1.0 Introduction
In this paper we argue for the concept of tonal complexes (Akinlabi and Liberman 2001a,b, 2003), structured combinations of tones that are analogous to the structured combinations of segments in moras, syllables and feet. Constraints mentioning such tonal structures can motivate deletion, epenthesis, spreading or re-ordering of tonal features, just as constraints on syllable or foot structure may motivate such processes in well-known cases of segmental phonology.

On this analogy, tone contour formation is like re-syllabification, in which a coda consonant becomes an onset for a following syllable. Tone polarization and polarized tone epenthesis are like the epenthesis of vowels and consonants in rescuing forbidden or marked syllable structures. And the phonetic dissimilation of tone sequences is like the different phonetic interpretation of high vowels or nasals in onset vs. rhyme positions in syllables. Finally, tonal metathesis is like the metathesis of segments dictated by syllabic wellformedness considerations.

Specifically, we propose a tonal unit consisting of paired HL or LH tones. We argue such units, long postulated as underlying elements in accentual systems, also play a crucial role in tonal phonology more generally.

We propose that a tonal complex has a maximal form like that in (1).

(1) Maximal form of a tonal complex:

(L (H L))

This can be seen as roughly like a CVC syllable, with the High tone playing the part of the Vowel. As in the syllabic case, the permitted partial forms must include the core High tone, so that the expected variants are

(2)(a) (H L) (b) (L H) (c) (H)

As in the case of syllabic sequences, there may be further restrictions, for example forbidding word-internal clusters of Low tones.

We develop the details of this proposal in the following sections through a number of case studies.

In section 2, we use the concept of tonal complexes to explain contour tone formation in Yoruba, where adjacent tones reorganize themselves to form accent-like contours, just as

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1 Reference to similar ideas in Bamba (and elsewhere)?
segments may reorganize themselves to repair otherwise defective syllables. We describe several unexpected connections between (derived) tonal complexes in Yoruba and (underlying) accents in languages like Japanese.

In section 3, we use the same concept to explain some cases of tonal polarization and epenthesis, in two languages of the Gur family, Kɔnni and Dagaare, where tones are changed or created in order to satisfy word-level constraints on the presence and location of tonal complexes, just as segmental features may be changed or created in order to satisfy syllable-structure constraints.

In section 4, we turn our attention to tonal metathesis and tonal epenthesis in Lokaa, an Upper Cross language of Nigeria. In Lokaa, verbs must have at least one high tone in isolation, and noun phrases cannot end with two high tones separated by a L tone; such a sequence metathesises to create a LHHL sequence. We argue that both tonal epenthesis and metathesis take place to satisfy word level requirements of forming tonal complexes.

Finally, section 5 summarizes our findings, etc.

2.0 Tone Spreading in Benue Congo

3.0 Tone polarization and epenthesis in Gur

In this section, we turn to tone polarization and epenthesis is two languages of the Gur family Gur family, Kɔnni and Dagaare.

Word-level constraints on the distribution of tonal complexes are a familiar phenomenon in accentual systems, where it is normal to find (for instance) that there must be a High tone on the last or next-to-last syllable of any noun. (REF???) In this section, we will argue that some of the characteristic complexities of Gur tonal systems can be explained by, in effect, stipulating word-final accent as an output constraint on certain phonological domains, while permitting a wide range of lexical tonal specifications. Other fact about Gur tonology may be related to a requirement that lexical tones be parsed into a series of tonal complexes, just as lexical segments must be parsed into syllables.

This approach allows us to make sense of some constraints on word-level tonal patterns that are otherwise disconnected, and may even seem rather peculiar. For example, consider the case of the tone patterns of nouns in Kɔnni, a language of the Gur family (of Niger Congo) spoken by about 2500 Kɔma people in the Northern region of Ghana (Naden 1989, Cahill 1999).

(i) All Kɔnni nouns must contain at least one High tone.
(ii) Although any number of initial syllables may be Low, at most one syllable at the end of a noun may be Low.
(iii) Noun-internal HLH sequences are possible – they surface as H!HH – but noun-internal HLLH sequences are not found.
This much is point-for-point analogous to the word patterns allowed by a simple syllabic system, in which non-final syllables must be V or CV, while word-final syllables may be V, CV or CVC. The remaining issue is to specify the principles of alignment between the tonal and non-tonal (structured) tiers. In Kɔnni, basic nouns (i.e. excluding compounds) must end with one of three tonal patterns:

(3) (a)  s s  (b)  s  (c)  s  
| |  | \  |
H L  H L  H

This is equivalent to saying that the last tonal complex must be aligned with the end of the noun, with the core High also as close to the end as possible. (3)(a) is permitted because it allows the final L to have its own syllable; (3)(b) arises just in case the configuration in (3)(a) is ruled out by other factors.

As we will see later on, this same idea about targeted output structures can help explain cases in which tonal features “polarize” in some morphological contexts.

3.1 The facts of Kɔnni tone

We begin by presenting the facts of Kɔnni tone. All the data discussed here are from Cahill’s (1999) detailed and insightful description of the language. We differ from Cahill’s interpretation and analysis of the data in significant respects, as we will show. Kɔnni nouns exhibit tonal contrasts; but verbs have no lexical tone, their tonal is dependent on aspect. Our focus here will therefore be on nouns.

3.1.1 Nouns

Following Cahill’s description, Kɔnni has High and Low basic tones, and a downstepped High tone which occurs after a High. The tonal contrast is visible in the monosyllabic nouns in (4) and disyllabic nouns in (5). Each of following monosyllabic nouns ends in the word-final singular suffix -ŋ, so an LH monosyllabic noun is actually a Low tone stem and a High tone suffix. The disyllabic H'H nouns in (5) are HL stem nouns followed by the singular suffix -ŋ.

(4) Monosyllabic nouns

<table>
<thead>
<tr>
<th>LH (rising) vs. H</th>
</tr>
</thead>
<tbody>
<tr>
<td>kɔ̀ąŋ 'back'</td>
</tr>
<tr>
<td>dāáŋ 'stick, day'</td>
</tr>
<tr>
<td>ńńŋ 'bush partridge'</td>
</tr>
<tr>
<td>ńńŋ 'market'</td>
</tr>
</tbody>
</table>
\textbf{H vs. H^1H}

- chííŋ ‘moon, month’
- gbíŋ ‘catfish’

\textbf{HL vs. LH}

- chíän ‘chair’
- mű ‘older sibling’

\textbf{LH vs. HH}

- kpibíŋ ‘louse’
- nóámíŋ ‘floor pounder’
- yísíŋ ‘duiker antelope’

\textbf{LH vs. H^1H}

- hááříŋ ‘tree (sp.)’
- kpílíŋ ‘thigh’
- tóólíŋ ‘headpad’

\textbf{LLH vs. HH}

- nànjúŋ ‘pepper’

(5) Disyllabic nouns

\textbf{LH vs. HH}

- kpíbíŋ ‘louse’
- nóámíŋ ‘floor pounder’
- yísíŋ ‘duiker antelope’

In spite of the apparent tonal contrasts in (4) and (5), there are significant restrictions on tonal occurrence.

