1977), Clements (1981), Kiparsky (1985), Archangeli & Pulleyblank (1994), it has been common to assume that such a rule applies iteratively. Hence in a word such as ùǎ 'famine', nasality would appear underlyingly on the final low vowel, spread to the glide on the first iteration, and spread to the initial high vowel on a second iteration. Such iterative application is possible only if each intermediate target is also a trigger. That is, if any conditions are imposed on X₂ in (27), then those conditions must hold of the trigger on every iteration. This is problematic in the Mòbà case because nasal consonants are *not* eligible triggers. Hence the nasality on the initial vowel of ìmǎ 'palm leaf' is the result of the nasalised low vowel, not the result of the intervocalic /m/.

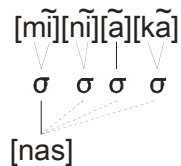
As noted in work such as Pulleyblank (1996, 2002) and Hansson (2007), such cases show a clear requirement for separating representational properties from constraint formulation. As shown schematically in (16) and (17), the output of harmony can be either a multiply-linked nasal feature, or more than one singly-linked nasal feature. Hence the harmonic constraint must impose agreement for nasality without specifying a particular way of achieving such agreement. In addition, even if the representations that harmony gives rise to respect the requirements of strict locality in the sense of Gafos (1999), Ni Chiosain & Padgett (2001), etc., it is clear in the case under consideration that the trigger and target of the harmonic constraint do not respect string-adjacency.

The treatment of this case therefore requires some relaxation of strict string adjacency. The precise manner in which this is achieved, however, is somewhat tricky. For example, according to definitions such as those in Archangeli and Pulleyblank (1994), adjacency must be

calculated at the root node level since both consonants and vowels are potential anchors for nasality in Mòbà. Such definitions of adjacency would therefore rule out reference between vowels over a consonant and incorrectly predict Mòbà to be impossible. An alternative would be a proposal such as that of Piggott (2003), an account that includes a treatment of Mòbà.

Piggott (2003) proposes that nasal harmony should be parametrised, with languages selecting either the ‘segment’ or the ‘syllable’ as the appropriate nasal-bearing unit. Languages selecting the ‘segment’ nasalise contiguous spans of appropriate segments, with any neutral segment interrupting the nasal sequence (*opacity*); languages selecting the ‘syllable’ (like Mòbà) nasalise contiguous spans of syllables, with nasality percolating to all sonorants within the nasal span. Piggott (2003: 391) provides a Barasana example to illustrate the proposal:

(28) Parametric nasalisation of syllables



A neutral obstruent can therefore be ‘skipped’ (*transparency*) in the sense that a contiguous span of syllables is nasalised, with or without obstruents as one segment type within that span.

Though Piggott proposes such a syllable-based analysis of Mòbà, a detailed examination of Mòbà’s patterns of nasalisation does not support the categoric parametrisation that he argues for. Piggott’s proposal (2003: 389) is that in languages of the Mòbà type, nasal syllables are governed by “Nasal Licensing/σ” which he defines as “the nasal feature is licensed as a property of a syllable”. He goes on to propose that “in a nasal syllable, the feature must be associated with the nucleus and projected to all other sonorants.” For Mòbà, this requirement is satisfied as a morpheme structure constraint, but not in derived contexts – a problem for such a theory. We illustrate both patterns here.

Within a morpheme, both Standard Yorùbá and Mòbà exhibit syllables with two oral sonorants or with two nasalised sonorants, but combinations of oral and nasal sonorants are not allowed. This means that nasal consonants may occur before any of the vowels [ĩ, ã, ù] but never before an oral vowel. Hence morphemes such as (29a-c) are attested while morphemes such as (29d-g) are impossible; see also (7) above.

(29) Standard Yorùbá & Mòbà: syllable-internal agreement as a morpheme structure constraint

- | | | | | |
|----|----|--------------|----|--------------------|
| a. | mũ | <i>drink</i> | d. | *mi, *ma, *mu |
| b. | ńĩ | <i>have</i> | e. | *ni, *na, *nu |
| c. | ná | <i>spend</i> | f. | *me, *mɛ, *mɔ, *mo |
| | | | g. | *ne, *nɛ, *nɔ, *no |

It is important to note that the types of impossible nasal oral sequences in (29d-e) are rather different from those in (29f-g). Sequences of a nasal consonant and a high or low vowel are possible, provided that the vowel itself is nasalised, as in (29a-c).⁸ Sequences of a nasal consonant and a mid vowel, on the other hand, are impossible whether the mid vowel in question is oral or nasalised. Such a sequence is ruled out by *Mid/Nas (3/20a) if the mid vowel is nasalised, and ruled out by *[Nas/son Oral/son]_σ (8b) if the mid vowel is oral.

