Ga imperatives and Richness of the Base*

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Abstract

This paper proposes a solution to a Richness of the Base problem that is inherent in the morpho-tonology of Gã verbs to which the imperative morpheme i.e. a floating high tone (plus sometimes, a segmental -mɔ́) suffix is attached. Generally, this morphophonological process suggests that there is an asymmetry between surface low-toned monosyllabic stems but not bisyllabic stems, in the language. A rule-based account by Paster (2000) leads to a verb inventory that excludes the existence of underlying low-toned bisyllabic verb stems in Gã contra earlier observations e.g. Wentum (1997). However given the Richness of the Base hypothesis in Optimality Theory, this is a problem. I argue and show that the missing bisyllabic verb stem contrast can be derived via a contraint ranking schema which forces both underlyingly low-toned and toneless bisyllabic stems to behave in a similar manner on the surface although it preserves the contrast in monosyllablic stems of similar tonal shapes.

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1 Introduction

Gã (Kwa, Niger-Congo) is a highly tonal language. A common problem that was observed in earlier works on the phonology of the language e.g. (Okunor, 1969) is that, some verbs which surface as low toned, behave differently from verbs of similar tone shapes with respect to certain tense-aspect morphophonological processes. The most recent approaches to explaining this problem i.e. Paster (2000), and Kropp Dakubu (2002), postulate that some of these stems are either toneless (Paster) or underspecified (Kropp Dakubu), and according to Paster, this is consistent with what obtains in other languages where an underlyingly three-way tonal contrast of L, H and toneless is realized on the surface as simply L and H, with the toneless stems, surfacing as L by default; see also Yip (2002).[1] For Gã, Paster's proposal is insightful. She provides a rule-based account for the surface irregularities. One of the core arguments for the L-toned and toneless verb stems distinction in Gã she argues, relies primarily on the behaviour of surface L-toned monosyllablic verb stems in the context of the singular imperative suffix, which is realized by at least a floating H tone.

But from an Optimality Theoretic (OT) perspective Prince & Smolensky (2004), there still remain some unresolved issues. The rule-based account fails to account for why there is no contrast between surface bisyllabic toneless stems, and LL stems, as there is for monosyllabic stems. In fact Paster mentions the bisyllabic LL pattern as one of the missing tone patterns. This brings to the fore a Richness of the Base (RotB) problem Prince & Smolensky (1993);

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[1] I will use the following notation in this paper: H = high tone, L = low tones, $\widehat{\mathrm{HL}}$ = high-low contour, $\widehat{\mathrm{LH}}$ = low-high contour (except $\widehat{\mathrm{LH}}$, I will mark them as (́), (̀), (̂) respectively on segments), μ = mora, σ = syllable, $^{!}$= downstep. I will mark no tone on underspecified or toneless segments. ⊖ = floating tone in input.

Smolensky (1996). And given the importance of RotB hypothesis in OT, and the advantages of constraint-based approaches over rule-based accounts in phonology e.g. Pater (1999, 2001), this problem cannot be overlooked.[2] In this paper, I provide an analysis that derives the apparent LL tonal pattern in Ga within parallel OT Prince & Smolensky (2004). My analysis relies basically on the same facts and data as Paster's.

The remainder of the paper is structured as follow: In section 2, I will provide a general background to the morpho- tonology of the relevant Gã verb paradigms. Section 3 discusses the relevant OT constraints and how they are motivated in Gã. Section 4 shows how the various surface forms are derived. I conclude with a summary in section 5.

2 Empirical background

2.1 Tones and tone-bearing units in Gã

Gã has two level tones: H and L. (1) exemplifies the phonemic status of tones in the language.

(1)

Tone	**Verb**	**Noun**
a. L	bé 'quarrel'	wù 'husband'
b. H	bè 'be cooked'	wú 'bone'

In various phonological and syntax-discourse contexts, these tones may manifest in different forms e.g. show signs of a downstep, (or downdrift), contour (H͡L/ L͡H) formation etc. The occurence of H tones is relatively restricted as compared to L tones (Kropp Dakubu, 2002). In fact there are strings of phonological units which may have no H atall such as (2).

(2) nũ̀ũ̀ àg͡bò kò bànã̀ wɔ̀ ɲɛ̀. (Kropp Dakubu, 2002, 10)
'A certain big man came and saw us yesterday.'

That Gã has H and L as the two underlying tones is uncontroversial as far as recent literature is concerned. Instead, there seems to be no consensus as to what the tone-bearing unit (TBU) is, in the language i.e. whether it is the syllable or the mora. I will briefly discuss this and a few other tonal phenomena which impact the purpose of this paper.

