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REVIEW

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VOWEL HARMONY AND NEUTRAL VOWELS IN C’LELA

Stephen H. Dettweiler  
United Missionary Church of Africa, Nigeria

This article concerns aspects of the vowel system of c’Lea, a Kainji language of Nigeria that has had little previous phonological description. C’Lea 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’Lea 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’Lea vowel harmony and neutrality.

Le présent article porte sur certains aspects du système vocalique du c’lela, langue kain-ji du Nigeria sur laquelle il n’existe qu’un minimum de descriptions phonologiques préétablies. Le c’lela est caractérisé par un système d’harmonie voca-cale basé sur la hauteur; certaines voyelles sont, toutefois, neutres par rapport à cette harmonie. Les phénomènes de l’harmoni-sation, de la transparence et de l’opacité sont illustrés 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, en 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 voca-cales en c’lela.

0. INTRODUCTION

The purpose of this article is twofold. First, it describes some aspects of the vowel system of c’Lea, 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’Lea.

Section 1 of the article briefly presents the phonemic inventory and syllable structure of c’Lea as preliminaries to the description of vowel harmony. Section 2 describes the height-based vowel harmony observed in c’Lea, showing that it is a harmony internal to noun and verb roots (as well as other monomorphic 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

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1 The United Missionary Church of Africa (UMCA) has sponsored the author’s linguistic research in Nigeria from 1991 to the present.
2 C’Lea is the language of the Leelas (sg. K’lela) or the Dadori, 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-Wasa L.G.A. in Kebbi State, Nigeria. The population of the Leela is conservatively estimated at 90,000 (Dettweiler and Dettweiler 1993:4). It has been my privilege to live since 1993, 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 Matke near the town of Bendi. This phonological description is based on the Zuru dialect of c’Lea. The language data was contributed and verified by Sunday Anko and Dominic Baba, both of Zuru, and by Ayuba Gomanna of Dabai.

The unprefixsed root of the language and people name, Leela, is the designation used in linguistic literature to date. C’Lea 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’Lea is a paper giving an inventory of the phonemes of c’Lea, authored and presented by two Lela men (Rikato and Rikmen 1996) after their participation in an introductory course in applied linguistics. Carl Hoffmann (1967) outlined the noun class system of Dukarkur, 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 Kambart (Hoffman 1972). This is shown in (1).

(1) Vowel inventory of c’Lela

\[
\begin{array}{c}
\text{i} \\
\text{e} \\
\text{a} \\
\text{o} \\
\text{u} \\
\text{ɛ} \\
\text{o} \\
\text{a}
\end{array}
\]

All vowels have contrastive length (Rikoto and Rumu 1996). There is also a non-phonemic5 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 [ə] (raised schwa) in the data.

All vowels can occur in nasalized form. Nasalized vowels (i) are in complementary distribution with VN (vowel plus nasal consonant). The VN representation is the form used in this article’s transcription of data.

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

(2) Consonant inventory of c’Lela

\[
\begin{array}{c}
p \\
p' \\
b \\
b' \\
m \\
m' \\
f \\
f' \\
v \\
r \\
l \\
w
\end{array}
\]

\[
\begin{array}{c}
t \\
w \\
d \\
w \\
n \\
w \\
h \\
w \\
h \\
h \\
h
\end{array}
\]

\[
\begin{array}{c}
k \\
k' \\
g \\
g' \\
g
\end{array}
\]

\[
\begin{array}{c}
\tilde{t} \\
\tilde{d} \\
\tilde{g} \\
\tilde{g}' \\
\tilde{g}
\end{array}
\]

\[
\begin{array}{c}
\tilde{f} \\
\tilde{s} \\
\tilde{h} \\
\tilde{z} \\
\tilde{r}
\end{array}
\]

\[
\begin{array}{c}
\tilde{t} \\
\tilde{d} \\
\tilde{g} \\
\tilde{g}' \\
\tilde{g}
\end{array}
\]