(i) There are no LL nouns. No noun, or other word in Kɔnni, is pronounced with all Low tones in isolation (regardless of the number of syllables) (Cahill 1999: 372). It is instructive to note that \textit{Moore} and \textit{Dagaare} (two other Gur languages) have similar surface tone patterns: in disyllabic nouns, HH, HL, and LH are attested, but not LL (Kenstowicz, Nikiema, & Ourso 1988; Anttila & Bodomo 1997, 2002; Anttila 2001).

(ii) In Kɔnni, an “utterance” must have a High tone somewhere. If there is none in underlying representation, one is inserted. (Cahill1999: 372). Though Cahill uses the word “utterance”, our focus is on nouns and we will restrict the domain of this restriction to N^0, a bare noun.
(iii) There is no HLH sequence phonetically within a word, and only rarely across words. An underlying HLH sequence is realized as H¹HH on the surface. (Cahill 1999: 340, etc.)

(6)  \(zàsìŋ \) ‘fish’  \(\hat{y} \ pò \ 'zàsìŋ \) ‘I lack fish’

Within a word, sequences of two or more L syllables between H syllables appear never to occur: *HLLH, *HLLLH, etc.

(iv) In CV syllables, only the HL falling tone is attested. LH rising does not occur on a CV syllable, they occur only on bimoraic syllables, such as a long vowel or a closed syllable.

In the following discussion we link ALL of the above restrictions, as well as the occurrence of tone polarization, to the formation of tonal complexes.

3.2 An explanation of the Kɔnni facts within the Tonal Complexes Approach

The above tonal facts can be accounted for by assuming that a tonal complex must be formed at end of every minimal N⁰ in Kɔnni. This includes a noun stem with a number suffix, or a bare noun stem in a compound construction. It does NOT include a noun followed by a determiner, which is logically a structure at a higher phrasal level of the syntactic hierarchy, such as N¹ or DP.

We will capture this observation with the constraint ALIGNCOMPLEX:

(7) ALIGNCOMPLEX: A tonal complex must be aligned with the right edge of each minimal N⁰.

In many cases, the final tonal complex is the only tonal marking of a Kɔnni noun. The constraint ALIGNCOMPLEX enforces this. In other cases (those with internal downsteps) there are several tonal complexes (because two H tones separated by an L tone cannot parse into a single tonal complex). As far as we can tell, these forms are always morphologically complex, so perhaps a simple noun stem in Kɔnni must always have exactly one tonal complex. However, this is not crucial to our analysis.

Note that L tones in Kɔnni nouns are treated in three different ways from the point of view of alignment. At the beginning of a noun, an arbitrary number of L syllables is allowed.

(8)  \(zàsìŋ \) ‘fish’  \(nù\text{àmìŋ} \) ‘floor pounder’

---

2 Cahill regards H¹H as a falling tone, and he notes that it also occurs only on bimoraic syllables, such as a long vowel or a closed syllable.
nànjùownik  ‘pepper’

It is natural to treat these as multiple linkage of an (optional) initial L. Internally in a noun (i.e. between H tones) only individual L tones are allowed underlyingly, and these do not surface phonetically, appearing only as downsteps in a sequence of H tones. At the end of a noun, at most one L syllable is permitted (and a final HL contour is also permitted).

We see the fact that L tones are not permitted internally as a pointer to the fact that the peak of a tonal complex wants to be as close as possible to the end of the complex. We express this as ALIGNPEAK, stated below.

(9) ALIGNPEAK: The peak of a tonal complex is aligned with right edge of the tonal complex.

If we leave the internal (downstep-inducing) L’s in place, and apply the OCP (in Leben's original sense), so that any sequence of like-toned syllables is treated as multiple linkage of a single tone, then the permitted tonal sequences in Kònni nouns are like those shown in (10):

(10) H, HL, LH, LHL, LHLHL, LHLH, HLH, HLHL, etc.

These are all and only the alternating patterns that contain at least one H tone. They are also isomorphic to the CV patterns of a language in which onsets are obligatory except in word-initial position, and codas are forbidden except in word-final position.

To get the surface tonal patterns of Kònni, we must

(11) (a) allow the initial L to spread to multiple syllables;
     (b) allow all H’s to spread to multiple syllables;
     (c) turn each medial L into !H
     (d) assign the final L to the final syllable (which may or may not also be linked to the preceding H).

The result is the observed syllable-by-syllable pattern of surface tones Kònni nouns, such as

(12) HHL, HHH, LLH, LLHHL, etc.

Our argument is that the emergence of the patterns in (10) and (12) are not accidental conspiracies of lexical specification and morpho-tonological rules, but rather are targeted outcomes roughly in the way that surface syllable structures are, with an extra wrinkle imposed by constraints on the alignment of tonal and segmental structures.

The additional alignment constraints, which ensure that initial and final L tones survive, are the tonal equivalent of aligning word edges with prosodic structures. We state the
constraint as ALIGNTONE(L) and ALIGNTONE(R). We will refer to them both as ALIGNTONE, unless it is crucial to separate them.

ALIGNTONE(L): Initial lexical tone is aligned with the left edge of a tonal complex.
ALIGNTONE(R): Final lexical tone is aligned with the right edge of a tonal complex.

In addition to the above markedness constraints, we will need some general markedness and faithfulness constraints to derive the tonal patterns observed above. Most of these constraints have been employed in prior studies of tone within Optimality theory (Prince and Smolensky 1993).

(13a) Faithfulness Constraints
MAX(T): Do not delete tones.
SPEC(T): No toneless syllables.
DEP(T): Do not insert tones.
IDENT(T): Do not change tonal features.
IDENT (RT): Do not change Root tonal features.

(13b) Markedness Constraints:
PARSE-T: Parse tones into tonal complexes.
PEAK-H: A tonal complex must have a peak (an H tone).
* [LH]: No LH complex.
* [HL]: No HL complex.
OCP: Adjacent identical tones are prohibited.
* FLOAT: A tone must be anchored to a tone-bearing unit.
* MERGE: Output tones may not have multiple correspondents in the input.

3.2.1 Sample Derivations of the Kɔnni nominal tones

(a) Lack of LL nouns, and H insertion: The absence of LL sequence, and the mandatory insertion of an H on the surface even when there is none in the input.

We propose that both facts follow from ALIGNCOMPLEX, and the kind of complexes allowed as seen above. For a surface form like hɔɡo ‘woman’ (LH), Cahill (1999: 368, 479) argues that the underlying tonal representation is Ø (i.e. underlyingly toneless). His argument is based on the following paradigm, in which the form takes a different tonal pattern (LH, HH, or HL) depending on the context.

Cahill further proposes that associative constructions, and his/her constructions have a floating H tone.

(animate ‘one’)

---

3. See for example Kisseberth 1993; Akinlabi 1996; Anttila and Bodomo; Bickmore; Cahill 1998, 1999; Downing; Myers; Pulleyblank; Zoll 2003.
We can now derive the isolation form of hògú “woman”, as follows. Tonal complexes are encased in square brackets [HL].

