Two harmony theories and high vowel patterns in Ebira and Yoruba[1]

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Abstract

This article examines the behavior of high vowels in Ebira and Yoruba (three dialects), and discusses the implication of attested patterns for two harmony theories: stem control theory (Baković 2000, Baković and Wilson 2000) and alignment and licensing theory (Pulleyblank 1996, Piggott 1997, Orie 2001a). First, the problems posed for the stem control account are laid out. Second, it is shown that the alignment and licensing analysis is not subject to these problems.

1. Introduction

Four Benue-Congo harmonic systems – Ebira and three Yoruba dialects[2] (Standard Yoruba, Ifẹ and Ekiti) – exhibit several crucial patterns.[3] First, they exhibit

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[2] There is a long-standing debate about whether Ebira and Yoruboid languages have the same underlying oral vowel inventory. Specifically, the controversy concerns whether present day Yoruba, like Ebira, historically had contrastive retracted and advanced high vowels (George 1972) or only advanced high vowels (Oyelaran 1973, Capo 1985). For this paper, I accept the arguments of Oyelaran (1973) that retracted oral high vowels are not contrastive.

[3] Transcriptions of Yoruba and Ebira data are in Standard Yoruba orthography throughout, unless specially indicated. In Yoruba orthography *ẹ* = [ɛ], *ọ* = [ɔ], *ị* = [ɪ], *ụ* = [ʊ], *Vn* = nasalised vowel, *ṣ* = [ʃ], *p* = [k͡p] (*p* = [p] in Ebira), ´ = H, ` = L, ¯ or unmarked for tone = M, a tone-marked nasal = syllabic nasal.

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regressive harmony. Second, whereas retracted high vowels are harmonic triggers in Ebira (*sị́* ‘take’, *ộsị́* ‘he takes’), oral high vowels can never be the source of a retraction feature in Yoruba (√*òṣị̀* ‘poverty’ **ọsị́*).[4] Third, although both [+ATR] and [−ATR] mid vowels may precede advanced high vowels in Standard Yoruba (SY), only [+ATR] mid vowels occur before final high vowels in central Yoruba dialects such as Ifẹ and Ekiti:

(1)		SY	Ifẹ and Ekiti	
	a.	*ẹ̀bi*	*èbi*	‘guilt’
		ẹwìrì	*ewìrì*	‘bellows’
	b.	*ebi*	*ebi*	‘hunger’
		èkuru	*èkuru*	‘food made of beans’

Fourth, medial high vowels exhibit interesting differences: in SY, they are advanced and opaque, blocking the transmission of retraction from one mid vowel to another; in Ifẹ, they are advanced and transparent; in Ekiti, they undergo retraction. Ekiti data show that a high vowel, which is not in root-final position, may be the target of retraction in Yoruba. These differences are illustrated below:

(2)	SY	Ifẹ	Ekiti	
	orúkọ	*ọrúkọ*	*ọrụ́kọ*	‘name’
	èlùbọ́	*ẹ̀lùbọ́*	*ẹ̀lụ̀bọ́*	‘yam flour’
	ewúrẹ́	*ẹúrẹ́*	*ẹụ́rẹ́*	‘goat’
	ọ̀ṣùpá	*ọ̀sùpá*	*ọ̀ṣụ̀pá*	‘moon’

The goal of this article is to assess two harmony theories – the stem control theory and licensing/alignment theory – in the context of a discussion of these high vowel patterns. I argue that whereas Ebira provides no insight for choosing between the two theories, the Yoruba patterns show that the stem control theory compares unfavorably with the alignment/licensing theory. The specific flaws of the stem control theory are (1) it misses generalizations, (2) the theory posits abstract underlying contrasts which are neutralized on the surface, (3) it makes incorrect predictions, and (4) its analysis of transparency compromises the locality condition.

The article begins in Section 2 by presenting a stem control analysis of high vowels in Ebira and Yoruba and discusses four substantial problems raised by the Yoruba data. It is then shown in Section 3 that the theory of alignment and licensing more effectively accounts for the properties of high vowels in Yoruba. Finally, Section 4 outlines the conclusions of the paper.

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[4] Oral high vowels constitute the focus of this paper because (i) Ebira lacks nasal vowels, and (ii) the behavior of Yoruba nasal high vowels is complex and intricate. See footnote 9 for more discussion.

2. A Stem control harmony analysis of high vowels in Ebira and Yoruba

Baković (2000) proposes that Yoruba regressive harmony is an instance of stem control harmony. Since Yoruba is a prefixing language, the final vowel is assumed to be the root vowel and non-final vowels are assumed to be prefixes.[5] Two faithfulness constraints AGREE(ATR) and SA-IDENT[F], defined in (3) and (4) respectively, compel prefixes to harmonize with root vowel.

(3) AGREE(ATR): Articulatorily adjacent vowels must have the same specification for [ATR].

(4) SA-IDENT[ATR]: A segment in an affixed form [Stem + affix] must have the same value of ATR as its correspondent in the stem of affixation [Stem].

In Yoruba and Ebira, systems with prefixing rather than suffixing morphology, the affixed form in (5) is [affix + Stem]. Ranking AGREE(ATR) and SA-IDENT[ATR] above the general IDENT[ATR] constraint, which requires correspondent segments to have the same value of the feature ATR, compels an initial vowel to harmonize with a final vowel. The following tableau gives a schematic illustration of the interaction of these constraints:

(5) AGREE(ATR), SA-IDENT[ATR] $\gg$ IDENT[ATR]
Input: /eCɛ/ Stem [Cɛ]

Candidates	AGREE(ATR)	SA-IDENT[ATR]	IDENT[ATR]
a. ☞ ɛCɛ			*
b. eCe		*!	*
c. eCɛ	*!		

Candidate (5a) is optimal because it satisfies AGREE(ATR) and SA-IDENT [ATR], the constraints requiring prefixes to harmonize with the root harmonic value. Candidate (5b) is non-optimal because the input feature of the root is not the harmonizing feature in the output, creating an SA-IDENT[ATR] violation. Candidate (5c) is also flawed because disharmonic input values are retained contrary to the demand of AGREE(ATR). In the following subsection, the behavior of Ebira high vowels is accounted for using the stem control analysis.

2.1. Stem control harmony and Ebira high vowels

Ebira has nine underlying oral vowels, which may be grouped into advanced and retracted sets (Adive 1989):

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[5] A referee notes, and rightly so, that the term "prefix" is inappropriate because the initial vowel of underived nouns is not removable.

(6) Ebira vowels
Advanced: i, e, o, u Retracted: ı̣ [ɪ], ẹ [ɛ], a, ọ [ɔ], ụ [ʊ]

Within a nominal root, three harmonic patterns are observed. First, only mid vowels of the same set cooccur, as in (7):

(7)	Advanced mid vowels		Retracted mid vowels	
	òzè	‘road’	*ọhẹ́*	‘pillar of a house’
	òbó	‘rope’	*ọpọ́*	‘mask’
	ècè	‘wine’	*ẹdọ*	‘antelope’
	òsé!	‘wife’	*ẹhẹ*	‘world, life’

Second, whereas both advanced and retracted vowels occur after low vowels, only retracted vowels may precede low vowels, as follows:[6]

(8)	Low-Mid		Mid-Low	
	ayì	‘measles’	*ı̣rá*	‘fire’
	ako	‘a calabash cup’	*ụ̀bà*	‘vulture’
	anọ́	‘salt’	*ẹ̀pà*	‘root’
	ajẹ	‘egg’	*ọ̀pà*	‘arrow’
			**epa, *opa, upa, *ipa*	

The cases involving mid-low sequences demonstrate that harmony is regressive: low vowels are invariably retracted and they transmit retraction to preceding vowels.

The third and most crucial observation is that both advanced and retracted high vowels are attested and they trigger and undergo harmony, as the following examples show:

(9)	Roots with high vowels			
	Vowels with advanced value		Vowels with retracted value	
	isú	‘house rat’	*ı̣̀kụ̀*	‘sickness’
	uye	‘meat’	*ụ̀nọ*	‘cow’
	ukere	‘wooden door’	*ụkọ́rọ*	‘work’
	okuku	‘imaginary being’	*ẹcụ́kụ*	‘bone’

Having laid out the harmonic properties of Ebira vowels, we are now in a position to see how the facts involving high vowels may be analyzed within a stem control account. The crucial data are the examples in (9). Given that

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[6] There are two exceptions. The first one is the form *eebaa* ‘yes, indeed’, which has long vowels. Since vowel length is not contrastive in Ebira, it could be that this form is derived through assimilation. Alternatively, as a referee suggests, *eebaa* could be two separate words: [ee] ‘yes’ [ba] ‘indeed.’ The second exception is the form *iyá* ‘pounded yam’, which is a borrowing from Yoruba.

retracted high vowels trigger and undergo harmony like advanced high vowels, HI/ATR, the grounding constraint requiring an enhancement relation between [+high] and [+ATR] (Archangeli and Pulleyblank 1994; hereafter A&P 1994) must be a low-ranking constraint:

(10) HI/ATR: If HIGH then +ATR.

