Why spread? Kalabari clitics spread their tone due to word-minimality, prosodic constituency, and *LHH tonotactics

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5   Why do certain morphemes and constructions spread their tones, while other morphemes and
6   constructions do not? We address this fundamental question in Kalaḅarị-Ịọ, a language spoken in
7   southern Nigeria, wherein a class of clitics triggers a 'low tone spread' process targeting high tones (e.g.
8   the clitic **à** 'I' in /**à páḅụ́rụ́ tę́⁺ę́**/ → [**à pàḅụ̀rù tę́⁺ę́**] 'I have stammered'). We provide the first
9   comprehensive description of this process, establishing that its only triggers are a small class of
10   prosodically deficient pronominal clitics, all of which are low-toned, monosyllabic, and onsetless. We
11   claim that these properties together prevent it from being parsed as a separate phonological word (i.e.
12   they are sub-minimal), and instead the low tone of these clitics must tonally incorporate into a
13   neighboring prosodic domain. We argue that the domain for low tone spread is the phonological phrase,
14   and show independent evidence for this exact constituent from grammatical tone. Finally, low tone
15   spread is unbounded, targeting all continuous high tones within the relevant domain. We attribute its
16   unbounded nature to a consequence of tonal incorporation: this creates new LHH sequences which are
17   marked in the language. We catalogue the independent evidence for a *LHH tonotactic constraint
18   operating at different prosodic levels, and demonstrate low tone spread as one additional response to
19   such a sequence. We end our paper by discussing contexts where a phrase-level *LHH constraint appears
20   to be tolerated, which we would expect to be subject to tone spread as well. We take such data as showing
21   that low tone spread constitutes a phonologically derived environment effect: unbounded spread only
22   takes place if some other phonological operation (e.g. tonal incorporation) takes place first. In total, our
23   Kalaḅarị-Ịọ study demonstrates that tone spread can profitably be decomposed into several sub-
24   operations triggered by multiple interacting factors (here, word-minimality, prosodic constituency, and
25   *LHH tonotactics).

26   *clitics; prosody; tone; spreading; word minimality; prosodic constituency; tonotactics*

1   Introduction

28 How do we model and ultimately explain the cross-linguistic propensity for tones to spread? Such a
29 question continues to shape tonological research, resulting in a range of theoretical innovations seeking to
30 capture some guiding intuition. These include spreading due to a requirement that all vowels bear tone or
31 due to a requirement to align tone with a specific prosodic edge (e.g. SPECIFY-TONE and ALIGN-TONE,
32 respectively – Yip 2002), or spreading as due to a requirement that local segments phonologically 'agree'
33 in some fundamental way (e.g. SHARE-TONE – McCarthy 2011; Agreement By Correspondence – Shih &
34 Inkelas 2018). In the languages which have spawned this research, generally tone spreading is central to
35 the phonological grammar, whose effects are pervasive and cannot be overlooked. In this paper, however,
36 we examine a case of tone spreading which is the exception rather than the norm in the language: it is
37 triggered by three and only three morphemes.
38   Specifically, we examine a process of 'low tone spread' in Kalaḅarị-Ịọ (hereafter simply called
39 'Kalabari'), a member of the Ijoid language family of southern Nigeria. While other aspects of this
40 language's tonology have been established (Jenewari 1977, Harry 2003, 2004, Harry & Hyman 2014), low
41 tone spread has not hitherto been investigated. An example of low tone spread is provided in (1a), which
42 shows that the low tone of the pronominal clitic **à** 'I' in subject position spreads to both the following object
43 and verb, and in this way is unbounded (i.e. it is not *per se* bounded to a particular number of vowels). In

44 contrast, the superficially similar pronominal clitic **àrì** 'I' (appearing before vowel-initial words) does *not*
45 trigger tone spread (1b). Native intuitions interpret such pronunciations as ungrammatical.
46
47 (1)   Unbounded low tone spread in Kalabari
48   a. **à** féní sélé té⁺é → [**à fènì sèlè** té⁺é]
49   I bird choose PERF   'I have chosen a bird'
50   b. **àrì** ígbé sélé té⁺é → [**àrì** ígbé sélé té⁺é]   (cf. *[**àrì ìgbè sèlè** té⁺é])
51   I box choose PERF   'I have chosen a box'
52
53 In this paper, we ask (i) what precisely defines the triggers of low tone spread, (ii) what are its targets, (iii)
54 what is the domain within which spread operates, and finally (iv) why does it happen in the first place?
55   Starting from these questions, we present three major empirical findings. First, we establish that the
56 only triggers of low tone spread are three pronominal clitics, **à** 'I', **ò** 'he', and **ǹ** 'they'. These form a
57 phonologically natural class in that they are all low-toned, monosyllabic, and onsetless, and consequently
58 we refer to them as 'V̀-clitics' in what follows. No other comparable morphemes fit this exact phonological
59 profile. Second, the target of low tone spread is always a contiguous string of high tones to the right of the
60 triggering V̀-clitic. Tone spread exhibits two surface patterns. In one, low tone spreads to all but the final
61 high tone in the string (i.e. V̀ V́…V́V́ → V̀ V̀…V̀V́). We refer to this informally as 'H-compression'. In
62 another, low tone spreads to all high tones (i.e. V̀ V́…V́V́ → V̀ V̀…V̀V̀), and is only found before a domain-
63 external high tone. We refer to this informally as 'H-absorption'. Importantly, any intervening low tone (or
64 downstepped high) blocks spreading up to that point (i.e. V̀ V́V́V̀V́ → V̀ V̀V́V̀V́, not *V̀ V̀V̀V̀V́). The third
65 major empirical finding is that while low can spread across multiple words (as in 1a), it is constrained by
66 underlying syntactic structure. Modifiers plus their nouns (NPs) and NPs plus their verbs (VPs) form single
67 domains for spread, but other similar structures do not, e.g. nouns plus determiners/quantifiers, verbs in
68 series, or verbs plus inflectional particles, auxiliaries, or clause-final markers.
69   Based on these empirical findings, we develop an analysis for low tone spread based on the interaction
70 of three factors: word minimality, prosodic constituency, and tonotactics. First, the three properties which
71 define the triggers of low tone spread – low tone, monosyllabicity, and onsetlessness – all characterize
72 prosodic weakness cross-linguistically. In Kalabari, when all three factors are present they prevent the
73 morpheme from being an independent phonological word, ω (i.e. such words would be sub-minimal). Thus
74 while pronouns like bisyllabic **àrì** 'I' form separate phonological words, e.g. (**àrì**)ω (**ígbé**)ω… from (1b),
75 V̀-clitics do not, e.g. **à** (**féní**)ω… from (1a). Second, we posit that Kalabari has a constraint which requires
76 that all tones be associated to a vowel within a phonological word. This results in the low tone of a V̀-clitic
77 having to associate to the word to the right, what we refer to as 'tonal incorporation'. Of note is that while
78 the tone incorporates into the following ω-word, its counterpart segments remain unincorporated, showing
79 a lack of complete isomorphy between prosodic constituents on separate phonological tiers.
80   These components of our analysis account for why low tone spread is initiated, but do not account for
81 its unbounded nature within its domain, nor what precisely that domain is. To this end, we posit that the
82 domain for low tone spread is the phonological phrase, φ, and that the unbounded spreading is a response
83 to the general markedness in the language of a low-toned vowel followed by two high-toned vowels, what
84 we call the '*LHH' constraint. We present independent evidence for phonological phrases from replacive
85 grammatical tone, which precisely match the domain for low tone spread (what we call 'prosodic domain
86 matching'). Low tone can target high tones within the same φ-phrase, but cannot extend past a φ-boundary.
87   Further, when V̀-clitics are tonally incorporated, this may result in novel LHH sequences. The last
88 component of our analysis centers this fact as the ultimate cause of the unbounded nature of low tone spread:
89 LHH sequences are marked and avoided in Kalabari. They are categorically banned within the phonological
90 ω-word, and are rare within a phonological phrase due to a conspiracy of factors. When they do arise, they
91 are (optionally) subject to repair via downstep insertion or other lowering operations, which are not
92 available in non-LHH contexts. Most commonly, LHH sequences appear across phrases – e.g.

93 …(LH)ω}φ(H)ω… sequences – where they are obligatorily repaired via downstep insertion (i.e. LH H →
94 LH ⁺H). Spreading the tone of V̀-clitics prevents new violations of *LHH at both the word and phrase level.
95 　　We diagram our analysis in Figure 1, using the data from (1). This shows that the V̀-clitic **à** spreads its
96 low tone first to the following word (the dotted association line), followed by unbounded spread of this low
97 tone to the end of the φ-phrase in response to *LHH (the association lines with alternating dots and dashes).
98 This is contrasted with the other clitic **àrì** which does not trigger low tone spread.
99
100 　　Figure 1: LTS (H-compression) – Complies with *{V̀V́V́}φ, but creates new *V̀V́}φV́ violation

a.

b.
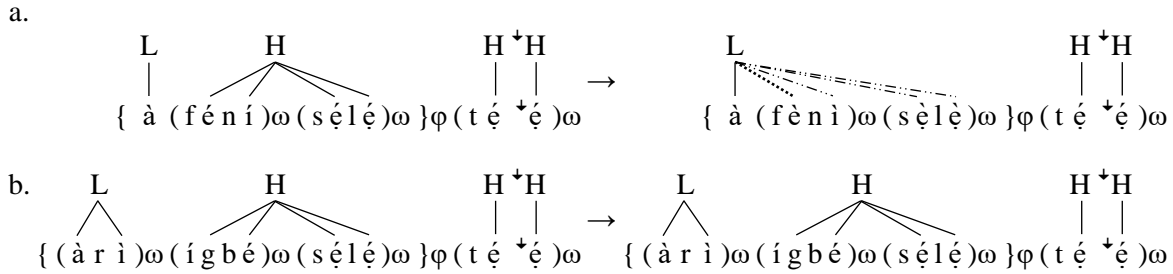
101
102 　　We end our paper with an observation about examples like Figure 1b: although clitics like **àrì** are
103 independent words and therefore do not need to be 'tonally incorporated', by virtue of them forming a
104 phrase with the following verb phrase they too create new violations of *LHH. Why does this not also
105 trigger low tone spread? It appears that unbounded low tone spread is parasitic on the application of tonal
106 incorporation, which only happens with prosodically deficient V̀-clitics. In this way, low tone spread
107 resembles a phonologically derived environment effect, whereby the application of a rule exists "only by
108 virtue of the application of another phonological alternation" (Inkelas 2014:242). In short, phonologically
109 derived environments are subject to unbounded spread to avoid a phrase-level *LHH violation (Figure 1a),
110 but non-phonologically derived environments are not and must instead tolerate this violation (Figure 1b).
111 　　This paper is organized as follows. §2 provides important background information on the Kalabari
112 language and tone system. §3 begins our comprehensive description of low tone spread, including its
113 triggers, targets, domain of application, and how low tone spread differs from other tonal processes in the
114 language. §4 lays out our analysis involving tonal incorporation and defends our thesis that low tone spread
115 derives from a *LHH constraint. §5 provides a conclusion.

116 **2　　Kalabari language**

117 Kalabari (also known as Kalaḅarị-Ịjọ; IPA [kálá⁺ɓárɪ́]; ISO code 639-3: [ijn]) is an Ijoid language in the far
118 south of Nigeria within the Niger Delta area, with perhaps 500,000 speakers (Eberhard, Simons, & Fennig
119 2023).[1] Kalabari is a regionally important language, though the consistent influx of Nigerian Pidgin and
120 English render the language endangered. It is bordered by other Ijoid languages to its west (numerous Izon
121 dialects [ijc], including Nembe/Akassa [ijs]) and to its east (Kirike [okr]), as well as bordering many non-
122 Ijoid languages to its north from three different branches of Benue-Congo (Igboid, Cross River, and Edoid).
123 The data for this paper is based around the speech and intuitions of AUTHOR 2, a native speaker of the
124 Buguma (also called Asarị) dialect. Where we supplement this with data from the Kalabari literature, we
125 note this explicitly. For a review of Kalabari linguistic literature, see Harry (2004).

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[1] Similar figures are found on the Joshua Project webpage (https://joshuaproject.net/people_groups/12441/NI). In
decades past, previous estimates put the speaker population at approximately 250,000 speakers (Jenewari 1989:108).

2.1   *Typological profile*

In our transcriptions, we follow Kalabari orthographic practices. All consonants are equivalent to their IPA value except the following: <ḅ>=/ɓ/, <ḍ>=/ɗ/, <j>=/dʒ/, and <y>=/j/. The language exhibits tongue root vowel harmony, where non-advanced vowels ([-ATR], a.k.a. retracted tongue root) are written with a dot, i.e. <ị ẹ ọ ụ>. The sole low vowel /a/ may appear with either set, and can be classified as neutral for our purposes (see Akinlabi 1997 for discussion). Nasal vowels are written as an orthographic <n> after the vowel, e.g. **ḅín** 'full' is IPA /ɓ[n over i]/. Syllabic nasals in Kalabari are marked with tone in this work, which will distinguish them from their non-syllabic counterparts. Long vowels will be treated as a sequence of two adjacent vowels and transcribed as such, and are often the result of tone-conditioned lengthening. Morphemes may begin with either a consonant or a vowel, but codas are prohibited.

Kalabari word order is strongly head-final, which makes it noticeably distinct from the non-Ijoid languages in the area (and indeed Niger-Congo generally, the phylum within which it is traditionally placed). Clause-level word order is [SUBJECT ADVERBIAL OBJECT VERB INFL], where INFL stands for a set of inflectional particles encoding tense, aspect, mood, and polarity. Within the noun phrase, modifiers generally precede the noun (e.g. possessors, modifying nouns, adjectives, numerals, and demonstratives). However, quantifiers and determiners follow the noun. In adpositional phrases, the noun precedes the postposition. These orders are in line with canonical head-final syntax (Dryer 2007:52), and will become important when we examine the domain of low tone spread (§3-4).

2.2   *Tone system*

Kalabari has a basic contrast between low (L) and high (H) tone. Downstepped high tones (i.e. ⁺H) also occur in some underlying and derived contexts, discussed separately in §2.4 below. All lexical morphemes and most functional morphemes are fully specified for tone on all tone-bearing units. There is evidence for floating tones conditioned by certain morphemes and morphological constructions. We denote floating tones with a circle (following Yip 2002), e.g. a floating low tone as Ⓛ.

Table 1 shows a representative sample of tonal patterns with monosyllabic and bisyllabic lexical items (i.e. nouns and verbs). Contour tones are only allowed on long vowels or diphthongs (e.g. **pùá** 'split, divorce' – Harry 2004:23), which we interpreted as adjacent level tones.

Table 1: Lexical contrasts in nouns and verbs

Tone pattern		Example nouns		Example verbs	
a.	L	sò	'sky'	sọ̀	'cook'
	H	sẹ́	'nation'	só	'go'
b.	LL	pùlò	'oil'	lẹ̀gì	'sit down'
	LH	gàrí	'*garri* flour'	ḍùkó	'tell, talk'
	HL	bélè	'light'	ḅámà	'punish'
	HH	námá	'meat'	ólọ́	'cough'
	H⁺H	ḅá⁺rá	'hand'	ọ́⁺lọ́	'hold'

2.3   *Tonal processes*

Lexical tone patterns are manipulated by three main tonal processes, all of which are morphologically conditioned in some way. The first is the most basic, which we refer to as 'concatenative grammatical tone'. As the name suggests, in this type a tone or sequence of tones is simply added (i.e. concatenated) to the edge of an independent word. For example, the imperative/subjunctive is expressed by a floating ⒽⓁ sequence which is concatenated to the right edge of the verb (Table 2).