A fully faithful toneless form like candidate (e) is ruled out since all vowels must be produced with tone on the surface. In such toneless forms as hògú ‘woman’, markedness constraints will prefer the insertion of L tones (to satisfy Spec(T)), because they are less marked, as in candidate (d). AlignComplex however requires an H tone. The reverse order of tones, with HL as in *hògù, is bad because the H peak wants to be aligned with the end of the tonal complex. Therefore, in forms like this, the single inserted H tone will occur at the end of the lexical item.

(b) There is no surface HLH: Our explanation of this fact is as follows:

(i) HLH cannot constitute only one tonal complex (just as VCV cannot form a single syllable).
(ii) We must assume that in an H!H sequence there are two tonal complexes, built around the two H tones. This is forced by the need not to delete any tones.
(iii) HL tonal complex is dispreferred word internally, because of Align(Peak).
(iv) A final LH complex is ruled out in this case because of *LH.
The tableau in (16) illustrates these points.

(16) táśín ‘headpan’

<table>
<thead>
<tr>
<th>HL-H</th>
<th>ALIGN(PEAK)</th>
<th>*LH</th>
<th>*FLOAT(H)</th>
<th>*FLOAT(L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>tas - ə</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| [H][L H] |             |     |           |           |
| a. tas ə |             |     |           |           |

| [H L][H] |               |     |           |           |
| b. tas ə |               |     |           |           |

| [H][L H] |               |     |           |           |
| c. tas ə |               |     |           |           |

| [H][L H] |               |     |           |           |
| d. tas ə |               |     |           |           |

All of the candidates in the above case must violate ALIGNCOMPLEX, which calls for only one tonal complex in the noun, if all the tones are to be parsed into tonal complexes. The tones are also parsed in each of the candidates, including “floating” tones. Thus the constraints ALIGNCOMPLEX and PARSET are omitted in the above tableau. Note that the constraint *LH is violated only if both tones are linked to create a contour tone. Thus the crucial difference between candidates (a) and (c) is that the L tone is linked in (c) while it is floating in (a). The phonetic interpretation of this in (a) is downstepping the H, and a contour in (c).

3.3 Tone Polarization

An overwhelming majority of nouns, whether singulars or plurals, definite or not, end with a High tone. The high tone can be either a downstepped High or a ‘plain’ High. The examples in (17) show that this high tone derives from one of the many high toned nominal suffixes. The exceptions to this generalization are some plurals in Classes 1 and 3, and a few singulars in Class 3 and 5. We return to the plural classes in the next section.

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4 A candidate that we have not considered in this tableau is one in which the floating L tone is parsed into the preceding tonal complex, as follows:

\[\text{[HL]} \ [H]\]
\[\text{tas} \ ə\]

This will be the optimal candidate in a language in which the floating H causes the preceding H to be raised. (See Akinlabi and Liberman 1995 for an interpretation of the Yoruba floating L along this direction.) As far as we can tell at this point, this candidate has the same exact violations as the optimal candidate in Konni, the difference coming only in phonetic interpretation.
(17) Nouns

<table>
<thead>
<tr>
<th>Noun Class 1</th>
<th>Singular</th>
<th>Sg.+ Art</th>
<th>Plural</th>
<th>Pl.+ Art</th>
</tr>
</thead>
<tbody>
<tr>
<td>-η/</td>
<td>-rl/</td>
<td>-A/</td>
<td>-A-hÅ/</td>
<td></td>
</tr>
<tr>
<td>stone</td>
<td>tàη</td>
<td>tànη</td>
<td>tàná</td>
<td>tànåhå</td>
</tr>
<tr>
<td>chest</td>
<td>nōöη</td>
<td>nōöři</td>
<td>nōñra</td>
<td>nō1-råhå</td>
</tr>
<tr>
<td>nail</td>
<td>yí1-η</td>
<td>yí1-ři</td>
<td>yímå</td>
<td>yí1-måhå</td>
</tr>
<tr>
<td>bee</td>
<td>siéβη</td>
<td>siéβři</td>
<td>siéβåe</td>
<td>siéβå1-he</td>
</tr>
<tr>
<td>breast</td>
<td>bũsη</td>
<td>bũsři</td>
<td>bũså</td>
<td>bũsåhå</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Noun Class 2</th>
<th>-η/</th>
<th>-kÜ/</th>
<th>-tl/</th>
<th>-tî-tî/</th>
</tr>
</thead>
<tbody>
<tr>
<td>courtyard</td>
<td>gbååη</td>
<td>gbååkó</td>
<td>gbååtí</td>
<td>gbååtítî</td>
</tr>
<tr>
<td>farm</td>
<td>kóåŋ</td>
<td>kóåkó</td>
<td>kóåtí</td>
<td>kóåtítî</td>
</tr>
<tr>
<td>hawk</td>
<td>kpí1-řη</td>
<td>kpí1-řkó</td>
<td>kpí1-řtí</td>
<td>kpí1-řtítî</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Noun Class 3</th>
<th>-η/</th>
<th>-kÅ/</th>
<th>-sÅ/</th>
<th>-sî-sî/</th>
</tr>
</thead>
<tbody>
<tr>
<td>person</td>
<td>vúóŋ</td>
<td>vúóké</td>
<td>vúóså</td>
<td>vúósåså</td>
</tr>
<tr>
<td>dawadawa</td>
<td>trú1-ŋåå</td>
<td>trú1-kåå</td>
<td>trúåså</td>
<td>trúåsåså</td>
</tr>
<tr>
<td>axe</td>
<td>lî1-åŋ</td>
<td>lîå1-kåå</td>
<td>lîåså</td>
<td>lîå1-såså</td>
</tr>
<tr>
<td>fly</td>
<td>nånjóŋ</td>
<td>nånjókåå</td>
<td>nånjóså</td>
<td>nånjósåså</td>
</tr>
<tr>
<td>man</td>
<td>dëmbîŋ</td>
<td>dëmbikåå</td>
<td>dëmbiså</td>
<td>dëmbisåså</td>
</tr>
<tr>
<td>headpan</td>
<td>tå1-sîŋ</td>
<td>tåsî1-kåå</td>
<td>tåsåså</td>
<td>tåså1-såså</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Noun Class 4</th>
<th>-η/</th>
<th>-bÜ/</th>
<th>-tl/</th>
<th>-tî-tî/</th>
</tr>
</thead>
<tbody>
<tr>
<td>water</td>
<td>∫aåŋ</td>
<td>∫aåbó</td>
<td>∫ååtí</td>
<td>∫ååtítî</td>
</tr>
<tr>
<td>meat</td>
<td>nोŋ</td>
<td>nòmbó</td>
<td>nònåtí</td>
<td>nònåtítî</td>
</tr>
<tr>
<td>sleep</td>
<td>gbî1-ηåå</td>
<td>gbî1- bóå</td>
<td>gbî1-tåå</td>
<td>gbî1-tååtå</td>
</tr>
<tr>
<td>peanut</td>
<td>šiŋkpååŋ</td>
<td>šiŋkpååbó</td>
<td>šiŋkpååtí</td>
<td>šiŋkpååtítå</td>
</tr>
<tr>
<td>ash</td>
<td>tåŋê1-řîŋ</td>
<td>tåŋê1-libå</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Noun Class 5</th>
<th>-Ø/</th>
<th>-wÅ/</th>
<th>irreg.</th>
<th>irreg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>child</td>
<td>bûå</td>
<td>bûåwåå</td>
<td>båålå</td>
<td>båålålå</td>
</tr>
<tr>
<td>woman</td>
<td>hògå</td>
<td>hòwååå</td>
<td>hååŋå</td>
<td>hååbåå</td>
</tr>
<tr>
<td>sister</td>
<td>tååå</td>
<td>tåå1-wåå</td>
<td>tåå1-řîŋ</td>
<td>tåålå1-båå</td>
</tr>
</tbody>
</table>