The basic syllable structures in Gã are V and CV (Kropp Dakubu, 2002), where C and V refer to consonant and vowel respectively. But there are also a few words which have syllabic consonants. Every vowel and syllabic consonant bears a tone (at least on the surface). Thus some authors e.g. Kropp Dakubu (2002); Wentum (1997), consider the syllable as the TBU. Following Paster (2000) however, I assume in this paper that the mora is the TBU in Gã. For instance in (3), the affixation of the future negative marker i.e. -ŋ, causes the stem vowels to shorten, because it occurs at a coda position and thus moraic. Significantly, it appears that the tone of the elided vowel is hosted by the moraic coda. It is thus reasonable to assume that this coda mora is a TBU, and by extention, all morae bear tones in Gã. Thus I assume the structure

(3)

Stem	Future negative	
a. / ʧɔ̀**ɔ̂**/ 'show'	é-[**ʧɔ́ꜜŋ́**] g͡b**é**ꜜkɛ́ lɛ́	'He won't teach the child'
b. /p**î** /'suffer'	e-[**píꜜŋ́**] g͡b**é**ꜜkɛ́ lɛ́	'He won't cause the child to suffer'

in (4-a) to be the underlying structure for syllables in Ga (where T = tone). The representation in (4-b) accounts for situations where a syllable has only one mora. Here, no surface distinction can be made between the syllable or the mora as the TBU given that they are equivalent. The structure in (4-b) is the commonest syllable structure in Ga, accounting for the words like *kàtà*

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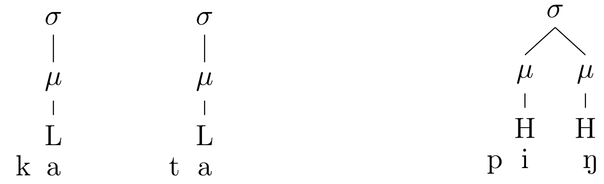
[2] Here I make specific reference to the issue of "consipiracies" in phonology.

‘to lift up’ in (5-a). *píꜝŋ́* ‘suffer’ in (3-b) thus exemplifies a two-mora syllable, and may be represented as in (5-b). I would refer an interested reader to Paster’s work for further empirical evidence in support of the the claim that the mora is the TBU in Ga.

(4) *Basic syllable structure vis TBU*

(5) a. *kàtà* b. *hòó*



2.2 Floating tones

Though on the surface, tones are typically associated with segments, there are a number of important tones in the phonology of Gã which are not associated to any particular TBU underlyingly. Many tense-aspect-mood and polarity (TAMP) paradigm marking morphemes involve one floating tone or another (Paster, 2003). A few are summarised in (6) (where – indicates where the stem occurs). Some of the floating tones/affixes above are prefixes e.g.(6-a,b) some are circumfixes e.g. (6-d,e), and others are suffixes e.g. (6-c,f).

(6) *A sample TAMP morphemes with floating tones*[3]

TAMP	Tone	Example	
a. Simple Past	L–	è–bò	‘he shouted’
b. Perfective	H–	é–bò	‘he has shouted’
c. Habitual	–L	è–bò–ɔ̀	‘he shouts’
d. Generic Negative	é–HH͡L	é–bóóô	bé ‘he doesn’t shout’
e. Negative Future	é–Hŋ́	é–bóŋ́	‘he won’t shout’
f. Imperative	–H	bòó	‘shout!’

As may be obvious from the accompanying examples, the forms as presented in (6) are a rather simplified version of a more complex morpho-tonology situation in Gã . The discussions in this paper focus on the imperative affix; but I will occasionally refer to the generic negative affix.

2.3 Toneless segments

Just as there are floating tones (i.e. tones without underlying segments) in Gã, there are also several segments of words in the language whose tones cannot be stated in terms of the established level or contour tones. Kropp Dakubu (2002) describes these as ’underspecified’. In (7) for instance, the tone on the final mora of the verb *káe* ‘remember’ depends on the tone of the immediately succeeding TBU. Again, toneless TBUs are particularly apparent in the interaction of tones in the marking of certain tense and aspect paradigms. Paster (2000, 2003) would refer to TBUs such as the final vowel of ká**e** in (7) as **toneless**.

(7) *Toneless/underspecified segements*

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[3] Note that some floating tones (or morphemes) have segmental parts.