The situation is more complex when potentially nasalised sequences arise across words. Two types of cases arise. First, in a sequence of the type C₁V₁+V₂... it may be the case that V₂ is nasalised while C₁ and V₁ are oral; in such cases, the result of deletion of V₁ is a derived consonant-vowel sequence which should be nasalised because of *[Oral/son Nas/son]_σ (8a). Examples are given in (30):⁹

(30) Mòbà: Derived nasalisation of sonorant consonants

- | | | | | | | | |
|----|----------------|------------------|----------------|----------------|------------------|--------|--------------------|
| | <i>careful</i> | <i>connected</i> | | <i>careful</i> | <i>connected</i> | | |
| a. | wá ùgbĩ | wũgbĩ | look for snail | c. | rí ùkpì | ĩrùkpì | see KIND OF INSECT |
| b. | rí ùkú | ĩrùkú | see squirrel | d. | wá ìfũ | wĩfũ | look for intestine |

Note that nasal harmony applies from right to left within syllables, but otherwise does not occur across word boundaries. This can be seen in the ‘careful speech’ forms of (30). Note that it is not simply the fact of vowel deletion that allows/triggers nasal spreading. In examples such as

⁸ Note in this context that Yorùbá orthography does not indicate nasalisation on a vowel following a nasal consonant. Hence a word like [mũ] ‘drink’ would be represented orthographically as ‘mu’. This orthographic convention must not be allowed to confuse the issue under discussion here: ‘mu’ is possible as a spelling for [mũ], but the phonological sequence [mu] (nasal consonant followed by oral vowel) is not allowed.

⁹ The tonal representations of these contracted forms requires further investigation.

(31), we see that there is no derived nasal assimilation in cases where the spreading would not be motivated by syllable-internal harmony.

(31) Mòbà: no nasalisation across word boundaries (except syllable internally)

	<i>careful</i>	<i>connected</i>		<i>careful</i>	<i>connected</i>
a.	yí ùgbǐ	yigbǐ	<i>roll snail</i>	c. yí ìkǎ	yíkǎ <i>roll termite</i>
b.	yí ùkú	yíkú	<i>roll squirrel</i>	d. yí ìdĩ	yidĩ <i>roll maggot</i>

The second type of case involves sequences where a nasal C_1 comes to precede an oral V_2 , that is, cases of the type $/m\tilde{V}_1 + V_2CV/$ where \tilde{V}_1 deletes. To cover the relevant cases, it is important to consider the three possibilities for \tilde{V}_1 , namely $/\tilde{i}, \tilde{u}, \tilde{a}/$ and the three possible height classes for V_2 , namely high ($/i, u/$), mid ($/e, \varepsilon, \text{ɔ}, o/$) and low ($/a/$). Note first that for all types of cases, it is possible for V_2 to delete, a circumstance that sheds no light on the issue of derived nasal-oral sequences:

(32) Mòbà: cases of V_2 deletion: not relevant for nasalisation

	<i>careful</i>	<i>connected</i>		<i>careful</i>	<i>connected</i>
a.	mú igi	múgi	<i>take stick</i> ¹⁰	d. mĩ ata	mĩta <i>swallow pepper</i>
b.	sũ eku	sũku	<i>roast the rat</i>	e. sã eó	sãó <i>pay money</i>
c.	mĩ usu	mĩsu	<i>swallow yam</i> ¹¹	f. mã ùkòkò	màkòkò <i>mould pot</i>

We do not address here the issue of what determines whether the first or second vowel in a sequence deletes (see Awóbùlúyì 1987, Awóyalé 1985, Pulleyblank 1988b, Bámgbóšé 1989, Oḷa 1991, Oyelaran 1972, 1990, for discussion of this issue in Standard Yorùbá). The crucial point is that both V_1 deletion and V_2 deletion are attested in Mòbà. We turn now to the patterns of nasality resulting under V_1 deletion.