With the systematic exception of the plurals [-a/-e] in Noun Class 1, all the suffixes are High-toned. As the examples in (17) show, this High tone does not alternate (even after High toned stems (siéβη ‘bee’; kóåŋ ‘farm’). This is an apparent violation of the Obligatory Contour Principle (Leben 1973, Goldsmith 1976, McCarthy 1986, Yip 1988, Myers 1997, and others), stated in (18).
The Obligatory Contour Principle (OCP):

Adjacent identical elements are prohibited (on the same tier).

\[
\begin{array}{c|c}
\sigma & \sigma \\
H & H \\
\end{array}
\]

The question that arises here is whether the OCP is relevant in the noun-suffix domain in Kònni. There are two possible answers to this question. The first obvious answer is to say no, because a High tone suffix can follow a High tone stem. Cahill (1999) for example argues that the OCP is totally absent (or violated) in Kònni because two High tones can follow each other as shown by the surface contrast in the examples in (19). His argument is that there are two High tones in the first form (shade), and they are not fused, resulting in a falling tone in the plural noun (shades); whereas “river” has a single high tone and hence there is no falling tone in the plural “rivers”.

\[(19) \quad jágíñj \quad jág-à \quad \text{‘shade(s)’ (HH input)}
\]

\[
mógíñj \quad móg-à \quad \text{‘river(s)’ (H input)}
\]

One possible way of accounting for the difference in the plural forms in (19) is to say that “shade” includes an additional “floating” H tone, which is absent in “river”. If we assume that the OCP forbids two associated H tones, then the problem is solved, and we do not have to assume that the OCP is absent in Kònni.

The second possible view, and the one that we will assume here, is that the noun+suffix domain is indeed an OCP domain in Kònni. The forms in (17) with two High tones can be accounted for by assuming that the suffixal High tone fuses with the stem High tone, respecting the OCP.

If this assumption is true, then how is it that some suffixal tones are High and others (the [a]/[e] Class 1 plurals) polarize, within the same domain? We turn to these polarizing suffixes in the next section.

### 3.3.1 The Noun Class 1 Plurals

The Kònni noun class 1 suffixes are realized as either -a or -e, depending on vowel harmony. It is –a after [-ATR] stem vowels and –e after [+ATR] stem vowels. This suffix exhibits tonal polarity, surfacing with a tone opposite to the preceding stem tone. As the examples in (20) show it is realized with a High tone after Low tone noun stems and with a Low tone after High tone stems. The first three examples in (20) illustrate monosyllabic noun stems while the remaining four illustrate disyllabic noun stems. The last example, síkpárà “hearts” shows that it is H after an LH stem.
The class 1 plural suffix however shows a level of complication that suggests this is not a simple case of tone polarization. If the root is HL, the plural does not surface as HLH, as would be expected. Rather, the pluralized noun surfaces as HL. The singular citation forms in (21) show that the nouns have input HL tones on the stem, because they surface as H!H in combination with the singular suffix.

(21)

The data in (21) raises an important question: what is the underlying tone of the Noun Class 1 plural suffix, since as we have seen, it sometimes polarizes and other times it does not? The underlying tone of the suffix cannot be High, because High tone suffixes do not alternate (i.e. polarize), as the singular suffix [-] shows.

Again, there are two possible answers to this question. The first, and probably most obvious answer is to assume that the suffix is toneless. Thus it takes the tone opposite to the tone of the preceding noun stem. The second answer is to assume that the suffix is Low toned. It dissimilates to the preceding tone when it is Low. We argue here that the plural suffix is indeed Low toned.5

At first look, one could see the tone dissimilation in the plural class 1 suffix as an OCP effect: a Low tone suffix dissimilates to a preceding Low. But there are several issues in the analysis of Kɔn̄ni tone facts, which are beyond the OCP.

(22) (i) Why is an H tone required in a word?
    (ii) Why is an OCP violation resolved by H tone fusion in the H suffixes, and by dissimilation in the L tone suffixes?

5 Note that Cahill (1999) argues that the plural class 1 suffix cannot be L toned because “this runs into problems in the case of tànáhá ‘the stones.’ This word is divided into morphemes as tàn-á-há. If the plural suffix -á is underlyingly Low-toned, there is now no motivation for it to change to High, since a High is already present in the definite suffix -há.”
(iii) Why does the L tone suffix not dissimilate to H after an HL stem in the examples in (20)?

The first question has already been addressed above. We propose that the answer to the last two questions lies again in the formation of tonal complexes, and we now proceed to show how.

### 3.3.2 The low tone suffix

We can re-state the second question as follows: **why is there polarization in only one suffix?** The answer to this is that the polarizing suffix is the only suffix that is Low toned. As we have suggested above, H tones are analogous to vowels. Therefore, H tones can independently form a tonal complex or join with an L, just as vowels can independently form syllables or join with consonants. L tones are like consonants; hence they must form tonal complexes with H’s.

The majority of Kónni suffixes are H toned, as in the singular suffix [-ŋ]. They can join with either a preceding L to form a final LH complex (like CV). They can also merge with the preceding H to respect the OCP, as they do after H tone noun stems.

The plural class 1 suffix, being L toned, **must** form a tonal complex with a preceding stem. It dissimilates to H after an L toned root to form a complex with it (forming an LH complex), because it cannot form a complex by itself. It remains L after an H stem because a HL complex is possible (like a VC). If the preceding stem tone is LH, it remains L. In this case it joins with the preceding LH, forming a maximal complex LHL (sort of like CVC).

We begin our illustration with a simple form with tone dissimilation, like yisé ‘antelopes’. In this form, the general idea is that since tones must be parsed into tonal complexes, and since the L tone suffix must form a tonal complex with the preceding noun root, and since an L tone cannot form the peak of a complex, dissimilation is compelled.
Both **PEAK-H** and **IDENT(RT)** must outrank *MERGE* in order for the observed output to emerge, as candidates (b) and (c) illustrate. These two candidates show that it is the suffixal tone that will change for the peak to be aligned with the edge of the tonal complex, and for the tonal complex to have an H peak.

The derivation of a form like *jág-â* ‘shade(s)’ (HH input), illustrates a case in which there is already an H in the noun root, and so dissimilation is unnecessary to achieve a well-formed tonal complex.

