

VOWEL HARMONY AND NEUTRAL VOWELS IN C'LELA

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This article concerns aspects of the vowel system of c'Lela, a Kainji language of Nigeria that has had little previous phonological description. C'Lela manifests a system of vowel harmony based on the feature of height with examples of vowels that are neutral to this harmony. After presenting a variety of data which illustrate the phenomena of harmonization, transparency, and opacity, the article seeks to account for the two neutrality phenomena. It develops this account by applying to the c'Lela data an autosegmental analysis based in part on proposals made in Hulst and Smith (1986). This yields an economical and consistent way of explaining c'Lela vowel harmony and neutrality.

Le présent article porte sur certains aspects du système vocalique du c'lela, langue kainjie du Nigéria sur laquelle il n'existe qu'un minimum de descriptions phonologiques préalables. Le c'lela est caractérisé par un système d'harmonie vocalique basé sur la hauteur; certaines voyelles sont, toutefois, neutres par rapport à cette harmonie. Les phénomènes de l'harmonisation, de la transparence et de l'opacité sont illustrées à l'aide de diverses données; ensuite, l'article cherche à rendre compte des deux phénomènes de neutralité que l'on trouve dans la langue. Pour ce faire, on applique aux données c'lela une analyse autosegmentale fondée en partie sur des propositions faites dans Hulst et Smith (1986). Les résultats ainsi obtenus rendent compte, de façon à la fois économique et consistante, de la nature de l'harmonie et de la neutralité vocaliques en c'lela.

0. INTRODUCTION

The purpose of this article is twofold.¹ First, it describes some aspects of the vowel system of c'Lela,² particularly the manifestation of a harmony system based on the feature of height. Second, it seeks to account in a consistent fashion for the phenomena of vowels *neutral* to the process of harmonization (Hulst and Smith (1986)) as realized in c'Lela.

Section 1 of the article briefly presents the phonemic inventory and syllable structure of c'Lela as preliminaries to the description of vowel harmony. Section 2 describes the height-based vowel harmony observed in c'Lela, showing that it is a harmony internal to noun and verb roots (as well as other monomorphemic words) and that it spreads to a limited set of affixes and pronouns. The puzzle of affixes containing vowels transparent or opaque to the spread of harmony is also introduced. Section 3

¹The United Missionary Church of Africa (UMCA) has sponsored the author's linguistic research in Nigeria from 1991 to the present.

²C'Lélà is the language of the Lélà (sg. k'Lélà) or the Dakarkari, as they are called in Hausa. It is spoken by a majority of the inhabitants of Zuru Local Government Area (L.G.A.) and Danko-Wasagu L.G.A. in Kebbi State, Nigeria. The population of the Lelna is conservatively estimated at 90,000 (Dettweiler and Dettweiler 1993:4). It has been my privilege to live since 1995, along with my wife and two children, in the language homeland, first in the town of Zuru and more recently in the village of Tungan Marke near the town of Bedi. This phonological description is based on the Zuru dialect of c'Lela. The language data was contributed and verified by Sunday Ango and Dominic Baba, both of Zuru, and by Ayuba Gommawa of Dabai.

The unprefix root of the language and people name, Lela, is the designation used in linguistic literature to date. C'Lela is the spelling of the language name which its speakers prefer and understand, so it is the name used in this article, with the exception of references to others' work.

Gerhardt (1989:363) classifies Lela as Benue-Congo, Western Kainji, Group 7. To the best of my knowledge, the only previous study which has focused on the phonology of c'Lela is a paper giving an inventory of the phonemes of c'Lela, authored and presented by two Lelna men (Rikoto and Rumu 1996) after their participation in an introductory course in applied linguistics. Carl Hoffmann (1967) outlined the noun class system of Dakarkari, with the aim of shedding light on the relationship between prefix and suffix class systems.

suggests a way to account for these neutral vowel phenomena; §4 summarizes the discoveries made concerning c'Lela vowel harmony and neutrality.

1. PRELIMINARIES

1.1 THE PHONEMES OF C'LELA

C'Lela can be said to have an eight-vowel system like others of its Western Kainji relatives, for example Dukawa (Heath and Heath forthcoming) and arguably Kambari (Hoffman 1972). This is shown in (1).