To achieve harmony in cases such as (9), AGREE(ATR) and SA-IDENT[ATR] must crucially dominate HI/ATR, as the evaluation of *ịkụ* 'sickness' demonstrates:[7]

(11) AGREE(ATR), SA-IDENT[ATR] ≫ IDENT[ATR], HI/ATR
Input: /ikụ/ Stem [kụ]

Candidates	AGREE(ATR)	SA-IDENT[ATR]	IDENT[ATR]	HI/ATR
a. ☞ ịkụ			*	**
b. iku		*!	*	
c. ikụ	*!			*

Tableau (11) illustrates vowel harmony when the stem contains a retracted high vowel. The optimal candidate (11a) violates low-ranking IDENT[ATR] and HI/ATR, while the non-optimal forms (11b, c), violate high ranking SA-IDENT[ATR] and AGREE(ATR). The fact that AGREE(ATR) and SA-IDENT [ATR] dominate IDENT[ATR] and HI/ATR ensures that full harmony, which is triggered by the stem, is optimal even when violations of grounding result.

As for stems with advanced high vowels, advancement must be transmitted to a non-low vowel prefix,[8] even if the prefix has a retracted value in the input, as evidenced by the well-formedness of (12a):

(12) AGREE(ATR), SA-IDENT[ATR] ≫ IDENT[ATR], HI/ATR
Input: /ịsu/ Stem [su] 'house rat'

Candidates	AGREE(ATR)	SA-IDENT[ATR]	IDENT[ATR]	HI/ATR
a. ☞ isu			*	
b. ịsụ		*!	*	**
c. ịsu	*!			*

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[7] While it is standard to use capital letters (I, U, E, O, A) to represent an affix with no inherent ATR specification, I follow the practice in Backović (2000) here by assigning ATR specifications to roots and prefixes in the input. Note, however, that only the root's harmonic value is preserved in the output as prefixes must harmonize with roots in a stem control language.

[8] In Ebira and Yoruba, only non-low vowels harmonize with respect to advancement; low vowels do not. Given that low vowels are invariably retracted, LO/ATR, which requires low vowels to be retracted, must be ranked highly to rule out possible instances of low vowel advancement when the stem has an advanced value (for example, *ako* 'a calabash cup' but **əko*).

We see from (11) and (12) that, under a stem control analysis, Ebira harmony is expressed simply as a process which involves assimilation between a root and a prefix. When a root is retracted, a prefix is retracted; when a root is advanced, a prefix is also advanced. As shown, high vowels are triggers and targets of retraction harmony, demonstrating that HI/ATR is low-ranking. While the behavior of Ebira high vowels seems to support the stem control harmony analysis, advanced high vowels in Standard Yoruba, which seem to transmit retraction, clearly pose a problem, as we will see in the next section.

2.2. *Stem control harmony and crossdialectal Yoruba high vowels*

2.2.1. Harmonic similarities in Yoruba. Across Yoruba dialects, there are seven underlying oral vowels,[9] as shown in (13):

(13) Seven underlying oral vowels: i, e, o, u, ẹ [ɛ], a, ọ [ɔ]

Two possible surface vowel inventories may result from the underlying vowels in (13), depending on whether or not high vowels undergo harmony in a retraction context. In dialects such as Standard Yoruba and Ifẹ, the seven underlying vowels are realized on the surface (14a) because high vowels are invariably advanced in these dialects. In central dialects such as Ijeṣa and Ekiti, on the other hand, oral high vowels undergo retraction when they appear before a retracted vowel, resulting in nine surface oral vowels (14b).

(14) Surface vowels
a. Standard Yoruba/Ifẹ: i, e, o, u, ẹ [ɛ], a, ọ [ɔ]
b. Ijesa/Ekiti: i, e, o, u, ı̣ [ɪ], ẹ [ɛ], a, ọ [ɔ], ụ [ʊ]

A number of harmonic properties are common to all Yoruba dialects. First, in roots consisting solely of mid vowels, advanced mid vowels [e, o] and retracted mid vowels [ẹ, ọ] cooccur with members of their set, not with members of the opposite set (*òde* ‘outside’, *ẹ̀dọ̀* ‘liver’, **odẹ*). Second, the facts concerning low vowels demonstrate that harmony is regressive: as in Ebira, the retracted value of a low vowel causes a preceding mid vowel to retract (*ọba* ‘king’ **oba*), but both advanced and retracted mid vowels may follow a low vowel (*abo* ‘female’, *abọ́* ‘plate’). Third, only advanced oral high vowels occur in CV roots; retracted

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[9] Nasal vowels are also attested. SY and Ifẹ have three nasal vowels [in, un, ọn] Ekiti has five [ịn, in, un, ụn, ọn]. See Footnote 10 for information on the harmonic behavior of nasal high vowels.

oral high vowels do not (*bi* ‘ask’ **bị* **bụ*).[10] Fourth, only advanced oral high vowels occur in root-final position; retracted oral high vowels do not (*ẹ̀bi* ‘guilt’ **ẹ̀bị*). The third and fourth properties show that oral high vowels cannot be the source of retraction in Yoruba.

2.2.2. Harmonic differences involving high vowels. Aside from these commonalities, crossdialectal high vowels exhibit some interesting divergences in initial, final, and medial positions. The unique properties associated with each position are described and analyzed below.

2.2.2.1. Initial high vowels. Initial high vowels exhibit two patterns. In SY and Ifẹ, initial high vowels are invariably advanced even when there is a retracted vowel at the end of the root. In Ekiti, an initial high vowel may be advanced or retracted, depending on the harmonic value of the final vowel. The examples in (15) illustrate these patterns:[11]

(15)			SY/Ifẹ	Ekiti	Gloss
	a.		*idẹ*	*ụdẹ*	‘brass’
			iyọ̀	*ụyọ̀*	‘salt’
		−ATR	*igbá*	*ụgbá*	‘calabash’
	b.		*igbó*	*ugbó*	‘bush’
			ilé	*ulé*	‘house’
		+ATR	*isu*	*uṣu*	‘yam’

The initial high vowel patterns are summarized in (16):

(16)	Initial high vowel patterns	SY	Ifẹ	Ekiti
	Initial high vowel is +ATR when final vowel is +ATR	yes	yes	yes
	Initial high vowel is −ATR when final vowel is −ATR	no	no	yes
	Initial high vowel is +ATR when final vowel is −ATR	yes	yes	no

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[10] However, it has been argued that both advanced and retracted high nasal vowels are contrastive in Ekiti (for example Bamgboṣe 1967), but see Oyelaran (1973) for a different view. The phonological behavior of nasal high vowels is interesting and complex. For example, although nasal high vowels are advanced in SY and Ifẹ, they function ambiguously as advanced (*erin* ‘elephant’ in all three dialects) or retracted (SY: *ẹnun*; Ifẹ: *ẹrun* versus Ekiti: *ẹrụn* ‘mouth’). In some roots, a final high nasal vowel in SY may cause a preceding mid vowel to be retracted (*ẹnín* ‘mat’) whereas the same high vowel may produce mid vowel advancement in Ifẹ and Ekiti (*enín* ‘mat’). For detailed discussion of harmonic properties of nasal vowels with special focus on the development of such vowels in dialects such as Ijesa and Ekiti, see Akinlabi et al. (in preparation).

[11] As can be seen in (15), another marked difference is that initial high back vowels are attested in Ekiti, whereas SY and Ifẹ use only front high vowels in initial position. See Orie (2000) for a prosodic explanation of this contrast.

The ranking of HI/ATR determines the surface realization of initial high vowels in Yoruba. In SY and Ifẹ, ranking HI/ATR above AGREE(ATR) makes it optimal for a prefix not to harmonize with a retracted root, as the optimality of (17a) demonstrates.