The explanation from this tableau is that the output form is one in which the two H tones fuse, the L tone plural suffix remains L, and the suffix forms a single tonal complex with the preceding fused H. In doing so, this form has a single tonal complex in the
Noun+suffix domain; it does not delete any input tones, and it does not violate the OCP. Notice that the winning candidate in Cahill’s (1999) proposal is candidate (c). If in fact it is indeed the case that the class 1 plural suffix is toneless as he proposed, there is no reason why candidate (d) is not the optimal candidate since there are two H tones and one of the two vowels is underlyingly toneless.

### 3.3.3 An Explanation of the HL Root Complication

If the noun root is underlyingly HL, the plural does not surface as HLH or H!HH as may be expected from simple dissimilation of the suffixal L tone. Rather, the suffixed noun surfaces as HL. We repeat the examples from (21) above.

(25)

\[
\begin{align*}
yí’í’ý & \quad \text{‘arrow’} & yí’í’mă & \quad \text{‘arrows’} & \text{(cf. } *yí’í’mă) & yí’í’rí & \quad \text{‘the arrow’} \\
bítí’í’ék & \quad \text{‘chin’} & bítìè & \quad \text{‘chins’} & \text{(cf. } *bítì’ék) & bítìè’í’rí & \quad \text{‘the chin’}
\end{align*}
\]

The question is, why is the surface output HL better than the surface output H!HH? One obvious difference is that it is one tonal complex rather than two. This might be preferable in and of itself, or it might be preferable because in the two-tonal-complex case, the first tonal complex is quite non-final.

Note that the primary goal appears to be that the surface tonal structure forms a tonal complex. The input structure HL can already form a complex by itself, so there is no need for the suffixal L tone “dissimilate” to supply an H. Therefore the L of the suffix simply fuses with the final L in any HL noun, hence the apparent conspiracy.

The above solution provides a unification with what happens in the H tone suffix after H tone stems – nothing. The H tone suffix must be assumed to “fuse” with the H of the stem. After L tone stems they don’t “polarize” because they can form complexes with the preceding Ls. (It also provides support for our position that the plural suffix must be L.)

Essentially, the generalization is that a suffix tone does not “polarize” unless there is the need to form a tonal complex. If one can be formed without polarization, then nothing happens.

Words like bítìè ‘chins’ can be derived as follows:
Therefore there are no constraints like **Polarize**. Tone dissimilation or polarization occurs simply to satisfy a higher prosodic demand: the demand that tones form tonal complexes. If tonal complexes can be formed without dissimilation, then nothing happens.

### 3.4 Conclusion

The three intriguing properties of this language: the lack of LL nouns, the presence of H in every noun, and polarity in just one suffix all result from the need to form tonal complexes of a restricted kind. There is however a second situation in which tones can dissimilate in spite of the ability of input tones to form a tonal complex: when a language forbids tone merger. We turn to a case like this in a closely related language, Dagaare.

### 3.5 Tone Polarization in Dagaare

The facts of Dagaare, another Gur language, are close to those of Kɔnni. All data discussed here are from Anttila and Bodomo (1997, 2002), and Anttila (2001). Like Kɔnni, there are no LL nouns. Also like Kɔnni there must be an H in a word. Our goal here is to account for the differences between the two languages.

We will here assume the underlying representation of nouns proposed in Anttila and Bodomo (2002). The basic tonal differences between Kɔnni and Dagaare are the following:

(27) (a) The number suffixes (singular and plural) are High toned.
    (Dagaare does not have a Low tone suffix like Kɔnni.)
(b) The number H-tone suffix polarizes in Dagaare, unlike Kɔnni.
(c) In trisyllabic nouns of the form HØ + H, that is, a disyllabic noun plus a number suffix, the H tone suffix does not polarize.6

The relevant polarization data are as follows:

(28)  
<table>
<thead>
<tr>
<th>Root Tone</th>
<th>Suffix Tone</th>
<th>Surface Tone</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) toneless</td>
<td>H</td>
<td>HH</td>
<td>nyũŋ-ri̲</td>
</tr>
<tr>
<td>(b) L</td>
<td>H</td>
<td>LH</td>
<td>kùù-ri̲</td>
</tr>
<tr>
<td>(c) H</td>
<td>H</td>
<td>HL</td>
<td>yi̲-ri</td>
</tr>
<tr>
<td>(d)</td>
<td></td>
<td>LL</td>
<td>----</td>
</tr>
</tbody>
</table>

We propose the following account of Dagaare. Dagaare has the same requirement of a tonal complex within a minimal N0 as Kɔn̩ni, and Dagaare has the same tonal complexes as Kɔn̩ni. Tone polarization takes place in the number suffix in Dagaare because of the ranking of *MERGE over IDENT(T), whereas such a ranking does not exist in Konni. That is, as long as the requirements of having a tonal complex and satisfying the OCP are met, Dagaare chooses feature change over feature merger in the number suffixes.

To illustrate our analysis, we derive the form yi̲-ri | ‘house’ in (29). The constraint IDENT(T)-RT forbids changing root tone instead of suffix tone. Anttila ranks this constraint over OCP. We have no evidence for his ranking in the example we are deriving here.

(29) yi̲-ri | ‘house’

---

6 We will account for the first two differences, since Anttila (citing Kennedy 1966) notes that the trisyllabic nouns may be compounds.
The crucial forms are the first two candidates. Both candidates satisfy all top constraints calling for tonal complexes, and satisfaction of the OCP. But they do it differently. While candidate (a) changes the suffix tonal features, candidate (b) merges them. Dagaare prefers feature change to feature merger.

Evidence that the OCP domain is N^0 in Dagaare

OCP violations are tolerated in Dagaare between two roots that are monosyllabic, but not between a root and suffix that are each monosyllabic.

(a) H’s can be side by side in Noun + Noun constructions
(b) L’s can be inserted before another L in Noun + Adjective
(c) A floating H can dock onto a toneless stem and make it adjacent to a H toned suffix, in violation of the OCP.

The domain of the OCP is therefore the N^0.
4.0 Tonal Insertion and Tonal Metathesis in Lokaa

In this section we turn our attention to tonal metathesis and tonal epenthesis in Lokaa, an Upper Cross language of Nigeria (Faraclas 1988). In Lokaa, verbs must have at least one high tone in isolation. A verb which has no H tone underlyingly must have one inserted. However, if there is a high tone clitic or prefix preceding the verb, the H tone insertion is blocked. Secondly, a noun (plus clitic) cannot have two high tones separated by a L tone (i.e. HLH); such a sequence metathesises to create a LHHL sequence. We argue that tonal epenthesis in verbs or its blocking, and metathesis take place to satisfy word level requirements of forming tonal complexes. In each case, we note that there is a conspiracy to avoid an HLH tonal sequence within a domain. This conspiracy is accounted for if we assume that what is being avoided is having two tonal complexes in one domain. The domain of a tonal complex in the Lokaa verb is a verb (plus a preceding clitic). In nouns the domain is a noun plus a preceeding clitic. While the preceding clitic is mandatory in the case of the noun, an imperative or infinitive verb can form a tonal complex domain by itself. We begin with an introduction to tonal contrast in Lokaa nouns. The description presented in sections (4.1 and 4.2) draws heavily from Iwara, Akinlabi and Truckenbrodt (2003).