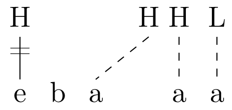
a. Kofi [**káè**] **À**dò ‘Kofi remembered Ado’ ⍰ → L /–LL
b. Kofi [**káé**] **Á**kú ‘Kofi remembered Aku’ ⍰ → H /–HH
c. Kofi [**káè**] **Ò**tú ‘Kofi remembered Otu’ ⍰ → L /–LH

With regard to L tones in particular, Paster (2000) provides two main tests for ascertaining whether a surface L tone of a verb stem is also underlyingly L or toneless, since as in many tone languages, either surface as L (Yip, 2002). One of the tests relies on the interaction of surface L-toned or toneless verbs with the third person singular subject prefix (SP) **e-**, and the generic negative marker as exemplified in (8). Note that the SP is toneless, in the sense of what has been described for (7); its tonal specification depends on the tone of the surrounding TBU.

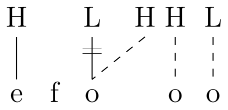
(8) a. /**ba**/ ’come’ [**è-bá**-áâ] ’He didn’t come. (SP surfaces as L)
b. /**fò**// ’cut’ [**é-$^{!}$fó**-óô] ’He didn’t cut.’ (SP surfaces as H)
c. /lá/ ’sing’ [è-lá-áâ] ’He didn’t sing.’ (SP surfaces as L)

In (8), it must also be noted that the generic negative marker is a sort of discontinuous morpheme i.e a circumfix, with **é-** as prefix. Here, it is not absolutely clear whether the segmental part of the morpheme replaces the SP with which it is homophonous, but certainly, the surface tone of the SP interacts with this prefix. Paster (2000, 2003) assumes that in such configurations, the morphemic prefix readily replaces the SP (or one can assume that the tone is replaced by the more specific one of the morpheme). In (8), **e-** therefore at some points starts out with a H tone. The crucial difference between the two surface L-toned stems (8-a-b) (recall that (8-a) will also surface as L) is demonstrated by whether they deassociate an underlyingly L tone, which would lead to a downstep between two H tones, or not. We see an illustration in (9) and (10) where (9) represents (8-a) and (10) represents (8-b).

(9) CV toneless (SP=L, downstep on stem)



(10) CV L (SP=H, downstep on stem)



The idea is that the SP in (10) which has an underlyingly L stem verb maintains the H whereas in (9) where the stem is underlyingly toneless, the prefix loses the H. This is because the former delinks the L which leads to a downstep between the SP and the TBU (now) verb stem H, and thereby avoiding a kind of Ocp-H (which Paster calls ‘Polarity’) violation. If this were not the case, it would have led to a delinking of the H on the prefix **e-** as in (9). In (9), it is this lack of an intervening (delinked) L which causes the H on the prefix to be delinked leading to a surface L, given that there is a H spread unto the stem. Throughout this paper, this will be the working definition of downstep i.e. the context in which a floating L tone intervenes between two H tones.

The second major test for the L-toned-toneless distinction involves the suffixation of a floating H which marks imperative. Paster shows that L-tone stems yield to the Rising Tone Lengthening rule (see (11-b)) while toneless monosyllabic stems do not.[4] Essentially this rule inserts a mora to host the imperative H while in the case of the toneless surface L verbs, the suffix simply associates and thus (11-a) surfaces with a H while (11-b) surfaces as LH. We will discuss the imperative marking in later sections of this paper.

(11) *Imperative marking on monosyllabic stems*
a. /**ba**/ ‘come’ [**bá**] ‘Come !’ ☐ →H
b. **fò** ‘cut’ [**fòó**] ‘Cut !’ L →LH
c. /lá/ ’sing’ [lá] ‘Sing !’ H →H

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[4] The imperative suffix also has a segmental part. I talk more about this in the next section.

2.4 Contour tones and vowel length

In many languages, vowel length, and contour tones are restricted to certain positions (Yip, 1989; Zhang, 2004), an observation dating back to Goldsmith (1976). In Gã, H͡L contour is typically found at the right edge of a phonological phrase e.g. *hê* 'buy' and *wiê* 'talk', and it becomes H in phrase-medial positions. In addition, it never occurs with long vowels or at the initial syllable of a polysyllabic stems. L͡H contours on the other hand never occur with stems with short vowels (or one mora). As a result, when H attaches to L, it may result in the short vowel lengthening e.g. *hɔ̀*+H → *hɔ̀ɔ́* and not **hɔ̌* 'braid!'. Paster (2000) accounts for this with the 'Rising Tone Lengthening' rule which essentially inserts a mora to host the H tone morpheme. The place of contour tones in Gã phonology is crucial for any contraint-based account that deals with tones in the language.