Table 2: Concatenative grammatical tone – Imperative as Ⓗ Ⓛ

	Lexical tone	Verb		Surface	Imperative form	
a.	L	sò	→	LHL	sòóò	'cook!'
	H	só	→	HL	sóò	'go!'
b.	LL	lègì	→	LHL	lègíì	'sit down!'
	LH	dùkó	→	LHL	dùkóò	'tell!'
	HL	bámà	→	H⁺HL	bá⁺máà	'punish!'
	HH	ólọ́	→	HHL	ólọ́ọ̀	'cough!'
	H⁺H	ọ́⁺lọ́	→	H⁺HL	ọ́⁺lọ́ọ̀	'hold!'

Concatenative grammatical tone never replaces the underlying lexical tones of the verb. For example, the low-toned verb **sò** 'cook' is realized as a contour [**sòóò**] 'cook!' with a super-long vowel, a pattern not found in monomorphemic contexts. The fact that low-toned **lègì** 'sit down' becomes [**lègíì**] rather than *[**lègìíì**] provides evidence that there is only one lexical L tone spread over two vowels. Relatedly, the fact that high-toned verbs (**só** 'go') are realized as [**sóò**] 'go!' suggests that the lexical and grammatical high tones fuse.

Concatenative grammatical tone may also occur with post-verbal inflectional particles that have overt segmental structure, such as future tense and factative tense/aspect (for our purposes, 'factative' can be interpreted as akin to perfective/completive aspect). Two examples are shown in (2) with low-toned Ⓗ **bà** FUTURE (FUT) and downstepped Ⓗ⁺ **ḿ** FACTATIVE (FAC). The words which precede the particles otherwise have all low tones, but in this context surface with a final high.

(2) Concatenative grammatical tone with overt post-verbal inflectional particles
  a. námá sì Ⓗ bà → [námá **sìí bà**]
      animal be.bad FUT 'the animal will become bad' (Harry & Hyman 2014:658)
  b. òrì ìbì Ⓗ⁺ ḿ → [òrì **ìbí ⁺ḿ**]
      he be.good FAC 'he is a good-natured person' (Jenewari 1977:470)

The second type of tonal process is 'replacive grammatical tone', which is triggered in the context of certain morphemes and/or morphological constructions. The main patterns of replacive grammatical tone are established in Harry (2004) and Harry & Hyman (2014), most commonly found in noun phrases. Most pre-nominal modifiers assign a grammatical tone which neutralizes lexical tone and replaces it with one of four tone patterns: HL, HLH, LH, or L. These four patterns are illustrated in Table 3, with a possession-compound construction involving a possessor **tùbọ̀** 'a child's __', a possessive pronoun **ìnà** 'their', and two other pre-nominal modifiers **tọ̀** 'which' and **jà** 'some'. The replacive grammatical tone is indicated with the ⇒ arrow to distinguish it from concatenative tone. Modifiers tend to pattern as a single class, e.g. all possessive pronouns assign a replacive ⇒Ⓗ Ⓛ Ⓗ, which surfaces as [H⁺H] or [HLH] depending on target length.

Table 3: Replacive grammatical tone completely neutralizing lexical tone (Harry & Hyman 2014:232)

Lexical tone			tùbọ̀ 'the child's __' (⇒Ⓗ Ⓛ)	ìnà 'their __' (⇒Ⓗ Ⓛ Ⓗ)	tọ̀ 'which __' (⇒Ⓛ Ⓗ)	jà 'some __' (⇒Ⓛ)
LL	pùlò	'oil'	tùbọ̀ **púlò**	ìnà **pú⁺ló**	tọ̀ **pùló**	jà **pùlò**
LH	gàrí	'*garri* flour'	tùbọ̀ **gárì**	ìnà **gá⁺rí**	tọ̀ **gàrí**	jà **gàrì**
HL	bélè	'light'	tùbọ̀ **bélè**	ìnà **bé⁺lé**	tọ̀ **bèlé**	jà **bèlè**
HH	námá	'meat'	tùbọ̀ **námà**	ìnà **ná⁺má**	tọ̀ **nàmá**	jà **nàmà**
H⁺H	bá⁺rá	'hand'	tùbọ̀ **bárà**	ìnà **bá⁺rá**	tọ̀ **bàrá**	jà **bàrà**

Replacive grammatical tone is also seen in simple [OBJECT VERB] phrases. Unlike with noun phrases, in [OBJECT VERB] phrases the lexical tone of the verb is deleted but no dedicated tonal pattern replaces it.

197 Instead, the final tone of the object spreads onto the verb. Examples are in Table 4, showing the object's
198 tone spreading to the verb, thereby neutralizing the lexical tone distinction between low-toned **sèlè** 'choose'
199 and high-toned **ẹ́rị́** 'see'.

200
201

Table 4: Replacive grammatical tone in [OBJECT VERB] phrases

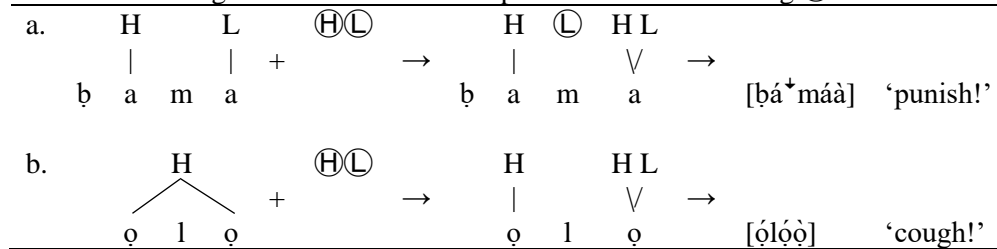| Object \ Verb	/L/ sèlè 'choose'	/H/ ẹ́rị́ 'see'
/LL/	à **bìtè sèlè** tẹ́[↓]ẹ́ 'I have chosen cloth'	féní **pùlò èrì** tẹ́[↓]ẹ́ 'the bird has seen the oil'
/HL/	à **sírì sèlè** tẹ́[↓]ẹ́ 'I have chosen a leopard'	ò **bélè èrì** tẹ́[↓]ẹ́ 'he has seen the light'
/HH/	àrì **ígbé sẹ́lẹ́** tẹ́[↓]ẹ́ 'I have chosen a box'	á **námá ẹ́rị́** tẹ́[↓]ẹ́ 'she has seen the meat'
/LH/	ò **gàrị́ ⁺sẹ́lẹ́** tẹ́[↓]ẹ́ 'he has chosen *garri* flour'	ò **gàrị́ ⁺ẹ́rị́** tẹ́[↓]ẹ́ 'he has seen the *garri* flour'
/H⁺H/	à **wá⁺rị́ sẹ́lẹ́** tẹ́[↓]ẹ́ 'I have chosen a house'	à **wá⁺rị́ ẹ́rị́** tẹ́[↓]ẹ́ 'I have seen the house'

202
203   Unlike concatenative and replacive grammatical tone, the third and final tonal process has not yet been
204 studied in the Kalabari literature, namely the aforementioned 'low tone spread' (described in §3 below).

205 **2.4**   *Downstepped high tones*

206 Before turning to low tone spread, the final piece of background information involves downstepped high
207 tones, hereafter simply called 'downstep'. The appearance of downstep can be divided into three contexts:
208 underlying downstep, word-level derived downstep, and derived downstep above the word.
209   The first type was shown in Table 1 above, where downstep is part of the underlying representation of
210 a word (e.g. **ḅá⁺rá** 'hand'), creating a three-way contrast between HL, HH, and H⁺H. Let us illustrate the
211 next two, where downstep is derived in certain environments. One such environment happens within words,
212 e.g. when a low tone becomes delinked between two high tones or is never linked in the first place (i.e. the
213 low tone is floating in the output). We have seen this already in Table 2, when the concatenative Ⓗ Ⓛ tones
214 dock to a /HL/ verb root (e.g. **ḅámà** 'punish'). The result is a [H⁺HL] pattern, where the lexical L tone has
215 now become a downstep. This is shown in Figure 2 below, where the derived floating Ⓛ corresponds to
216 downstep in the output (example a). In this figure we compare this to the behavior of /H/-toned roots where
217 no downstep occurs (b).

218
219

Figure 2: Derived downstep from a derived floating Ⓛ


```
a.     H      L      ⒣Ⓛ              H    Ⓛ   H L
       |      |   +        →         |     \/   →
   ḅ   a   m  a                  ḅ   a   m   a         [ḅá⁺máà]   'punish!'


b.        H          ⒣Ⓛ              H        H L
         / \      +        →         |        \/   →
     ọ   l   ọ                   ọ   l   ọ             [ólọ̀ọ̀]      'cough!'
```

220
221 A similar alternation between a low tone and a downstep can be seen in replacive grammatical tone patterns
222 from Table 3 above, where the replacive floating tone sequence ⇒Ⓗ Ⓛ Ⓗ associated with possessive
223 pronouns surfaces as either [H⁺H] or [HLH] depending on the length of the target. Tying together lexical
224 downstep and word-level derived downstep, Harry (2004:22-23) explicitly analyzes H⁺H patterns as
225 underlying /HⓁH/.

226   Finally, as stated downstep can also be derived above the word. This takes place when a word which
227 ends in a LH pattern precedes another word which begins with H, i.e. …LH#H… → […LH#⁺H]. Examples
228 are provided in (3), where a downstep is inserted between the LH and H words (other examples were seen
229 as well already, in Table 4 above).

230

231   (3)   Derived downstep above the word level: LH#H → LH#⁺H
232   a.   **òdòdó fṵ́n**   sélé̩   té̩⁺é̩   → [**òdòdó ⁺fṵ́n** sélé̩ té̩⁺é̩]
233   snake   salt   choose PERF   'the snake has chosen salt'
234   b.   bì̩là   má   **dì̩sé̩ sábá̩**   árì̩   → [bì̩là má **dì̩sé̩ ⁺sábá̩** árì̩]
235   elephant the.PL sneeze cross CONT   'the elephants are sneezing over'

236

237 We shall see instances of this type of derived downstep in the examples throughout this paper, and it
238 consistently applies if the environment is met. Note, however, that such derived downsteps are rarely
239 indicated in the Kalabari linguistic literature example, and as such will not be reflected when we cite data
240 taken from this literature. In §4.5 below we tie such derived downsteps to a general prohibition against
241 LHH patterns in Kalabari (and the Ijoid family in general), as well as showing certain contexts which
242 explicitly do not repair LHH contexts with downstep in this way.[2]

243 **3**   **Low tone spread**

244 **3.1**   *What are the triggers?*

245 Low tone spread (LTS) is triggered by only one class of morphemes: low-toned, vowel-initial, monosyllabic
246 pronominal clitics. Let us first establish the paradigm of pronominal clitics. When pronominal clitics are
247 used as the structural subject, they have two forms: one used before consonants and one used before vowels.
248 This allomorphy is shown in (4) where the clitic expressing third singular masculine 'he' is **ò̩** before
249 consonants and **òrì** before vowels (note an independent process of vowel harmony in these examples – see
250 §4.3). This happens regardless of whether the following word is a verb, object, adverbial, *etc*.

251

252   (4)   Pronominal clitic allomorphy based on C/V-initiality _(Jenewari 1977)
253   a.   **ò bó̩** bà   'he will come'   _(p. 312)
254   **ò mìnìní** bà   'he will agree'   _(p. 132)
255   **ò̩ wámì̩nà** èrí bà   'he will see us'   _(p. 263)
256   **ò̩ páà** ékúén árì̩   'he is still talking'   _(p. 540)
257   **ò̩ kpó̩mà** á bé̩lé̩má ⁺ḿ 'he really loves her' _(p. 156)
258   b.   **òrì ìgàní** bà   'he will get annoyed' _(p. 132)
259   **òrì ì** kún bà   'he will catch me'   _(p. 261)
260   **òrì ífó̩kò̩** mù té̩⁺é   'he has gone to Ifoko' _(p. 158)
261   **òrì árú** kè bó ⁺ḿ   'he came by boat'   _(p. 158)
262   **ò̩rì ìbì̩ò̩kú** ànì̩ yé ⁺ḿ 'he did it well'   _(p. 156)

263

264   A complete paradigm of pronominal clitic allomorphs is in Table 5. While there are clearly similarities
265 between the pre-C and pre-V allomorphs, there are no regular phonological rules which can derive one form
266 from the other and we therefore treat them as suppletion. The only clitic not exhibiting allomorphy is 'we'

---

[2] For the rule LH#H → LH#⁺H to apply, the LH sequence must specifically be contained within a single word, and
the H#H sequence must be across words. No downstep is inserted if the tones are each associated to a separate word
(i), nor is downstep ever inserted within a word in a L#HH sequence (ii).

    (i)   ò̩   **tà**   **fṵ́n**   **fé̩** té̩⁺é̩   → [ò̩ **tà fṵ́n fé̩** té̩⁺é̩]   (cf. *[ò̩ **tà fṵ́n ⁺fé̩** té̩⁺é̩])
          his   wife   salt   buy PERF   'his wife has bought salt'
    (ii) **sò kánákáná** té̩⁺é̩   → [**sò kánákáná** té̩⁺é̩]   (cf. *[sò **ká⁺nákáná** té̩⁺é̩])
          sky   dark   PERF   'the sky is dark'

which is uniformly **wá** in both contexts. This is also the only clitic which begins with an onset (**ǹ** 'they' is a syllabic nasal, bearing tone).

<div align="center">Table 5: Pronominal clitic allomorphy (in subject position)[3]</div>

		'I'	'you' (SG)	'he'	'she'	'we'	'you' (PL)	'they'
	Before C	**à**	í	**ọ̀**	á	wá	ọ́	**ǹ**
	Before V	àrì	íyé	òrì	árì		ọ́mìnì	ìnì
Cf.	Non-clitic independent series	ìyèrí	íyérí	òrì	árì	wámìnì	ọ́mìnì	ìnì

In bold in this table are the three triggers of LTS: the pronominal clitics **à** 'I', **ọ̀** 'he', and **ǹ** 'they'. They are unified phonologically in being monosyllabic (cf. **àrì**), not having an onset (cf. **wá** 'we'), and being low-toned (cf. **á** 'she'). These three triggers do not form a morphosyntactically natural class. Example (5) demonstrates LTS with each of these clitics, using the high-toned verb **pábụ́rụ́** 'to stammer, stutter'. Hereafter we will refer to these as 'V̀-clitics', a subset of pronominal clitics as a whole.

(5)   LTS from V̀-clitics (low-toned, monosyllabic, onset-less subject clitics)
      a. **à** pábụ́rụ́ tẹ́⁺ẹ́   →   [**à pàbụ̀rụ̀** tẹ́⁺ẹ́]   'I have stammered'
      b. **ọ̀** pábụ́rụ́ tẹ́⁺ẹ́   →   [**ọ̀ pàbụ̀rụ̀** tẹ́⁺ẹ́]   'he has stammered'
      c. **ǹ** pábụ́rụ́ tẹ́⁺ẹ́   →   [**ǹ pàbụ̀rụ̀** tẹ́⁺ẹ́]   'they have stammered'

Also shown in Table 5 above, pronominal clitic allomorphy is not identical to the non-clitic independent pronoun series. Independent pronouns are used in topic positions, copula complements, single-word responses, and to denote emphasis when in subject position (Jenewari 1977:244f.). While pronominal clitics generally harmonize for ATR with the following word, independent pronouns do not: they are either inherently [+ATR] (e.g. **òrì** 'he') or [-ATR] (e.g. **ọ́mìnì** 'you' (PL)). We return to independent pronouns in §4.3.

While concatenative and replacive grammatical tone are obligatory, LTS is optional but it is preferred under normal speaking conditions. The two pronunciations in (6) are both fully acceptable: one where the V̀-clitic **ò** 'he' spreads its low to the following verb **gélé** 'be tall', and one where it does not. The utterance with LTS sounds more natural (on naturalness, see Table 6 in §3.2 as well).

(6)   Optionality of LTS
    ò gélé   á néngí   Ⓗ⁺ḿ → [**ò gèlè** á néngí ⁺ḿ]~[**ò** gélé á néngí ⁺ḿ]
    he   tall   her be.more.than   FAC   'he is taller than she is'

Currently, we cannot attribute a clear meaning difference to forms with versus without LTS (the second author's intuition points to increased 'emphasis' being conveyed in utterances without LTS). As the point of this paper is to understand the precise environments where LTS occurs and its implications for Kalabari phonology, we leave this optionality issue for future work.