(17) SY/Ifẹ: HI/ATR ≫ SA-IDENT[ATR] ≫AGREE(ATR) ≫ IDENT[ATR]
Input: /idẹ/ Stem [dẹ] ‘brass’

Candidates	HI/ATR	SA-IDENT[ATR]	AGREE(ATR)	IDENT[ATR]
a. ☞ idẹ			*	
b. ịdẹ	*!			*
c. ide		*!		

On the other hand, in Ekiti, the subordination of HI/ATR to AGREE(ATR) enforces harmony when a root vowel is retracted, as evidenced by the well-formedness of (18a).

(18) Ekiti: AGREE(ATR), SA-IDENT[ATR] ≫ IDENT[ATR], HI/ATR
Input: /udẹ/ Stem [dẹ] ‘brass’

Candidates	AGREE(ATR)	SA-IDENT[ATR]	IDENT[ATR]	HI/ATR
a. ☞ ụdẹ			*	*
b. ude		*!	*	
c. udẹ	*!			

To summarize: In a stem control analysis, the differences in the behavior of initial high vowels follows from the crucial ranking of HI/ATR and AGREE (ATR). Ranking HI/ATR above AGREE(ATR) accounts for the non-harmonizing behavior of SY and Ifẹ high vowels in a retraction context. Conversely, in Ekiti, where initial high vowels retract when the final vowel is also retracted, we have seen that the dominance of HI/ATR by AGREE(ATR) is crucial.

2.2.2.2. Final high vowels. Let us now consider the behavior of final high vowels. When a final high vowel cooccurs with an initial mid vowel in roots, two harmonic patterns are possible. The first pattern, observed in Ifẹ and Ekiti, is one where mid vowels preceding a final high vowel are always advanced. In the second pattern, observed in dialects like SY, final oral high vowels function ambiguously as retracted (19a) or advanced (19b):

(19)		SY	Ifẹ́/Ekiti	Gloss
	a.	*ẹtu*	*etu*	‘antelope’
		ẹ̀bi	*èbi*	‘guilt’
		ẹwìrì	*ewìrì*	‘bellows’
		ẹ̀bùrú	*èbùrú*	‘shortcut’

b.	*etí*	*etí*	‘ear’
	eku	*eku*	‘rat’
	èrìgì	*èrıgì*	‘molar’
	ògiri	*ògiri*	‘wall’

The differences noted above are summarized in (20):

(20)

Final high vowel patterns	SY	Ifẹ	Ekiti
Final +ATR high vowel	yes	yes	yes
Final −ATR high vowel	no	no	no
Final +ATR high vowel is preceded by −ATR mid vowel	yes	no	no
A mid vowel preceding a final +ATR vowel must be advanced	no	yes	yes

The Ifẹ/Ekiti pattern in (19) can be derived with the rankings already established in (17) and (18). To illustrate, consider the evaluation of *etu* ‘antelope’ in Ifẹ:

(21) Ifẹ: HI/ATR ≫ SA-IDENT[ATR] ≫AGREE(ATR) ≫ IDENT[ATR]
Input: /ẹtu/ Stem [tu] ‘brass’

Candidates	HI/ATR	SA-IDENT[ATR]	AGREE(ATR)	IDENT[ATR]
a. ☞ etu				*
b. ẹtụ	*!	*		*
c. ẹtu		*!	*	

As demonstrated in (21), a prefix must harmonize with its stem in accordance with requirements of SA-IDENT[ATR] and AGREE(ATR). Thus, (21a) is optimal. In contrast, candidates which fail to harmonize with the stem are rejected, as shown by the non-optimality of (21b, c).

The same point is illustrated by the Ekiti example in Tableau (22): a prefix must be advanced if its stem is advanced.

(22) Ekiti: AGREE(ATR), SA-IDENT[ATR] ≫ IDENT[ATR], HI/ATR
Input: /ẹtu/ Stem [tu] ‘brass’

Candidates	AGREE(ATR)	SA-IDENT[ATR]	IDENT[ATR]	HI/ATR
a. ☞ etu			*	
b. ẹtụ		*!		*
c. ẹtu	*!			

Although the facts of Ifẹ and Ekiti receive a straightforward explanation in the stem control theory, comparable facts in SY are problematic because the final high vowel, a phonetically advanced vowel, seems to be transmitting retraction to a preceding mid vowel, contrary to expectation (*ẹtu* ‘antelope’). The following tableau illustrates the problem: [12]

(23) SY: HI/ATR ≫ SA-IDENT[ATR] ≫AGREE(ATR) ≫ IDENT[ATR]
Input: /ẹtu/ Stem [tu] ‘antelope’

Candidates	HI/ATR	SA-IDENT[ATR]	AGREE(ATR)	IDENT[ATR]
a. 💣 etu				*
b. ẹtụ	*!	*		*
c. ẹtu		*!	*	

The major problem with the stem control analysis in (23) is that the prefix is predicted to harmonize with the advanced high vowel, but it does not.

To overcome this difficulty, Baković (2000) proposes an abstract analysis, arguing that roots, which appear to transmit retraction, are underlyingly [+HI, −ATR]. That is, *ẹtu* ‘antelope’ is *etụ* in underlying representation. At this opaque level, *etụ* takes a retracted prefix to allow harmonic agreement (*ẹtụ*). However, at the surface, the [−ATR] value of the final high vowel is changed to [+ATR], producing the actual output – *ẹtu*.

This proposal encounters two major difficulties. The first problem with proposing a retracted high vowel as a source of retraction is that it misses the generalization that no Yoruba dialect has retracted oral high vowels in root-final position. The second and more serious problem with this analysis is that it wrongly predicts that the initial vowel in SY MID-HIGH-HIGH sequences such as *ẹwìrı* ‘bellows’ should derive its retraction value from the final high vowel. The problem is that medial high vowels are advanced and opaque in SY (more discussion to follow in Section 2.2.2.3). Thus, even if a retraction value were posited in root-final position, its retraction value can never be transmitted across the medial high vowel to the initial mid vowel. Consequently, the predicted form is unattested **ewiri*.

2.2.2.3. Medial high vowels. To complete our discussion of the harmonic distribution of high vowels, let us turn to roots with medial high vowels – MID-HIGH-MID forms. As shown in (24), when the final vowel of the root is advanced, initial and medial vowels are also advanced across dialects. However, cases with retracted final vowels exhibit interesting differences. In SY, medial high vowels are advanced and opaque, and block the transmission of retraction from one mid vowel to another (Archangeli and Pulleyblank 1989). In Ifẹ, they

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[12] A bomb (💣) in a tableau designates a candidate that is evaluated as optimal by the analysis but is in fact ungrammatical.

are advanced and transparent (Orie 2001b). In Ekiti, they undergo retraction (Bamgbose 1967).[13]

(24) Medial high vowels

	SY (opacity)	Ifẹ (transparency)	Ekiti (fully harmonic)	Gloss
+ATR	*èbúté*	*èbúte*	*èbúte*	‘harbor’
	ewúro	*eúro*	*eúro*	‘bitter-leaf’
−ATR	*orúkọ*	*ọrúkọ*	*ọrụ́kọ*	‘name’
	odídẹ	*ọdídẹ*	*ọdị́dẹ*	‘parrot’
	ewúrẹ́	*ẹụ́rẹ́*	*ẹúrẹ́*	‘goat’
	èlùbọ́	*ẹ̀lùbọ́*	*ẹ̀lụ̀bọ*	‘yam flour’
	ọ̀ṣùpá	*ọ̀sùpá*	*ọ̀ṣụ̀pá*	‘moon’
	ewùrà	*ẹùrà*	*ẹụ̀rà*	‘water-yam’

Baković and Wilson (2000) propose that the three patterns in (24), to wit, opacity, transparency, and full harmony follow from the interaction of four constraints: AGREE(ATR), IDENT[ATR], → NO(HI, −ATR), and AGREE(ATR//). We have already encountered AGREE(ATR) and IDENT[ATR]. → NO(HI, −ATR) is the constraint disfavoring retracted high vowels when the flanking vowels are retracted; it repairs the ill-formed configuration by replacing a retracted high vowel with an advanced high vowel. AGREE(ATR//) is the constraint requiring a medial vowel to have the same harmonic specification as flanking vowels. These two constraints are defined below (arrow in constraint means ‘targeted constraint’):

(25) → NO(HI, −ATR): Candidate x' is preferred over x iff x' is exactly like x except that at least one target vowel has been *replaced* by a member of F1-Sim(α)[14] that is not marked according to HI/ATR [emphasis is mine].