4.1 Tonal Contrast

Like many of the Benue-Congo languages, Lokâa operates a two-tone system (H & L) as illustrated in the following nominal minimal pairs (Iwara 1982:55-60):

(1) a. ëtî ‘stick’ ëtì ‘road’
    b. ëtò ‘house’ ëtò ‘hyena’
    c. këbî ‘impotence’ këbî ‘squirrel’
    d. èkóó ‘advice’ èkóó ‘friendship’

4.2 Tone Insertion in Verb stems

The verbal system shows a simple underlying contrast between stems with H and stems with L tone. Disyllabic H-stems occur with H on both syllables, while disyllabic L-stems occur with a LH tonal pattern in the infinitive and imperative.

(2)        H-stems                  L-stems
        Imperative and
        Infinitive           yòmô  ‘measure’           yòmô  ‘lie down’
        tó (lôbô)  ‘cry (crying)’     làú  ‘rub off’
        màná (bôôñ) ‘hold (something)’  bàná  ‘place’

In general, while disyllabic nouns may carry L tone throughout as in the first three examples in (1), verbs cannot have all-L surface realizations. Following Iwara et. al.

---

(2003), we analyze the final H in the L-tone class in (2) as a tone that is inserted so as to meet a demand on the presence of at least one H tone in verbs (3a). Its insertion on the right, rather than on the left, may be seen to allow left-alignment of the verbal stem with the tone of the verb, represented as in (3b). The process can be represented informally as follows:

(3) a. **Verbs have at least one H tone in isolation.**
   
   b. $\begin{array}{c|c|c}
   b & a & n \\
   \hline
   a & n & a
   \end{array}$ → $\begin{array}{c|c|c}
   b & a & n \\
   \hline
   L & L & H
   \end{array}$

The requirement that verbs have at least one H can also be seen with monosyllabic stems. These may be monomoraic (short), as in (4a), in which case they are always H. They may also be bimoraic (long), in which case they can be all-H (from /H/), as in (4b), or LH (from /L/), as in (4c). The latter two cases are comparable to the bisyllabic forms. The absence of monomoraic L-stems supports the contention that there is a ban on verbs with L tone only at work.

(4) a. **monomoraic**
   
   b. **bimoraic /H/**
   
   c. **bimoraic /L/**

<table>
<thead>
<tr>
<th></th>
<th>tá</th>
<th>táá' 'investigate'</th>
<th>tålá' 'win'</th>
</tr>
</thead>
<tbody>
<tr>
<td>dó</td>
<td>'clean up'</td>
<td>dóó' 'to be satisfied/full'</td>
<td>dójó' 'throw away'</td>
</tr>
<tr>
<td>wú</td>
<td>'pin'</td>
<td>wúú' '[river] be swollen'</td>
<td>wúú' 'steal'</td>
</tr>
</tbody>
</table>

The understanding of the final H of LH verbs along the lines of (3) receives further support when we add one level of complexity. The Aorist is marked with the agreement prefix [á-], 'you' in (5). As shown in (6a), the addition of this prefix to a H-stem leads to an all-H verb form, as expected. Of interest here is the addition of [á-] to L-stems as in (6b). The prefixal [á-] here surfaces as H, which motivates the assignment of an underlying H tone to this prefix in our analysis. Interestingly, the final H tone that was seen on the unprefixed L-stems in (2) and (4c) is not realized in (6b).

(5) Subject-agreement 'you': [á-]

(6) **Aorist**

<table>
<thead>
<tr>
<th>a. H-stem</th>
<th>b. L-stem</th>
</tr>
</thead>
<tbody>
<tr>
<td>á-tóó' you cried'</td>
<td>á-yóó-yí' you wove'</td>
</tr>
<tr>
<td>á-mán' you held'</td>
<td>á-báñ' you placed'</td>
</tr>
<tr>
<td>á-táá' you shot'</td>
<td>á-táá' you won'</td>
</tr>
<tr>
<td>á-dói' you were full'</td>
<td>á-dóó-yí' you threw away'</td>
</tr>
</tbody>
</table>

---

8 It can be seen in these forms that the segmental make-up in the Aorist may vary. Iwara (1982:180ff) distinguishes thirteen morphological subclasses in this connection. Crucial for the purpose at hand is that choice of subclass does not change the tonal behavior in the relevant respects.
Here the demand on H tones in verbs (3a) is satisfied by the prefixal [á-], so there is no need for the insertion of a final H. This lends support to the understanding of the final H in (2) as a default, as in (3).

Further evidence that the inserted H tone is not necessary if there is already an H in the input comes from a class of nominalized verbs. These nominalized verbs are formed by reduplicating a verb stem, and prefixing [yo/yO] to this base, depending on the ATR quality of the stem vowel. The data in (7), from Iwara (1982:113), are monosyllabic verb stems, while those in (8) represent the bisyllabic verb stems.

The tonal generalizations from the nominalized verbs in (7) and (8) are the following. The nominalizing prefix is underlyingly L-toned, since this tone is invariant regardless of the tone of the verb stem. The (prefixal) reduplicant must be H toned and the stem itself retains the input tone of the verb.

(7) Nominalized verbs
   (a) H tone verbs
       kpé   yò- kpé kpé   learn/learning, teaching
       tâu  yò- tátâu  dance/dancing, a dance
       nóŋ   yò- nóŋ nóŋ   do/work
   (b) L tone verbs
       kpé:  yò- kpé kpé:  sell/selling, things sold
       yó:   yò- yó yó:   weave/weaving, woven things
       bɛm   yò- bɛ bɛm   beg/begging, borrowing
       fí:   yò- fí fí:   kill/killing

(8) Disyllabic verbs (data from Ijaja Eno)
   kówá  yò - kókówá  peel/peeling
   tàlí  yò - tátáli  pull/pulling
   pàná  yò - pàpàná  touch/touching

Notice that the L tone monosyllabic verb stems in (7b) have rising tones in isolation, and their bisyllabic counterparts in (8) have LH in isolation. In the nominalized forms of the verbs, the final H in both monosyllabic and disyllabic verbs has disappeared. Notice that the disyllabic verbs prove that we cannot account for the absence of the final H with an assumption that there is nowhere for it to dock, since the final H in these cases do not create contours.

Again, in a rule-based approach, the tonal characteristics of the verbs in isolation can easily be accounted for by a high tone insertion rule. In a constraint based approach such as the one adopted in this work, the HIGH tone can be accounted for with a constraint that requires at least a HIGH tone in verbs, as informally stated in (3a). But two questions
arise from these tonal characteristics of verbs, which have no explanation in either approach:

(9) Unexplained issues in Lokaa verb tonology:
(a) Why should EVERY verb have at least one HIGH tone in isolation?
(b) Why is the high tone suddenly unnecessary just in case there is a clitic (6), or a prefix (7, 8) that has a HIGH tone?

4.2.1 Proposed Account of Lokaa Tone Insertion

Both of the above questions are easily explained if we assume that tones group into tonal complexes in Lokaa, and that in verbs the domain of a complex is V⁰, which comprises a verb in isolation, or a verb and a subject clitic (or basically a prosodic word). ⁹ If tones are assumed to group into tonal complexes in this domain, the reason that we have H insertion is that what represents the nucleus of a complex, an H tone, is missing from L tone verbs in isolation, either in imperatives or in infinitives. Thus the H insertion is like the insertion of a vowel to license a stranded consonant so that it can be parsed into a syllable.