In contrast, bisyllabic low-toned pronominal clitics *never* trigger LTS, e.g. the pre-vocalic allomorphs in (7).

---

[3] How pronominal clitics are used in *non*-subject position is complicated. Some of the pronominal clitics in Table 5 can be used in possessor position in a possessive pronoun construction, e.g. second singular **í** in [**í** ná⁺**má**] 'your meat' (Harry & Hyman 2014:654). For others, however, there is a dedicated non-subject clitic used in object and/or possessor position, e.g. compare **ì/ìyè̩** 'me, my' to the explicit subject form **à/àrì** 'I'. In addition, plural clitics have a special morphological ending with **-(n)à** in possessor position, e.g. **wánà**~**wámìnà** 'our', **ọ́mìnà** 'your' (PL), **ìnà** 'their' (cf. the forms in Table 5). Because the focus of our paper is specifically on low tone spread, and the only context which shows this process are pronominal clitics in subject position, and because objects and possessors trigger their own tonal processes (§2.3), pronominal clitics in these other environments are not readily comparable.

(7) Bisyllabic low-toned pronominal clitics never trigger LTS

    a. **àrì** íyé érí Ⱨꜜ́m   → [àrì íyé érí ꜜm]   Cf. *[àrì ìyè …]
        I   you see FAC   'I saw you (SG)'   (Jenewari 1977:268)
    b. **òrì** íkírí mà ḅó árì   → [òrì íkírí mà ḅó árì]   Cf. *[òrì ìkìrí …]
        he creep MAN come CONT   'he comes creeping'   (Jenewari 1977:406)
    c. **ìnì**   ówú Ⱨbà   → [ìnì ówú bà]   Cf. *[ìnì òwú …]
        they   cry   FUT   'they will cry/weep'   (Jenewari 1977:260)

Other comparable monosyllabic contexts also do not trigger LTS, or any process like it. For example, LTS is not triggered by low-toned monosyllabic lexical items such as **sò** 'sky, heaven, destiny' (8), nor is it triggered by functional particles such as **mà** 'not yet' (9).

(8) No LTS from low monosyllabic lexical items

    a. **sò** kánákáná téꜜέ   Cf. *[**sò** kànàkànà téꜜέ]
        sky dark   PERF   'the sky is dark' (Blench 2008:195)
    b. **sò** ḅálápú téꜜέ   Cf. *[**sò** ḅàlàpù téꜜέ]
        sky twinkle PERF   'heaven displays a sudden flash of fire'   (Blench 2008:320)

(9) No LTS from low monosyllabic functional particles

    a. **mà**   wá mú áꜜá   Cf. *[**mà wà mù** áꜜá]
        not.yet we go NEG   'we are not going (there) yet'   (Jenewari 1977:539)
    b. **mà**   á ḅó   á   Cf. *[**mà à ḅò** á]
        not.yet she come NEG.Q   'hasn't she come yet?'
    c. tùḅó **mà** ḅíkí á   Cf. *[… **mà ḅìkì** á]
        who   not.yet fall NEG.Q   'who has not yet fallen?'

Equally, there is no equivalent 'high tone spread' triggered by high-toned monosyllabic pronominal clitics, e.g. **á** 'she' in (10).

(10) No comparable process of 'high tone spread'

    a. **á** fịnì pòkú ꜛkpó téꜜέ   Cf. *[**á fịní** …]
        she fire heap tie   PERF   'she has tied the bundle'
    b. **á** màngì wérí árì   Cf. *[**á mángị** …]
        she run   keep CONT   'she has run away (and is still not back)'

    An exhaustive search of the Kalabari dictionary (Blench 2008) reveals that the only other words of the shape /V̀/ are pronominal clitics **ì** 'my' and **ọ̀** 'his' used in possessive contexts. However, because pronominal possessives as a class assign a HLH replacive grammatical tone to the noun (Table 3), the prerequisite tonal environment needed for LTS is not met (to be made precise momentarily).[4]

---

[4] There does exist one prefix of the shape /V-/, namely the plural maker **a-** which attaches to nouns. Examples are in (iii)-(iv), where an effect akin to LTS may be observed on high-toned nouns **fúkúrú** 'hole' and **túḅóníápú** 'traders'.

    (iii)   òpù **a-**fúkúrú   → [òpù **à-fùkùrú**]~[òpù **à-fùkù**rú]   'big holes'
    (iv)   ìḅì **a-**túḅóníápú   → [ìḅì **à-tùḅònìàpù**]~[ìḅì **à-tùḅònìà**pù]   'good traders'

However, several factors conspire to undermine a clear analysis of these data. First, the plural marker **a-** always takes the tone of the previous word, e.g. low in (iii)-(iv) versus high in [**sịn á-ḅárá**] 'branches of trees' with **sịn** 'tree' (Blench 2008:1). Therefore we must attribute the low tone in these examples to the pre-nominal modifier (i.e. **òpù** 'big, important' and **ìḅì** 'good'), and not to an underlying value of **a-**. Further, pre-nominal modifiers like **òpù** themselves trigger a type of optional low tone operation, e.g. lexically high **ḅúrúmá** 'indigo' variably becoming all low in /**òpù ḅúrúmá**/ → [**òpù ḅùrùmà**]~[**òpù ḅúrúmá**] 'big indigo' (Harry & Hyman 2014:658). It is therefore difficult to specifically attribute the changes in (iii)-(iv) to **a-** itself or the pre-modifier. We return to the tone properties of the modifier **òpù** in §4.5.

    Secondly, Jenewari (1977:211) states that the plural prefix **a-** never appears in phrase initial position and is always preceded by a modifier. This prevents us from testing whether it unambiguously triggers LTS itself.

3.2 *What is the target?*

With regard to the target, LTS targets a contiguous string of high-toned vowels after the trigger. There are
two surface patterns: one where all high tones become low in the relevant string (i.e. V́V́V́→V̀V̀V̀), and
one where all high tones but the last become low (i.e. V́V́V́→V̀V̀V́). We shall revise our formulation of
LTS as we further scrutinize the data, but this is a sufficient characterization at this juncture. To illustrate,
consider the data in (11) involving V̀-clitics before verbs of one to four syllables. In each of these, low tone
can spread unboundedly to the end of the verb (that is, it is not bound to spreading to only one vowel).

(11)   LTS targeting contiguous strings of high tones
  a. 1σ: ọ̀   ḅó   tẹ́⁺ẹ́   →   [ọ̀ ḅò tẹ́⁺ẹ́]
            he   come   PERF   'he has come' (Jenewari 1977:144)
  b. 2σ: ọ̀   ḅíkí   tẹ́⁺ẹ́   →   [ọ̀ ḅìkì tẹ́⁺ẹ́]
            he   fall   PERF   'he has fallen'
  c. 3σ: à   páḅụ́rú   tẹ́⁺ẹ́   →   [à pàḅụ̀rù tẹ́⁺ẹ́]~[à pàḅụ̀rú ⁺tẹ́⁺ẹ́]
            I   stammer   PERF   'I have stammered'
  d. 4σ: à   fékéféké tẹ́⁺ẹ́   →   [à fèkèfèkè tẹ́⁺ẹ́]~[à fèkèfèké ⁺tẹ́⁺ẹ́]
            I   be.light PERF   'I have become light (in weight)'

Notice the two alternative pronunciations in (11c) and (11d). The all-low pronunciation is most natural,
while the one where one high remains is possible but with an ambiguous meaning difference related to
emphasis. As stated in §3.1, each of these utterances may alternatively be pronounced with its lexical all-
high pattern without low tone spread. This is the least natural pronunciation but still grammatical. Note as
well the derived downstep in (11c) and (11d), due to the fact that a new LH#H environment was created
across the word boundary (§2.4). We return to this fact in §4.5 below.

  To characterize the variation in the two pronunciations with LTS, we deconstruct spread into two
informal components: 'H-compression' and 'H-absorption'. The first of these processes is H-compression,
schematized in Figure 3. This is presented in an autosegmental representation (Goldsmith 1990), where the
parentheses indicate tonal domains (to be formalized in §4). H-compression captures the pattern where a
low spreads to all but the last high-toned vowel, i.e. the string of high tones is compressed to the rightmost
position. This results in patterns like /à páḅụ́rú tẹ́⁺ẹ́/ → [à pàḅụ̀rú ⁺tẹ́⁺ẹ́] (again, ignoring derived
downstep for the moment).

<div align="center">

Figure 3: Schema of H-compression

</div>

L   H   H   L   H   H
| /|\ | → |⌐····· | |
V̀   (V́ V́ V́   )   (V́   …   V̀   (V̀ V̀ V́   )   (V́   …
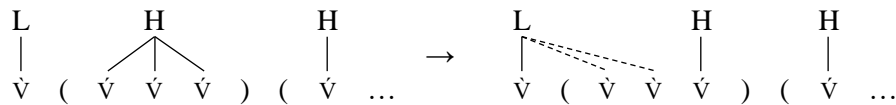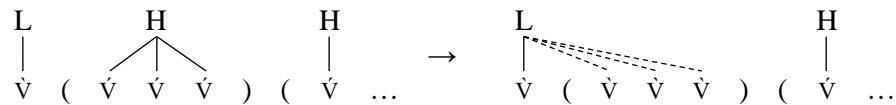
Figure 4 schematizes the other operation, H-absorption. Here, there is no trace of the target H, i.e. it is
'absorbed' by the following domain-external H. This results in the alternative (and more natural)
pronunciation [à pàḅụ̀rù tẹ́⁺ẹ́].

<div align="center">

Figure 4: Schema of H-absorption

</div>

L   H   H   L   H
| /|\ | → |⌐············ |
V̀   (V́ V́ V́   )   (V́   …   V̀   (V̀ V̀ V̀   )   (V́   …

383

384 A logically possible set of spreading patterns is in Table 6, using /**à fékéféké tẹ́⁺ẹ́**/ 'I have become
385 light' from (11d). In Table 6a LTS does not apply, which as we have said is possible but is least natural and
386 not preferred. The other rows demonstrate that whenever LTS applies, it always shows the effects of H-
387 compression and preferably, but not necessarily, H-absorption. Other pronunciations are ungrammatical
388 (Table 6b-c), where LTS does not apply to the immediate high tones in the string.

389

390 Table 6: Possible patterns with LTS

		/à fékéféké tẹ́⁺ẹ́/	LTS:	H-compression	H-absorption
a.	ok	[**à** fékéféké tẹ́⁺ẹ́]	No	-	-
	(least natural)				
b.	*	[**à fè**kéféké tẹ́⁺ẹ́]	Yes	No	No
c.	*	[**à fèkè**féké tẹ́⁺ẹ́]	Yes	No	No
d.	ok	[**à fèkèfè**ké ⁺tẹ́⁺ẹ́]	Yes	Yes	No
	(less natural)				
e.	ok	[**à fèkèfèkè** tẹ́⁺ẹ́]	Yes	Yes	Yes
	(most natural)				

391

392 Moreover, multi-word units are also targeted by LTS, as long as they form a contiguous string of high-
393 toned vowels. Representative examples are in (12). Such multi-word targets display the same patterns as
394 single-word targets with respect to H-compression and H-absorption.

395

396 (12)   Multi-word target of LTS
397   a. **ò**   jén   bọ́   á⁺á   → [**ò jèn bọ̀** á⁺á]
398   he again come   NEG   'he didn't come again'
399   b. **ò**   yé   tólúmá sí⁺mé Ⓗ⁺ḿ   → [**ò yè tòlùmà** sí⁺mé ⁺ḿ]
400   he thing teach used.to FAC   'he used to teach' (but no longer)
401   c. **ọ̀**   tírá   sákí   kẹ̀ dèrì Ⓗ⁺ḿ   → [**ọ̀ tìrà sà**kí kẹ̀ dèrí ⁺ḿ]
402   he three time   P laugh   FAC   'he laughed three times'
403   d. **ò**   búrúmá sélẹ́   tẹ́⁺ẹ́   → [**ò bùrùmà sèlẹ̀** tẹ́⁺ẹ́]
404   he indigo choose PERF   'he has chosen indigo'
405   e. **ǹ**   júmọ́júmọ́ dúká   bọ́   ⒽⓁ → [**ǹ jùmọ̀jùmọ̀ dùkà** bọ́ọ̀]
406   they each.other follow come SBJV   'they should follow each other'
407   f. **ǹ**   dúẹ́ín   díbí   pírí   érí tẹ́⁺ẹ́ → [**ǹ dùẹ̀ìn dìbì pì**rí ⁺érí tẹ́⁺ẹ́]
408   they corpse bury   ground see PERF   'they have seen a cemetery'
409   g. **à**   jén   féní   fẹ́ tẹ́⁺ẹ́   → [**à jèn fènì fẹ̀** tẹ́⁺ẹ́]
410   I another bird   buy PERF   'I have bought another bird'
411   h. **ò**   númé   súsú   tẹ́ sẹ́kí árì → [**ò nùmè sùsù tẹ̀** sẹ́kí árì]
412   he song sing.REDUP and dance CONT   'he is alternatively singing and dancing'

413

414 The multi-word targets in (12) show a large range of syllable counts (1-4σ words) and phrase types, such
415 as noun compounds, other complex noun phrases, [OBJECT VERB] constructions, and [ADVERBIAL VERB]
416 sequences. Notice, however, that not all continuous high tones are targeted by LTS, e.g. in (12h) the second
417 verb **sẹ́kí** 'dance' is *not* targeted. We turn to the prerequisite syntactic structure of target domains in §3.3.
418 Further, as its name implies H-absorption applies only before H tones and never applies before L tones.
419 Compare the patterns in (12) above to those in (13) below, which show the obligatory retention of the
420 rightmost H in the target string before a L.

421

11

(13) Obligatory retention of rightmost H tone before L
    a. **à** pélémà té⁺é → [**à pèlé**mà té⁺é] (cf. *[**à pèlè**mà té⁺é])
        I pour.one.to.another PERF 'I have poured from one (container) to another'
    b. **à** féní púlò èrì té⁺é → [**à fènì** púlò èrì té⁺é] (cf. *[**à fènì pù**lò èrì té⁺é])
        I bird oil see PERF 'I have seen bird's blood'
    c. **ǹ** kémékémé mà bó té⁺é → [**ǹ kèmèkè**mé mà bó té⁺é]
        they stealth MAN come PERF 'they have come stealthily'
    Cf. *[**ǹ kèmèkèmè** mà bó té⁺é]

Where there is only a single high-toned vowel LTS cannot apply at all (14).

(14) LTS cannot apply with single high-toned vowels
    a. **à** bó Ⓗbà → [**à** bó bà] (cf. *[**à bò** bà])
        I come FUT 'I shall come' (Jenewari 1977:476)
    b. **ò** jén dèrì á⁺á → [**ò** jén dèrì á⁺á] (cf. *[**ò jèn** …])
        he again laugh NEG 'he didn't laugh again'
    c. **ò̩** wámìnà sín Ⓗ⁺ḿ → [**ò̩** wámìnà sín ⁺ḿ] (cf. *[**ò̩ wà**mìnà …])
        he us call FAC 'he called/invited us' (Jenewari 1977:269)

Finally, let us examine how LTS works before an (underlying) downstep (recall §2.4). The data in (15) with ** béké⁺ké** 'chin' shows the possibility of H-absorption before a downstepped high tone, though it sounds degraded/questionable to AUTHOR 2. We indicate this pronunciation with a superscript '?', which contrasts with the preferred form without H-absorption. In contrast to these two interpretations, it is always fully ungrammatical for LTS to spread past the downstep (i.e. the form with *).

(15) LTS before downstep: H-absorption questionable
    à béké⁺ké érí té⁺é → [**à** bèké⁺ké érí té⁺é]~[?][**à bèkè**ké …] (cf. *[**à bèkèkè** …])
    I chin see PERF 'I have seen a chin'

Multi-word targets may also show the optionality of H-absorption before a downstep, in the two acceptable surface pronunciations in (16). As expected, it is ungrammatical for LTS to spread past the downstep, or to affect only a single high-toned vowel.