(1) Vowel inventory of c'Lela³

i		u
	i	
e		o
ε		ɔ
	a	

All vowels have contrastive length (Rikoto and Rumu 1996). There is also a non-phonemic⁴ vowel which serves as a short transition between certain occurrences of consonants in clusters. It is useful for our purposes in this article to represent this non-phonemic feature by [ʔ] (raised schwa) in the data.

All vowels can occur in nasalized form. Nasalized vowels (\tilde{V}) are in complementary distribution with VN (vowel plus nasal consonant).⁵ The VN representation is the form used in this article's transcription of data.

The consonant inventory of c'Lela is given in (2).⁶

(2) Consonant inventory of c'Lela

p p ^j	t t ^w	k k ^j k ^w
b b ^j	d d ^w	g g ^j g ^w
m m ^j	n n ^w	
f f ^j	s s ^w	tʃ tʃ ^w h h ^j h ^w
v	z z ^w	ɖ ɖ ^w
	r r ^w	
	l l ^w	
w		j

³The near-close unrounded central vowel is symbolized as /i/ here and throughout the article. It is actually a bit lower phonetically than [i] and [u].

⁴The phonetic brevity of the vowel relative to all others makes it quite easy to identify. In some cases it seems to be an echo of the full vowel preceding the consonant, i.e., its quality is not always mid-central. Hoffmann (1967:240) also identified c'Lela as having eight phonemic vowels, and noted the existence of "a non-phonemic vowel glide between consonants". Literate speakers of the language do not see any need for representing this vowel in the orthography.

⁵The following data illustrates the complementary distribution:

(1) nasalized vowels only before /w/, /j/, /h/, /h^w/, /h^j/, [ʔ], or phrase-finally, e.g., **bēja** 'rice'; **kā h^wici** 'leader'; **kā ʔesse** 'neighbour'; **i d^wr^wi**. 'It's a knee'.

(2) vowel plus nasal consonants elsewhere, e.g., **d^wk^winti** 'hoe'; **kan dimi** 'junior sibling'; **kaŋ koma** 'near neighbour'; **r^wind^w we** 'whose knee?'.

⁶Rikoto and Rumu (1996) list these thirty-eight consonants with examples of contrast between phonetically similar consonants.

1.2 SYLLABLE STRUCTURE

Hoffmann (1967:241) observed concerning c'Lela noun roots that they "show a much greater variety in their phonological shapes than the usual CV or CVCV patterns that tend to be regarded . . . as typical for languages in the Western Sudan". This statement can be extended to verb roots. Nevertheless, there are constraints on the makeup of c'Lela noun roots and verb roots. First, the vast majority of these roots are either monosyllabic or disyllabic. Also, the 'heavy' syllable patterns such as CVC, CVV, and CVCC are almost always found in either monosyllabic roots or in the initial syllable of disyllabic roots. Hoffmann also noted that root syllables have mandatory onsets (p. 241). Roots which appear to be vowel-initial may be regarded as beginning with a root-initial glottal stop, more noticeable when the root is preceded by a prefix. The data⁷ in (3) illustrate these generalizations.

(3) Syllable patterns in roots⁸

CV:

[k [◌] .l̩.bɔ́]	clay
[nà.pà]	know
[s [◌] .ʔù.rú]	walls
[t ^w è.ré]	tail

CVV:

[nàa.tà]	early millet
[ʔóo.pá]	ten
[a.b̩i]	lower back
[jfi.rù]	eight

CVC:

[hàm.cè]	visitor
[i.g ^w ám.bá]	spoon
[d [◌] .k ^w in.t̩]	hoe (n)
[ʔún.cù.bù]	warbler

CVCC:

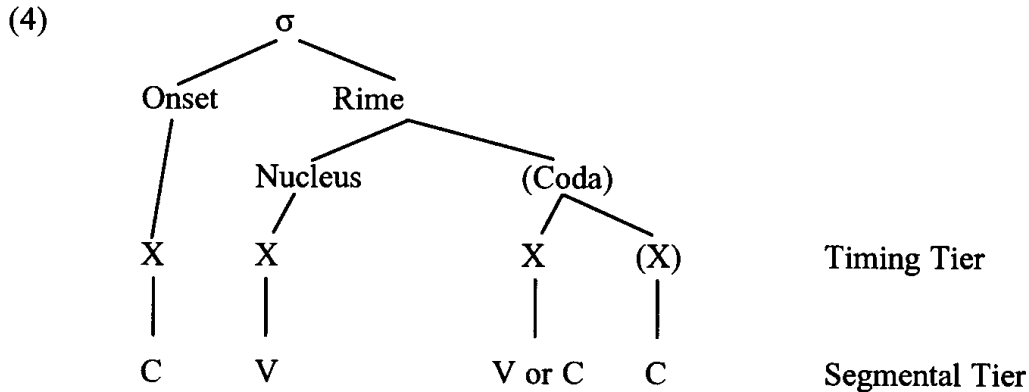
[jàmp.râ]	late millet
[mám [◌] g [◌] .sà]	repair

The data in (3) suggest the syllable template in (4).

⁷The data is given in phonetic forms, except that syllable divisions are included. The following departures from standard IPA usage in the representation of data in this article should be noted:

/i/	represents a near-close unrounded central vowel
/c/	represents [tʃ]
/ɾ/	represents [r]

⁸Notice that every noun root has a class marker (sometimes \emptyset) which is lexically assigned. In this data, the class markers are the prefixes in regular type, contrasting with the boldface type of the roots. Tone is not marked on them, but seems to be low in the isolation form. In the roots, tone is marked on the first vowel of each syllable. Subsequent presentations of data do not show tone, since it does not appear to be relevant to the vowel harmony system.



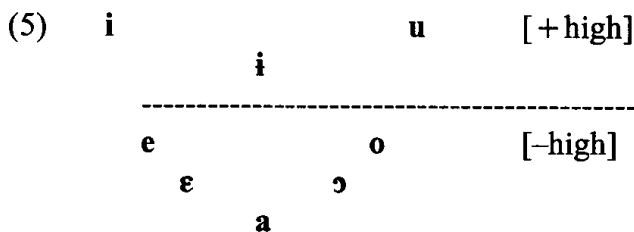
This template allows all the syllable types observed in the data. It also predicts the existence of CVVC syllables, which are quite common in derived words, but disallows CVVCC syllables by having only four timing slots. A syllable onset is mandatory, and neither onset nor nucleus may branch. There are fairly severe restrictions on what types of consonant clusters are permitted in the coda.

2. THE VOWEL HARMONY SYSTEM IN C'LELA

2.1 VOWEL HARMONY IN ROOTS

The first clue that some kind of vowel harmony is operative in c'Lela came in connection with the naming of our younger son. My wife and I thought we had chosen a name, *Mika*, that would be spelled and pronounced consistently in whatever Nigerian language we chose to work in. But to our surprise, Lelna friends showed a preference for using [e] in place of [i] in our son's name, hence *Meka*. Soon we began to notice that the Lelna pronunciation of other proper names varied from the Hausa one: they said **Reba**, not **Riba**; **Ziidi**, not **Zoodi**; **Yeso**, not **Yesu**. A woman reading a Hausa primer could not make sense of the Hausa word, **tuwo**, for the basic form in which local grains are cooked. When my wife explained the word using the c'Lela equivalent, she responded, "Oh, you mean **tuwi!**"

These and other observations led us eventually to see that the feature of vowel height seats a harmonic system in c'Lela. The harmonic system is quite pervasive in that almost all noun and verb roots have their vowels drawn from one of two disjoint sets of vowels, [+high] and [-high].⁹ These two sets of vowels are indicated in (5).



This vowel height harmony in c'Lela roots is illustrated by the data in (6) and (7), and can also be seen by re-examining the data in (3).

⁹Many but not all of the apparent exceptions to this vowel harmony can be identified as loan words from Hausa, compound words, or disharmonic dialectal variants of roots that are harmonic in other dialects.