A number of verb stems appear to have surface long vowels. Many of such stems have a final contour tone e.g. *fèê* 'do', *sàâ* 'repair' and *bɛ̀ɛ̂* 'sweep'. As the examples suggest, such verbs usually occur in a CVV shape. I will treat verbs of this shape as bisyllabic i.e. CV.V.

2.5 Marking imperatives

2.5.1 Surface morphophonology

As indicated in section 2.2, the (singular) imperative in Gá is marked by a suffix comprising two phonological unit: a floating **H** tone and segmental part **-mɔ́** (note that it also has a H tone). However both units of the morpheme are not realized on all verb stems. The verb stems given under Stem in (12), are the citation forms i.e. without contexts. The generalization is that bisyllabic stems (12-d-i) realize both units of the suffix on the stem while monosyllabic stems (12-a-c) tend to realize only the H tone. Thus (12-d) is possibly underlyingly bisyllabic which makes it possible for it realize the *-mɔ́* part of the affix as well. I am not aware of any proposal that adequately accounts for this phenomenon, and I do not intend to do so in this paper.

(12) *Stem citation plus imperative*

Stem	Imperative	Example	
a. **L**	**H**	**bà↔bá**	'come'
b. **L**	**LH**	**fò↔fòó**	'cut'
c. H	H	lá↔ lá	'sing'
d. H͡L	H	hê↔hé-mɔ́	'buy'
e. L.H	L.H	kòʤó↔kòʤó-mɔ́	'judge'
f. **L.L**	**H.H**	**kàtà↔kátá-mɔ́**	'hand-lift'
g. H.H	H.H	fíté ↔fíꜝté-mɔ́	'destroy'
h. H.ꜝH	H.ꜝH	káꜝné↔káꜝné-mɔ́	'read'
i. L.H͡L	L.H	fèê↔fèé-ꜝmɔ́	'do'

2.5.2 Low tone asymmetry

An interesting aspect of the paradigms in (12) is the asymmetry between (12-a) and (12-b). We observe that two surface low-toned monosyllabic stems realize the imperative H tone differently: (12-b) maintains the original L tone but then there is (what may be described as) a copy of the stem vowel to which the imperative suffix is attached. In (12-a) on the other hand, the original L tone is lost in the imperative form. Thus for the L-toned monosyllabic stems, we have either L↔LH or L↔H on the surface for monosyallabic stems. When we consider their bisyllabic counterpart in (12-f) however, we do not (readily) find a similar contrast of either L.L↔L.LH or L.L↔H.H; we have only the latter option. The asymmetry in the monosyllabic stems has been reported in the literature since Okunor (1969), and more recently, Paster (2000) has proferred a solution. The analysis to be pursued in this paper builds on that of Paster's. In the next section, we will (re-)consider Paster's proposal, and later proceed with an alternative proposal from the perspective of OT, all aimed at giving a systematic account of the afore-mentioned problem.

2.6 Section summary

Thus far, we have made the following observations about Gã morpho-tonology: There is basically H and L, and the TBU is the mora. There is toneless segments which on the surface cannot be distinguished from L tones, and there is floating tones. There is downstep when the L of a HLH tone sequence is dessaciated. There is also two main types of contour tones: $\widehat{\text{HL}}$ (which become H in word-medially) and $\widehat{\text{LH}}$ which never occur on one mora. Crucially, we have also seen that toneless and L-toned monosyllabic verbs show surface differences with respect to the marking of the imperative.

3 Accounting for the Low-tone asymmetry

3.1 Paster's account

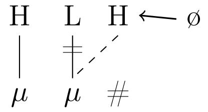
While discussing the tonal processes that are affected by TAMP marking on Gã verbs, Paster (2000) comes up with a verb stem inventory for Gã. In (13), I have presented the relevant paradigms (compared with (12)). In her summary paragraph, she says: "The following gaps and asymmetries are observed:...There apparently are also no verbs of the type CV LHL, **CVCV L**, or CVCV LHL.". I take the CVCV L to be the same as CVCV LL.