(16) H-absorption before ⁺H in a multi-word target
    ò̩ gbó̩rú̩ wá⁺rí fé té⁺é → [**ò̩ gbò̩rù̩** wá⁺rí fé té⁺é]~[**ò̩ gbò̩rù̩ wà**rí …]
    he one house buy PERF 'He has bought a house'
    (cf. *[**ò̩ gbò̩rù̩ wàrì** …]~*[**ò̩ gbò̩**rú̩ wá⁺rí …]

3.3 *The domain of low tone spread*

What is the domain of LTS? We have seen several cases where low tone spreads over multiple words, but there also have been several cases of high-toned words which conceivably could have undergone LTS but did not, e.g. one repeated in (17) below where the domain of LTS is denoted by parentheses. Here, LTS does not extend into the second verb phrase.

(17) High-toned words not undergoing LTS
    ò númé súsú té sé̩kí árì → [(**ò nùmè sùsù tè̩**) sé̩kí árì]
    he song sing.REDUP and dance CONT 'he is alternatively singing and dancing'
    Cf. *[(**ò nùmè sùsù tè̩ sè̩kì**) árì]

In this section, we catalogue the various contexts which act as a single domain for LTS and those which do not, specifically tying it to phrase and clause structure.

One LTS domain involve nouns plus any pre-nominal modifiers, which we shall refer to simply as the noun phrase (NP) for our purposes. Example (18) shows low tone spreading across multiple words within an NP, such as in possession-compound constructions **dúéín díbí pírí** 'cemetery' (18a) or **féní mínjí kùkù** 'bird's water pot' (18c), or in a quantified nominal construction (**tírá sákí** 'three times', 18d). In each of these examples, the NP constituent is indicated in the input (in square brackets) which corresponds to a LTS domain in the output (in parentheses)

(18) NP as a single domain for LTS

    a. **ǹ** [dúéín díbí pírí]_{NP} Ⓗ érí té[↓]é → (**ǹ dùèìn dìbì pìrí**) [↑]érí té[↓]é
       they corpse bury ground D see PERF 'they have seen a cemetery'

    b. **à** [námá kálíyè]_{NP} fè té[↓]é → (**à nàmà kàlíyè**) fè té[↓]é
       I animal small.thing buy PERF 'I have bought a small-ish animal'

    c. **à** [féní mínjí kùkù]_{NP} fè té[↓]é → (**à fèní mìnjí kùkù**) fè té[↓]é
       I bird water pot buy PERF 'I have bought a bird's water pot'

    d. **ò** [tírá sákí]_{NP} kè dèrì Ⓗ[↑]ḿ → (**ò tìrà sàkí**) kè dèrí [↑]ḿ
       he three time P laugh FAC 'he laughed three times'

    e. **à** [bébé óbóngòrò]_{NP} fè té[↓]é → (**à bèbè òbóngòrò**) fè té[↓]é
       I whole turtle buy PERF 'I have bought a whole turtle'

The mapping of an NP to a single LTS domain holds regardless of the size or contents of the modifiers. For example, (19) shows pre-nominal relative clauses (RCs) of various complexity e.g. **yé télémá bó** 'blacksmith' (19a; lit. thing-fix-person, 'the person who fixes things'). As long as these consist of a contiguous string of high-toned vowels, both the relative clause and the noun will be targeted for LTS.

(19) NP with relative clauses forming a single domain for LTS

    a. **ǹ** [[yé télémá]_{RC} bó]_{NP} Ⓗ érí té[↓]é → (**ǹ yè tèlèmà** bó) [↑]érí té[↓]é
       they thing fix person D see PERF 'I have seen a blacksmith'

    b. **à** [[ménjí té]_{RC} túbárà]_{NP} bé dókí té[↓]é → (**à mènjì tè tù**bárà) bé [↑]dókí té[↓]é
       I walk PERF antelope the look.for PERF
       'I have looked for the antelope that has walked'

    c. **à** [[námá fúrú]_{RC} óbóngòrò]_{NP} mé dókí té[↓]é
       I meat steal turtle the look.for PERF
       → (**à nàmà fùrù** òbóngòrò) mé [↑]dókí té[↓]é
       'I have looked for the turtle that stole the meat'

Another domain which forms a single LTS domain are [OBJECT VERB] constructions, which we refer to simply as verb phrases (VPs). Examples with unmodified nouns in object position are in (20). As above, the VP constituent is indicated in the input with square brackets, which corresponds to a LTS domain in the output in parentheses.

(20) VPs as a single domain for LTS

    a. **ò** [búrúmá sélé]_{VP} té[↓]é → (**ò bùrùmà sèlè**) té[↓]é
       he indigo choose PERF 'he has chosen indigo'

    b. **ò** [yé tólúmá]_{VP} sí[↓]mé Ⓗ[↑]ḿ → (**ò yè tòlùmà**) sí[↓]mé [↑]ḿ
       he thing teach used.to FAC 'he used to teach' (but no longer)

    c. **ǹ** [júmójúmó dúká]_{VP} bó ⒽⓁ → (**ǹ jùmòjùmò dùkà**) bóò
       they each.other follow come SBJV 'they should follow each other'

As expected, the VP forms a single domain with a complex NP if it is in object position (21).

522 (21) VPs with a complex NP forming a single domain for LTS
523   **à** [[jén féní]ₙₚ fé́]ᵥₚ té́⁺é́   → (**à jèn fènì fè̀**) té́⁺é́
524   I   another bird   buy   PERF   'I have bought another bird'

The NP and the VP are the two major constituents which correspond to a single LTS domain. In contrast, most other types of constructions/sequences do *not* form a single domain. Let us go through these systematically. First, any modifiers which follow the noun are not part of the LTS domain. These include various determiners and quantifiers many of which are high-toned, such as the determiner **mέ** 'the', **rέ** 'instead', **íngέrí** 'only', **ímgbà** 'all', and the floating tone Ⓗ DETERMINER (D) which acts as a general determiner.[5] In the examples in (22), low tone from the V̀-clitic cannot spread to the determiner/quantifier.

533 (22) Noun plus following determiner/quantifier forming separate LTS domains
534   a. **ò** námá mέ sέlέ té́⁺é́   → (**ò nàmà**) mέ ⁺sέlέ té́⁺é́   (cf. *ò nàmà mè̀ …)
535   he animal the choose PERF   'he has chosen the meat'
536   b. **ò** dín   mέ ímgbà kέ àǹì yè Ⓗ⁺ḿ → (**ò dìn**) mέ ímgbà kέ àǹì yé ⁺ḿ
537   he night the all   P it do FAC   'he spent the whole night doing it'
538   Cf. * (**ò dìn mè̀** …)
539   c. **à** námá rέ   fέ té́⁺é́   → (**à nàmà**) rέ ⁺fέ té́⁺é́
540   I   animal instead buy PERF   'I have bought an animal instead'
541   d. **à** námá íngέrí fέ té́⁺é́   → (**à nàmà**) íngέrí ⁺fέ té́⁺é́
542   I   animal only   buy PERF   'I have bought only an animal (alone)'
543   e. **ò** b́úrúmá Ⓗ sέlέ té́⁺é́   → (**ò bùrù**má) ⁺sέlέ té́⁺é́
544   he indigo D choose PERF   'he has chosen the indigo'

Moreover, while [OBJECT VERB] VPs form a single domain, any material which follows the verb does not. Some structures which form separate LTS domains are lexical verbs in series (i.e. [VERB VERB]) with or without the linking marker **tè̩** 'and', verbs plus auxiliary verbs (i.e. [VERB AUX]) such as **wέrí** 'keep', verbs with post-verbal inflectional particles encoding tense, aspect, mood, and polarity (i.e. [VERB INFL]), and verbs plus various clause-final markers (i.e. [VERB CFM]) such as **tírémè̩** 'before'. Example sets illustrating each of these contexts are in (23)-(26).

553 (23) Verbs in series [VERB VERB] forming separate LTS domains
554   a. **ò** ménjí sábá té́⁺é́   → (**ò mènjì**) sábá té́⁺é́ Cf. *(**ò mènjì sàbà**) …
555   he walk   cross PERF   'he has stepped over'
556   b. **ò** gélé á néngí   Ⓗ⁺ḿ → (**ò gèlè**) á néngí ⁺ḿ Cf. *(**ò gèlè à nè̩ngí**) …
557   he tall her be.more.than FAC 'he is taller than she is' (Jenewari 1980:30)
558   c. **à** bó yé   fí Ⓗbà   → (**à bò**) yé fí bà   Cf. *(**à bò yè**) …
559   I   come thing eat FUT   'I will come eat'
560   d. **ò** bóbó   té só árì → (**ò bòbò tè̩**) só árì
561   he come.REDUP   and leave CONT 'he comes and goes from time to time'
562   Cf. *(**ò bòbò tè̩ sò**) árì   (Jenewari 1980:146)

564 (24) Verb plus auxiliary [VERB AUX] forming separate LTS domains
565   **ò** bíkí wέrí árì → (**ò bìkì**) wέrí árì   Cf. *(**ò bìkì wè̩rì**) …
566   he fall keep CONT   'he has fallen' (and still on the ground)

---

[5] Although we can often identify the presence of this floating Ⓗ, at this point its exact semantic contribution is not clear. In the examples we have, it corresponds to translations with both definite and indefinite meaning. Harry & Hyman (2014:673) simply call it the 'final determiner tone', and we gloss it as DETERMINER (D). It may be related to what Jenewari (1977:140) calls the 'non-interrogative sentence marker' (realized as a downstepped high plus vowel lengthening), albeit at the phrase level.

(25) Verb plus inflectional particle [VERB INFL] forming separate LTS domains[6]

    a.   **ọ̀** bíkí̩ té̩⁺é̩ → (**ọ̀ bị̀kị̀**) té̩⁺é̩   Cf. *(**ọ̀ bị̀kị̀ tè̩é̩**)

         he fall PERF   'he has fallen'

    b.   **ọ̀** bíkí̩ Ⓗ⁺ḿ → (**ọ̀ bị̀kí̩**) ⁺ḿ   Cf. *(**ọ̀ bị̀kị̀** ḿ)

         he fall FAC   'he fell'

    c.   **à** bọ̀ á ⁺só̩ → (**à bọ̀**) á ⁺só̩   Cf. *(**à bọ̀ à**) só̩

         I come NEG even   'even if I didn't come…'

(26) Verbs plus clause-final marker [VERB CFM] forming separate LTS domains

     ò bó̩ tíré̩mè̩, wá só Ⓗ⁺ḿ → (**ò bọ̀**) tíré̩mè̩, …   Cf. *(**ò bọ̀ tì̩**ré̩mè̩)…

     he come before we leave FAC   'he came before we left'

    Finally, adverbials as a whole (of different phonological lengths and semantic types) form their own LTS domain. As stated in the typological profile (§2.1), adverbials appear between the subject and the verb phrase. Example (27) shows that low tone does not spread through the adverb to the following object or verb of the verb phrase.

(27) Adverbials form a separate LTS domain

    a.   **ò** [kpékélé]ADV bó̩ á⁺á → (**ò kpèkèlè**) bó̩ á⁺á   Cf. *(**ò kpèkèlè bọ̀**) …

         he in.time come NEG   'he did not come in time'

    b.   **ọ̀** [bú̩ró̩]ADV Kálábà̩rì̩ má bé̩lé̩má á⁺á → (**ọ̀ bù̩rọ̀**) Kálábà̩rì̩ ~ (**ọ̀ bù̩**ró) Kálábà̩rì̩ …

         he RHET Kalabari the love NEG   'Does he not love the Kalabari people?!

         (surely he does!)' (*rhetorical question*)

         Cf. *(**ọ̀ bù̩rọ̀ Kà**lábà̩rì̩) …

    While this generalization holds for most adverbials, there are two adverbial contexts where results are mixed. The first is with multiplicative expressions involving a numeral followed by **sákí̩** 'time'. These optionally form a single LTS domain with the following verb (28). We take this variation as reflecting two distinct underlying structures: one where the multiplicative is a true adverbial and thus forming its own domain (28a), and another where it is the object and thus forming a joint domain with the verb (28b).

(28) Domain variation with multiplicatives

    a.   **à** [tí̩rá sákí̩]ADV mú té̩⁺é̩ → (**à tì̩rà sàkí̩**) ⁺mú té̩⁺é̩

         I three time go PERF   'I have gone three times'

    b.   **à** [[tí̩rá sákí̩]OBJ mú]VP té̩⁺é̩ → (**à tì̩rà sàkì̩ mù**) té̩⁺é̩

    The second exceptional adverbial context is with **jén**, which has two functions: in noun phrases it means 'another, next' (21), while in an adverbial function it means 'again'. Unlike other adverbials, the adverbial use of **jén** forms a single LTS domain with the following verb (29).

(29) Adverbial **jén** 'again' forming a single LTS domain with following verb

     ọ̀ jén bó̩ á⁺á → (**ò jèn bọ̀**) á⁺á

     he again come NEG   'he didn't come again'

---

[6] Recall from the end of §3.2 that H-absorption is questionable before a downstep. Here, however, the form is interpreted as fully ungrammatical when it involves an inflectional particle, suggesting it forms a separate domain.

612 We assume that unlike all other adverbials, **jén** is prosodically deficient, and as such it does not form a
613 separate prosodic domain. Therefore the clitic **ò̩** can spread through **jén** to the verb. We shall turn to matters
614 of prosodic constituency shortly.[7]
615   To summarize, noun phrases (a pre-nominal modifier plus the head noun) and verb phrases (an object
616 plus the head verb) form a single domain with respect to LTS, while other contexts form separate domains.
617 These include a noun plus a post-nominal determiner/quantifier (D/Q), verb/verb phrases in series, a verb
618 plus an auxiliary (AUX), post-verbal inflectional particle (INFL), or clause-final marker (CFM), or a clause
619 with an adverbial. This is schematized in Table 7.

620
621   Table 7: Schematic summary of contexts forming single vs. separate LTS domains

Single spread domain			Separate domains					
à	[V́ V́]$_{NP}$	→ (à V̀ V̀)	**à**	[V́ V́]$_{NP}$	V́$_{D/Q}$	→ (à V̀ V̀) V́	Cf.	*(à V̀ V̀ V̀)
à	[V́ V́]$_{VP}$	→ (à V̀ V̀)	**à**	[V́ V́]$_{VP}$	[V́]$_{VP}$	→ (à V̀ V̀) V́	Cf.	*(à V̀ V̀ V̀ V̀)
à	[[V́ V́]$_{NP}$ V́]$_{VP}$	→ (à V̀ V̀ V̀)	**à**	[V́ V́]$_{VP}$	V́$_{AUX}$	→ (à V̀ V̀) V́	Cf.	*(à V̀ V̀ V̀)
			à	[V́ V́]$_{VP}$	V́$_{INFL}$	→ (à V̀ V̀) V́	Cf.	*(à V̀ V̀ V̀)
			à	[V́ V́]$_{VP}$	V́$_{CFM}$	→ (à V̀ V̀) V́	Cf.	*(à V̀ V̀ V̀)
			à	[V́ V́]$_{ADV}$	[V́]$_{VP}$	→ (à V̀ V̀) V́	Cf.	*(à V̀ V̀ V̀)

622
623 Abstracting over these contexts, the domain for LTS is a syntactic constituent to the right of the V̀-clitic,
624 necessarily terminating at the lexical head of that constituent.

3.4   *Low tone spread as a distinct tonal process*

626 Let us briefly return to the other tonal processes introduced in §2.3 – replacive grammatical tone and
627 concatenative grammatical tone – and show how LTS is distinct. Firstly, while LTS appears to
628 systematically replace high tones with low tones (akin to replacive grammatical tone), it acts differently
629 from replacive tone in an important way: the target of LTS must be of a specific (underlying) tonal shape.
630 We schematize this difference in Table 8, comparing replacive grammatical tone from **jà** 'some' with LTS
631 from **à** 'I' (for actual examples with **jà**, see Table 3). Table 8 shows that while replacive tone applies with
632 nouns of all lexical tone shapes and always completely neutralizes tone, LTS *only* applies on nouns
633 beginning with H tone (strings). LTS never effects lexical tone of other shapes.