(6) Roots with [+high] internal vowel harmony

d³tindi	nest
c³rini	charcoal
irmi	man
kumu	get
k³piru	flower
dwiri	hyena

(7) Roots with [-high] internal vowel harmony

kwesa	show
³ddakso	palm (of hand)
c³gyombo	eyebrows
soma	run
d³veso	broom
s³ava	tongs

Table 1 summarizes the vowel distributions for 260 disyllabic c'Lela noun and verb stems drawn from the author's lexical database. V₁ refers to the vowel of each stem's first syllable, and is given by the row headings in the left-hand column of the table. V₂ refers to the vowel of each stem's second syllable, as given by the column headings in the top row of the table.

V ₁ \ V ₂	i	u	ɨ	e	ɛ	o	ɔ	a	Totals
i	8	2	11		(1)			(1)	23
u		28			(1)				29
ɨ	6	9	18					(1)	34
e				8		3		17	28
ɛ	(1)			1	23	5			30
o				1		18		14	33
ɔ				2		5	24		31
a	(1)			10		10		31	52
Totals	16	39	29	22	25	41	24	64	260

Table 1. Vowel distributions in disyllabic c'Lela stems

Numbers in the body of the table are the frequencies of occurrence of each pair of vowels. Thus, for example, the number 17 in the /e/ row and /a/ column indicates that there are 17 disyllabic words (out of the 260 studied) which have /e/ in the first syllable and /a/ in the second syllable. The shaded cells of the table show the near non-occurrence of disyllabic words in which high and non-high vowels co-occur, with the frequency of exceptions to height harmony shown in parentheses. The much higher frequencies in the two unshaded portions of the table indicate how common vowel harmony is in disyllabic noun and verb stems. The blank entries in the unshaded portions of Table 1 hint at other vowel co-occurrence restrictions in addition to the vowel height harmony that is the focus of this article.

2.2 HARMONIZING VOWELS IN SUFFIXES AND CLITICS

Besides this root-internal harmony of vowels, c'Lela displays a second trait common to vowel harmony systems. There are morphemes (typically suffixes) in the lan-

guage that regularly alternate in vowel quality in agreement with roots or other morphemes of fixed vowel quality.

The first set of examples of c'Lela harmonic alternation, shown in (8), displays harmonization of pronominal suffixes representing the first, second, and third persons singular with a small group of noun roots.

- (8) Harmonization of pronominal suffixes:
-me/-mi 'my', **-vo/-vu** 'your (sg.)', **-o/-u** 'his/her'
- | | |
|------------------|-------------------|
| i in-mi | It's my mother. |
| it's mother-my | |
| i cet-me | It's my father. |
| it's father-my | |
| i in-vu | It's your mother. |
| it's mother-your | |
| i cet-vo | It's your father. |
| it's father-your | |
| i in-u | It's her mother. |
| it's mother-her | |
| i cet-o | It's her father. |
| it's father-her | |
| i hin-u | It's his sibling. |
| it's sibling-his | |
| i waar-o | It's his child. |
| it's child -his | |

Following a standard autosegmental approach, the lexical representation of these three suffixes will be unspecified for vowel height. Then at some point in the phonology, the vowel height feature will spread to the suffix vowel from the preceding noun root.

The second set of examples, shown in (9), illustrates application of the harmonic system at the phrase level, with vowel height agreement between verb roots and certain direct object pronouns.

- (9) Harmonization of two direct object pronouns: **me/mi** 'me', **vo/vu** 'you'
- | | | |
|--|---|--|
| im epk³ vo | / | iv epk³ me |
| I bit you. | | You bit me. |
| im buz³k³ vu | / | iv buz³k³ mi |
| I chased you. | | You chased me. |
| im wegaka vo | / | iv wegaka me |
| I indicated you. | | You indicated me. |
| im sipk³ vu | / | iv sipk³ mi |
| I grabbed you. | | You grabbed me. |
| im batk³ vo | / | iv batk³ me |
| I released you. | | You released me. |
| im fukt³k³ vu | / | iv fukt³k³ mi |
| I pulled you. | | You pulled me. |