\[
\begin{array}{c}
\tilde{f} \\
\tilde{s} \\
\tilde{h} \\
\tilde{z} \\
\tilde{r}
\end{array}
\]

\[
\begin{array}{c}
\tilde{t} \\
\tilde{d} \\
\tilde{g} \\
\tilde{g}' \\
\tilde{g}
\end{array}
\]

\[
\begin{array}{c}
\tilde{f} \\
\tilde{s} \\
\tilde{h} \\
\tilde{z} \\
\tilde{r}
\end{array}
\]

\[
\begin{array}{c}
\tilde{t} \\
\tilde{d} \\
\tilde{g} \\
\tilde{g}' \\
\tilde{g}
\end{array}
\]

\[
\begin{array}{c}
\tilde{f} \\
\tilde{s} \\
\tilde{h} \\
\tilde{z} \\
\tilde{r}
\end{array}
\]

\[
\begin{array}{c}
\tilde{t} \\
\tilde{d} \\
\tilde{g} \\
\tilde{g}' \\
\tilde{g}
\end{array}
\]

\[
\begin{array}{c}
\tilde{f} \\
\tilde{s} \\
\tilde{h} \\
\tilde{z} \\
\tilde{r}
\end{array}
\]

\[
\begin{array}{c}
\tilde{t} \\
\tilde{d} \\
\tilde{g} \\
\tilde{g}' \\
\tilde{g}
\end{array}
\]

\[
\begin{array}{c}
\tilde{f} \\
\tilde{s} \\
\tilde{h} \\
\tilde{z} \\
\tilde{r}
\end{array}
\]

\[
\begin{array}{c}
\tilde{t} \\
\tilde{d} \\
\tilde{g} \\
\tilde{g}' \\
\tilde{g}
\end{array}
\]

\[
\begin{array}{c}
\tilde{f} \\
\tilde{s} \\
\tilde{h} \\
\tilde{z} \\
\tilde{r}
\end{array}
\]

\[
\begin{array}{c}
\tilde{t} \\
\tilde{d} \\
\tilde{g} \\
\tilde{g}' \\
\tilde{g}
\end{array}
\]

\[
\begin{array}{c}
\tilde{f} \text{ (from s)} \\
\text{class 1 mark to the note}
\end{array}
\]

5The rear-close unrounded central vowel is symbolized as /i/ here and throughout the article. It is actually a bit lower phonetically than [i] and [u].

6The following data illustrates the complementary distribution:

(1) nasalized vowels only before /w, ŋ, /h, /h/, /h/, /ʔ/, or phrase-finally, e.g., bēja 'rice'; kā h'lei 'leader'; kā 'esse 'neighbour'; i d'ri 'it's a knee'.

(2) vowel plus nasal consonants elsewhere, e.g., ḋ'k'inti 'hose'; kan dimi 'junior sibling'; kaj koma 'near neighbour'; r'ind we 'whose knee'.

7Rikoto 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 CVCC 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 data in (3) illustrate these generalizations.

(3) Syllable patterns in roots

CV:

[k's̥l̥.bati] clay
[na.pati] know
[s̥°.aug.rati] walls
[t°.e.re] tail

CVV:

[n̄a.tati] early millet
[s̥°.ga.pati] ten
[a.bati] lower back
[j̄i.rati] eight

CVC:

[hãm.ca] visitor
[i.g°.am.bà] spoon
[d°.k°.m.tà] hoe (n)
[t°.un.cu.bà] warbler

CVCC:

[jãmp.rà] late millet
[maing°.sà] repair

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

7 The 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
/a/ represents [t][i]
/r/ represents [ɾ]

8 Notice that every noun root has a class marker (sometimes 0) 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.
(4)

\[
\begin{array}{c}
\sigma \\
\text{Onset} \\
\text{Rime} \\
\text{Nucleus} \\
\text{(Coda)} \\
\text{Timing Tier} \\
X \\
X \\
X \\
V \\
V \text{ or } C \\
C \\
\text{Segmental Tier}
\end{array}
\]

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, Leina 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 Leina pronunciation of other proper names varied from the Hausa one: they said Reba, not Riba; Ziddi, 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]. These two sets of vowels are indicated in (5).