634
635   Table 8: Replacive grammatical tone with **jà** 'some' vs. LTS with **à** 'I'

a.	/jà HH/	→	[jà **LL**]	Cf.	/à HH/	→	[à HH]~[à **L**H]~[à **LL**]	
b.	/jà LH/	→	[jà **LL**]		/à LH/	→	[à LH]	*[à **LL**]
c.	/jà HL/	→	[jà **LL**]		/à HL/	→	[à HL]	*[à **LL**]
d.	/jà H˙H/	→	[jà **LL**]		/à H˙H/	→	[à H˙H]~[à **L**H]	*[à **LL**]

636
637 Example (30) shows the lack of LTS with LH words **lò̩kò̩ló̩kó̩** 'prosperous' and **wè̩é̩n** RP, a type of
638 resumptive pronoun.
639

---

(30)   Underlying LH sequences are not subject to LTS
    a. Bèné fí sá⁺kí , **ọ̀** lọ̀kọ̀lọ́kọ́ wérí árì   (cf. *[…**ọ̀ lọ̀kọ̀lọ̀**kọ́ ~ **lọ̀kọ̀lọ̀kọ̀** …])
      Bene die time he prosperous keep CONT
      'When Bene died, he was well off' (Jenewari 1980:152)
    b. Gògó fị tẹ́⁺ẹ́ , **à** wẹ̀ẹ́n ná   ⁺ḿ   (cf. *[…**à wẹ̀ẹ̀n** ná …])
      Gogo die PERF I RP   hear FAC
      'I heard that Gogo is dead' (Jenewari 1977:394)

Moreover, LTS is also unlike concatenative grammatical tone. To illustrate, let us consider the tonal near minimal pair **sọ̀** 'cook' versus **só** 'go'. (31a) shows that when low-toned **sọ̀** occurs with the floating tone sequence Ⓗⓛ expressing subjunctive mood (SBJV), the tones concatenate and result in a LHL contour which is otherwise not found on monosyllables in Kalabari. In (31b), in contrast, when this floating Ⓗⓛ concatenates with high-toned **só** with, the result is simply a HL contour [**sóò**] rather than a LHL contour. In this example LTS is not possible, i.e. it does not result in the same LHL contour *[**sòóò**].

(31)   Concatenative grammatical tone creates rare LHL contours, but LTS cannot
    a. ọ̀ sọ̀   Ⓗⓛ   → [ọ̀ sọ̀óò]
      he cook   SBJV   'he should cook'
    b. **ò** só   Ⓗⓛ   → [**ò** sóò] (cf. *[**ò sò**óò] with LTS)
      he go   SBJV   'he should go'

If these clitics were like concatenative grammatical tone, this would entail a hypothetical underlying structure /ọ̀ⓛ/ with a floating tone. The fact that no tonal effect from the clitic can be detected here indicates that LTS is indeed a spreading operation and does not involve an additional floating tone. Taken together, LHL contours are possible only to preserve underlying tone (including floating tone), and cannot be created otherwise (e.g. by a spreading operation).

4   Analysis

4.1   *Prosodic deficiency and word-minimality*

The first part of our analysis is examining why V̀-clitics (**à**, **ọ̀**, and **ǹ**) and only V̀-clitics act as triggers of LTS. As we have stated, they are the only morphemes in the language which are monosyllabic, onsetless, and low-toned. These three qualities make them non-prominent compared to multisyllabic, onsetful, and/or high-toned counterparts. We formalize this non-prominence as a prosodic deficiency: these clitics do not form an independent phonological word (i.e. the ω-word). We adopt the following word-minimality constraint in (32), referred to as '*((V̀)σ)ω' as a shorthand. This constraint recapitulates the generalization that phonological words cannot solely consist of a single syllable which lacks both an onset and high tone. We formulate this constraint with respect to 'vowels' ('Vs') for convenience, and it should be understood as applying to any tone-bearing unit to cover the case of syllabic **ǹ**.

(32)   *((V̀)σ)ω: Phonological words cannot consist only of an onsetless low-toned vowel

V̀-clitics do not satisfy this constraint (i.e. they are sub-minimal), and therefore they cannot form phonological words on their own. This is illustrated below where the V̀-clitic **à** 'I' does not form a phonological word (33a). Compare this to its bisyllabic counterpart clitic **àrì** (33b), the high-toned onsetless clitic **á** 'she' (33c), or the low-toned but onsetful lexical noun **sò** 'sky, heaven' (33d).

685 (33) V̀-clitics are sub-minimal and do not form a separate phonological word (ω)
686 a. **à** (pélɛ́mà)ω (tɛ́⁺ɛ̀)ω (→ [**à pɛ̀**lɛ́mà tɛ́⁺ɛ̀])
687 I pour.one.to.another PERF
688 'I have poured from one (container) to another'
689 b. **(àrɪ̀)ω** (íyɛ́)ω (ɛ́rɪ́)ω (⁺ḿ)ω
690 I you see FAC
691 'I saw you'
692 c. **(á)ω** (màngɪ̀)ω (wɛ́rɪ́)ω (árɪ̀)ω
693 she run keep CONT
694 'she has run away (and is still not back)'
695 d. **(sò)ω** (bálápʊ́)ω (tɛ́⁺ɛ̀)ω
696 sky twinkle PERF
697 'heaven displays a sudden flash of fire' (Blench 2008:320)
698

699   The prosodic deficiency of these three dimensions of V̀-clitics – i.e. its low tone, onsetlessness, and
700 monosyllabicity – has much precedence in the literature. First, it is well-known that monosyllables may not
701 satisfy the minimal requirement for prosodic wordhood (e.g. Hayes' 1995:87f. 'minimal word syndrome').
702 Second, high tone tends to be treated as prominent across languages while low tone as non-prominent (see
703 overviews in Yip 2001 and de Lacy 2002). For example, stress (or other prominent positions) and high tone
704 have a known affinity to one another (e.g. Köhnlein 2013), and equally there is an avoidance of stress and
705 low-toned syllables (e.g. in Huajuapan Mixtec [miu] – Pike & Cowan 1967). De Lacy (2002) provides a
706 typology of stress-tone interactions with extensive empirical studies and references, resulting in a
707 prominence hierarchy 'H>M>L', where cross-linguistic evidence points to H being most prominent and L
708 least prominent.
709   Lastly, while onsets are traditionally understood as independent of prosodic prominence (e.g. with
710 respect to stress and weight considerations), a growing body of literature demonstrates that the presence of
711 an onset and/or the type of onset repeatedly plays a role in prosodic patterns. Onsetless syllables often suffer
712 from prosodic deficiency (Downing 1998, Schwartz 2013, Rolle 2021), e.g. as manifested by being invisible
713 for stress assignment (e.g. Gordon 2005, Topintzi 2010) or high tone alignment (Bamba 1991, Odden 1995,
714 2006, Jenks & Rose 2011). One clear example of this comes from Yoruba [yor], also spoken in southern
715 Nigeria. Orie (2000) details numerous places in (standard) Yoruba morphophonology where onsetless
716 syllables pattern differently from onsetful ones, e.g. a ban on high tone on word-initial onsetless syllables
717 (i.e. there are words **ōwó** 'money' and **òwò** 'business', but not *ówó). Combing these results of these studies
718 together, the core conclusion is that vowels without onsets are non-optimal for starting prosodic constituents
719 and non-optimal as tone-bearing units.[8]

720 **4.2** *Tonal incorporation*

721 Kalabari is perhaps unique in requiring all three deficiency conditions to be present (monosyllabicity, low
722 tone, and onsetlessness) in order for a morpheme to be considered phonologically deficient, reflected by
723 our constraint *((V̀)σ)ω. This constraint however cannot account for the patterns alone. The second
724 component of our analysis posits that all tones must be associated to some vowel (i.e. tone-bearing unit)
725 within a phonological word. We refer to this as 'tonal incorporation', and capture this via a constraint 'T-
726 to-ω', defined in (34):
727
728 (34) T-to-ω: Tones must associate to a vowel within a phonological word

---

[8] Unlike in Yoruba, in Kalabari VCV monomorphemic words show no restrictions on the tone on the initial vowel.
All five main lexical tone patterns are attested: **èkpè** 'chest', **èkpé** 'he-goat', **éré** 'female', **élè** 'space', and **é⁺né** 'rain'
(Harry 2004). This indicates that initial onsetless vowels within larger words are syllabified and not prosodically
deficient *per se* (cf. Orie 2000). It is only when such onsetless vowels appear by themselves in a (low-toned)
monosyllabic morpheme that they are deficient.

729

730   The combination of these two constraints initiates low tone spread. A V̀-clitic is not parsed into a
731 phonological word (due to *((V̀)σ)ω), but there remains a requirement that its low tone be parsed into one
732 (due to T-to-ω). To accommodate this contradiction, the tone must 'tonally incorporate' into a neighboring
733 phonological word by spreading rightward. This is shown in Figure 5. Note that the segmental component
734 of the V̀-clitic does *not* incorporate with the following word, and it remains unparsed in fact at the prosodic
735 word level. The tonal and segmental tiers thus diverge here with respect to prosodic constituency. We return
736 to matters of prosodic constituency shortly (§4.3-4.4).

737

738   Figure 5: Low tone spread as a consequence of *((V̀)σ)ω plus T-to-ω

739

740   As we have detailed, low spreads only under certain phonological conditions: it spreads to HH words but
741 not LH or HL words (i.e. **à HL** does not become ***à LL** – see Table 8 above). Low tone can only spread
742 such that the H tone remains on the final high-toned vowel (H-compression), and spreads further only if
743 followed by another H (H-absorption); otherwise it does not apply. In such cases, we may assume that T-
744 to-ω is simply unsatisfied and cannot otherwise be repaired.
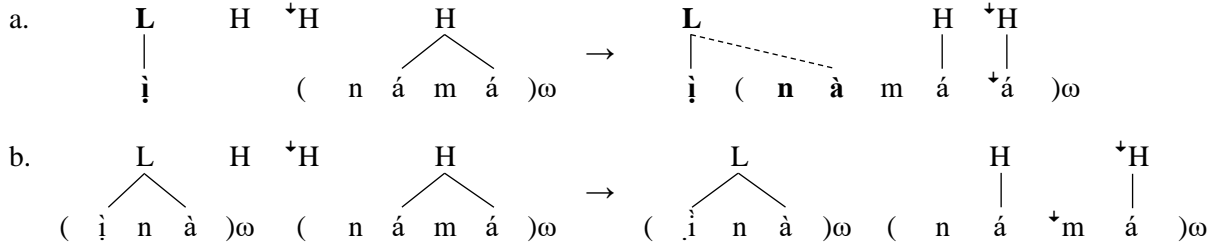745   A crucial independent piece of evidence for the T-to-ω constraint and tonal incorporation comes from
746 tone alignment with replacive grammatical tone (Table 3, §2.3). Of interest are possessive pronoun
747 constructions, which assign a ⇒H⁺H replacive grammatical tone as a class, e.g. **ìnà námá → [ìnà ná⁺má]**
748 'their meat'. Relevant for our analysis, Harry & Hyman (2014) additionally state that the alignment of this
749 H⁺H sequence depends on the phonological shape of the possessor itself: if it is of the shape V̀ (i.e. low-
750 toned, onsetless, and monosyllabic – the same as the relevant V̀-clitics), then the following noun surfaces
751 with an initial L. This is shown in Table 9, where the exceptional forms are in bold. This pattern is not
752 reported with other low-toned possessors, e.g. bisyllabic **ìnà** 'their'.[9]

753

754   Table 9: Alignment of replacive grammatical tone with V̀ possessive pronouns (Harry & Hyman 2014:654)

	Possessor		Replacive tones		Head noun		Surface	Meaning
1SG	**ì**	+	⇒H⁺H	+	námá	→	**[ì nàmá⁺á]**	'my meat'
2SG	í	+	⇒H⁺H	+	námá	→	[í ná⁺má]	'your meat'
3SG.M	**ò̩**	+	⇒H⁺H	+	námá	→	**[ò̩ nàmá⁺á]**	'his meat'
3SG.F	á	+	⇒H⁺H	+	námá	→	[á ná⁺má]	'her meat'
1PL	wánà	+	⇒H⁺H	+	námá	→	[wánà ná⁺má]	'our meat'
2PL	ómì̩nà	+	⇒H⁺H	+	námá	→	[ómì̩nà ná⁺má]	'your meat'
3PL	ìnà	+	⇒H⁺H	+	námá	→	[ìnà ná⁺má]	'their meat'

755

756   We can straightforwardly account for this special association if V̀-shaped possessors do not form their
757 own phonological word either, i.e. they are subject to the constraint *((V̀)σ)ω. The low tone must therefore
758 spread into the neighboring word (due to T-to-ω). This consequently shifts the grammatical tones one vowel
759 to the right (Figure 6a). In contrast, a possessor **ìnà** forms its own word and therefore its low tone does not
760 need to spread (Figure 6b).

761

---

[9] On the relation of these possessive pronouns to V̀-clitics in subject position (our focus), see Footnote 3.

Figure 6: Consequence of *((V̀)σ)ω plus T-to-ω with grammatical tone alignment

a. L   H   ⁺H   H   →   L   H   ⁺H
    | |
    ì   (n á m á)ω   ì (n à m á ⁺á)ω

b. L   H   ⁺H   H   →   L   H   ⁺H
    (ì n à)ω (n á m á)ω   (ì n à)ω (n á ⁺m á)ω

Our proposal thus unites two separate tonal patterns under the same account: low tone spread from pronominal clitics and exceptional grammatical tone alignment are both due to the prosodic deficiency of the trigger, coupled with the requirement to be (tonologically) parsed into a phonological word.

4.3   *The domain of low tone spread as the phonological phrase*

The second component of our analysis addresses the unbounded nature of low tone spread: it does not merely target a single vowel in a neighboring word, but rather spreads to *all* contiguous high-toned vowels (within the relevant domain). A constraint such as T-to-ω would be satisfied by merely spreading once, and therefore we require some other explanation. In short, how exactly does tone incorporation lead to H-compression and H-absorption?

In addressing this part of the analysis, we start by positing the precise domain for LTS: the phonological phrase (i.e. φ-phrase). This φ-phrase constituent by default is assumed to be the next level of the prosodic hierarchy after the phonological word (Nespor & Vogel 1986; Selkirk 2011; *inter alia*). For maximum clarity, phonological phrases will be notated in curly brackets, i.e. { }φ. To explicate this proposal, let us first establish phonological phrasing generally in Kalabari.

A basic prosodic division can be made between a (lexical) subject and its accompanying predicate. These form separate φ-phrases, a common cross-linguistic finding in the prosodic literature (Selkirk & Shen 1990; Dobashi 2003, 2014; Samuels 2009; Kalivoda 2018). We show this in (35), where the lexical noun **féní** 'bird' in subject position is prosodically separate from the verb phrase **pùlò èrì** 'see oil'. An equivalent rendition of the prosodic structure is in Figure 7.
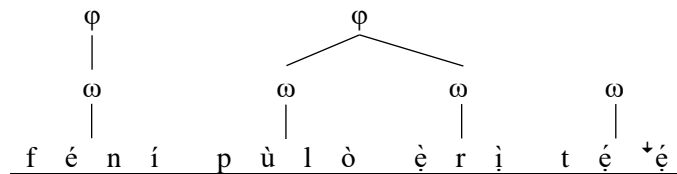
(35)   Lexical noun in subject position and predicate forming separate φ-phrases
        féní   pùlò   èrì té⁺ę́   →   {(féní)ω}φ {(pùlò)ω (èrì)ω}φ (té⁺ę́)ω
        bird   oil   see PERF   'the bird has seen the oil'

Figure 7: Subject and predicate forming separate phonological phrases

φ   φ
| /   \
ω   ω   ω   ω
| | | |
f é n í   p ù l ò   è r ì   t ę́ ⁺ę́

The inflectional particle **té⁺ę́** PERF is not included within the last phonological phrase, but it does form a phonological word on its own. We justify its independence from the previous φ-phrase shortly.