- | | | |
|--|---|--|
| i kaat u-rim-u-ni
black
It's a black shoe. | / | i u-rim-u
It's black. |
| i kaat u-g^hɔz-u-ne
red
It's a red shoe. | / | i u-g^hɔz-o
It's red. |
| i kaat u-rek-u-ne
It's a small shoe. | / | i u-rek-o
It's small. |
| i kaat u-s^wa-u-ne
big
It's a big shoe. | / | i u-s^wa-wi
It's big. |
| (17) a-koma 'hand' (class marker a-) | | |
| i kom a-rim-a-ne
it's hand CM-black-CM-ADJM
It's a black hand. | / | i a-rim-a
it's CM-black-CM
It's black. |
| i kom a-g^hɔz-a-ne
It's a red hand. | / | i a-g^hɔz-a
It's red. |
| i kom a-rek-a-ne
It's a small hand. | / | i a-rek-a
It's small. |
| i kom a-zis-a-ne
It's a long hand. | / | i a-zis-a
It's long. |
| i kom a-s^wa-a-ne
It's a big hand. | / | i a-s^wa-na
It's big. |
| (18) d^ɔ-taare 'stone' (class marker d-) | | |
| i taar d^ɔ-pus-d^ɔ-ni
it's stone CM-white-CM-ADJM
It's a white stone. | / | i d^ɔ-pus-di
it's CM-white-CM
It's white. |
| i taar d^ɔ-rim-d^ɔ-ni
It's a black stone. | / | i d^ɔ-rim-di
It's black. |
| i taar d^ɔ-g^hɔz-d^ɔ-ne
It's a red stone. | / | i d^ɔ-g^hɔz-di
It's red. |
| i taar d^ɔ-rek-d^ɔ-ne
It's a small stone. | / | i d^ɔ-rek-di
It's small. |

Vowel height association as described in (12)–(14) works as expected in the right-hand column of (15) and (16) and in all the items of (18). The final items in (15) and (16) show the apparent conversion of the class marker to a glide, **j** and **w**, respectively, along with the appearance of an epenthetic vowel **i**.¹² These changes illustrate an apparent constraint of c'Lela to avoid word-final heavy syllables in the word derivation

¹²Vowel epenthesis is a pervasive phenomenon in c'Lela. Ito's theory (1989) has been very helpful in understanding its relation to syllable structure constraints.

process. (Similarly, the final item in (17) shows the epenthesis of **n** before the word-final **a**, apparently to avoid the heavy syllable **s^waa** word-finally.) Notice that the vowel of the newly formed CV syllable does not show harmony with the vowel of the adjective root in the preceding syllable. Possibly this indicates that epenthesis is ordered after harmony has already applied, or possibly that the epenthetic vowel is inherently specified as [+high]. Word-final epenthesis of a non-alternating **i** also accounts for the items in the right-hand column of (18). The left-hand column illustrates that the consonantal class marker suffix **-d** does not stand in the way of vowel height spreading. This is not surprising in that, being non-syllabic, it does not introduce a new syllable nucleus. Only a syllable nucleus can be either subject to height alternation or bear its own height specification.

Looking next at the items of (17), we see that the class marker suffix **-a** does not alternate depending on the vowel height of the adjective roots, nor does the suffix **-ne** which follows it in the left-hand column. The suffix **-a** is accordingly identified as OPAQUE to vowel height harmony. Opaqueness to harmony is one of two types of NEUTRAL vowel behaviour (Hulst and Smith 1986:234); transparency to harmony is the other type.

Turning now to the left-hand column of (15) and (16), we notice some unusual behaviour of the class marker suffixes **-i** and **-u** with respect to the spreading of vowel height. We have seen that they alternate “properly” in harmony with the adjective roots preceding them in the right-hand column. However, in the same post-root positions in the left-hand column, the **-i** and **-u** do not alternate in harmony with the vowel of the adjective. The behaviour of the **-i** and **-u** class markers in this context is that of segments TRANSPARENT to vowel harmony (Hulst and Smith 1986:234).¹³ In particular, (1) they fail to alternate in the harmonic feature, remaining constantly [+high], and (2) they occur with both preceding and following [-high] vowels; in fact, the harmony of a vowel following a transparent segment systematically correlates with the harmonic value of the vowel preceding it (either both are [-high] or both are [+high]).

These characteristics of transparency are illustrated in (20), with data selected from (15) and (16)¹⁴ and where the + and – signs show the value of the [high] autosegment.