(5) 

\[
\begin{array}{c}
i \\
\text{[+ high]} \\
\hline \\
e \\
\text{[- high]} \\
g \\
a
\end{array}
\]

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).

---

*Many 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
   d'tindi  nest
   c'rhini  charcoal
   irmi  man
   kumu  get
   K'piru  flower
   dwiri  hyena

(7) Roots with [-high] internal vowel harmony
   kwcusa  show
   'udakso  palm (of hand)
   c'gyombo  eyebrows
   soma  run
   d'veso  broom
   s'ava  tongs

Table 1 summarizes the vowel distributions for 260 disyllabic c'Lela noun and verb stems drawn from the author’s lexical database. \( V_1 \) 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. \( V_2 \) refers to the vowel of each stem’s second syllable, as given by the column headings in the top row of the table.

```
<table>
<thead>
<tr>
<th>( V_2 )</th>
<th>i</th>
<th>u</th>
<th>i</th>
<th>e</th>
<th>o</th>
<th>a</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td>8</td>
<td>2</td>
<td>11</td>
<td>(1)</td>
<td>(1)</td>
<td>(1)</td>
<td>23</td>
</tr>
<tr>
<td>u</td>
<td>28</td>
<td>17</td>
<td>(1)</td>
<td>17</td>
<td>28</td>
<td>30</td>
<td>126</td>
</tr>
<tr>
<td>e</td>
<td>16</td>
<td>9</td>
<td>18</td>
<td>8</td>
<td>3</td>
<td>(1)</td>
<td>34</td>
</tr>
<tr>
<td>o</td>
<td>16</td>
<td>9</td>
<td>18</td>
<td>8</td>
<td>3</td>
<td>(1)</td>
<td>34</td>
</tr>
<tr>
<td>a</td>
<td>16</td>
<td>9</td>
<td>18</td>
<td>8</td>
<td>3</td>
<td>(1)</td>
<td>34</td>
</tr>
<tr>
<td>Totals</td>
<td>16</td>
<td>39</td>
<td>29</td>
<td>22</td>
<td>25</td>
<td>41</td>
<td>64</td>
</tr>
</tbody>
</table>
```

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

The first set of examples of o’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 mother-my
  - i cet-me
  - it’s father-my
  - i in-vu
  - it’s mother-your
  - i cet-vo
  - it’s father-your
  - i in-u
  - it’s mother-her
  - i cet-o
  - it’s father-her
  - i hin-u
  - it’s sibling-his
  - i waar-e
  - 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 epk’ vo
  - i bit you.
  - im buz’k’ vu
  - i chased you.
  - im wegaka vo
  - i indicated you.
  - im sipk’ vu
  - i grabbed you.
  - im batk’ vo
  - i released you.
  - im funt’k’ vu
  - i pulled you.
  - iv epk’ me
  - You bit me.
  - iv buz’k’ mi
  - You chased me.
  - iv wegaka me
  - You indicated me.
  - iv sipk’ mi
  - You grabbed me.
  - iv batk’ me
  - You released me.
  - iv funt’k’ mi
  - You pulled me.
In spite of a surface similarity to the suffixes in (8), these pronouns are clitics rather than suffixes. Other words can be inserted between the verb and the object pronoun form, and the pronoun cliticizes to the word which immediately precedes it, as shown by the harmonization of its vowel. For example, if the emphatic particle bo is inserted before the pronoun mi in the phrase a wahalla kum mi 'when trouble gets me', we have a wahalla kum bo me 'when trouble really gets me'. I have not discovered phrase-level vowel harmony in c'Lela except for cases involving these pronominal clitics.