The prosodic structure of lexical subjects contrasts with pronominal clitics. The latter do not form their own phonological phrase, and instead they must be grouped with the following φ-phrase. Additionally, based on our analysis in §4.1 pre-vocalic allomorphs such as **òrì** 'he' form their own phonological word but pre-consonantal V̀-clitics like **ò** 'he' do not. Their updated prosodic structures are shown in Figures 8-

796 **9**, repeating examples **òrì ìgàní ḅà** 'he will get annoyed' and **ò mìnìní ḅà** 'he will agree' from (4). In both
797 these figures, the subject clitic adjoins to the verb's φ-phrase (cf. Figure 7 above with a lexical subject).
798
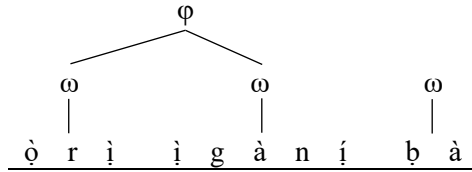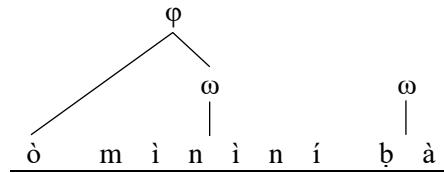
799 Figure 8: Pronominal clitic and verb forming φ-phrase

800
801 Figure 9: V̀-clitic and verb forming joint φ-phrase

802

803   Independent evidence for this prosodic constituency comes from advanced tongue root (ATR)
804 harmony, introduced in §2.1. Akinlabi (1997) shows that pronominal clitics harmonize with the word to
805 their right in ATR value, shown in (36). ATR harmony applies to both the pre-consonant allomorph series
806 (36a) as well as the pre-vocalic one (36b-c). Recall that [-ATR] vowels are written with a dot under the
807 vowel, while [+ATR] vowels are typographically unmarked.
808

809 (36)   All pronominal clitics are subject to ATR harmony _(Akinlabi 1997:106)
810   a.   [+ATR]   **ó** ḅóò   'you (PL) are to come'
811   [-ATR]   **ọ́** lègíì   'you (PL) are to sit down'
812   b.   [+ATR]   **òrì** ókí ꜜḿ   'he swam'
813   [-ATR]   **ọ̀rì** lègí ꜜḿ   'he sat down'
814   c.   [+ATR]   **ìnì** ólókú ꜜḿ   'they shouted'
815   [-ATR]   **ìṇì** ẹrí ꜜḿ   'they saw (it)'
816

817   In contrast, lexical subjects do not undergo harmony, nor do counterpart independent pronouns, which
818 are not clitics. Independent pronouns were introduced in Table 5, and are used in numerous positions where
819 pronominal clitics are not permitted. Such contexts include when modified by a post-nominal modifier (e.g.
820 **sọ́** 'also' in 37a), being in the initial or final position of a copular clause (37b-d), or acting as a single-word
821 response (37e).
822

823 (37)   Distribution of independent pronouns
824   a. **ìyèrí** ⁺sọ́   òrì èrí ⁺m̄
825   **I**   also   him see FAC
826   'I saw him too' (Jenewari 1977:407)
827   b. **ìyèrí** àní⁺é ọ̀ dá
828   **I**   COP   his father
829   'I am his father'
830   c. **ìyèrí** tù ḅọ́ ?
831   **I**   who
832   'Who/what am I?'
833   d. ìndé⁺é **ìyèrí** ?
834   where **I**
835   'Where am I?'
836   e. A: tù ḅọ́ ḅó ?   B: **ìyèrí**⁺í !
837   who   come   I
838   A: 'Who came?'   B: 'Me!'
839

840 This distribution is explained if such positions require content which must be able to form its own
841 phonological phrase (a requirement not present in normal subject or object positions). Only independent
842 pronouns fit this criterion – pronominal clitics do not (38).
843

844 (38)   Pronominal clitics disallowed in positions requiring independent pronoun
845   **òrì** pápá   tòmḅọ̀   Cf. *ọ̀ pápá tòmḅọ̀
846   he useless person
847   'he is a useless person'
848

849   As stated, unlike pronominal clitics, independent pronouns *never* harmonize with the following word.
850 Both [+ATR] independent pronouns (39a) and [-ATR] ones (39b) retain their underlying harmony value in
851 the same context.
852

853 (39)   Lack of ATR harmony with independent pronouns
854   a. **òrì** tù ḅọ́ ?   'Who/what is **he**?'
855   **ìnì** tò̩ àpú ?   'Who/what are **they**?'
856   b. **ìyèrí** tù ḅọ́ ?   'Who/what am **I**?'
857   **ọ́mìnì** tò̩ àpú ? 'Who/what are **you** (PL)?'
858

859 Example (40) is particularly telling. This example set involves a pre-subject independent pronoun in topic
860 position with a co-referential pronominal clitic in subject or object position. The pronominal clitics undergo
861 harmony while the independent pronouns do not, even in cases where they are otherwise phonologically
862 identical and adjacent (40c).
863

864 (40)   Lack of ATR harmony with independent pronouns
865   a. **òrì** ,   ò ḅọ́   ⁺m̄
866   **he**   he come FAC
867   'As for him, he came' (Jenewari 1977:274)
868   b. **òrì** ,   ọ̀ kìnì   sín   ⁺m̄
869   **he**   he someone call FAC
870   'As for him, he called someone'
871   c. Gògó   òrì èrémè ḅèlèmá árì   kúmà **ìnì** , ìnì   ò̩   ḅèlèmà á⁺á
872   Gogo his women love CONT but **they** they him love   NEG
873   'Gogo loves his wives but they do not love him' (Jenewari 1977:251)
874

These data can be accounted for if independent pronouns form a separate φ-phrase, and that ATR harmony is restricted to targets within a single φ-phrase (i.e. ATR cannot spread across a φ-phrase boundary). A partial diagram of (40c) is in Figure 10.

Figure 10: Independent pronouns form separate phonological phrases
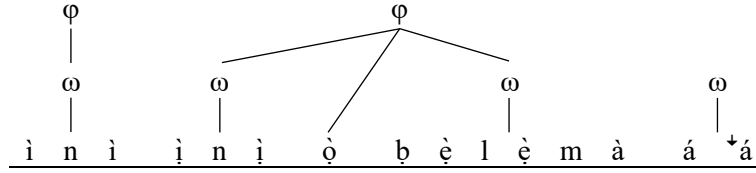
Post-verbal inflectional particles are also not part of this phonological phrase, e.g. **á⁺á** NEG in this Figure 10. This correctly predicts that they do not undergo ATR harmony with the word to their left. As Akinlabi shows, the particle **tẹ́⁺ẹ́** PERF in (41) keeps its inherent [-ATR] value.

(41)   Inflectional particles do not undergo ATR harmony (Akinlabi 1997:106)
        Bòmá   Gògó   fómú   **tẹ́⁺ẹ́**   (cf. *[…fómú **té⁺é**])
        Boma   Gogo   beat   PERF   'Boma has beaten Gogo.'

Notice that in our analysis, such post-verbal inflectional particles form their own phonological word. One piece of evidence for their phonological wordhood is that all of such particles contain a high tone. This complies with the constraint *((V̀)σ)ω stating that phonological words cannot consist only of a single low-toned vowel. Inflectional particles include Ⓗ⁺**ḿ** FACTATIVE, **tẹ́⁺ẹ́** PERFECT, **árị̀** CONTINUOUS, Ⓗ**bà** FUTURE (plus its various allomorphs – Jenewari 1977:474f.), the floating tone sequence ⒽⓁ IMPERATIVE/SUBJUNCTIVE, and **á⁺á** NEGATIVE. An inflectional particle of the shape **m̀** or **à** (or even **bà**) is not attested.[10]

Having established the foundation for phonological phrasehood, let us return to the tonal facts. A remaining *explanandum* concerns the domain of LTS: some multi-word units form a single domain, others form separate domains, and a few contexts allow both (§3.3). To account for this contrast, we claim that low tone spreads rightward within a φ-phrase but cannot spread past it. Two examples of single LTS domains are in Figures 11-12. These figures model both H-compression (42a), as well as H-absorption before a phrase-external high tone (42b). Spreading is indicated via a checked line, and delinked tone association is indicated by a light gray line.

(42)   a. **à** [féní   mínjí   kùkù   fè]VP   tẹ́⁺ẹ́   → {**à fènì mì**njí kùkù fẹ̀}φ tẹ́⁺ẹ́
               I   bird   water   pot   buy   PERF   'I have bought a bird's water pot'
        b. **ò** [bụrúmá   sẹ́lẹ́]VP   tẹ́⁺ẹ́   → {**ò bụrùmà sẹ̀lẹ̀**}φ tẹ́⁺ẹ́
               he indigo   choose PERF   'he has chosen indigo'

Figure 11: LTS within the phonological phrase (H-compression)
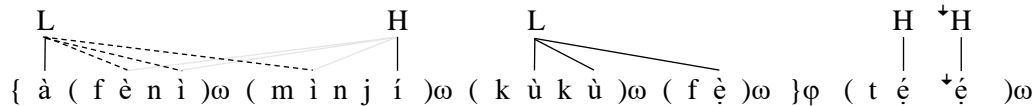
[10] A reviewer asks whether these particles also form their own phonological phrase. In future figures, we shall assume that they do not and attach directly to the intonational phrase (ιP, e.g. Figure 15 below). We cannot definitely diagnose their status however, as the environments which give evidence for independent φ-phrasehood do not directly appear before these inflectional clitics (e.g. the V̀-clitics triggering low tone spread). Whether these form a separate φ-phrase or not is not crucial for the rest of our analysis.

23

910
911
Figure 12: LTS within the phonological phrase (H-compression with H-absorption)

L   H   ⁺H

{ ò (ḅ ù r ù m à)ω (s è l è)ω }φ (t ẹ́ ⁺ẹ́)ω

912
913   Recall that LTS in the context of a lexical downstep preferably leaves one high-toned vowel before the
914   downstep (§3.2); H-absorption in these contexts was questionable (compare spreading past the downstep,
915   which is fully ungrammatical). An example is repeated in (43), whose variable surface pronunciations are
916   diagramed in Figures 13-14.

917
918   (43)   à   [ḅéké⁺ké   ẹ́rí]ᵥₚ   tẹ́⁺ẹ́   →   {à ḅèké⁺ké ẹ́rí}φ tẹ́⁺ẹ́ ~ ⁇{à ḅèkèké … }φ
919   I   chin   see   PERF   'I have seen a chin'

920
921   Figure 13: LTS in lexical downstep context (H-compression)

L   H   ⁺H   H   ⁺H

{ à (ḅ è k é ⁺k   é)ω (ẹ́ r í)ω }φ (t ẹ́ ⁺ẹ́)ω
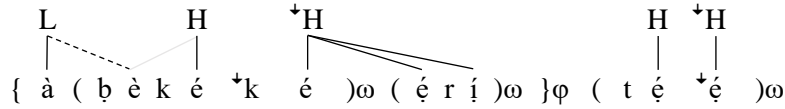
922
923   Figure 14: LTS in lexical downstep context (H-compression with questionable H-absorption)
⁇

L   H   ⁺H   H   ⁺H

{ à (ḅ è k è k   é)ω (ẹ́ r í)ω }φ (t ẹ́ ⁺ẹ́)ω
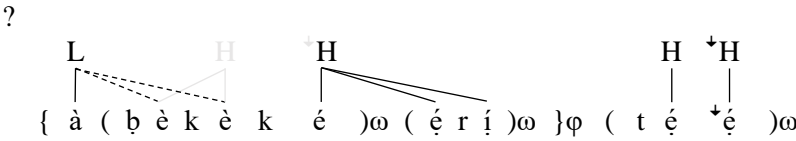
924
925   These structures point to H only questionably being able to be absorbed by a downstepped ⁺H when LTS
926   applies.
927   Any material outside of the phonological phrase – such as the inflectional particle tẹ́⁺ẹ́ PERF in these
928   figures – is not targeted by LTS. Other examples of such extra-phrasal material are in (44), such as post-
929   nominal quantifiers (íngẹ́rí 'only', 44a), the second verb in serial verb constructions (44b), a clause-final
930   marker (tírémè 'before', 44c), or material after an adverbial (44d).

931
932   (44)   Absence of low tone spread across a phonological phrase boundary
933   a.   à   námá   íngẹ́rí   fé   tẹ́⁺ẹ́   →   {à nàmà}φ {íngẹ́rí ⁺fé}φ tẹ́⁺ẹ́
934   I   animal   only   buy   PERF   'I have bought only an animal (alone)'
935   b.   ò   ménjí   sáḅá   tẹ́⁺ẹ́   →   {ò mènjì}φ {sáḅá}φ tẹ́⁺ẹ́
936   he   walk   cross   PERF   'he has stepped over'
937   c.   ò   ḅó   tírémè , …   →   {ò ḅò}φ tírémè
938   he   come   before   'he came before, …'
939   d.   ò   kpékélé ḅó   á⁺á   →   {ò kpèkèlè}φ {ḅó}φ á⁺á
940   he   in.time come   NEG   'he did not come in time'

941
942   We schematize the relevant syntax-phonology mappings in the table below. Subjects and adverbials
943   (Table 10a-e) by default are mapped to their own φ-phrase (with the exception of pronominal clitics as a
944   class – Figures 7-9). A pre-nominal modifier, the head noun object, and the head verb (the complex VP)

24

945 are mapped to a single φ-phrase (Table 10a). Modificational structure after the head noun object or head
946 verb do not belong to this φ-phrase, e.g. determiners/quantifiers (Table 10b), other verbs (Table 10c),
947 auxiliaries (Table 10d), or inflectional particles (INFL) and clause-final markers (CFM).[11]
948
949

Table 10: Syntax-phonology mapping

a.	[	{SUBJECT}φ	{MOD	NOUN	VERB}φ	INFL CFM	]ɩ
b.	[	{SUBJECT}φ	{NOUN}φ	{D/Q	VERB}φ	INFL CFM	]ɩ
c.	[	{SUBJECT}φ	{NOUN	VERB}φ	{VERB}φ	INFL CFM	]ɩ
d.	[	{SUBJECT}φ	{NOUN	VERB}φ	{AUX}φ	INFL CFM	]ɩ
e.	[	{SUBJECT}φ	{ADV}φ	{NOUN	VERB}φ	INFL CFM	]ɩ

950
951   Notice in this table that the entire clause maps to an intonational phrase (ɩ-phrase), denoted with an ɩ in
952 square brackets. This is meant for the sake of completeness rather than for any worked out clause-level
953 prosody (e.g. involving intonational boundary tones). Representing the ɩ-level also makes it clear that while
954 post-verbal inflectional particles and clause-final markers are not placed within a phonological phrase, they
955 *are* parsed within a supra-word prosodic constituent. This is shown in Figure 15 (an expansion of Figure
956 9), where the final phonological word is directly dominated by the ɩ-phrase, with no φ-phrase mediating
957 between the two. Although this structure violates the *exhaustivity* principle of the prosodic hierarchy
958 prohibiting 'level-skipping', recent incarnations of the prosodic hierarchy accept that this constraint is
959 violable (e.g. Selkirk 1996, 2011).
960
961

Figure 15: A ω-word directly dominated by ɩ-phrase
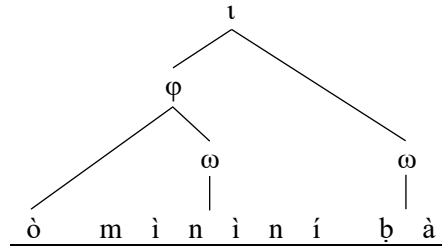
962 **4.4**   *Prosodic domain matching*

963 A tacit assumption of prosodic constituency is that constituents are transparent and stable, meaning that
964 they should be visible (i.e. accessible) to other phonological processes in the language, and they should
965 persist at different stages of a phonological derivation. This does not entail that there will always be
966 converging data, but when it is found it provides excellent corroborating evidence for prosodic
967 constituency. When distinct phonological processes refer to the same prosodic constituent, we shall refer
968 to this as 'prosodic domain matching'.[12]
969   Kalabari exhibits domain matching when comparing low tone spread with the scope of replacive
970 grammatical tone. As established (Table 3, §2.3), in noun phrases pre-nominal modifiers assign one of four
971 replacive grammatical tone patterns (HL, L, LH, and H˯H~HLH), while in verb phrases (Table 4) the final
972 tone of the object replaces all tones of the verb. Replacive grammatical tone does not simply target just the
973 lexical head or just the following word: *all* words between the trigger and lexical head are targeted,
974 including intervening modifiers. Consider the pronoun in possessor position ɪ̩ 'my'. This assigns a
975 H˯H~HLH replacive tone to the lexical noun if it is adjacent (45a), but if there are intervening modifiers
976 then this replacive melody 'spreads out' over all intervening words (45b-d). As with all cases of replacive
977 grammatical tone, the lexical tone of all target words is completely neutralized.