(13) *Ga verb stem inventory* (Paster, 2000, 9)[5]

Stem	Example	
a. **CV toneless**	**e-ba**	'he came'
b. **CV L**	**e-fo**	'he cut'[6]
c. CV H	e-lá	'he sang'
d. CV HL	e-hê	'he bought'
e. CV LH	e-màjé	'he sent'
f. **CVCV Toneless**	**e-kàtà**	'he hand-lift'
g. CVCV H	télé	'he carried on head'
h. CVCV HL	e-chá$^!$lá	'he mended'
i. CVV L HL	e-fèê	'he did'

When we compare (13) with (12), the main differences can be found in the (a) and (f) examples where the stems in (12) are L on the surface but are realized as toneless in (13), and (h) where the H$^!$H stem in (12) is rendered as H.L in (13) though the corresponding examples are equivalent. Regarding, (13-h), reference is made to the HL rule (14) in Gã, a rule which forces underlying final L tones to surface as $^!$H whenever another H precedes them as show in (15). This is a productive process in Gã (see also Dakubu (1986). For instance we see the effect of this rule in (15-a) but not (15-b) because in the latter context, there is L tone on the stem which is not the final L tone in the morphophonological string, and thus the full context for the rule's application is non-existent. Paster (2003) discusses this rule in detail.

(14) *High-Low rule*



(15) a. ká$^!$né 'read'
b. kánè wòlò 'read a book'.

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[5] In Paster's representations, only H tones are marked but I mark both here.

Crucially, Paster's categorization of the surface L of the examples in (13-b) and (13-f) as underlyingly toneless is due to their interaction with the imperative suffix as well as the SP-generic negative affix. The empirical generalization about these two patterns is presented in (16).

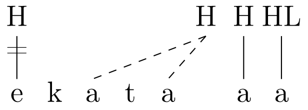
(16) *Surface L in contexts*

SURFACE L	SP-NEG	IMPERATIVE	
a. CV L	é-$^{!}$fó-óò	fò-ó !	'cut'
b. CV L	è-bá-áà	bá !	' come'
c. CV HL	è-$^{!}$ká$^{!}$n é-é è	káné-mɔ́ !	'read'
d. CV LH	é-$^{!}$kóʤó-ó ò	kòʤó-mɔ́ !	'judge'
e. CVCV LL	è-kátá-áà	kátá-mɔ́ !	'hand-lift'
f. CVV L HL	é-$^{!}$fé-éè	fèé-mɔ́ !	'do'

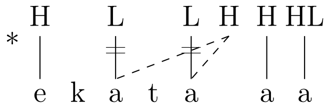
For the surface LL bisyllabic stems, the challenge that the empirical data in (16-e) poses for any alternative account to Paster's is to account for the asymmetry demonstrated by the same verb stem in both the generic negative and the imperative context, as in (17) and (18) below. As (16) shows, other stems which have their L tone deassociated under the SP-Neg test also show downstep effects.

Given that (18) is unattested, we can only conclude for now that Paster's claim about the underlying tone structure of surface LL stems in Gã i.e. as being underlyingly toneless, cannot be contested. The conceptual (and to some extent the empirical) basis of the argument in support of the generic negative test will not be pursued any further in this paper.

(17) Bisyllabic Toneless (SP=L)



(18) Bisyllabic LL (SP cannot be H)



As indicated earlier, the focus here is to tackle a problem that arises when we consider the toneless and L-toned stems asymmetry from the perspective of the imperative affixation. Based on the imperative test, no surface contrast (comparable to (17) and (18), especially since the second person imperative does not require a subject prefix) could be established for both underlyingly LL and toneless bisyllabic stems.

3.2 An OT account

The main puzzle about the underlying and surface verb stems presented in (14) remain unresolved from an Optimality Theoretic (Prince & Smolensky, 1993) perspective. There is the need to account for why there is a surface contrast between surface monosyllabic L stems but not bisyllabic L.L stems in the context of the imperative affix. As a solution, I will claim that there is actually an underlying contrast for bisyllabic surface LL stems comparable to what obtains in their monosyllabic counterparts. The non-surface true nature of this claim is attributable to a contraint ranking schema which results in an output for which the candidates which would otherwise show this asymmetry are sub-optimal and therefore never emerge as optima. In other words, both toneless and LL-toned bisyllabic stems are realized as H.H in the context of the imperative morpheme, and this is attributable to the relevant constraints interaction in Gã.

3.2.1 A Richness of the Base problem

The problem outlined above is quintessentially a Richness of the Base (RotB) (Prince & Smolensky, 1993) problem in Gã. According to the RotB hypothesis, we cannot place a restriction on inputs i.e.(underlying representations), especially when such restrictions do not preserve surface contrasts. Based on the RotB thus, we can only derive systematic surface difference by reranking constraints and not by relying on a (language) specific set of inputs.