In many autosegmental approaches, e.g., Pulleyblank (1986), Goldsmith (1990), and Mutaka (1995), the lexical representations of these two direct object pronouns (the first- and second-persons singular) would not include a specification for vowel height. These pronouns seem to have no inherent height specification but alternate in harmony with the vowel height of the verb root.

Other direct object pronouns do not, however, display harmonic alternation with a preceding verb root, as the data of (10) illustrate.

(10) Non-harmonization of other direct object pronouns:
- o 'him/her', na 'us' (inclusive), co 'us' (exclusive), no 'you' (plural), ni 'them', e 'them' (inanimate)

<table>
<thead>
<tr>
<th>a wegaka o</th>
<th>a wegaka na</th>
</tr>
</thead>
<tbody>
<tr>
<td>They indicated him.</td>
<td>They indicated us (incl.).</td>
</tr>
<tr>
<td>a sipk'o</td>
<td>a sipk'na</td>
</tr>
<tr>
<td>They grabbed him.</td>
<td>They grabbed us (incl.).</td>
</tr>
<tr>
<td>a batk'co</td>
<td>a batk'no</td>
</tr>
<tr>
<td>They released us (excl.).</td>
<td>They released you.</td>
</tr>
<tr>
<td>a buz'k'co</td>
<td>a buz'k'no</td>
</tr>
<tr>
<td>They chased us (excl.).</td>
<td>They chased you.</td>
</tr>
<tr>
<td>na batk'ni</td>
<td>na batk'ni</td>
</tr>
<tr>
<td>na fumt'k'ni</td>
<td>We released them.</td>
</tr>
<tr>
<td>na ked'k'e</td>
<td>We pulled them.</td>
</tr>
<tr>
<td>na hin'k'e</td>
<td>We picked them.</td>
</tr>
<tr>
<td></td>
<td>We uprooted them.</td>
</tr>
</tbody>
</table>

The object pronouns in the examples on the left, where the verb roots have [-high] vowels, are identical to those in the examples on the right, where the verb roots have [+high] vowels. There appears to be no phonological reason that these pronouns do not exhibit the harmonic alternation displayed in identical contexts by the first- and second-person singular pronouns in the data of (9). Hence we could suppose that they are somehow marked in the lexicon as exceptions to vowel harmony.

From the data of (8) and (9), vowel height association may be described as in (11), provided that the clitics of (9) are considered part of the same phonological word with their preceding morphemes.

(11) Vowel height association

\[
\begin{array}{c|c}
V1 & V2 \\
[\pm \text{high}] & \\
\end{array}
\]

Domain: the phonological word
This process is illustrated in (12)–(14) for two items from (8) and one from (9):

(12) cet - mE → cet-me
    | [-high]       | [-high]

(13) in - mE → in-mi
    | [+high]       | [+high]

(14) sipk3 vO → sipk3 vu
    | [+high]       | [+high]

Suffixes in adjective constructions also participate in the vowel height harmony system. Suffixes which harmonize include noun class markers that are vowels and a word-final suffix -ne/-ni whose grammatical function is not yet clear. Examples are shown in (15)–(18), where the sentences in the left column include the suffix -ne/-ni and those in the right column do not. In both left and right columns, the noun class marker occurs both as prefix and as suffix to the adjective root. Note that each head noun used in (15)–(18) (with isolation form given at the beginning of each part) has a phrase-medial allomorph that drops both the class marker prefix and the final vowel from the noun’s isolation form. (15)–(18) give harmony in adjective constructions with class markers and the suffix -ne/-ni.

(15) i-vana ‘knife’ (class marker i)
     i van i-rek-i-ne / i i-rek-e
    it’s knife CM-small-CM-ADJM it’s CM-small-CM
    It’s a small knife. It’s small.11
     i van i-zis-i-ni / i i-zis-i
    long It’s long.
     i van i-po-i-ne / i i-po-ji
    It’s a new knife. It’s new.