---

[11] Based on data such as (40), topics would also map to their own φ-phrase, not shown.
[12] This should not be conflated with 'Match Theory' (Selkirk 2011, Kalivoda 2018), which concerns the mapping of
syntactic phrases to prosodic phrases (not prosodic phrases with one another *per se*).

978
979 (45)　Possessor replacive grammatical tone H⁺H~HLH targeting multiple words (Harry & Hyman 2014)
980 　　　a.　ì　námá　　　　　　　　　　→　ì **nàmá⁺á**
981 　　　　　my meat　　　　　　　　　　'my meat'　　　　　(p. 654)
982 　　　b.　ì　féní　námá　　　　　　　→　ì **fèní nàmá**
983 　　　　　my bird　meat　　　　　　　'my bird's meat'　　(p. 654)
984 　　　c.　ì　féní　mìnjì　kúkú　　　　→　ì **fèní mìnjì kùkú**
985 　　　　　my bird　water　pot　　　　'my bird's water pot'　(p. 655)
986 　　　d.　ì　sóná　námá　kálá⁺　wá⁺rí　→　ì **sòná nàmà kàlà wàrì**
987 　　　　　my five　animal small　house　'my five animals' small house'　(p. 660)
988

989 　　　The data in (45) show that the replacive pattern can target more than one word. However, it never
990 targets any material past the lexical head. Compare the minimal pair below where a pre-nominal modifier
991 can be targeted by replacive tone (**féní** 'bird', 46a), but a post-nominal quantifier cannot (**mángbà** 'all',
992 46b).
993

994 (46)　Replacive tone cannot target the quantifier beyond the head noun (Harry & Hyman 2014)
995 　　　a.　ì　féní　　námá　→　ì **fèní nàmá**
996 　　　　　my bird　　meat　　'my bird's meat'　(p. 654)
997 　　　b.　ì　námá　mángbà→　ì **nàmá⁺á** mángbà
998 　　　　　my animal all　　　'all my animals'　(p. 665)
999 　　　　　(cf. *ì **nàmá màngbá**)
1000

1001 This restriction holds for all the triggers of replacive tone – e.g. demonstratives assigning LH (47) or
1002 possession-compound constructions assigning HL (48) – and holds for all post-nominal modifiers as well
1003 – e.g. **améè̩** PLURAL (47c) or **mé̩** 'the' (48b). The underlying tone is always retained in these contexts.
1004

1005 (47)　Replacive LH from demonstrative cannot target post-nominal modifiers (Harry & Hyman 2014)
1006 　　　a.　mí　féní　　námá　　　　→　mí **fèní nàmá**
1007 　　　　　this bird　　meat　　　　'this bird's meat'　(p. 656)
1008 　　　b.　mí　námá　mángbà　　　→　mí **nàmá⁺** mángbà ~ mí **nàmà** mángbà
1009 　　　　　this animal　the　　　　'all these animals'　(p. 665)
1010 　　　　　(cf. *mí **nàmà màngbá**)
1011 　　　c.　má　námá　améè̩　　　→　má **nàmá** améè̩ ~ má **nàmà** àméè̩
1012 　　　　　these　animal　PL　　　　'these animals'　(p. 665)
1013 　　　　　(cf. *mí **nàmà àmé̩**)
1014

1015 (48)　Replacive HL in possession-compound construction cannot target post-nominal (Harry & Hyman 2014)
1016 　　　a.　é⁺né　mìnjì　fú⁺rú̩　→　é⁺né **mínjí fù̩rù̩** ~ é⁺né **mínjì fù̩rù̩**
1017 　　　　　rain　water　smell　　'rainwater smell'　(p. 661)
1018 　　　b.　féní　púló　mé̩　→　féní **púlò** mé̩
1019 　　　　　bird　oil　the　　'the bird's oil'　(p. 667)
1020 　　　　　(cf. *féní **púló mè̩** ~ *féní **púlò mè̩**)
1021

1022 　　　Parallel restrictions exist for replacive grammatical tone affecting verb phrases (49). Replacive tone
1023 from the object targets the tones of the verb (the lexical head of the VP), which is in bold in the output
1024 forms. In all cases, this replacive tone cannot target past the verb, such as to post-verbal inflectional particles
1025 (49a), other verbs (49b), or auxiliary verbs (49c).
1026

(49) Replace tone from object to verb in VP cannot target beyond verb

a. féní pùlò érí té⁺é → féní pùlò **èrì** té⁺é (cf. *… pùlò **èrì tè**)
   bird oil see PERF 'the bird has seen the oil' _(Harry & Hyman 2014:670)

b. ìnà nàngà sábá → ìnà **nàngà** sábá (cf. *ìnà **nàngà sàbà**)
   them trample cross 'cross them by trampling' _(Harry 2004:88)

c. òrì ànì yé dín té⁺é → òrì ànì **yè** dín té⁺é (cf. *… ànì **yè dìn** …)
   he it do know.how PERF 'he knows how to do it' _(Jenewari 1977:519)

Comparing these data to low tone spread, we see that replacive grammatical tone exhibits the same boundary: it cannot target beyond the noun in a noun phrase or a verb in a verb phrase. This prosodic domain matching between low tone spread and replacive tone is summarized in Table 11.

Table 11: Prosodic domain matching

Structure	Low tone spread	Replacive tone
MOD NOUN (NP)	Y	Y
NOUN VERB (VP)	Y	Y
MOD NOUN VERB	Y	Y
N D/Q	N	N
VERB VERB	N	N
VERB AUX	N	N
VERB INFL	N	N

These co-extensive domains are united under our proposal: both are bound to the phonological phrase, and this phrase terminates with the lexical head.

4.5 **LHH constraints in Kalabari*

We have thus far established the triggers, targets, and domain of low tone spread. The final component of our analysis is answering exactly *why* low tone spread happens in the first place and why it is unbounded (again, why is spreading to just one vowel of the next ω-word not sufficient?). Our proposal is that LTS is a consequence of a general *LHH constraint, which prohibits a low-toned vowel followed by two high-toned vowels. Before explicating this point, let us first establish how *LHH plays a key role in the tonology of Kalabari (and indeed the Ijoid family as a whole), independent of LTS.

First, *LHH should be understood rightly as a family of constraints which reference different layers of the prosodic hierarchy. This is schematized in (50).

(50) *LHH constraint family

a. Word-level: *(V̀V́V́)ω
b. Phrase-level: *{V̀V́V́}φ
c. Inter-phrase-level: *V̀V́}φV́

The first constraint '*(V̀V́V́)ω' is a word-level constraint against *LHH (50a). This is the clearest example of *LHH, as such sequences are categorically banned within lexical tone patterns. Harry (2004) establishes the licit and illicit lexical tone patterns which appear on 3σ and 4σ lexical items, recapped in Table 12. In this table, licit patterns are not marked, marginal patterns appear with a '%' in light gray, and illicit patterns are marked with an asterisk in darker gray.

Table 12: Licit, marginal (%), and illicit (*) lexical tone patterns (3σ-4σ)[13]

3σ			4σ					
LHL	HHL	*HꜜHL	LLHL	*LHHL	*LHꜜHL	HLHL	HHHL	*HHꜜHL
%LHH	HHH	HꜜHH	*LLHH	*LHHH	*LHꜜHH	*HLHH	HHHH	*HHꜜHH
LHꜜH	HHꜜH	*HꜜHꜜH	LLHꜜH	*LHHꜜH	*LHꜜHꜜH	HLHꜜH	*HHHꜜH	*HHꜜHꜜH
LLH	HLH		LLLH	LHLH		*HLLH	HHLH	
LLL	%HLL		LLLL	%LHLL		*HLLL	%HHLL	

All cells with a LHH sequence are in bold in a checked box, all of which are either illicit or marginal. The marginal pattern %LHH appears in only two loanwords, **àkótó** 'small container' and **ègúsí** 'melon' (Harry 2004:108). These appear to be recent loanwords, the latter term being found across Nigeria as the general name for this melon dish (e.g. Yoruba **ègúsí**). For our purposes we adopt a categorical prohibition against *LHH at the word-level.[14]

The second *LHH constraint is '*{V̀V́V́}φ' (50b, above) which applies to the phonological phrase level. This manifests in several ways. First, we established that pre-nominal modifiers plus their noun (roughly the NP) and objects plus their verb (roughly the VP) form a single φ-phrase (Table 10 above). Such φ-phrases conspire to avoid LHH sequences. As established, pre-nominal modifiers assign one of four replacive grammatical tone patterns (§2.3), regardless of their own tone. This is recapped in Table 13. While HL, HꜜH, L, and LH replacive patterns are all attested, conspicuously missing are cases of a low-toned modifier assigning a H replacive tone. This would result in the illicit {V̀V́V́}φ sequence.

Table 13: Lack of H replacive grammatical tone pattern

tùbò̩ + ⇒HL	ìnà + ⇒HꜜH~HLH	tò̩ + ⇒LH	jà + ⇒L	Cf.	*… + ⇒H
'the child's __'	'their __'		'which __'	'some __'	

*LHH sequences at the phrase level are thus rare, and arise only occasionally, in three primary contexts. For each of these contexts, however, the derived LHH sequence is optionally or obligatorily altered. One context is with pre-nominal low-toned modifiers **mà** 'two' and **ò̩pù** 'big, which do not consistently assign a replacive grammatical tone. When they appear before high-toned nouns, this may result in a LHH sequence. However, such context show two surface pronunciations (51): one which allows the all high-toned noun to surface as such (in violation of *{V̀V́V́}φ), and another which has an all low pattern. For the modifier **mà** 'two' (51a), we might attribute this to a variable L replacive grammatical tone. Many other numerals have this replacive pattern, and nouns of all lexical tone patterns can undergo lowering (e.g. **wáꜜrí̩** → [**wàrì̩**], as indicated). However, this is not a possible explanation for the other modifier **ò̩pù** 'big' (51b), where only all-H nouns are affected. Unlike with **mà**, other lexical tone patterns show no alternation here.

(51)   Derived {V̀V́V́}φ sequences with pre-nominal modifier (Harry & Hyman 2014:657-658)
    a.   mà   féní   → {mà féní}φ   → [mà féní] ~ [mà **fènì**]
        two   bird   'two birds'
        (cf. [mà wáꜜrí̩] ~ [mà **wàrì̩**] 'two houses')
    b.   ò̩pù   féní   → {ò̩pù féní}φ   → [ò̩pù féní] ~ [ò̩pù **fènì**]
        big   bird   'big bird'
        (cf. [ò̩pù wáꜜrí̩], but *[ò̩pù **wàrì̩**] 'big house')

---

[13] LLHH 4σ words are marked as illicit because the only instances are reduplicants, e.g. **lò̩kò̩ló̩kó̩** 'prosperous' (30a). Additionally, all 4σ patterns which begin with HꜜH are unattested, not shown in this table.

[14] Harry (2004) unites this *LHH restriction and an additional HLL gap also apparent in Table 12, via a right-to-left association algorithm that generates the acceptable tonal outputs for Kalabari words. This connection appears to hold only at the word-level; there is no comparable restriction on HLL at the phrase-level (as demonstrated by the lack of a counterpart 'high tone spread', in 10).

A second context where LHH comes up is with possession-compound constructions. This happens when the possessor NP has underlying LH tones and assigns a HL replacive pattern (again, see Table 5). Here, too, there are two surface pronunciations (52): the LH trigger (the possessor) may either surface as [LH], or lose its final high tone and surface as [LL] (i.e. **èkpé** → [**èkpè**]). Superficially, this resembles the H-absorption pattern seen in LTS.

(52)   Derived {V̀V́V́}φ sequences in a possession-compound construction
        èkpé   ⇒HL   námá   →   {èkpé **námà**}φ   →   [èkpé námà] ~ [**èkpè** námà]
        he-goat   meat   'he goat's meat'   (Harry & Hyman 2014:686)

Finally, in [OBJECT VERB] VP constructions the final tone of the object spreads and replaces the verb tone. Thus, if the object bears lexical LH tones, its H tone spreads rightward and results in a derived LHH sequence. However, in this construction a downstep must be inserted between the LH object and the all-H verb (53), seemingly to repair the *LHH violation that has been created (i.e. LH#H → [LH#⁺H]).

(53)   Derived {V̀V́V́}φ sequences in a verb phrase
        ò̩   kúkàlí   sè̩lé̩   té̩⁺é̩   →   {ò̩ kúkàlí **sé̩lé̩**}φ té̩⁺é̩   →   [ò̩ kúkàlí ⁺**sé̩lé̩** té̩⁺é̩]
        he   fruit   choose   PERF   'he has chosen the fruit'   (Harry & Hyman 2014:668)

Let us now examine the last constraint of the *LHH family from (50c): the constraint *V̀V́}φV́, which applies *across* a phrase boundary, rather than *within* a phrase. Such sequences are very common and are derived whenever a phrase ends in a LH and is followed by a high tone outside of the phrase. In such inter-phrasal contexts, these structures are repaired by the insertion of a downstep; no repairs involving tone lowering of either the target or the trigger are permitted. Representative inter-phrase examples are below, involving nouns plus determiners/quantifiers (54a), verbs in series (54b), verbs followed by auxiliaries (54c) or inflectional particles (54d), and subjects followed by a verb phrase (54e). The relevant φ-boundary is in bold, as is the LH sequence before it and the H tone after it.

(54)   Downstep insertion to repair *V̀V́}φV́ violations in inter-phrase contexts
        a.   …NOUN}φ D/Q…   (Harry & Hyman 2014)
              gàrí̩}φ mé̩   →   [gàrí̩ ⁺mé̩]   'the *garri* flour'   (p. 663)
              gàrí̩}φ mámgbà   →   [gàrí̩ ⁺mámgbà]   'all *garri* flour'   (p. 663)
              mí̩ **nàmá}φ mámgbà**   →   [mí̩ **nàmá** ⁺mámgbà]   'all the animals' house'   (p. 665)
        b.   …VERB}φ VERB…
              bì̩là}φ   má}φ   **dì̩sé̩}φ sábá̩}φ** árì̩   →   [bì̩là má **dì̩sé̩** ⁺**sábá̩** árì̩]
              elephant   the.PL   sneeze   cross   CONT   'the elephants are sneezing over'
        c.   …VERB}φ AUX…
              ǹ   **dì̩sé̩}φ dín}φ**   ⁺ḿ   →   [ǹ **dì̩sé̩** ⁺**dín** ⁺ḿ]
              they   sneeze know.how   FAC   'they know how to sneeze'
        d.   …VERB}φ INFL…
              námá}φ   **sè̩lé̩}φ**   té̩⁺é̩   →   [námá **sè̩lé̩** ⁺té̩⁺é̩]
              meat   be.chosen   PERF   'the meat has been chosen'   (Harry & Hyman 2014:668)
        e.   …SUBJECT}φ VP…
              ò̩dò̩dó}φ   **fú̩n**   sé̩lé̩}φ té̩⁺é̩   →   [ò̩dò̩dó ⁺**fú̩n** sé̩lé̩ té̩⁺é̩]
              snake   salt   choose   PERF   'the snake has chosen salt'

The fact that downstep is used as a repair makes it clear that sequences of LH⁺H do not violate any of the *LHH constraints (see Footnote 15 below for additional commentary on downstep).