(19) *Richness of the Base*
The source of all systematic cross-linguistic variation is constraint reranking. In particular, the set of inputs to the grammars of all languages is the same. The grammatical inventories of a language are the outputs which emerge from the grammar when it is fed the universal set of all possible inputs. (Prince & Smolensky, 1993, 191)

For the Gã phenomena we have been considering so far thus, the RotB hypothesis amounts to an assertion that it is not possible that there is no underlying bisyllabic LL stems with similar contrast as monosyllabic L stems.

3.2.2 The constraints inventory

I propose the following faithfulness (20) and markedness (22) constraints for the analysis to be pursued later on in this paper. I will discuss in turns how they are motivated in the Gã.

(20) FAITHFULNESS CONTRAINTS
   a. DEP-μ: No insertion of moras
   b. *ASSO: Do not insert association lines.
   c. *DIS: Do not delete association lines.
   d. ID-T(σ_1): Do not change any specified tone in the first syllable.
   e. MX-H: Do not delete a H tone.

DEP-μ is a specific version of a more general constraint that penalizes insertion of any sort; it bans the insertion of mora. For Gã, this is violable in the instances where a TBU is inserted in order to host a floating tone. Given that floating tones are eventually realized, a violation of *ASSO is also inevitable. It is violated whenever there is new association between a TBU and a tone whether the tone was floating and it is now associating or it is reassociating. *DIS is the mirror image of *ASSO. It ensures that already associated TBUs do not lose their association. Since Gã sometimes inserts a mora in order to get the right output, the ranking: *ASSO≫DEP-μ is necessary. *DIS is ranked even lower because sometimes the language violates this constraint in order to satisfy some higher-ranked ones.

Across many languages, the first syllable position is a strong one (Beckmann, 1998). ID-T(σ_1) preserves all underlying tones that are associated to this position, where the initial position refers to the first syllable. Thus an alteration of *any underlying tone* specification of a TBU in this position incurs a violation of this constraint. This constraint is a kind of *DIS and *ASSO but with special reference to the first syllable. Crucially, a TBU in the input without a specified is not impacted by this constraint. An important observation for Gã is that, monosyllabic stems do not permit an alteration in their tonal specifications unless it is required for a higher-ranked constraint. Thus such stems also count as first syllable.

Depending on how ID-T(σ_1) interacts with other (markedness) constraints, the general observation about the stems to which the imperative suffix is attached is that while a tone on a non-initial syllable TBU may be altered (either by deassociation, deletion or tonal change through deassociation and reassociation to another TBU) except when it is H, the tone on the first syllable is sometimes preserved. This tone feature preservation is particularly possible when MX-H dominates ID-T(σ_1) in order to protect H tones in non-initial syllable position. And since sometimes association of floating tones does not reach the first syllable, we can summarize the ranking inforamation of the above faithfulness constraints as in (21):

(21) *Ranking faithfulness constraints*
MX-H≫ID-T(σ_1)≫*ASSO≫DEP-μ≫*DIS

(22) Markedness constraints

a. *LH(μ): No $\overset{\frown}{\mathrm{LH}}$ tone must be associated to a one mora

b. *Fl-H: Every H must be associated to a TBU

c. Aln-L-σ: No syllable must intervene between Ⓗ and the left-most edge of the phonological word.

d. R-(Cont): Every contour must be associated to the right edge of the phonological word.

e. T_i-$\mathrm{T}_i(\sigma)$: No two identical tones must be associated with one syllable.

Regarding (22), LH contours are crosslinguistically marked (Zhang, 2000). For Gã as described above, *LH(μ) is motivated by the fact $\overset{\frown}{\mathrm{LH}}$ contours are never associated to a single mora (Kropp Dakubu, 2002; Paster, 2000) though such association is attested for their $\overset{\frown}{\mathrm{HL}}$ counterparts e.g. *hê* 'buy'. This constraint thus eliminates sub-optimal candidates which would have $\overset{\frown}{\mathrm{LH}}$ associated to a single mora in the output. For *Fl-H, we recall that Gã allows some floating tones to remain unassociated. We see this effect with floating L tones which result in downstep in various contexts. But for floating H tones, they are required to be associated. Thus any unassociated H violates the *Fl-H constraint. Aln-L and R-(Cont) are relativized versions/members of the constraint family, Align(Contour) (Yip, 2002; Klein, 2005; Zerbian, 2006). The former penalizes any syllable that blocks the spread of Ⓗ to the left-most syllable of the phonological word. It is important to note that this association requirement is not specific to only the imperative suffix in Gã. All morphemic floating H tones (see e.g. (6) above) seem to target the first syllable. The latter i.e R-(Cont) ensures that the observation that at least $\overset{\frown}{\mathrm{HL}}$ contour are realized the right edge of the phonological phrase. Since there are stems whose final H tone blocks the spread of the imperative suffix to the first syllable, Aln-L-σ must rank below Mx-H which in itself also ranks below *Fl-H$\gg$*LH(μ).