(16) u-kaata ‘shoe’ (class marker u-)
     i kaat u-pus-u-ni / i u-pus-u
    it’s shoe CM-white-CM-ADJM it’s CM-white-CM
    It’s a white shoe.

---

10 I originally supposed that -ne/-ni marked the adjective as attributive, and its lack meant the adjective was being used predicatively (as the sentence glosses in (15)–(18) imply). However, speakers of c’Lola have since told me that either form of the adjective may be used in both environments. For example, it is quite correct to say i van i-rek-e for ‘It’s a small knife’ and to say i i-rek-i-ne for ‘It’s small’ (in referring to an i-class object such as a knife).

11 Notes concerning these glosses:
   (a) Morpheme glosses are provided for the first two examples of each noun (to establish the pattern for that noun) and the first time a morpheme is used.
   (b) The sentence-initial i in all parts of (15)–(18) is a copula, glossed as ‘it’s’.
   (c) The CM gloss identifies the noun class marker, which in this construction is affixed to the adjective root, both as prefix and as suffix.
   (d) ADJM is the gloss for the -ne/-ni suffix.
i kaat u-rim-u-ni
black
It's a black shoe.

i kaat u-g'oqz-u-ne
red
It's a red shoe.

i kaat u-rek-u-ne
It's a small shoe.

i kaat u-s"a-u-ne
big
It's a big shoe.

(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 kom a-g'oqz-a-ne
It's a red hand.

i kom a-rek-a-ne
It's a small hand.

i kom a-zis-a-ne
It's a long hand.

i kom a-s"a-a-ne
It's a big hand.

(18) d'-taare 'stone' (class marker d-)
i taar d'-pus-d'-ni
it's stone CM-white-CM-ADJM
It's a white stone.

i taar d'-rim-d'-ni
It's a black stone.

i taar d'-g'oqz-d'-ne
It's a red stone.

i taar d'-rek-d'-ne
It's a small stone.

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. These changes illustrate an apparent constraint of c'Lela to avoid word-final heavy syllables in the word derivation.

12 Vowel epenthesis is a pervasive phenomenon in c'Lela. Lefevre'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\textsuperscript{\textacuten}aa 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 -a 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 syllabic nucleus. Only a syllabic 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). 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)\textsuperscript{11} and where the + and - signs show the value of the [+high] auto-segment.

\begin{align*}
\text{rek-i-ne} & \quad \text{small} \quad \text{versus} \quad \text{rek-e} \quad \text{small} \\
\quad - + - & \quad \quad \quad - - \\
\text{zis-i-ni} & \quad \text{long} \quad \text{versus} \quad \text{zis-i} \quad \text{long} \\
\quad + + + & \quad \quad \quad + + \\
\text{rim-u-ni} & \quad \text{black} \quad \text{versus} \quad \text{rim-u} \quad \text{black} \\
\quad + + + & \quad \quad \quad + +
\end{align*}

\textsuperscript{11}Kenszewsck (1994:355-358) discusses similar transparent behaviour of high vowels in the [ATR] harmonic system of Wolof. An important difference between c'Lele and Wolof (besides the harmonic system being seated on different features) is that the c'Lele transparent segments are clearly PSEUDO-neutral, in the terminology used by Huls and Smith. That is, although in c'Lele /i/ and /u/ have harmonic counterparts /i/ 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.

\textsuperscript{12}The 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)).
rek-u-ne small versus rek-o small
- + -
- - -

The same class marker suffixes which display transparency to vowel height harmony in word-medial position, as in rek-i-ne, show harmonic alternation when in word-final position, as in rek-e. This raises the question, to be explored in §3, of how to satisfactorily account for these differences in the behavior of the same morphemes in different phonological environments.\(^{15}\)

At least one other c’Lela affix, a widely used verbal suffix, also displays transparency to vowel height harmony. To be more exact, the first vowel of the suffix displays transparency, and the second vowel of the suffix alternates in harmony with the vowel of the verb root, as shown in (20). As in (19), transparency occurs in word-medial position and harmonic alternation in word-final position.