(26) AGREE(ATR//): A vowel that is articulatorily adjacent to two [αATR] vowels (that is, between them) must be specified [αATR].

When agreement constraints (AGREE(ATR) and AGREE(ATR//)) are obeyed, full harmony results. Violation of → NO(HI, −ATR) may result if the root vowel is retracted and if there are high vowels in the harmonic domain. Full harmony is derived by ranking →NO(HI, −ATR) below the AGREE constraints, as in (27):

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[13] The fourth logical pattern [ẹ/ọ. . .HI. . .e/o], which also depicts opacity, is unattested. Archangeli and Pulleyblank (1989) argue that this gap is a consequence of right-to-left association of the morphemic specification of [−ATR].

[14] F1-Sim represents first formant similarity.

(27) Full harmony (Ekiti)
AGREE(ATR), AGREE(ATR//) ≫ →NO(HI,−ATR), IDENT[ATR]
Input /orúkọ/ Stem [kọ] ‘name’

Candidates	AGREE(ATR)	AGREE(ATR//)	NO(HI,−ATR)	IDENT [ATR]
a. ☞ ọrụ́kọ			*	*
b. ọrúkọ	*!	**		*
c. orúkọo	*!			

In (27), satisfaction of AGREE(ATR) makes candidate (a) the preferred form. Its competitors are dismissed because of AGREE(ATR) violation.

In the case of transparency, ranking →NO(HI,−ATR) above AGREE(ATR), SA-IDENT[ATR],[15] and AGREE(ATR//) accounts for the non-harmonizing character of medial high vowels in a retraction context. Thus, as shown in (28) below, candidate (a) with high vowel transparency incurs a minimal violation of AGREE(ATR) and SA-IDENT[ATR] and is selected as the optimal form. The rejected candidates either incur fatal violations of AGREE(ATR), SA-IDENT[ATR] or →NO(HI,−ATR).

(28) Transparency (Ifẹ)
→ NO(HI,−ATR)≫AGREE(ATR)≫ SA-IDENT[ATR]
≫AGREE(ATR//), IDENT[ATR]
Input /orúkọ/ Stem [kọ] ‘name’

Candidates	→NO (HI,−ATR)	AGREE (ATR)	SA-IDENT [ATR]	AGREE (ATR//)	IDENT [ATR]
a. ☞ ọrúkọ		*	*	**	*
b. ọrụ́kọ	*!				**
c. orúkọ		*	**!	*	

Finally, opacity is derived by ranking →NO(HI,−ATR) and AGREE(ATR//) above AGREE(ATR). The evaluation of the candidate exhibiting opacity is shown in (29). As can be seen, the second candidate, the fully harmonic form, is non-optimal because it violates high-ranking →NO(HI,−ATR). The third candidate with a transparent medial high vowel fails because it incurs a fatal violation of AGREE(ATR//), the constraint requiring medial vowels to have the same harmonic value as flanking vowels. Therefore, the first candidate with minimal violation of AGREE(ATR//) is preferred.

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[15] SA-IDENT[ATR] is not mentioned in Backović and Wilson (2000). However, it is required to exclude the opaque candidate (29c) from emerging as optimal.

(29) Opacity (SY)
→ NO(HI, −ATR) ≫ AGREE(ATR//) ≫ AGREE(ATR), IDENT[ATR]
Input /orúkọ/ Stem [kọ] ‘name’

Candidates	NO(HI, −ATR)	AGREE (ATR//)	AGREE (ATR)	IDENT [ATR]
a. ☞ orúkọ		*	**	
b. ọrụ́kọ	*!			**
c. ọrúkọ		**!	*	*

Let us now evaluate the stem control analysis of medial high vowel patterns in Yoruba. Full harmony is the easiest pattern and can be accounted for in any standard framework. The stem control model is no exception. It explains the Ekiti pattern straightforwardly: all vowels with the root must harmonize with the final vowel, irrespective of whether or not HI/ATR is satisfied.

Opacity is also straightforwardly explained in standard accounts of harmony: the universal prohibition on crossing of lines of association (Goldsmith 1976) makes it optimal not to spread a retraction value from one mid vowel to another when there is an intervening high vowel. As shown in (29), the stem control account also explains opacity, and does so without relying on representational devices such as association lines. However, AGREE(ATR//),the crucial constraint deriving opacity, is theoretically suspect for two reasons. One, given the existence of AGREE(ATR), which requires adjacent vowels to have the same specification for [ATR], an additional constraint like AGREE(ATR//), which requires a medial vowel to harmonize with flanking vowels, seems superfluous. The data in (30) illustrate the other problem:

(30)	a.	*òbùkọ*	‘male goat’
		èkùrọ́	‘palm-nut’
		odídẹ	‘parrot’
	b.	*ẹ̀gúsí*	‘melon’
		ẹwìrì	‘bellows’
		ẹ̀lírí	‘type of rat’

On the surface, AGREE(ATR//) seems to have the ability to motivate harmony between the medial vowel and one flanking vowel: in (30a) the initial and medial vowels are advanced and in (30b) both the medial and final vowels are advanced. As we have seen in (30), AGREE(ATR//) may well be relevant for deriving cases such as (30a) but this constraint plays no role in accounting for the examples in (30b).

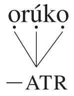
To explicitly flesh out the nature of the problem posed by (30), recall that final vowels determine the harmonic value of other vowels within a word in a stem control account. In (30a), the root’s retracted value is confined to the final vowel because HI/ATR prevents the medial high vowel from harmonizing. Furthermore, the demand of AGREE(ATR//) causes the medial vowel to harmonize with the initial vowel. On the other hand, the medial high vowel cases in (30b) require an entirely different analysis (Baković 2000). First, an abstract stage is posited. At this stage, there is a retracted high vowel at the end of the root and the general AGREE(ATR) constraint causes its retraction specification to be transmitted to the medial and initial vowels. For the example *ẹwìr̀ı* ‘bellows’, the output form at the abstract level would be **ẹwìr̀ı̣*, an unattested form. This unattested form serves as the input of the second stage. The optimal output at the second stage is *ẹwìr̀ı* because undominated HI/ATR causes the retracted high vowels to be advanced in SY. Thus, the advancement agreement between the medial and final vowels in (30b) follows from HI/ATR, not AGREE(ATR//).

In a nutshell, the problem raised by the data in (30) is this: the stem control theory provides no single mechanism for explaining medial high vowel patterns. In (30a), AGREE(ATR//) is required to account for opacity, but in (30b), AGREE(ATR//) plays no role in forcing the advancement of the medial and final high vowels. HI/ATR is the crucial constraint in this context. Given the lack of uniformity in formalizing the behavior of SY medial high vowels, the main rationale for a constraint like AGREE(ATR//) is subverted.

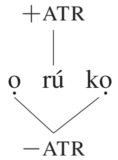
Of all the patterns in (27) through (29), transparency is the most difficult to formalize: descriptively, it involves a long distance relation in violation of the universal Locality Condition, which requires elements in linguistic relation to be adjacent (Steriade 1995, Piggott and van der Hulst 1997). According to Baković and Wilson (2000: 54), the analysis of transparency in (28) maintains “strict locality in its strongest form: there is no constraint in our analysis that evaluates candidates by comparing the feature specification of non-adjacent segments.” However, proper evaluation of the optimal output of transparency in (28) contradicts this statement. As shown in (31), the “replacement clause” embedded in the definition of → NO(HI, −ATR) entails that a retracted high vowel is first created through AGREE(ATR) and is replaced by an advanced high vowel, as follows:

(31) a. Input /orúkọ/, Stem [kọ]

b. Full harmony



c. → NO(HI, −ATR) Replacement/Output



As can be seen in (31c), the initial mid vowel harmonizes with the stem vowel in accordance with the requirement of SA-IDENT[ATR]. However, the constraint → NO(HI, −ATR) and the representation it creates are flawed for two reasons. First, →NO(HI, −ATR) is inadequate because its "replacement clause" mimics derivation in its formulation and is therefore contrary to the spirit of Optimality Theory. Second, the representation in (31c) violates the Locality Condition because the initial vowel does not share its retraction specification with an adjacent vowel.[16]

To conclude this discussion: I have shown that crossdialectal high vowel patterns in Yoruba are problematic for the stem control analysis. First, by positing abstract retracted high vowels in root-final position, the stem control theory misses the generalization that retracted oral high vowels are not the source of harmony in any dialect. Second, it makes wrong predictions for mid-high-high sequences in dialects such as Standard Yoruba. Third, AGREE(ATR//), the constraint responsible for opacity does not explain all the medial high vowel patterns in Standard Yoruba. Fourth, the constraint which enforces transparency in the stem control analysis is derivational in its formulation and resulting surface forms violate the universal Locality Condition, which requires linguistic elements in relation to be adjacent.