Given the relative position of Aln-L-σ, it is possible for a candidate to associate a floating H that has overwritten an intervening L in order to associate to another H in the initial syllable. Such candidates are eliminated by T_i-$\mathrm{T}_i(\sigma)$ which penalizes the presence of two identical tones in a single syllable. For languages which have the syllable as the TBU, this is easily motivated on the basis of locality. But for Gã, this constraint is somewhat comparable to the Aln-L-σ, in the sense that they are both sensitive to the syllable despite the fact that the mora is the TBU. But crucially, T_i-$\mathrm{T}_i(\sigma)$ must dominate Aln-L-σ. So that a candidate would prefer associate a floating H tone to two identical tones of one syllable in order to satisfy a higher-ranked constraint of *Fl-H even if they do not associate to the initial syllable and hence violate Aln-L-σ. For the markedness constraints thus, we need the ranking information in(23). And we can summarize the ranking information for the constraints outlined so far as in (24).

(23) *Ranking of markedness constraints*
*Fl-H$\gg\mathrm{T}_i$-$\mathrm{T}_i(\sigma)\gg$*LH(μ)$\gg$Mx-H$\gg$Aln-L-σ

(24) *Overall ranking information*
Fl-H$\gg$ T_i-$\mathrm{T}_i(\sigma)\gg$*LH(μ)$\gg$Mx-H$\gg$Aln-L-$\sigma\gg$R-(Cont)$\gg$Id-T(σ_1)$\gg$*Asso$\gg$Dep-$\mu\gg$*Dis

4 Deriving the imperatives

4.1 A note on the OT tableaux

Before I proceed to illustrate how the constraints interact to give the desired outputs, I would like to make a few remarks about the representational convention adopted for the OT tableaux in this paper. I use comparative tableaux (Prince, 2002) for the OT representations that follow. In this formalism, we establish competition between the optimal candidate and the sub-optimal ones with respect to every constraint, proceeding by one candidate row per time. As per standard practice in this formalism, I use **W** for the slots where the optimum wins and **L** for those that favour the sub-optima. The ranking logic is that for every row of competition between the optimum and a sub-optimum candidate, a **W** will precede an **L**. Thus in the row of the optimal candidate, no **W**s and **L**s are registered at all. Also, rows with only **W**s suggest that the sub-optimal candidate in question is *harmonically-bound* (Samek-Lodovici & Prince, 1999) i.e. none of such candidates can ever emerge as the optimum irrespective of the constraint (re)ranking.

Also, for economy reasons, I will use only the relevant constraints in the individual tableaux. But I maintain that the ranking in (24) is the reference point for all the ranking schema to be presented in the tableaux that follow.

4.2 Monosyllables

Recall that the main focus of this paper is to account for the lack of surface contrast between a possible underlying bisyllabic LL- toned and toneless stems. This goal is justified because we see a parallel contrast between underlyingly L-toned and toneless stems though they both surface as L-toned. We will first account for the monosyllabic stem contrast.

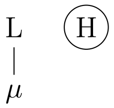
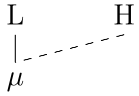
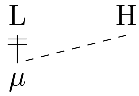
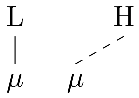
(25) and (26) show the ouput contrast between toneless and L-toned monosyllabic stems. In (25), it is required that ID-T(σ_1) ranks above *ASSO. Though (25-c) violates *ASSO, it emerges as the optimum over (25-a) which is penalized by the higher-ranked MX-H for deleting the H tone morpheme which was present in the input. Note that ID-T(σ_1) would be redundant in this competition because the input has no underlying tone to begin with. (25-b) is harmonically bound and thus emerges sub-optimal as well. Therefore the winning candidate in (25) simply associates the floating H to a toneless syllable.

(25) **CV Toneless→H e.g. /ba/→[bá]** MX-H≫*ASSO

Ⓗ μ	MX-H	*ASSO	DEP
a. μ	W	L	
b. H μ μ			W
☞ c. H μ			

In (26) where the imperative formation for a monosyllabic stem with an underlying L tone is involved, the optimal candidate (26-d) inserts a mora to realize the affixed H tone. This violates DEP which in the context of (25), would have made it a sub-optimal candidate by allowing any of (26-a-c) to emerge as optimum. However, given that (26-d) inserts the mora in order to obey higher ranked constraints like *LH(μ), MX-H and ID-T(σ_1), it wins. (26-a-c) on the hand violate at least one of all these higher-ranked constraints. It is also important to mention that the ranking among these three higher- ranked constraint does not matter in the evaluation of this tableau given that the constraints that favour the sub-optimal candidates i.e. *ASSO, DEP, rank much lower.