Furthermore, if a prefixed verb or a verb plus a preceding clitic must form one tonal complex domain, then the lack of insertion of the final H in these forms is explained. Such an insertion will create two tonal complexes instead of one. It is instructive to note that the gratuitous insertion of a final H tone into a structure with an H tone clitic (such as 6) will result in an HLH sequence, while the insertion of an H tone in the nominalized verbs in (7) and (8) will result in an LHLH sequence. Each of these structures must group into two tonal complexes.

To account for the Lokaa tonal facts, we will employ the same set of general markedness and faithfulness constraints already seen in the preceding section. We repeat the relevant ones below for convenience:

(10a) Faithfulness constraints:
MAX-T: Do not delete tones
DEP-H: Do not insert H tones

(10b) Markedness Constraints
PARSE-T: Parse tones into tonal complexes
PEAK-H: A tonal complex must have a peak (an H tone).
* [LH]: No LH complex
* [HL]: No HL complex

Some of the above constraints require further comments. Note that universally, HL contour tones are less marked than LH contour tones. Therefore we predict that HL complexes are less marked than LH complexes. We predict that the fixed ranking among these two constraints is as follows:

---

⁹ This is unsurprising because, as the examples in (7) and (8) show, this is also the domain of vowel harmony in Lokaa.
This has a serious prediction for the preferred insertion site of H, cross-linguistically. Since HL contour is predicted to be less marked than LH contour, it is predicted that the H insertion should be BEFORE an L, unless there is an overriding factor. In Lokaa, the overriding factor appears to be that the left edge of the verb be aligned with an underlying tone, as we noted above. We will represent this with a constraint that aligns underlying tones, as follows:

(12) **ALIGN-L**: A stem is left-aligned with an underlying tone.

The second prediction of the approach taken here is that HL complexes are less marked than LH complexes, a direct opposite of the syllabic analogy in which syllables with onsets are less marked than syllables with codas. Therefore, all else being equal, we predict that an L tone is more likely going to be parsed with a preceding H than with a following H.

We can now derive the L tone verbs of Lokaa. In the tableaux that follow, we will consider only candidates that are appropriately parsed into complexes, that is, candidates that satisfy PARSE-T. We will also not consider candidates in which the underlying Low tone of the verb is deleted, because these are never optimal. We must therefore assume that both PARSE-T and MAX are highly ranked in Lokaa.

<table>
<thead>
<tr>
<th>H tone insertion in verbs: / tạà/ → tạá ‘win’</th>
</tr>
</thead>
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<tbody>
<tr>
<td>tạà</td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>[tạà]</td>
<td></td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>[tạà]</td>
<td>*!</td>
<td></td>
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</tr>
</tbody>
</table>

In the forms with a preceding H clitic (as in the aorist forms in (6)), or H prefix (as in the nominalized verbs in (7) and (8)) the insertion of a High tone is gratuitous because not only is the requirement for a High tone in a complex already met, the insertion of a high tone here must create two complexes this domain. Recall that HLH cannot constitute a single tonal complex, just as VCV cannot constitute a single syllable.

(14) No H Insertion: Forms with H tone clitics.

<table>
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<tr>
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</thead>
<tbody>
<tr>
<td>á [tạà]</td>
<td></td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>[á tạà]</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[á tạà]</td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>
FOOTNOTE!! Question: How do you handle languages with Falling-rising contours? (i.e. HLH) (cf. Yip 2002). In this case we will have to assume a constraint that forbids doing anything to an underlying contour???

For the sake of completion, let us consider an approach that does not assume tonal complexes. To handle the above data, such an approach will require a constraint forbidding a rising tone LH after a high tone, something like *H LH. This would be factually correct. But the question is: what will be the motivation behind such a constraint? Having an LH after an H creates an HLH sequence, or in the approach taken here, a tone sequence that must be parsed into TWO tonal complexes. If there can only be one tonal complex in a V⁰, the ban is completely explained. More importantly, while the ban on LH works for monosyllabic verbs (because there is a contour), this approach is unable to explain why there is no H insertion in bisyllabic verbs (as in 8) where inserting an H does not create a rising tone (LH) after a H tone.

4.3 Tonal metathesis in Nouns
The second phenomenon, tonal metathesis, occurs in nouns. Just as we found in verbs, a High tone prefix appears to cliticize with a following noun. But since nouns can have any type of tonal combination, and since underlying tones are in general not deleted in Lokaa, what we find is that LH nouns metathesize to become HL whenever there is an H tone clitic or prefix.

In this section, we will discuss the facts of three constructions: associative constructions, questions and relative clauses. We present the facts of associative constructions in detail, and use the other two constructions as additional evidence of the same process of metathesis. We argue that in the three constructions, tonal metathesis occurs to allow the tonal sequence of a noun to be parsed into a single tonal complex.

4.3.1 “Associative” constructions
In Lokaa associative constructions, an associative marker occurs between N1 and N2. The associative marker is [C5]. The consonant is determined by the noun class of the head noun, which in this case is N1. In the following examples, it is clear that the associative marker must be underlyingly High toned. The underlying tonal structure of the preceding N1 is never altered, it is the tonal structure of N2 that is affected by the H tone of the associative marker. Therefore the examples in (15-18) are arranged based on the tone of N2, with HH in (15), HL in (16), LL in (17) and LH in (18). Secondly, it does not matter what the underlying tone of N1 is, the effect of H tone of the associative marker on N2 is consistent regardless of the tone of N1. The crucial tonal fact that we want to focus on is that an XX + H + LH becomes XX + H + HL. That is, a potential HLH sequence is reversed to HHL.
(15) **N2 as HH**  
**HH + HH**  
úkwá  
canoe  →  [úkwá  wó  é:fém]  
crocodile’s canoe  

efém  
crocodile  

**LH + HH**  
lètú  
head  →  [lètú  já  é:fém]  
crocodile’s head  

efém  
crocodile  

**HL + HH**  
itòm  
shrine  →  [ítòm  yó  é:plá]  
shrine of the market  

efém  
crocodile  

**LL + HH**  
[kòfè]  
leg  →  [kòfè  kó  é:fém]  
crocodile’s leg  

efém  
crocodile  

**Summary:**  XX + H+ HH  →  HHH  

(16) **N2 as HL**  
**HH + HL**  
[é:plá]  
market  →  [é:plá  yó  kétòm]  
Lizard’s market  

[kétòm]  
lizard  

**LH + HL**  
[lètú]  
head  →  [lètú  já  kétòm]  
Lizard’s head  

[kétòm]  
lizard  

**HL + HL**  
[kèṅkòñ]  
knife  →  [kèṅkòñ  só  kétòm]  
Lizard’s knife  

[kétòm]  
lizard  

**LL + HL**  
[èmà]  
mouth  →  [èmà  yó  kétòm]  
Lizard’s mouth  

[kétòm]  
lizard  

**Summary:**  XX + H+ HL  →  HHL  

(17) **N2 as LL**  
**HH + LL**  
[úkwá]  
   canoe  →  [úkwá  wó  lòpòn]  
   Town’s canoe  

[loòpòn]  
town  


4.3.2 Overall Summary:
Apparently, the associative marker agrees with N1 (the head noun) segmentally, but it cliticizes with N2. The summary of the tonal outputs in (15) – (18) is as follows.