¹⁰ This form can optionally be produced with V_1 deletion (mĩ gi); see below.

¹¹ The verb mĩ 'swallow' is underlyingly L, but is raised to M in examples such as those here by a productive rule of raising. See Ward (1952), Abraham (1958), Bámgbóšé (1966a), Awóbùlúyì (1978), Pulleyblank (1986), Déchaine (2001) and so on.

(33) Mòbà: cases of V₁ deletion

	<i>careful</i>	<i>connected</i>		<i>careful</i>	<i>connected</i>		
a.	mú igi	mí gi	<i>take stick</i> ¹²	h.	mĩ igi	mĩgi	<i>shake a tree</i>
b.	mú ejò	méjò	<i>take snake</i>	i.	mĩ ìwé	mĩ wé	<i>swallow/shake book</i>
c.	mú εja	méja	<i>catch fish</i>	j.	mã èdè	mèdè	<i>know language</i>
d.	mú ajá	májá	<i>catch dog</i>	k.	mã adé	madé	<i>know Ade</i>
e.	mú òbo	mó.bo	<i>catch monkey</i> ¹³	l.	mã àbúrò	màbúrò	<i>know younger sibling</i>
f.	mú olè	mólè	<i>catch thief</i>	m.	mã ɔkɔ	mɔkɔ	<i>know husband</i>
g.	mú usu	músu	<i>take yam</i>	n.	mã ojú	mojú	<i>know face</i>

We were unable to find unambiguous cases of V₁ deletion where V₁ is /ĩ/. The only cases of possible V₁ deletion involving /ĩ/ also involved /i/ as V₂ (33h,i); in our data, all cases involving /ĩ/ as V₁ are therefore also consistent with a hypothesis of V₂ deletion (see (32c,d). We have nevertheless included the examples (33h,i) here to illustrate the observation that *no* examples involving /...ĩ + i.../ ever result in a surface oral vowel. That is, under deletion a form such as *mĩ igi* must be *mĩ gi*, never **migi*. Also, we were unable to find cases of V₁ deletion with /a/ preceding either /i/ or /u/; in such sequences in our data, V₂ deleted (e.g. (32f)).

The following generalisations can be extracted from these cases of vowel deletion: (i) deletion cannot result in a sequence of a nasal consonant followed by an oral high vowel; either V₂ deletes in such a case (*mã ùkòkò/mãkòkò* (32f)) or the high vowel undergoes nasalisation (*mú igi/mí gi* (33a)); (ii) unlike within morphemes, oral mid vowels may follow nasal consonants as a result of vowel deletion (*mú olè/mólè* (33f)); (iii) there are no instances of derived nasalised low vowels; sequences of a nasal consonant and an oral low vowel are attested in vowel deletion contexts (*mú ajá/májá* (33d); *mã adé/madé* (33k)), and all instances of a nasal consonant followed by a nasalised low vowel are consistent with the nasalised low vowel being underlyingly present (*sã eó/sãó* (32e)).

Two aspects of these deletion patterns are of particular interest. First, they demonstrate that nasality is *not* a syllable-bound feature in any absolute sense. Though there is a strong tendency for all sonorant segments within a syllable to be either oral or nasal, this tendency is

¹² As seen above, this form can optionally be produced with V₂ deletion (múgi).

¹³ The dot indicates an 'assimilated L-tone' (Bamgboṣe 1966b, Ajiboye 1991, Laniran 1992, 1995, etc.).

governed by conditions. It is not the case that nasality is always licensed by linkage to a syllable nucleus. In examples such as (33b-f, j-n), nasal consonants occur although there is no nasal feature in the nucleus. The second point of interest is that we observe again the preference for nasality in Mòbà to appear on high vowels rather than mid or low vowels. In particular, even though low nasalised vowels are attested in Mòbà, we see that they are not derived in vowel contact situations as a result of the derived nasalisation of an oral low vowel. Hence the behaviour of nasality under vowel deletion provides additional evidence for the nasalisability scale proposed above in (20).