To summarize, several pieces of evidence converge on the general markedness of LHH sequences in Kalabari, which we have formalized as a family of *LHH constraints prohibiting a low-toned vowel followed by two high-toned vowels. How individual *LHH constraints manifest depend on the prosodic

29

1151 constituent and grammatical context, summarized in Table 14. Each of these contexts has a specific repair,
1152 and other logically possible repair strategies are not possible.

1153

1154 Table 14: Summary of *LHH restrictions (location of change is in bold and underlined)

Locus of *LHH violation	Repair	Schema		
Within word	Systematic gap	*(V̀V́V́)ω		
Within phrase (**mà** 'two', **òpù** 'big')	Target lowering	{(V̀)(V́V́)}φ	→	{(V̀)(**V̀V̀**)}φ
Within phrase (possession-compound construction)	Trigger lowering	{(V̀V́)(V́…)}φ	→	{(V̀**V̀**)(V́…)}φ
Within phrase (verb phrase)	Downstep insertion	{(V̀V́)(V́…)}φ	→	{(V̀V́)(**⁺V́**…)}φ
Across phrase boundary	Downstep insertion	V̀V́}φV́…	→	V̀V́}φ**⁺V́**…

1155

1156 As a final note, *LHH effects are typologically common (Hyman & Schuh 1974:98), and they are often
1157 repaired by spreading, but much less commonly by downstep insertion. Similar *LHH restrictions are found
1158 in other Ijoid languages as well, such as Izon varieties Kolokuma (Williamson & Timitimi 1983) and
1159 Gbarain (Rolle 2021). To a lesser extent, they are also present in a nearby non-Ijoid language Degema [deg]
1160 (Kari 2004, Rolle & Kari 2022), which has been significantly influenced by Kalabari.

1161 **4.6** *Low tone spread as a response to *LHH*

1162 Now that we have established the *LHH family of constraints and the ways they manifest within Kalabari
1163 tonology, let us connect it to our central focus: pronominal clitics and low tone spread. Recall from §4.3
1164 that unlike lexical nouns, pronominal clitics in subject position do not form their own φ-phrase, and instead
1165 belong to the following φ-phrase. This prosodic parsing is repeated in (55).

1166
1167 (55) **ò** b̩úrúmá sé̩lé̩ té̩⁺é̩ → {**ò** (b̩ùrùmà)ω (sè̩lè̩)ω}φ (té̩⁺é̩)ω
1168 he indigo choose PERF 'he has chosen indigo'

1169

1170 The V̀-clitic **ò̩** here has low tone and the following word or words have high tone. Since these belong to the
1171 same phrase, this prosodic parsing incurs new violations of the *LHH constraint *{V̀V́V́}φ which prohibits
1172 phrase-level LHH sequences (50b above). Our main contention is that low tone spread applies as a repair
1173 to these new LHH sequences.
1174 Let us walk through these final parts of our analysis. As established, V̀-clitics do not form separate ω-
1175 words, and thus they violate the constraint T-to-ω which requires all tones to associate to a vowel within a
1176 word (§4.2). Consequently, its low tone must tonally incorporate into the following ω. This component of
1177 the derivation is illustrated in Figure 16, where tone spreading is indicated with the checked line.

1178
1179 Figure 16: Tone of V̀-clitic tonally incorporates into following ω (due to T-to-ω)

1180
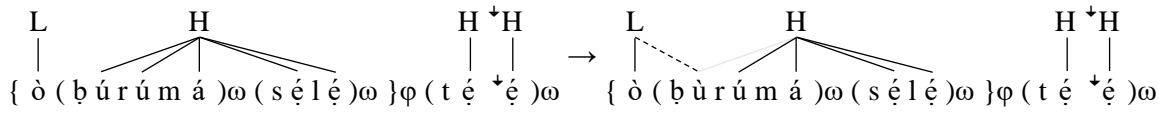
1181 Here, we see *LHH violations at both the ω-level and the φ-level. In response, LTS applies. Recall that
1182 there are two surface LTS patterns. In LTS patterns which exhibit only H-compression, low spreads to all
1183 high-toned vowels but one (Figure 17). This complies with the within-phrase constraint *{V̀V́V́}φ but ends
1184 up creating new across-phrase *V̀V́}φV́ violations. This must be repaired via downstep insertion (indicated

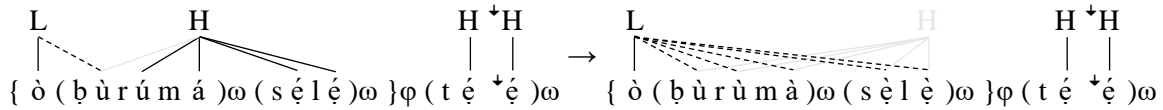1185 by the checked box in this figure). As summarized in Table 14, downstep insertion is the only possible
1186 repair for *LHH violations across a φ-phrase boundary.
1187

1188   Figure 17: LTS (H-compression) – Complies with *{V̀V́V́}φ, but creates new *V̀V́}φV́ violation

L   H ⁺H   L   H   ⁺H ⁺H

{ ò (b̩ ù r ú m á)ω (s é l é̩)ω }φ (t é̩ ⁺é̩)ω → { ò (b̩ ù r ù m à)ω (s è̩ l é̩)ω }φ (t é̩ ⁺é̩)ω

1189
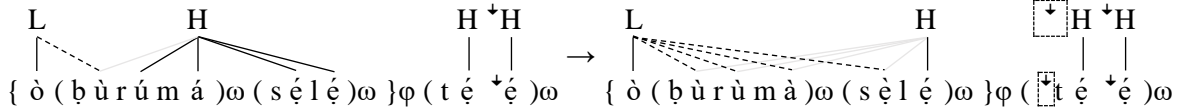
1190   In the other LTS pattern, H-absorption is exhibited as well whereby low spreads to all highs in the φ-
1191 domain (Figure 18). As established, this is only possible before another domain-external H. This complies
1192 with *V̀V́}φV́ but leaves no trace of the underlying H.
1193

1194   Figure 18: LTS (H-absorption) – Complies with *V̀V́}φV́

L   H ⁺H   L   H   H ⁺H

{ ò (b̩ ù r ú m á)ω (s é l é̩)ω }φ (t é̩ ⁺é̩)ω   { ò (b̩ ù r ù m à)ω (s è̩ l è̩)ω }φ (t é̩ ⁺é̩)ω

1195

1196   Data such as these involving multi-word targets provides crucial evidence that phrase-level *{V̀V́V́}φ
1197 is involved in LTS, not merely word-level *(V̀V́V́)ω. If the only relevant constraint were *(V̀V́V́)ω, then
1198 we would have expected spreading to terminate at the word boundary – i.e. *{ò (b̩ùrùmà)ω (sélé)ω}φ
1199 (té⁺é)ω – contrary to fact. LTS thus should be added to the list of repairs in Table 14, being most similar to
1200 the 'trigger lowering' repair in possession-compound constructions (i.e. where (V̀V́)(V́V̀) →
1201 [(V̀**V̀**)(V́V̀)]).[15]

1202 **4.7**   *Why does LTS not apply in other contexts?*

1203 Finally, recall that *all* pronominal clitics do not form their own φ-phrase, both pre-consonantal V̀-clitics
1204 such as **ò** 'he' in (55) above, but also their pre-vocalic counterparts such as **òrì** 'he' in (56) below. As
1205 indicated by the prosodic parsing in this example, clitics like **òrì** *do* form their own ω-word but belong to
1206 the following φ-phrase. However, unlike with V̀-clitics, LTS is not possible here.
1207

---

[15] There is one context where LTS applies which still requires an explanation: in contexts of lexical downstep.
Consider an example repeated in (v), where the V̀-clitic **à** 'I' spreads but leaves one high tone before the downstepped
high (the preferred form), but has an additional pronunciation where it spreads to all highs before the downstep (a
questionable form, but not ungrammatical).
    (v)   **à**   [b̩éké⁺ké   é̩rí]VP   té⁺é̩   →   {**à b̩èké⁺ké é̩rí**}φ té⁺é̩ ~ ?{**à b̩èkèké** … }φ
        I   chin   see   PERF   'I have seen a chin'
We have already established that the correct interpretation of *LHH is a low-toned vowel followed by two high-toned
vowels. This specifically does *not* include downstep, as evidenced by the fact that /LH⁺H/ lexical word patterns are
common (Table 12; cf. */LHH/), and that downstep insertion can be in fact a repair for *LHH violations. In short,
why does LTS seem to be able to 'overapply' here?
    Tentatively, we may assume that the same H-absorption rule applies here. In order to accommodate these
downstepping data, we may assume that what H-absorption is sensitive to is another H tone on the tonal tier. All
contiguous strings of high-toned vowels within a phrase are associated to only one H toneme (invoking some merger
operation). In contrast, contiguous strings of high-toned vowels *across* a phrase boundary constitute separate H
tonemes on the tonal tier (the merger operation alluded to cannot apply). Downstep would necessarily also involve
multiple H tonemes, within or across phrases. Viewing this together, H-absorption would apply both before phrase-
external H's as well as phrase-internal ⁺Hs, both of which would constitute separate H tonemes.

1208 (56) **òrì** íkírí mà ḅó árì̀ → {(**òrì**)ω (íkírí)ω (mà)ω}φ {(ḅó)ω}φ (árì̀)ω
1209 he creep MAN come CONT 'he comes creeping'

1211 Based on our analysis, this fact requires explanation. If *{V̀V́V́}φ militates against phrase-level LHH
1212 sequences, and if the structure in (56) constitutes a single φ-phrase, then why is LTS not possible here? In
1213 short, why does the low tone of **òrì** 'he' also not spread, i.e. *{(**òrì**)ω (**ìkì**rí)ω …}φ?
1214   Intuitively, we may understand LTS as due to a kind of 'chain reaction': if the tone of prosodically
1215 deficient V̀-clitics spreads to the following word (due to T-to-ω), it may thereafter spread unboundedly to
1216 all highs in the phrase (due to *{V̀V́V́}φ). Pronominal clitics like **òrì** are not subject to T-to-ω, as they form
1217 their own ω-word. The absence of this initial step results in no spreading at all, even in comparable
1218 environments which incur phrase-level violations.
1219   This constitutes a kind of phonologically derived environment effect (Inkelas 2014, *inter alia*).
1220 Phonologically derived environment effects arise when a new phonological environment is created due to
1221 some phonological operation, after which other phonological operations may take place. Crucially, these
1222 latter operations do *not* take place without the new phonological environment being created first. A common
1223 example comes from Finnish (57, as presented in Inkelas 2014:251-252), where in certain derived
1224 environments a palatalization process applies whereby /t+i/ → [si]. One context where we see this derived
1225 palatalization process is following another phonological process whereby /e/ becomes [i] word finally.

1227 (57) Phonologically derived environment effect in Finnish
1228   Underlying 'e→i' 't→s'
1229   /vete/ 'water' → veti → [vesi] (cf. [vete-] when suffixed)

1231 Here, the application of the 't→s' rule is parasitic on the application of the 'e→i' rule first (hence our 'chain
1232 reaction' analogy). We can compare this to non-derived phonological environments where palatalization
1233 does not occur, e.g. in **æiti** 'mother' (Inkelas 2014:243). In monomorphemic contexts, the 'e→i' rule is
1234 inapplicable.[16]
1235   In Kalabari, a similar parasitic relationship is evident. It is only if the low tone tonally incorporates into
1236 the following word (due to T-to-ω) that LTS can apply to the right edge of the phrase (due to *{V̀V́V́}φ).
1237 This is shown in (58). Contexts with words such as the clitic **òrì** 'he' do not violate T-to-ω and are therefore
1238 not subject to *{V̀V́V́}φ.

1240 (58) Kalabari LTS as a phonologically derived environment effect
1241   Underlying T-to-ω *{V̀V́V́}φ
1242 a. **ò** ḅúrúmá sélé̞ → **ò** ḅ**ù**rúmá sélé̞ → **ò** ḅ**ùrùmà** sè̞lé̞
1243 b. **òrì** íkírí → *does not apply* → *does not apply* (***òrì ìkì**rí)

1245 In short, for *{V̀V́V́}φ appears to result in LTS only to derived environments, and cannot otherwise apply.[17]

1246 ## 5   Conclusion

1247 This paper has shown that certain pronominal clitics in Kalabari trigger a process of unbounded low tone
1248 spread whereby a string of contiguous high tones become low. A canonical example is in (59).

---

[16] These Finnish data are more complicated than presented here, and alternative analyses exist (e.g. Nie 2018, who treats such data as lexical exceptions to prosodically conditioned assibilation). The logic of phonologically derived environment effects remains, regardless of the validity of this Finnish exemplar.
[17] It is unclear at this point if the target lowering and trigger lowering identified for certain phrases in §4.5 should be interpreted as LTS, and if so, whether this contradicts the notion that LTS only applies to phonologically derived environments. Future study is required.

1250 (59) **à** féní séḷé tẹ́⁺ẹ́ → [à **fènì sẹ̀ḷẹ̀** tẹ́⁺ẹ́] (cf. dispreferred [à féní séḷé tẹ́⁺ẹ́])
1251   I bird choose PERF   'I have chosen a bird'

1252

1253 We have shown that the only triggering clitics are low-toned, monosyllabic, and onsetless clitics, and that
1254 the target must be a string of high tones. Our analysis of these patterns involved prosodic constituency
1255 coupled with word- and phrase-level tonotactics. The V̀-clitics which trigger low tone spread were analyzed
1256 as prosodically deficient (they would be 'sub-minimal' words), which need to be tonally incorporated into
1257 the following prosodic domain. If all high tones follow the trigger, then its incorporation violates a
1258 tonotactic restriction against LHH sequences. To repair the *LHH violation, unbounded low tone spread
1259 takes place within the phonological phrase. We have provided ample independent evidence for *LHH
1260 tonotactics applying at different levels of the prosodic hierarchy, as well as independent evidence for the
1261 precise prosodic constituents of our analysis (what we called 'prosodic domain matching'). In total, our
1262 study has shown that tone spread can profitably be decomposed into several sub-operations, which are
1263 triggered by multiple interacting factors involving word-minimality, prosodic constituency, and tonotactics.

1264 **Glossing**

1265 • CONT   continuous aspect
1266 • COP   copula
1267 • D   general determiner
1268 • F   feminine
1269 • FAC   factative aspect (≈ perfective/completive)
1270 • FUT   future tense
1271 • M   masculine
1272 • MAN   manner adverbial maker
1273 • NEG   negative polarity
1274 • P   particle
1275 • PERF   perfect aspect
1276 • PL   plural
1277 • Q   question
1278 • REDUP   reduplication
1279 • RHET   rhetorical
1280 • RP   resumptive pronoun
1281 • SBJV   subjunctive
1282 • SG   singular

1283 **Symbols**

1284 • H   high tone
1285 • M   mid tone
1286 • L   low tone
1287 • Ⓗ   floating high tone
1288 • Ⓛ   floating low tone
1289 • ⁺   downstep
1290 • σ   syllable
1291 • ω   phonological word (ω-word)
1292 • φ   phonological phrase (φ-phrase)
1293 • ι   intonational phrase (ι-phrase)

Abbreviations

- ADV   adverb
- ATR   advanced tongue root
- AUX   auxiliary
- C   consonant
- CFM   clause-final marker
- D   determiner
- INFL   inflectional tense/aspect/mood/polarity particles
- LTS   low tone spread
- MOD   nominal modifier
- NP   noun phrase
- Q   quantifier
- V   vowel
- VP   verb phrase

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