(a) \(XX + H + HH \rightarrow HHH\)
(b) \(XX + H + HL \rightarrow HHL\)
(c) \(XX + H + LL \rightarrow H HL L\) (Associative H Spreads)
(d) \(XX + H + LH \rightarrow HHL\) (Reassociation or Metathesis?)

4.3.3 Two Possible Analysis of LH initial Nouns
Our focus here is on the LH N2 nouns in (18), since the others are relatively straightforward. There are at least two possible approaches to the LH nouns in (18):
(a) Spreading and disassociation (or deletion): the H from the associative marker spreads to the first syllable of N2, displacing its tone, and this tone in turn displaces the tone of the next syllable. The final H is not realized. That is $\text{HLH} \rightarrow \text{HL}$ (14).

(19) Graphic representation of “Spreading and disassociation”, beginning with the associative H.

\[ \begin{array}{ccc}
H & L & H \\
\mu & + & \mu & \mu \\
\end{array} \rightarrow \begin{array}{ccc}
H & L & H \\
\mu & \mu & \mu & \mu \\
\end{array} \]

This view must be considered because as the examples in (17) show, the H of the associative marker spreads to the initial L of N2 in LL nouns, to produce H HL L. The main problem with this approach is that the final syllable of N2 is never realized as an LH contour; rather the final H disappears.10

(b): Metathesis: the (initial) LH of the second noun (N2) metathesizes to HL.

(20) Graphic representation of “metathesis”:

\[ \begin{array}{ccc}
H & L & H \\
\mu & + & \mu & \mu \\
\end{array} \rightarrow \begin{array}{ccc}
H & H & L \\
\mu & \mu & \mu \\
\end{array} \]

There is in fact evidence in support of metathesis as opposed to spreading and disassociation. “Spreading and disassociation” makes the wrong prediction on the tonal output of trisyllabic and longer nouns. As the forms in (21) show, LHL nouns in N2 position change to HLL. If “spreading and disassociation were the way to go there is no reason why the supposed displaced H on the second syllable of an LHL noun cannot form a falling tone with the final L or displace the final L, but it never does.

(21) LHL \rightarrow HLL

\[
\begin{array}{ccc}
\text{úkwá} & \text{ítómbì} & \text{úkwá wó ítítòmbì} \\
\text{canoe} & \text{farm} & *\text{wó ítítòmbì} / *\text{wó ítítòmbì} \\
\end{array}
\]

\[
\begin{array}{ccc}
\text{ápà} & \text{lèítítàŋ} & \text{ápà yá lèítítàŋ} \\
\text{position} & \text{rib} & \text{position of rib} \\
\end{array}
\]

10 If the final H is seen as floating, another question that arises is what influence it exerts on a following L syllable when there is one. The question is difficult to test because all verbs (including L tone verbs) normally have an agreement prefix which is H toned.

Examples:
As the following graphic display shows, the predicted output of a “spreading and disassociation” approach to an input LHL noun in N2 position is HLH. But this is clearly the wrong output.

(22) Predicted wrong output from “spreading and disassociation” analysis:
\[ H + LHL \rightarrow *HHLH \]

(23) Graphic representation of the wrong output of “spreading and disassociation”:

On the other hand, a metathesis approach makes the right prediction that the initial LH of the noun metathesizes to HL. We must therefore conclude that metathesis accounts for the output tonal structure of the LH nouns.

(24) Predicted correct output from metathesis:
\[ H + LHL \rightarrow HHLL \]

(25) Graphic representation:

4.3.4 Questions and Relative Clauses

The same tonal change that we see above in the associative constructions is also true of nouns in relative clause constructions (26) (where there is an overt H toned “relator” Iwara (1982) before the noun), and in questions in which a floating H tone must be postulated to occur before the noun in (27). As in the associative constructions, LL nouns become HL L, while LH nouns become HL. Both HH and HL nouns remain unchanged.

(26) Relative Clauses (H toned CV “relator”)

HH noun: éyọŋ
\[ yìsọ̀wọ̀ fọ́ éyọŋ ọ̀dèi \]

The pot that Eyong bought \( \text{(HH éyọŋ)} \)
The main question from all of the above data is why metathesize LH? The answer is that if left as is, the output of the LH nouns will be HLH in combination with the preceding associative marker, and the output of the LHL nouns will be HLHL. Our explanation for metathesis is that there is preference for forming a single tonal complex in the associative marker + noun domain if that is at all possible. The combination H + LH should form two complexes. Metathesis provides a better single HHL complex, where the initial HH are fused into one H by the OCP. An HL nouns does not metathesize because the output forms a desirable HHL complex with the preceding H. LL nouns become HHLL, which again forms a single complex.

If in the associative constructions the associative marker cannot be a tonal complex domain by itself and must join the N2 to form a domain; and if there is preference for having only one tonal complex in this domain, then no ad-hoc rules or constraints are necessary. The reversal of LH to HL ensures that there is only one tonal complex in the domain, except when this is impossible. It will be impossible if the noun already has two tonal complexes in the input to begin with (such as in the case of HLH nouns), or if the noun begins with more than two L tones in a sequence.
4.4 Formal Analysis
Metathesis reverses the underlying linear order of segments (or tones in this case). Prince and Smolensky (1993) propose that the faithfulness constraint that enforces the linear order of segments is \textsc{linearity}. We give the relevant version of this constraint as in (28):

(28) \textsc{linearity-T}: Preserve the underlying linear order of tones (i.e. Do not metathesize tones).

Two things force the violation of linearity. The first is the need to parse tones to tonal complexes, enforced by \textsc{parse-t}. The second is the fact that the tones have to be parsed into a single tonal complex, within this domain.

(29) \textbf{Tonal Metathesis: Associative Constructions}
\begin{align*}
yó \ lèjí & \rightarrow [yó \ lèjí] \quad (H + LH \rightarrow HHL) \\
\end{align*}

<table>
<thead>
<tr>
<th>yó \ lèjí</th>
<th>\textsc{parse-t}</th>
<th>\textsc{linearity}</th>
</tr>
</thead>
<tbody>
<tr>
<td>yó \ [lèjí]</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>[yó \ lèjí]</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>yó \ lèjí</td>
<td>*!</td>
<td></td>
</tr>
</tbody>
</table>

\textbf{Conclusion}
In this section, we have shown that a conspiracy to avoid an HLH sequence results in two different processes, the blocking of H insertion in verbs and tonal metathesis in nouns. We have accounted for both processes with a single assumption: the need to have not more than one tonal complex within the domain of a verb plus a clitic, or a noun plus a clitic. In doing this, we have shown that both issues are symptomatic of higher-level organization of tones; called \textbf{tonal complexes} (Akinlabi and Liberman 2001a, b).
References


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