Piggott's (2003) parametric model succeeds in accounting for a subset of the Mòbà data, but fails to account for the full range of attested data.

5 Constraints on adjacent moras

Before proposing an analysis that will account for the range of patterns described above, it is instructive to consider one pattern from Standard Yorùbá and a related (though superficially different) pattern in Mòbà. As noted above, nasal agreement in Standard Yorùbá holds within the syllable and does not (in general) propagate either to the left or the right. In one circumstance, however, we do observe nasal assimilation extending beyond the syllable in Standard Yorùbá. Consider the examples in (34), illustrating a pattern of vowel assimilation attested in sequences of nouns (cf. Ajiboye 1999, Awobuluyi 1982, Awóyale 1985, Pulleyblank 1988a, Owólabí 1989, Oḷa Orié & Pulleyblank 2002).

(34) Standard Yorùbá: nasal agreement between two adjacent vowels

	<i>careful</i>	<i>connected</i>	
a.	ɛjí ɔba	ɛjĩ ɔba	<i>king's horse</i>
b.	ěří adé	ěřá ãdé	<i>Ade's laughter</i>
c.	ikù olú	ikò òlú	<i>Olu's stomach</i>
d.	ɔřù adé	ɔřà ãdé	<i>Ade's neck</i>
e.	ãřá olú	ãřó òlú	<i>Olu's velvet</i>
f.	ɛřã èbù	ɛřě èbù	<i>Ẹbun's meat</i>

In such noun-noun sequences in connected speech, the final vowel of the first noun assimilates to the initial vowel of the second noun with respect to vowel quality. We also see evidence for nasal agreement. When the first noun ends in a nasalised vowel, the nasal feature does not

undergo deletion when that vowel loses its quality. Instead nasality manifests itself on the surface on both vowels.

To account for such cases requires a constraint that is simultaneously more general and more specific than $*[\text{Nas/son Oral/son}]_{\sigma}$ (8b), reproduced in (35).

(35) Syllable-internal rightwards assimilation in Standard Yorùbá

$*[\text{Nas/son Oral/son}]_{\sigma}$: an oral sonorant incurs a violation if immediately following a nasal sonorant within a syllable

The required constraint must be more general in that it does not apply solely within syllables. That the *VV* sequences are not single syllables can be seen from prosodic evidence that is otherwise orthogonal to the concerns of this paper; see Ola (1995), Ola Orié & Pulleyblank (2002). For example, prosodic evidence shows that each of the nouns in (34) must be an independent foot. The assimilation in a case like *èrǎ áǎdé* ‘Ade’s laughter’ therefore crosses both syllable and foot boundaries.

A simple generalisation of the domain of $*[\text{Nas/son Oral/son}]_{\sigma}$ to include syllables to the right would overgenerate, however. As seen in *amǎrí* ‘preparedness’ and other examples in (26), to generalise the constraint to include a syllable to the right would result in nasalisation of both the sonorant consonant and the following vowel: $*[\text{amǎrí}]$. The correct generalisation is that rightwards nasalisation applies only between abutting vowels, never between a vowel and a following consonant. We propose, therefore, that Standard Yorùbá shows evidence of an additional constraint, related to $*[\text{Nas/son Oral/son}]_{\sigma}$ but distinct from it:

(36) Agreement in a nasal vowel-oral vowel sequence

$*[\text{Nas}/\mu \text{ Oral}/\mu]_{\text{Phrase}}$: an oral mora incurs a violation if immediately following a nasal mora; domain = phrase ($*[\text{N}\mu \text{ O}\mu]_{\text{Phrase}}$)

This constraint (where ‘mora’ = vowel) is illustrated in (37). Note that $*[\text{N}\mu \text{ O}\mu]_{\text{Phrase}}$ must be ranked above $*\text{Mid/Nas}$ (as well as $*\text{Low/Nas}$ and $*\text{High/Nas}$) since vowels of any height are targeted by mora-to-mora nasalisation. In addition, the domain of this constraint in Standard Yorùbá must be larger than the word since nasalisation crosses word-boundaries.