(19)	rek-i-ne	small	versus	rek-e	small
	– + –			– –	
	zis-i-ni	long	versus	zis-i	long
	+ + +			+ +	
	rim-u-ni	black	versus	rim-u	black
	+ + +			+ +	

¹³Kenstowicz (1994:355–358) discusses similar transparent behaviour of high vowels in the [ATR] harmonic system of Wolof. An important difference between c’Lela and Wolof (besides the harmonic system being seated on different features) is that the c’Lela transparent segments are clearly PSEUDO-neutral, in the terminology used by Hulst and Smith. That is, although in c’Lela /i/ and /u/ have harmonic counterparts /e/ and /o/ with respect to the feature [high], they still fail to harmonize in the contexts described in this article. By contrast, the Wolof high vowels have no harmonic counterpart with respect to the feature [ATR], so there is a neutralization of an opposition.

¹⁴The adjective prefixes are not included in this presentation of the data. Prefixes are assumed to be outside the domain for vowel height association (see (11)).

3. ACCOUNTING FOR NEUTRAL VOWELS AND HARMONIC ALTERNATION IN C'LELA PHONOLOGY

Hulst and Smith's typology of segments neutral to vowel harmony has proven quite helpful in suggesting a coherent means for describing and explaining the vowel harmony system of c'Lela.

In the terms of this typology, the three class markers of c'Lela that are vowels (**i**, **u**, and **a**) are pseudo-neutral segments, since they each have a harmonic counterpart (**e**, **o**, and **ɪ**, respectively). The class markers **i** and **u** are transparent in word-medial positions and harmonizing in word-final position. These class markers and some few other morphemes discussed in §2 furnish examples of IDIOSYNCRATIC (rather than PHONOLOGICAL) transparency. That is, the identification of the transparent segments must be made on a morpheme-by-morpheme basis and "directly encoded in the lexical representation of the relevant morphemes" (Hulst and Smith 1986:268). On the other hand, the class marker **a** is opaque in all positions. Moreover, we have no examples in other morphemes of any /a/ which is non-opaque. So the opacity of /a/ is presumably phonological.

Hulst and Smith argue for representing phonological features as single-valued.¹⁷ In a single-valued feature framework, the marked value of the feature is the only one specified in the lexicon; hence it is known as the LEXICAL value. The phonetic component interprets the segments which are not assigned the lexical value by either the lexicon or the phonological component as having the unmarked (or default) value of the feature.

Hulst and Smith also claim that, for any given language, segments showing transparency are *always* segments which have the lexical value of the harmonizing feature. On the other hand, segments showing opacity to harmony can have the default value *or* the lexical value. If we apply this claim to c'Lela, it follows that the lexical value of the vowel height autosegment is [Hi], since only high vowels show transparency in c'Lela.

I now proceed with a detailed formal analysis of c'Lela vowel harmony, including the behaviour of neutral vowels. Though aware of vowel harmony analysis which employ Optimality Theory (e.g., Hyman 1997, Leitch 1998), I will not explore c'Lela in terms of OT in this article. This analysis is based on standard assumptions of autosegmental theory, extended somewhat in the case of the treatment of transparent vowels to incorporate proposals made by Hulst and Smith. The principles relevant to c'Lela vowel harmony are the obligatory contour principle (OCP), which rules out identical autosegments that are adjacent, and the association conventions (ACs), which associate an initially unassociated autosegment with available vowels. The association conventions are assumed not to apply to autosegments already associated in the lexicon (Hulst and Smith 1986:255). This ensures a crucial property of transparent segments, that their lexical value does not spread to surrounding vowels. There is no need for default rules in the single-valued feature framework. Instead, the phonetic interpretation (PI) of all vocalic segments left unassociated to [Hi] by the phonological component is that they have the default value of the autosegment.

The derivations in (21) illustrate the behaviour of normal harmonizing vowels, whether in a root (21a,b), a suffix (21c), or a clitic (21d,e). Note that the archiphones

¹⁷In this article, I have so far represented the height feature as double-valued, i.e., [+high] and [-high]. I do not see the choice of a single-valued feature framework as *necessary* for applying Hulst and Smith's approach to c'Lela. Nevertheless, it is convenient to switch to a single-valued framework at this point, without any attempt to reiterate Hulst and Smith's arguments for its intrinsic superiority.