3. An alignment and licensing theory analysis of high vowels in Ebira and Yoruba

I now turn to the alternative analysis. In Pulleyblank's (1996) framework, harmony results from the interaction of grounding, faithfulness, and alignment constraints. The relevant grounding constraint (HI/ATR) has been defined

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[16] Following Archangeli and Pulleyblank (1994) and Pulleyblank (1996), it is assumed that locality is a property of UG, hence, not violable. However, see Itô, Mester and Padgett (1995) for a contrary view.

in (10). Two faithfulness constraints are important: MAX and DEP. MAX[17] regulates the parsing of input harmonic values and DEP prohibits the insertion of non-lexical harmonic specification (McCarthy and Prince 1995):

(32) MAX [+ATR]: Any value of +ATR in the input must have a correspondent in the output.
MAX [−ATR]: Any value of −ATR in the input must have a correspondent in the output.
DEP [+ATR]: Any value of +ATR in the output must have a correspondent in the input.
DEP [−ATR]: Any value of −ATR in the output must have a correspondent in the input.

In Pulleyblank's (1996) analysis of Standard Yoruba, only MAX[−ATR][18] is referenced because [−ATR] is assumed to be the only harmonic value specified in the input; [+ATR] is not specified because final high vowels in roots such as *ẹ̀bi* 'guilt' are inert with respect to the transmission of advancement to preceding non-high vowels. Thus, the difference between *ẹ̀bi* 'guilt' and *ebi* 'hunger' is that the former has a lexical [−ATR] while the latter is unspecified. Vowels that are unspecified in the input are interpreted as advanced:

(33) Input representation based on underspecification

a. −ATR
/EbI/ 'guilt'

b.
/Ebi/ 'hunger'

This analysis departs from the underspecification approach and assumes, following Backović (2000), that each root has a lexical [−ATR] or [+ATR]. In this way, underspecification will not be a distraction in evaluating the merits of the two models.

On the assumption that roots may have a lexical [−ATR] or [+ATR], the difference between *ẹ̀bi* 'guilt' and *ebi* 'hunger' in the input is as shown below:

(34) Input representation based on full specification

a. −ATR
/EbI/ 'guilt'

b. +ATR
/Ebi/ 'hunger'

---

17. McCarthy and Prince (1995) assume that correspondence is with respect to segments, not features. Features are assumed to be subject to another constraint, IDENT. Following work such as Pulleyblank (1996) and Myers (1997), I assume correspondence can make reference to feature-sized units, given that tonal phenomena also fall within the scope of correspondence theory (Myers 1997, Myers and Carleton 1996). If MAX can make reference to features and segments, IDENT seems redundant.

18. Like Backović (2000), this paper assumes a binary feature [±ATR]. Thus, Pulleyblank's (1996) monovalent feature "RTR" is here rephrased as [−ATR].

The realization of an input harmonic specification depends on the interaction of HI/ATR, MAX[−ATR], and MAX[+ATR]. For example, if retracted high vowels are prohibited in a grammar (SY and Ifẹ), HI/ATR must dominate MAX[−ATR] so that a lexically specified retracted high vowel will never be preserved in the output. On the other hand, if retracted high vowels are attested in a grammar (Ebira), MAX[−ATR] must dominate HI/ATR so that an input [ɪ] or [ʊ] can be preserved in the output.

Alignment is another crucial constraint. I assume that harmony is achieved through alignment, which requires a harmonic value to be aligned with the edges of a given domain (Akinlabi 1996, Cole and Kisserbeth 1994, Kirchner 1993a, 1993b, McCarthy and Prince 1993b, Pulleyblank 1996, Smolensky 1993). Since the root is the basic harmonic domain in Yoruba and Ebira,[19] the following morphological alignments are crucial:

(35) ALIGNRIGHT-ROOT: The right edge of an +ATR or −ATR span is aligned with the right edge of a root. (ALIGNR)
ALIGNLEFT-ROOT: The left edge of an +ATR or −ATR span is aligned with the left edge of a root. (ALIGNL)

Two properties are determined by alignment: the surface realization of a parsed specification and spreading. For instance, given a MID-HIGH vowel sequence with an input −ATR, if HI/ATR and MAX[−ATR] dominate ALIGNR, it would be optimal to parse the retraction specification at the left edge rather than the right edge (for example, *ẹ̀bi* 'guilt': SY). If, on the other hand, HI/ATR and ALIGNR dominate MAX[−ATR], then, perfect right-edge alignment would take precedence over parsing. The optimal strategy would be to *not* parse the retraction specification (for example, *èbi* 'guilt': Ifẹ and Ekiti Yoruba).

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[19] The domain of harmony is larger than the root. In Yoruba, harmony applies between roots and prefixes. For example, across dialects, the agentive prefix surfaces as [o] or [ɔ] depending on a root's harmony specification, as follows:

ọ̀ – lẹ	'lazy person'	*lẹ*	'indolent'
ò – bí	'parent'	*bí*	'give birth'

Unlike the agentive, high vowel prefixes exhibit harmonic alternation only if a dialect permits retracted high vowels (Ekiti). In dialects such as SY and Ife where retracted high vowels are disallowed, high vowel prefixes do not alternate:

SY/Ifẹ	Ekiti			
ì – lọ	*ʊ̀ – lọ*	'going'	*lọ*	'go'
ì – lò	*ù – lò*	'using'	*lò*	'use'

Unfortunately, word-based prefix harmony cannot be tested for Ebira because Adive (1989) does not discuss word-formation processes involving affixation. However, he shows that harmony is attested between verbs and proclitics. For instance, /ô sì/ 'he wants' versus /ộ sı̣/ 'he takes'.

The major modification proposed by Orie (2001a) is that alignment must be supplemented by prosodic licensing, following Piggott (1997, 2000). The standard approach in a purely alignment-based account is to assume that the observed regressive spread in Yoruba follows from ALIGNR. However, no principled reason is provided for this view. For instance, why is it impossible to spread a harmonic value progressively from an initial vowel in Yoruba? Why is the rightmost vowel special? To resolve this issue, Orie (2001a) proposes that final vowels are harmonic triggers because the prosodic head of the root, namely, the final syllable (Ọla 1995), licenses the harmonic value of the root:[20]

(36) Root αATR specification Licensing/Prosodic head (αATRLic/PrHd)
A root's prosodic head is the licenser of a root's input harmonic specification. (Abbreviation = Lic/PH)

A root's input harmonic value that is at the right edge of the root is properly licensed and also meets the demand of right-edge alignment (ALIGNR). In a fully harmonic root, ALIGNL extends the domain of harmony leftward so that all vowels within the root bear the same harmonic value as the final vowel.

This completes the overview of Pulleyblank's (1996) basic approach, as modified in Orie (2001a). In the next sections, high vowel patterns in Ebira and Yoruba (SY, Ifẹ, and Ekiti) are analyzed using this approach. In all these four systems, the variability of high vowels is shown to follow from the ranking of HI/ATR, faithfulness, alignment, and prosodic licensing constraints.

3.1. Alignment and licensing analysis and Ebira high vowels

Adopting the proposal that harmony is a product of grounding, faithfulness, alignment, and prosodic licensing, the presence of both retracted and advanced high vowels in Ebira follows from the fact that MAX, ALIGN,[21] and Lic/PH[22] dominate HI/ATR. That is, parsing, prosodic licensing, and alignment of a lexical −ATR or +ATR takes precedence over the satisfaction of grounding. Consider first the evaluation of *ịkụ* 'sickness', a root with a retraction value:

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[20] For detailed arguments motivating the final syllable as the prosodic head of words in Yoruba dialects, see Orie (2000).

[21] Satisfaction of ALIGNR is ensured by top ranking Lic/PH; hence, ALIGNR is not included in the tableaux.

[22] Cases involving final low vowels demonstrate that MAX[+ATR] is dominated by Lic/PH and LO/ATR, the constraint banning the cooccurrence of lowness and advancement. Thus, even if an input +ATR value were posited, it would never surface on the final vowel because of LO/ATR (*ọ̀pà* 'arrow', not **òpə̀*). Furthermore, high-ranking Lic/PH would make it impossible for +ATR to be licensed in a non-final position (*ọ̀pà* 'arrow', not **òpà*).