(37) Standard Yorùbá: Nasal agreement between adjacent moras

/èrǐ adé/	*[Nμ Oμ] _{Phrase}	*Mid/ Nas	Max Nas	*[O N] _σ	*[N O] _σ	*Low/ Nas	*High/ Nas
a. [èrǐ́ adé]	*!					*	
⇒ b. [èrǐ́ ãdé]						**	
c. [èrǐ́ ãdǐ́]		*!				**	

Before leaving the issue of rightwards nasalisation between adjacent vowels, it should be noted that the patterns are somewhat different in Mòbà. Consider the data below.

(38) Mòbà: no assimilation between two adjacent vowels

careful and connected speech

- a. ɛsǐ ɔba *king's horse*
- b. ẽrǐ́ adé *Ade's laughter*
- c. okù olú *Olu's rope*
- d. ɔrǐ́ adé *Ade's neck*
- e. ǎrǐ́ olú *Olu's velvet*
- f. ɛrǎ ɛbù *Ẹbun's meat*

As seen in (38), both in careful and connected speech, Mòbà exhibits forms that are comparable to the careful speech forms of Standard Yorùbá. In Mòbà, that is, assimilation of both place and nasality are restricted to the word level, not applying across word boundaries (Ajiboye 1999).

Given such rightwards nasalisation between adjacent vowels, we might ask whether leftwards nasalisation between vowels is also attested. Consider the data in (39) which illustrate the effects of consonant deletion.

(39) Standard Yorùbá: consonant deletion

- a. egũgũ eegũ *bone* d. ɛgũgũ ɛegũ *KIND OF PLANT*
- b. egúgú eégú *masquerade* e. òkùkù òòkù *darkness*
- c. òdúdú òódú *KIND OF PLANT* f. òkáká òóká *in front of*

When the intervocalic consonant in these examples does not appear, there must be assimilation between the vowels of both quality and nasality. For example, a form like *egũgũ* ‘bone’ can be pronounced as *eegũ* (with assimilation of both place and nasality), but not as **eũgũ* (with neither place assimilation nor nasal assimilation), **eugũ* (with assimilation of nasality but not of place), or **eẽgũ* (with assimilation of place but not nasality). Pulleyblank (1988a, 2008) analyses such cases as resulting from root node assimilation, unlike cases such as in (34) which involve place node assimilation. A clear alternative, however, is that Standard Yorùbá requires nasal agreement between adjacent vowels, prohibiting both oral-nasal and nasal-oral sequences.

(40) Agreement in a nasal vowel-oral vowel sequence

$*[Oral/\mu\ Nasal/\mu]_{Wd}$: an oral mora (i.e. vowel) incurs a violation if immediately preceding a nasal mora (i.e. vowel); domain = Word ($*[O\mu\ N\mu]_{Wd}$)

According to such an analysis, Standard Yorùbá would have a constraint that is the mirror image of $*[Nas/\mu\ Oral/\mu]_{Phrase}$ (36). Note that the examples in (39) would have to be resolved in favour of orality since Standard Yorùbá prohibits word-initial nasal vowels. While not absolutely required in Standard Yorùbá since the agreement in nasality can be derived by postulating root-node spreading, the $*[Oral/\mu\ Nas/\mu]_{Wd}$ constraint is nevertheless plausible as it expresses a surface-true generalization about Standard Yorùbá.

Turning to Mòbà, such a constraint is definitely required. Unlike Standard Yorùbá, Mòbà cases comparable to those in (39) do not exhibit vowel quality assimilation; like the Standard Yorùbá cases, however, Mòbà shows evidence of nasal agreement:

(41) Mòbà: consonant deletion: vowel juxtaposition

a.	egbìgbò	eìgbò	<i>root</i>	g.	egĩgũ	eìgũ	<i>bone</i>
b.	òkíkí	òìkí	<i>fame</i>	h.	àdíídù	àídù	<i>sweet thing</i>
c.	ètita	èìta	<i>flour remnants</i>	i.	ètítá	èìtá	<i>palm fruit</i>
d.	àkíkò	àìkò	<i>foul</i>	j.	èřřũ	èĩũ	<i>KIND OF SPONGE</i>
e.	erírú	eírú	<i>ashes</i>	k.	èńńú	èínú	<i>mercy</i>
f.	ekpìkpo	eìkpo	<i>chaff/bark</i>	l.	àńńí	àĩí	<i>middle</i>