A, E, and O are assumed to have no underlying specification for the height feature [Hi]. As in (12)–(14), E is assumed to be underlyingly specified as a front vowel and O as a back vowel, i.e., with single valued features [Ft] and [Bk], respectively. The archiphone A is assumed to be specified simply as a vowel, with no underlying features.

(21)	Input	Principles in effect	Output
a.	OblA		PI → obla 'snake'
b.	[Hi] tAtcO	ACs [Hi] └─┬─┘ tAtcO	PI → titcu 'three'
c.	[Hi] hAn + mE	ACs [Hi] └─┬─┘ hAn + mE	PI → hinmi 'my sibling'
d.	bAt mE		PI → bat me 'release me'
e.	[Hi] bOz mE	ACs [Hi] └─┬─┘ bOz mE	PI → buz mi 'chase me'

The examples in (22) illustrate the behaviour of transparent vowels.

(22)	Input	Principles in effect	Output
a.	[Hi] [Hi] └─┬─┘ bOz + EnE	OCP [Hi] bOz+EnE	ACs [Hi] └─┬─┘ bOz+EnE PI → buzini 'has chased'
b.	[Hi] └─┬─┘ bAt + EnE		PI → batine 'has released'
c.	[Hi] [Hi] └─┬─┘ rEm+O+nE	OCP [Hi] rEm+O+nE	ACs [Hi] └─┬─┘ rEm+O+nE PI → rimuni 'black' (u class)
d.	[Hi] └─┬─┘ rEk+O+nE		PI → rekune 'small' (u class)

In (22a) and (22b) the relative perfect suffix is shown to have one transparent and one harmonizing vowel. The first suffix in (22c) and (22d), a class marker, is a transparent vowel whereas the second suffix contains a harmonizing vowel. The reader should note (under Input in (22)) that the transparent segment is necessarily represented in all four examples as lexically associated with a [Hi] autosegment. This is crucial in Hulst and Smith's account of transparency behaviour, which we now apply to c'Lela.

In (22a) and (22c) the obligatory contour principle is assumed to merge the adjacent identical [Hi] autosegments into one, with simultaneous loss of the association

line which formerly linked the second autosegment to the transparent vowel.¹⁸ Then the association conventions link the floating [Hi] to all vocalic segments in the domain.

In contrast, the input forms of (22b) and (22d) do not violate the OCP, and the ACs do not spread the value of the already associated [Hi] autosegment. Nothing happens at all; the underlying forms provide the direct input for the phonetic interpretation. The surface effect in these underlyingly contrasting situations is the same: the transparency of the medial vowel.

The data of (17) illustrated the behaviour of a c'Lela suffix which displays opaqueness, the class marker -a. To account for opaqueness, our analysis assumes two constraints on representations produced by the ACs.¹⁹ First, there is a constraint against vowels being simultaneously high and low, shown in (23) as *[Hi,Lo].²⁰ Second, there is a constraint against the emergence of discontinuous association of an autosegment, shown in (18b) as *Gap.

(23) *[Hi,Lo] NOT [Hi]

|
V
[Lo]

(24) *Gap NOT [F]
 / \
 C V C V C V

(25) presents some of the data of (17) in terms of this account of opaqueness.

(25)	Input	Principles in effect	Output
a.	[Hi] rEm+ A +nE [Lo]	ACs, *[Hi,Lo], *Gap [Hi] rEm+ A + nE [Lo]	PI → rimane 'black' (a class)
b.	rEk+ A +nE [Lo]		PI → rekane 'small' (a class)

The analysis of (25) is as follows: the ACs associate [Hi] to the first vowel; given *[Hi,Lo], the autosegment cannot be associated to the second vowel because it is low; given *Gap, the autosegment cannot be associated to the third vowel while skipping the medial vowel. Phonetic interpretation assigns the default value of the autosegment to the second and third vowels. In (25) where there is no autosegment to associate, the underlying forms provide the direct input for the phonetic interpretation.