(37) Lic/PH ≫ MAX[−ATR], ALIGNL ≫ HI/ATR
Input: /IkU/−ATR

Candidates	Lic/PH	MAX[−ATR]	ALIGNL	HI/ATR
a. ☞ −A /\\ ịkụ				**
b. −A +A | | ị k u	*!			*
c. +A /\\ iku		*!		
d. +A −A | | i k ụ			*!	*

In Tableau (37), the input −ATR feature is not properly licensed in candidate (37b). The third candidate fails to parse a lexical −ATR and in the fourth candidate, the lexical harmonic value is not left-aligned. Since the violated constraints in (b–d) are high-ranking, the first candidate with violation of low-ranking HI/ATR is optimal.

Next, consider the evaluation of *isu* 'house rat', which has a lexical +ATR:

(38) Lic/PH ≫ MAX[+ATR], ALIGNL ≫ HI/ATR
Input: /IsU/ +ATR 'house rat'

Candidates	Lic/PH	MAX[+ATR]	ALIGNL	HI/ATR
a. ☞ +A /\\ isu				
b. −A /\\ ịsụ		*!		**
c. −A +A | | ị s u			*!	*
d. +A −A | | i s ụ	*!			*

The success of the first candidate demonstrates that parsing and alignment of a lexical +ATR is important. Thus, the second, third, and fourth candidates are non-optimal because they either violate parsing, alignment, or prosodic licensing.

Like the stem control analysis, the alignment and licensing approach generates all the desired output forms in Ebira. Prosodic licensing captures the privileged status of the final vowel, and alignment derives the realization of a single harmonic value throughout the root. As shown, the enforcement of parsing, licensing, and alignment creates violation of HI/ATR when a root has a lexical retraction specification.

3.2. Alignment-licensing analysis and Yoruba high vowels

3.2.1. Final high vowels. Recall that final high vowels in Yoruba exhibit the following properties. First, a final high vowel cannot be retracted (**ẹtụ*, **kụ*). Second, in dialects like SY, all high vowels are advanced, but a pre-high mid vowel may be retracted (*ẹtu* ‘antelope’, *ẹwìrì* ‘bellows’) or advanced (*etí* ‘ear’). Third, in dialects such as Ifẹ and Ekiti, final high vowels are advanced and pre-high mid vowels are always advanced (*etu* ‘antelope’, *etí* ‘ear’, *ewìrì* ‘bellows’).

The general ban on the occurrence of retracted high vowels in final position demonstrates that the prosodic head across Yoruba dialects requires satisfaction of HI/ATR:

(39) Prosodic Head Grounding (PH-HI/ATR)
The prosodic head must satisfy HI/ATR

Ranking prosodic head grounding above MAX[−ATR] and DEP[+ATR] ensures the impossibility of retracted high vowels in CV roots and VCV roots with final oral high vowels. Thus, assuming a CV root with a lexical retracted oral high vowel were posited, the proposed ranking will militate against the preservation of the input retraction feature, as follows:

(40) A final oral high vowel cannot be retracted in Yoruba
PH-HI/ATR ≫ MAX[−ATR] ≫ DEP[+ATR]
Input: /bI/ −ATR ‘ask’

Candidates	PH-HI/ATR	MAX[−ATR]	DEP[+ATR]
a. −A | bị	*!		
b. ☞ +A | bi		*	*

Likewise, in a root consisting solely of oral high vowels, the ranking in (40) forces the final oral high vowel to be advanced in the output even if it is retracted in the input.

(41) PH-HI/ATR ≫ MAX[−ATR] ≫ DEP[+ATR]
Input: /IgI/ −ATR 'stick'

Candidates	PH-HI/ATR	MAX[−ATR]	DEP[+ATR]
a. −A /\ ịgị	*!		
b. ☞ +A /\ i gi		*	*

Although the ranking in (41) selects candidate (b) as optimal, an unattested form like *[ịgi] which parses the input −ATR on the initial high vowel is not excluded. In the following sections, I consider the additional constraints ruling out *[ịgi] in SY, Ifẹ and Ekiti.

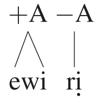
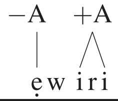
3.2.1.1. Final high vowels in Standard Yoruba. Aside from requiring final high vowels to be advanced, SY bans non-initial high vowels from bearing retraction specifications. This establishes that the context-free HI/ATR constraint (10) crucially dominates MAX[−ATR] and DEP[+ATR] (Pulleyblank 1996), as the optimality of candidate (42b) demonstrates:

(42) SY: HI/ATR, PH-HI/ATR ≫ MAX[−ATR] ≫ DEP[+ATR]
Input: /IgI/ −ATR 'stick'

Candidates	HI/ATR	PH-HI/ATR	MAX[−ATR]	DEP[+ATR]
a. −A /\ ịgị	*!	*		
b. ☞+A /\ i gi			*	*
c. −A +A | | ị g i	*!			

Although a retraction specification is never parsed in a root with high vowels, cases with MID-HIGH (*ẹtu*) or MID-HIGH-HIGH (*ẹwiri*) sequences show that a retraction value may be parsed in a non-final position.[23] That is, an input −ATR can move to the initial position, contrary to the demand of Lic/PH. This means that MAX[−ATR] outranks Lic/PH, as follows:

(43) SY: HI/ATR, PH-HI/ATR ≫ MAX[−ATR] ≫ DEP[+ATR], Lic-PH
Input: /EwIrI/ −ATR 'bellows'

Candidates	HI/ ATR	PH-HI/ ATR	MAX [−ATR]	DEP[+ATR]	Lic-PH
a. 	*!	*		*	
b. 			*!	*	
c. ☞ 				*	*

Candidate (a) violates higher-ranked grounding constraints and (b) violates high-ranking MAX[−ATR]. These violations are fatal because retracted high vowels are prohibited and a lexical −ATR must be realized if there is a non-high vowel in a root. In (c), high-ranking grounding and MAX[−ATR] force the retraction value to move leftward in search of a valid licenser – a non-high vowel. This results in violation of prosodic licensing, which is low in ranking. Hence, candidate (c) is optimal.

To summarize: the basic picture that emerges from the behavior of roots with final high vowels in SY is that a root retraction specification must be parsed if there is a mid vowel within a root. Phrased in derivational terms, an example such as *ẹwìrı* 'bellows' demonstrates that retraction links to the rightmost mid vowel, skipping over a string of high vowels.

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[23] With respect to cases such as *etí* 'ear' and *orí* 'head', which are systematically advanced across dialects, I assume that the root harmonic value is +ATR. The +ATR value is licensed at the right edge because HI/ATR violation is not incurred, and left edge alignment causes the initial vowel to be included within the scope of harmony. Unlike the forms with retracted mid vowels, these cases are uncontroversial.

3.2.1.2. Final high vowels in Ifẹ and Ekiti. Like SY, Ifẹ and Ekiti also prohibit disharmonic high vowels such as *[ịgị].[24] Unlike SY, however, Ifẹ and Ekiti mid vowels in roots with MID-HIGH or MID-HIGH-HIGH vowel sequences cannot be retracted (**ẹtu* 'antelope', **ẹwìrì* 'bellows'). Mid vowels are invariably advanced in this context (*etu* 'antelope', *ewìrì* 'bellows'). These restrictions are easily derived by ranking PH-HI/ATR and Lic-PH above MAX [−ATR].[25] This ranking makes it optimal to underparse a retraction feature, which cannot be licensed by the prosodic head. Tableau (44) illustrates the interaction of these constraints:

(44) Ifẹ/Ekiti: Lic-PH, PH-HI/ATR ≫ MAX[−ATR], DEP[+ATR]
Input: /IgI/ −ATR 'stick'

Candidates	Lic-PH	PH-HI/ATR	MAX[−ATR]	DEP[+ATR]
a. −A /\ ịgị		*!		
b. ☞ +A / \ i gi			*	*
c. −A +A │ │ ị g ị	*!			*

Given the proposed constraint ranking, an input −ATR feature must be realized on the final vowel. The ungrammaticality of candidates (a) and (c) demonstrates that −ATR parsing is non-harmonic if a root ends in an oral high vowel.

From this same ranking, the realization of SY *ẹwìrı* 'bellows' as *ewìrı* in Ifẹ/Ekiti is also straightforwardly explained.