All else being equal, we would expect regular nasal harmony to apply in cases such as (41). That is, a form like *eìgũ* ‘bone’ (41g) would be expected to surface as **eĩgũ*. The effect of

*[Oral/μ Nasal/μ]_{Wd} is to block the application of harmony in such a word – provided that *[Oral/μ Nasal/μ]_{Wd} be ranked below *Mid/Nas.¹⁴

(42) Mòbà: nasal agreement between adjacent vowels

/egigũ/	*Mid/ Nas	Max Nas	*[O N] _σ	*[N O] _σ	*Low/ Nas	*[Oμ Nμ] _{Wd}	Wd Harm	*High/ Nas
⇒ a. [eigũ]							*	
b. [eĩgũ]						*!		
c. [ẽĩgũ]	*!							

Since the word-level harmony constraint and *[Oral/μ Nasal/μ]_{Wd} are in direct conflict, and since *[Oral/μ Nasal/μ]_{Wd} wins, this means that *[Oral/μ Nasal/μ]_{Wd} must outrank word-level harmony. Cases like àídũ ‘sweet thing’ (*à’ídũ) show that *[Oral/μ Nasal/μ]_{Wd} must also be ranked below *Low/Nas.

To summarise, both Standard Yorùbá and Mòbà exhibit patterns where adjacent moras must agree in nasality. It is impossible for an oral vowel to either precede or follow a nasal vowel with the word. In Standard Yorùbá, we find evidence for the prohibition of nasal-oral sequences across word-boundaries (34) and for the prohibition of oral-nasal vowel sequences as a result of consonant deletion (39). While the latter case may be achieved by a particular formulation of progressive assimilation (Pulleyblank 1988a, 2008), it is striking that the prohibition against adjacent oral-nasal vowel sequences is surface-true. In Mòbà, the prohibition on oral-nasal vowel sequences can be seen in cases of consonant deletion (41). The prohibition against oral-nasal vowel sequences also forms a sub-part of the basic harmony pattern of Mòbà (see (12d), for example). We turn now to how to formulate the ‘word harmony’ constraint responsible for that pattern.

6 Sequential prohibition

Our proposal depends closely on Suzuki’s (1998) proposal that constraints in OT can be subject to conditions on proximity and similarity. Of relevance first is his proposal for a proximity

¹⁴ We have been unable to find clear examples where a nasal vowel-oral vowel sequence occurs in Mòbà, both in derived and underived contexts. Pending the identification of relevant data, we do not consider here such nasal-oral sequences.

hierarchy whereby the closer two elements are to each other the stronger their interaction. In his proposal for the Generalised OCP, he expresses this as:

(43) $*X...X = \{ *XX \gg *X-C_0-X \gg *X-\mu-X \gg *X-\mu\mu-X \gg *X-\sigma\sigma-X \gg \dots \gg *X-\infty-X \}$

Constraints subject to string adjacency are of the type at the left edge of the scale ($*XX$) while constraints holding over an unbounded string are of the right edge type ($*X-\infty-X$). In the unmarked case, constraints are of the string-adjacent type while in more marked instances, some degree of non-proximity may be tolerated.

For the Mòbà case, the string adjacent constraint of Standard Yorùbá ($*[Oral/\mu Nas/\mu]_{Wd}$) has generalised so that it applies across consonants, amounting to a shift of one place along Suzuki's scale:

(44) Nasal harmony

$*[Oral/\mu C_0 Nasal/\mu]_{Wd}$: an oral mora (i.e. vowel) incurs a violation if preceding a nasal mora (i.e. vowel) with or without intervening consonants; domain = word

That this formulation of Nasal harmony will work can easily be determined by simply reviewing previous tableaux, e.g. (13). The interest of the proposal, however, emerges from a comparison of the proposed constraint with the other constraints required for nasal assimilation. The full set of constraints discussed above is summarised in (45), along with indications of whether the constraint holds of Standard Yorùbá, of Mòbà, or of both dialects; a sample data set is indicated for each attested pattern.