(20) Transparency and harmonization in the verbal suffix\(^{16}\)-ine’-ini

\begin{verbatim}
i wen noc hin ep-inen
it's whom man this bite-PERF
Whom did this man grab?

I wen noc hin sip-inen
it's whom man this grab-PERF
Whom did this man bite?

i wen noc hin bat-inen
Whom did this man release?

i wen noc hin buzn-inen
Whom did this man chase?

i wen noc hin wega-inen
Whom did this man indicate?

i wen noc hin fumti-inen
Whom did this man pull?
\end{verbatim}

\(^{15}\)An earlier analysis of the data in (15)-(18) assumed (contra to Hoffman) that the first occurrence of the class marker in the adjective construction was a suffix to the head noun rather than a prefix to the adjective. This assumption led to a statement that the environments conditioning transparent versus harmonic behavior of the same morpheme were phrase-medial environment versus phrase-final environment. Collection of a few noun phrases which included two adjectives led to abandoning this earlier assumption and restating the conditioning environments as word-medial versus word-final. Following is one example of such a noun phrase:

\begin{verbatim}
i van i-rank-e i-geya-z-e
it's a small red knife.
\end{verbatim}

The things to note in the example are: (1) both adjectives have a class marker prefix in concord with the head noun, but the noun (in isolation i-vana knife) has no affixed class marker, and (2) the second occurrence of the class marker, as a suffix on the first adjective, harmonizes with the adjective root rather than being neutral to it. This is a phrase-medial but word-final environment.

\(^{16}\)This suffix is used to mark the perfect aspect whenever a sentence constituent other than the subject comes before the verb. Unmarked c’Lela sentence order is SVO.
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 i, 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. 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.

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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 [Fr] 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  ACs  [Hi]  PI →  obla 'snake'
  b. [Hi]  tAtcO  tAtcO  PI →  titcu 'three'
  c. [Hi]  hAn + mE  ACs  [Hi]  PI →  himmi  'my sibling'
  d. bAt  mE  PI →  bat me  'release me'
  e. [Hi]  boz  mE  ACs  [Hi]  PI →  buz mi  'chase me'

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

(22) Input  Principles in effect  Output
  a. [Hi]  [Hi]  OCP  ACs  [Hi]  PI →  buzai  'has chased'
  b. [Hi]  boz + EnE  bOz + EnE  PI →  batine  'has released'
  c. [Hi]  [Hi]  OCP  ACs  [Hi]  PI →  rimui  'black' (u class)
  d. [Hi]  rEm + O + nE  rEm + 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 (22e) 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. 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 behavior 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. First, there is a constraint against vowels being simultaneously high and low, shown in (23) as *[Hi,Lo]. 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]  
CVCVCV

(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  
PI → rimane  
‘black’ (a class)

b. rEk+ A +nE  
[Lo]  
PI → rckane  
‘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.

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38 This “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.
39 I am particularly indebted at this point in the analysis to constructive comments from the anonymous reviewer of an earlier form of this article.
40 This same constraint can be used to account for some of the examples of root-internal disharmony shown in Table 1, those involving /i/ whether as V, or V_i. 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, kantum ‘fruit bat’ and bogimbo ‘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 Huist and Smith typology.

(26) Input Principles in effect Output

a. \( rE_k + E \)

b. \( g'Oz + O \)

[Lo]

c. \( [Hi] \)

ACs: \[Hi\]

p0s + E

[Hi]

d. \( [Hi] \)

ACs: \[Hi\]

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 PI \( \rightarrow \) poji

Syllable Structure Constraints PI \( \rightarrow \) poji

b. \( S^*A + O \) S.S.C.s and Epenthesis PI \( \rightarrow \) s^*awi

From input of the harmonizing allomorphs of -i and -u we might expect output of p0e and s^*a, 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 vocal harmony 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.

REFERENCES