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[24] Although this form is excluded in Yoruba, a referee notes that the factorial typology of proposed constraints suggests that some Yoruba dialects or other languages with retraction harmony might have forms such as [ịgi], where the retraction value is realized on a non-final high vowel. While the existence of such disharmonic forms seems plausible, at this writing, I know of no dialect or language with such harmonic distribution.

[25] HI/ATR also plays a role in excluding retracted high vowels in initial position in Ifẹ as will be shown in Section 3.2.2.

(45) Ifẹ/Ekiti: PH-HI/ATR, Lic-PH ≫ MAX[−ATR], DEP[+ATR]
Input: /EwIrI/ −ATR ‘bellows’

Candidates	PH-HI/ATR	Lic-PH	MAX[−ATR]	DEP[+ATR]
a. +A −A ewi rị	*!			*
b. −A ẹwịr ị	*!			
c. −A +A ẹw ir i		*!		*
d. ☞ +A ewiri			*	*

As Tableau (45) shows, the first two candidates are rejected because they incur fatal violations of the prosodic head-based grounding constraint. In the third candidate, the prosodic licensing constraint is violated because the retraction value is at the wrong edge. The ranking chooses the last candidate because it is the only form that obeys the high-ranking constraints. In this candidate, a +ATR value is inserted and aligned throughout the root, resulting in surface advancement of the root vowels.

In summary, we see that observed harmonic restrictions involving final high vowels and cooccurring high and mid vowels follow from the ranking of grounding, prosodic licensing, parsing, and alignment constraints. Unlike the stem control analysis, which adopts an abstract approach in accounting for data like *ẹwiri* ‘bellows’, the account proposed here explains the observed patterns without resorting to opaque representations.[26]

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[26] See Kiparsky (1973a, b) for arguments against opaque representations.

3.2.2. Initial high vowels. As mentioned in Section 2, initial high vowels exhibit two patterns. In SY and Ifẹ, high vowels are invariably advanced regardless of whether they are followed by a retracted or advanced vowel (*idẹ* ‘brass’, *igbó* ‘bush’). In Ekiti, an initial high vowel may be advanced or retracted, depending on the harmonic value of the final vowel (*ụdẹ* ‘brass’, *ugbó* ‘bush’). In the following sections, these patterns are shown to follow from the ranking of ALIGNL and HI/ATR, the context-free grounding constraint.

3.2.2.1. Standard Yoruba initial high vowels. The non-harmonizing nature of initial vowels in SY in retraction contexts such as *idẹ* ‘brass’ demonstrates that ALIGNL is outranked by HI/ATR, as depicted in this tableau:

(46) SY: HI/ATR, PH-HI/ATR ≫ MAX[−ATR] ≫ Lic-PH ≫ ALIGNL
Input: /IdE/ −ATR ‘brass’

Candidates	HI/ATR	PH-HI/ATR	MAX [−ATR]	Lic-PH	ALIGNL
a. −A /\ ịdẹ	*!				
b. +A /\ ide			*!		
c. −A +A | | ị d e	*!			*	
d. ☞ +A −A | | i dẹ					*

The last candidate in Tableau (46) is optimal because it is the only form that obeys grounding, parsing, and licensing requirements. It violates left-edge alignment but it is not penalized because HI/ATR shields the initial high vowel from harmonizing in this context.

3.2.2.2. Ifẹ initial high vowels. Like SY, the non-harmonizing behavior of initial high vowels in a retraction context in Ifẹ is also explained through the subordination of ALIGNL to HI/ATR, as illustrated in (47):

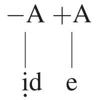
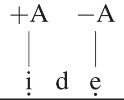
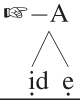
(47) Ifẹ: HI/ATR, PH-HI/ATR, Lic-PH ≫ MAX[−ATR] ≫ ALIGNL
Input: /IdE/ −ATR ‘brass’

Candidates	HI/ATR	PH-HI/ATR	Lic-PH	MAX [−ATR]	ALIGNL
a. −A /\ ịdẹ	*!				
b. −A +A | | ị d e	*!		*		
c. +A /\ ide				*!	
d. ☞ +A−A | | i dẹ					*

As shown above, the optimal candidate (47d) violates only low-ranking ALIGNL. In contrast, the other three candidates violate high-ranking constraints, leading to their rejection.

3.2.2.3. Ekiti initial high vowels. Unlike SY and Ifẹ which rank the context-free HI/ATR above ALIGNL to exclude retracted high vowels, Ekiti ranks ALIGNL above HI/ATR to make high vowel retraction optimal when a retracted vowel occurs in root-final position:

(48) Ekiti: PH-HI/ATR, Lic-PH, ALIGNL ≫ MAX[−ATR] ≫ HI/ATR
Input: /IdE/ −ATR ‘brass’

Candidates	PH-HI/ ATR	Lic-PH	ALIGNL	MAX [−ATR]	HI/ATR
a. 		*!			*
b. 			*!		
c. 				*!	
d. ☞ 					*

As shown in (48), the first three candidates are non-optimal because they violate high-ranking constraints (prosodic licensing, ALIGNL and MAX). In contrast, the last candidate violates low-ranking HI/ATR and thus emerges as the winner.

To summarize this section, the behavior of initial high vowels is a consequence of the interaction of grounding and left edge alignment. As shown, a retraction feature cannot spread leftward in SY and Ifẹ if the initial vowel is high because HI/ATR prohibits retracted high vowels in these two systems. These cases show that the prosodically-based HI/ATR and the context-free restricted HI/ATR crucially dominate alignment in dialects such as SY and Ifẹ. Like other Yoruba dialects, Ekiti prohibits retracted high vowels in root-final position but permits them in initial and medial positions (as we will see shortly) when a retracted non-high vowel occurs root finally. The Ekiti pattern is obtained by ranking the domain-based HI/ATR and alignment above the context-free HI/ATR.

3.2.3. Medial high vowels. The remaining cases to be examined are the medial high vowel patterns, exemplified by the following examples, repeated from (22) for ease of reference:

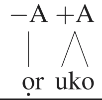
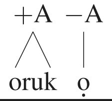
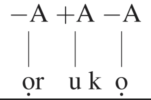
(49)

	SY (opacity)	Ifẹ (transparency)	Ekiti (fully harmonic)	Gloss
+ATR	*èbúté*	*èbúte*	*èbúte*	‘harbor’
	ewúro	*eúro*	*eúro*	‘bitter-leaf’
−ATR	*orúkọ*	*ọrúkọ*	*ọrụ́kọ*	‘name’
	odídẹ	*ọdídẹ*	*ọdị́dẹ*	‘parrot’

As discussed in Section 2, medial high vowels exhibit three patterns. First, medial high vowels in SY are advanced and opaque to the transmission of retraction. That is, retraction cannot spread from a final mid vowel to an initial mid vowel when there is an intervening high vowel. Second, in Ifẹ, they are advanced but do not block harmony. Third, in Ekiti, every vowel preceding a final retracted vowel undergoes harmony. Thus, medial high vowels retract in a retraction context. These three patterns are analyzed below.

3.2.3.1. Ekiti medial high vowels: Full harmony. The fully harmonic pattern of Ekiti, follows from the ranking already established in (48) where the subordination of HI/ATR to alignment causes non-final high vowels to be retracted when the final vowel is retracted:

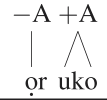
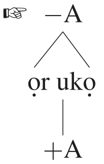
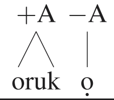
(50) Ekiti: PH-HI/ATR, Lic-PH, ALIGNR, ALIGNL ≫ MAX[−ATR] ≫ HI/ATR
Input: /OrUkO/ −ATR ‘name’

	PH-HI/ATR	Lic-PH	ALIGNL	MAX [−ATR]	HI/ATR
a.  −A +A ọr uko		*!			
b.  +A −A oruk ọ			*!*		
c.  −A +A −A ọr u k ọ			*!		
d.  +A oruko				*!	
e. ☞  −A ọrụkọ					*

The fully harmonic form in (50e) is the optimal candidate in Ekiti. The other candidates are flawed due to violation of high-ranking constraints. For instance, the sub-optimality of candidate (a) is due to violation of prosodic licensing: the root retraction value is licensed at the left edge instead of the right edge. Candidate (d) is non-optimal because the input −ATR is not parsed. The second and third candidates are interesting because they represent the opacity and transparency patterns in SY and Ifẹ, respectively. As can be seen, both involve violations of left edge alignment, which is not tolerated in a fully harmonic system. Hence, these two candidates are rejected.