(45) Assimilatory constraints on nasality in Standard Yorùbá and Mòbà

<i>Constraint</i>	<i>Ref</i>	<i>Definition</i>	<i>SY</i>	<i>M</i>
*[Oral/son Nas/son] _σ	(8a)	an oral sonorant incurs a violation if immediately preceding a nasal sonorant within a syllable	yes e.g. (7)	yes e.g. (7)
*[Nas/son Oral/son] _σ	(8b)	an oral sonorant incurs a violation if immediately following a nasal sonorant within a syllable	yes e.g. (29)	yes e.g. (29)
*[Oral/μ Nas/μ] _{Wd}	(40)	an oral mora incurs a violation if immediately preceding a nasal mora	(yes) e.g. (39)	yes e.g. (41)
*[Oral/μ C ₀ Nas/μ] _{Wd}	(44)	an oral mora incurs a violation if preceding a nasal mora with or without intervening consonants	--	yes e.g. (10)
*[Nas/μ Oral/μ] _{Phrase}	(36)	an oral mora incurs a violation if immediately following a nasal mora	yes e.g. (34)	--

The designation ‘yes’ in this table indicates that a constraint is necessary; a parenthesised ‘(yes)’ indicates that the data of the particular dialect are consistent with the constraint but that the constraint plays no crucial role.

Considering these five constraints from the perspective of proximity, we see that all constraints attested in Standard Yorùbá hold strictly of string-adjacent segments, while Mòbà has extended one constraint to hold even over a consonant. As stated above, this amounts to generalising the constraint by one step along Suzuki’s proximity scale.

Viewed in terms of similarity, we see a different pattern. All constraints require that the segments involved share the property of being sonorants; three of the five share the requirement that in addition to being sonorant, the segments involved must both be sonorants and moraic. Thus the Mòbà patterns are consistent with general observations that the more similar two segments are, the more likely they are to interact (Padgett 1991, Yip 1989, Pierrehumbert 1993, Frisch 1997, Suzuki 1998, Hansson 2001, Pulleyblank 2002, in press, Rose & Walker 2004, and so on).

These observations interact in interesting ways, and make certain interesting predictions. First we note a trade-off between proximity and similarity (cf. Archangeli & Pulleyblank 1994). As a constraint becomes more marked along one dimension, it tends to become less marked along another. For example, it is more marked for two segments to interact if non-adjacent and it is more marked for two segments to interact if less similar. The following scale is therefore predicted:

(46) Combining markedness patterns

<i>less marked</i>	<i>more marked</i>
adjacent/similar >>	adjacent/less similar >>
	non-adjacent/less similar
	non-adjacent/similar

The patterns of both Mòbà and Standard Yorùbá are consistent with this scale. Interactions involving adjacent segments that are similar are defined as the least marked. Both dialects exhibit such interactions, cases where segments that are sonorant and moraic interact when adjacent: *[Nas/μ Oral/μ]_{Phrase} and *[Oral/μ Nas/μ]_{Wd}. There are two patterns of intermediate markedness: i. segments that are less similar (sonorants but not both moraic) interact when adjacent: *[Oral/son Nas/son]_σ and *[Nas/son Oral/son]_σ; ii. segments that are more similar (moraic sonorants) interact even when non-adjacent: *[Oral/μ C₀ Nas/μ]_{Wd}. There is no evidence, however, for the most marked case, where a constraint would hold of non-adjacent segments that are not similar with respect to both sonority and moraic status. This is particularly interesting since the nasality pattern seen with *V C_{+SON} V* cases depends on a constraint referencing moras even though the intervening sonorant consonant agrees in nasality with the following vowel. Recall from (25d-f) that nasal consonants are not themselves triggers for heterosyllabic harmony.

Also related to this scale interaction, we note the relevance of domain size. As proposed by Mohanan (1993) and Archangeli & Pulleyblank (1994, 2002), constraints tend to hold more strongly of small domains than of large domains. We would therefore expect that a more marked interaction might be tolerated in a small domain where in a larger, less cohesive domain only a less marked interaction would be observed. This observation is consistent with the Mòbà patterns. In the smallest domain, the syllable, the fairly marked interaction of a consonant with a vowel is tolerated; beyond the syllable, on the other hand, only vowels interact with each other.