¹⁸This "active" use of the OCP, which Hulst and Smith propose in their account of the phenomenon of transparent vowels, is consistent with common autosegmental assumptions.

¹⁹I am particularly indebted at this point in the analysis to constructive comments from the anonymous reviewer of an earlier form of this article.

²⁰This same constraint can be used to account for some of the examples of root-internal disharmony shown in Table 1, those involving /a/ whether as V₁ or V₂. Furthermore, if the vowels /e/ and /o/ are also assumed to have the feature [Lo], then this constraint accounts for all examples of disharmony shown in Table 1. In addition, *[Hi,Lo] accounts for two trisyllabic examples of disharmony I have noticed, *kuntɔmɔ* 'fruit bat' and *bɔgimbo* 'cattle egret'. These disharmonic noun roots have the unlinked autosegment [Hi] included in their underlying form, and the Association Conventions only link it with any vowel which does not have the feature [Lo].

To complete this section, we examine data from situations in which the class marker suffixes *-i* and *-u* do not display transparent behaviour. Examples (15)–(18) have already presented the same data in a larger context; (26) now presents them in terms of the Hulst and Smith typology.

(26)	Input	Principles in effect	Output
a.	rEk + E		PI → reke 'small' (i class)
b.	g^lOz + O [Lo]		PI → g^lzo 'red' (u class)
c.	[Hi]	ACs	PI → pusi 'white' (i class)
d.	pOs + E [Hi]	ACs	PI → rimu 'black' (u class)
	rEm + O		

The first thing to note, in (26a) and (26b), is that the class marker suffixes harmonize with the adjective root's vowel in taking the default value of the autosegment. Whereas in (22d), in a word-medial context, the *-u* class marker is transparent to harmony, here in (26b) it harmonizes to the root vowel in a word-final context. This is surprising and unusual behaviour, to have the same suffix behaving transparently in the one position but harmonizing in the other. I am not aware of similar behaviour being reported in any other language.

The behaviour of the *-i* class marker and the *-u* class marker could be accounted for by allomorphy in their lexical representations. The allomorph (of *-i* or *-u*) used in a word-medial environment would be lexically associated with a [Hi] autosegment, as in (22), but the allomorph used in a word-final environment would not have a [Hi] autosegment present, as in (26).

(27) shows examples of the *-i* and *-u* class markers in another word-final context.

(27) a.	pO + E	Syllable Structure Constraints and Epenthesis	PI → pojⁱ 'new' (i class)
		[Hi]	
		pO + j A	
		∇ ∇	
		σ σ	
b.	S^wA + O	S.S.C.s and Epenthesis	PI → s^wawi 'big' (u class)
		[Hi]	
		s ^w A + w A	
		∇ ∇	
		σ σ	

From input of the harmonizing allomorphs of *-i* and *-u* we might expect output of **poe** and **s^wao**, rather than that observed. What takes effect here, as we have previously mentioned in connection with (15)–(18), is a syllable structure constraint against word-final heavy syllables arising as output from the phonology. This motivates the formation of a word-final CV syllable, with the *-i* or *-u* suffix taking the onset position in

the form of the corresponding glide -j or -w and the epenthetic vowel *i* taking the rime position. The epenthetic vowel is lexically specified as [Hi] so that it will not harmonize with the root vowel (unless one prefers the interpretation of this data previously mentioned in connection with (15)–(18), that vowel harmonization precedes the process of epenthesis).

4. SUMMARY

This article has described the height-based vowel harmony system of c'Lela. Further, it has sought to account for vowels which are neutral to harmonization, with reference to a theory of vowel behaviour proposed by Hulst and Smith and to a few phonological constraints or principles, specifically the Obligatory Contour Principle, the Association Conventions, and a positional constraint on syllable structure.

C'Lela vowel harmony furnishes an example of a system in which pseudo-neutral segments display the two neutrality phenomena of transparency and opacity. Further, the class of transparent segments must be identified on a morpheme-by-morpheme basis; that is, identification of transparent vowels is idiosyncratic and not phonological. We have in fact seen that idiosyncratic identification goes one step further in the case of c'Lela transparency: the -i and -u class marker suffixes each have a transparent allomorph for word-medial contexts and a harmonizing allomorph for word-final contexts.

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