3.2.3.2. Ifẹ medial high vowels: Transparency. Given that high-ranking alignment produces fully harmonic forms in Ekiti, one may be tempted to attribute the transparency of medial high vowels in Ifẹ to the demotion of ALIGNL. Such a ranking "works technically" but it is problematic. Consider tableau (51):

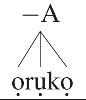
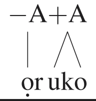
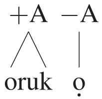
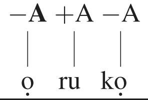
(51) Ifẹ: HI/ATR, PH-HI/ATR, Lic-PH ≫ MAX[−ATR] ≫ ALIGNL
Input: /OrUkO/ −ATR 'name'

Candidates	HI/ATR	PH-HI/ATR	Lic-PH	MAX [−ATR]	ALIGNL
a. 	*!				
b. 				*!	
c. 			*!		
d. ☞ 					*
e. 					**!

In Tableau (51), the first three candidates are eliminated because of fatal violations of grounding (a), parsing (b), and prosodic licensing (c). The most interesting cases are (d) and (e). Of these two candidates, the form with transparency (d) is selected as optimal by the analysis because it involves fewer violations of ALIGNL. There is a major problem with (51d), however: like the stem control output in (29c)/(31c), it violates the Locality Condition because the trigger and target of harmony are not adjacent.

In Pulleyblank's alternative account, the interaction of alignment and DEP derives opacity and transparency. In this analysis, transparency is not achieved through high vowel skipping and long-distance spreading. Rather, it is attributed to the insertion of [−ATR] values enforced by the requirements of high-ranking alignment. Applied to the case under consideration, in Ifẹ, the subordination of DEP[−ATR] to ALIGNL correctly selects the transparent candidate in (52e):

(52) Ifẹ: HI/ATR, PH-HI/ATR, Lic-PH, ALIGNR ≫ MAX[−ATR] ≫ ALIGNL ≫ DEP[−ATR]
Input: /OrUkO/ −ATR 'name'

Candidates	HI/ ATR	PH- HI/ATR	Lic- PH	MAX [−ATR]	ALIGNL	DEP [−ATR]
a. 	*!					
b. 			*!			
c. 				*!		
d. 					**!	
e. ☞ 					*	*

The winner, candidate (52e) better satisfies the constraint hierarchy than its competitors. As can be seen, violation of high-ranking constraints militate against the representations in (52a–c). (52d) is the major contender but it is ruled out by a fatal violation of ALIGNL.

3.2.3.3. Standard Yoruba medial high vowels: Opacity. As shown above, transparency effects can be attributed to the dominance of DEP[−ATR] by ALIGNL. This analysis is appealing because violation of locality is avoided.

The mirror image effect of transparency is one whereby alignment is subordinate to DEP, a ranking that renders harmony by insertion impossible. This ranking produces the opacity effect in SY (Pulleyblank 1996):

(53) SY: HI/ATR, PH-HI/ATR ≫ MAX[−ATR] ≫ Lic-PH ≫ DEP[−ATR] ≫ ALIGNL
Input: /OrUkO/ −ATR ‘name’

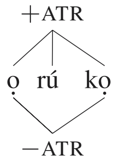
Candidates	HI/ATR	PH-HI/ATR	MAX [−ATR]	Lic-PH	DEP [−ATR]	ALIGNL
a. −A ọrụkọ	*!					
b. +A oruko			*!			
c. −A+A ọr uko				*!		
d. −**A** +A −A ọ ru kọ					*!	
e. ☞ +A −A oruk ọ						**

As can be seen, the ranking selects (53e) because given the top-ranked constraints, the optimal strategy is to retain the input −ATR at the right edge. Spreading creates a fatal HI/ATR violation (53a), and insertion creates a fatal DEP[−ATR] violation (53d). The other competitors are rejected because of parsing (53b) or prosodic licensing (53c) violations.

Before concluding this section, let us contrast the output of transparency in the alignment-licensing approach (54) with the corresponding output in the stem control analysis (55):

(54) Alignment-licensing: Transparency through insertion
−**A** +A −A
| | |
ọ r u k ọ

(55) Stem control: Transparency through assimilation



As mentioned previously in Section 2, the latter representation (55) derives transparency through assimilation (AGREEATR), so the lines crossing constraint (Goldsmith 1976) is not violated. However, due to the targeted → NO(HI, −ATR) constraint, the retracted medial high vowel is replaced by an advanced high vowel, resulting in an output like (55). One serious flaw with this representation is that strict locality is jeopardized: the initial non-high vowel does not share its retraction specification with an adjacent vowel.

In the alternative account, exemplified by (54), transparency results from feature insertion, not spreading. In other words, in (54), the harmonic agreement between the initial and final non-high vowels is achieved by inserting a retraction feature on the initial vowel, since spreading is rendered impossible by an intervening high vowel. Under this account, there is no line crossing and strict locality is maintained. Thus, my conclusion is that the insertion account of transparency is better than the targeted constraint based analysis.

One issue may arise from the configuration in (54). Given that (54) has two retraction values, it might be viewed as violating the Obligatory Contour Principle (OCP), which prohibits a representation with sequences of adjacent identical elements (Leben 1973, McCarthy 1986, Yip 1988). This potential problem is solved if, following Odden (1994), we assume that two elements are adjacent if there is no intervening material. If another element separates two identical elements, then, they are no longer adjacent and do not constitute OCP violations. Applied to (54), we can see that the two retraction values do not violate the OCP because they are separated by the medial high vowel, which has an advancement specification (Orie 2001b).

4. Conclusion

The aim of this article has been twofold: to illustrate the variability of high vowels in Ebira and three Yoruba dialects, and to consider the implications of attested patterns for two harmony theories: the stem control analysis and the alignment-licensing account. I have shown that the alignment-licensing based approach explains the observed patterns in a principled fashion. First, prosodic licensing explains the preference shown for retaining a root harmonic specification at the right edge: the final syllable is the prosodic head of the root and so licenses the root harmonic feature. Second, the surface manifestation of a root harmonic value depends on the variable ranking of prosodic licensing, alignment, MAX, and HI/ATR. For instance, the observed pattern in Ebira, where a final high vowel is a valid source of a retraction, follows from the dominance of HI/ATR by prosodic licensing, alignment, and MAX[−ATR]. The dislocation of a retraction value to the left edge in SY is a consequence of ranking prosodic licensing and alignment below HI/ATR and MAX[−ATR]. In Ifẹ, ranking prosodic licensing, alignment, and HI/ATR above MAX[−ATR] explains why a root retraction value can never be parsed when a root ends in a high vowel. Third, the behavior of high vowels in Ekiti motivates two types of grounding constraints: a prosodic head based HI/ATR and a context-free HI/ATR. The prosodic head-based HI/ATR, which is high-ranking, accounts for why retracted high vowels never occur in root final position; the context-free HI/ATR, a low-ranking constraint, explains why medial and initial high vowels harmonize in a retraction context.

I examined high vowel opacity and transparency effects in SY and Ifẹ Yoruba and demonstrated that the crucial interaction of left edge alignment and DEP[−ATR] derives these patterns within an alignment-licensing approach. This analysis has two major advantages over competing accounts. First, it does not postulate any opacity or transparency specific constraints; it employs constraints that are independently motivated across languages. Second, the surface forms do not violate the Locality Condition.

I also examined the implications of Ebira and crossdialectal Yoruba high vowel patterns for the stem control theory. While this theory explains the facts of Ebira, the Yoruba patterns are problematic. First, by positing retracted high vowels in root-final position, the stem control analysis misses the generalization that retracted high vowels are not the source of harmony in any Yoruba dialect. Second, it makes wrong predictions for mid-high-high sequences in dialects such as Standard Yoruba. Third, AGREE(ATR//), the opacity-specific constraint, is flawed because it does not capture all the medial high vowel patterns. Fourth, the stem control analysis account of transparency violates the universal Locality Condition, which requires linguistic elements in relation to be adjacent.

In conclusion, the alignment-licensing approach is preferred because it is less abstract than the stem control analysis. As shown, no crucial input distinctions are proposed to capture the variable behavior of final high vowels in Yoruba dialects: the same input representations are assumed and the different surface patterns derived through constraint ranking. Furthermore, the alignment-licensing analysis does not miss important harmonic generalizations. Finally, it does not predict incorrect crossdialectal patterns.

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