That interaction between a consonant and a vowel is more marked in this system than interaction between two vowels is interesting because of the way in which nasal harmony preferentially affects vowels, glides, liquids, fricatives and stops, in that order (Pulleyblank 1989, Walker 1998, Piggott 2003, etc.). By definition, for a language to have nasal 'harmony', nasality must affect vowels. This is not, quite clearly, the most common thing for a language to do. According to the UCLA Phonological Segment Inventory Database (UPSID) discussed in Maddieson (1984), for example, only about 22% of languages exhibit nasality on vowels. In contrast, almost all languages have at least one nasal consonant. It is therefore odd that nasal consonants must be excluded from the scale that appears cross-linguistically motivated for nasal harmony. Piggott (2003) attempts to explain this exclusion by appealing to phonetics. He suggests that considerations of stricture would place nasal stops on a par with obstruent stops, but that considerations of sonority would place them in a position comparable to other sonorants (Piggott 2003:398). Since these requirements are contradictory, nasals are simply not placed on the scale. It is not clear, however, why such considerations would not equally exclude liquids which display similar contradictions between stricture and sonority. The oddity is that the prototypical nasal segment type (sonorant nasal stops) should in some cases fail to interact in nasal harmony systems.

Considerations of similarity provide a straightforward alternative account. There is no question that nasal stops are the least marked nasal segment type. A survey like Maddieson (1984) makes this clear. Nevertheless, in languages exhibiting nasal harmony, nasal stops are among the segments that are maximally dissimilar from nasalised vowels. While it is certainly possible for nasal stops to interact with nasalised vowels, where conditions of similarity are invoked, the conditions will tend to dissociate vowels and stops.

This makes an immediate prediction. In cases where two segments exhibit a nonlocal interaction involving nasality, nonlocal interactions should be favoured between segments that are similar to each other, hence between sonorant moraic segments (vowels) or between sonorant nonmoraic segments (consonants). Such nonlocal interaction between vowels is precisely what we have observed in Mòbà; nonlocal interaction specifically between sonorants or between voiced consonants in general can be seen in nasal consonant harmony patterns, for example, Yaka (Hyman 1995, Walker 2000); see Hansson (2001) and Rose & Walker (2004) for discussion of numerous relevant cases. Least expected to interact nonlocally would be segments at extreme ends of a scale of similarity, segments such as consonants and vowels.

One might counter that interaction between nasal consonants and vowels is perhaps the most common type of segmental interaction involving nasality that is attested cross-linguistically. The point, however, is that two factors are expected to interact: (i) the more similar two segments are, the greater the likelihood of their interaction, and (ii) the closer two segments are, the greater the likelihood of their interaction. Given sufficient proximity, segments that are even quite dissimilar may interact; given sufficient similarity, segments that are even quite distant from each other may interact.

The proposal developed here is qualitatively different from that of Rose & Walker (2004) in a significant respect. Rose & Walker note the important role of similarity in long-distance harmony effects¹⁵ and build it into their formal account through the use of similarity-driven constraints on segment-to-segment correspondence. For local agreement/assimilation, however, they suggest that similarity is not a factor. Their proposal, therefore, is to postulate two different types of constraints, one (similarity-based) to govern nonlocal assimilation and a second (not similarity-based) to govern local assimilation. This distinction between local and nonlocal types does not appear to be consistent with the nasality patterns of Mòbà. The distinction between local and nonlocal constraints in Mòbà appears to be more of ‘quantity’ than ‘quality’. The same factors seem to be at play – similarity based on [sonorant] and moraic status – with the only difference being that the local constraints require string adjacency while the nonlocal constraint of Mòbà allows the presence of an intervening consonant. Whatever the precise mechanism for harmony, therefore, the patterns of Yorùbá argue that it should be the same for both local and nonlocal effects.

7. Conclusion

This paper has examined parallel processes of nasal harmony in Standard Yorùbá and Mòbà. The previously described pattern of Standard Yorùbá is one where sonorant segments agree for nasality within the syllable, and where (sonorant) moras agree for nasality when adjacent to each other. Mòbà exhibits these same patterns but extends the harmonic effects in one significant respect. Just as adjacent moras are required to agree in nasality in both dialects, in Mòbà even moras separated by a consonant exhibit the same effect. Building an account of harmony based on sequential cooccurrence conditions, we have argued that the Mòbà-type

¹⁵ See also Hansson (2001).

grammar involves a simple extension of the same constraint type responsible for the local effects of the standard language.

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