(26) **CV L-toned→H e.g. /fò/→[fòó]** Id-T(σ_1) ≫*Asso

	*LH(μ)	Mx-H	Aln-L	Id-T(σ_1)	*Asso	Dep	*Dis
a. 		W			L	L	
b. 	W			W		L	
c. 				W		L	W
☞ d. 							

4.3 Bisyllables

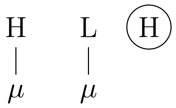
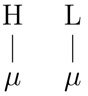
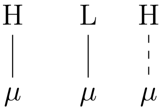
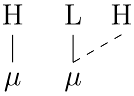
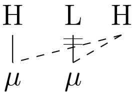
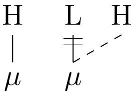
Now we direct our focus to the interaction of the above constraints for bisyllabic stems. We will show the equivalent of the asymmetry that we find with the stems in (25) and (26) in the following disyllabic stems.

In (28), the optimal candidate needed to deassociate (hence violate *Dis) in order to get the right output. The closest competitor, (28-d) loses out because it associates another H tone to a syllable which has H and thereby violates *T_i-$\mathrm{T}_i(\sigma)$. This is despite satisfying the otherwise highly-ranked Aln-L. An alternative candidate which could summount the *T_i-$\mathrm{T}_i(\sigma)$ constraint would insert a mora in the first syllable to host the spreading H. But this hypothetical candidate I assume, is ruled out by an undominated constraint in (27) which bans the insertion of mora in such positions i.e. intra-morpheme insertion.

(27) m-o-contig ("No internal insertion") (Landman, 2002)
The portions of the output standing in correspondence and belonging to the same M form contiguous strings. (Where M refers to a morpheme or a stem)

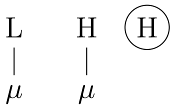
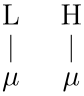
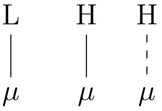
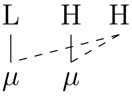
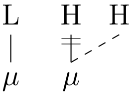
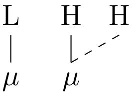
(28-c) fails because it associates the floating H tone to the same mora that hosts the final L of the stem, violating *LH(μ). The imperative suffix needs to overwrite the tone of the second syllable. The effect of the deassociated floating L is seen in the downstep on the second syllable.

(28) **CVCV H.L→H.ꜜH e.g. /kánè/→[káꜜné-mɔ́]** $*T_i$-T_i≫Aln-L

	*LH(μ)	Mx-H	*T_i-T_i(σ)	Aln-L	*Asso	Dep	*Dis
a. 		W			L		L
b. 						W	L
c. 	W						L
d. 			W	L	W		
☞ e. 							

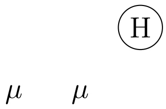
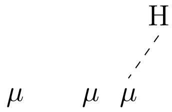
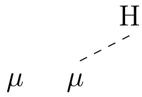
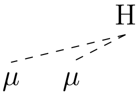
Unlike (28-c), the optimal candidate in (29-e) associates the non-initial syllable of a stem with H to the imperative H. But the violations of *T_i-T_i(σ) and Aln-L are compensated for by satisfying a higher-ranked *Fl-H. This is what makes the closest competitor (29-d) sub-optimal i.e. it deassociates a H and thus violates *Fl-H. Thus though (29-e) is marked in the context of (28), it is nonetheless preferred over other candidates in (29). For, this implies that surface H-toned segments may be either H.H or H underlyingly. This is expected given that Ga makes a surface distinction between only H and L tones.

(29) **CVCV LH→LH e.g. /kòʤó/→[kòʤó-mɔ́]** Mx-h ≫*T_i-T_i

	*Fl-H	*LH(μ)	Mx-H	*T_i-T_i(σ)	Aln-L	*Asso	Dep	*Dis
a. 			W	L		L		
b. 							W	
c. 		W			L	W		
d. 	W			L				W
☞ e. 								

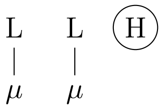
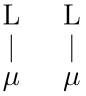
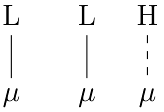
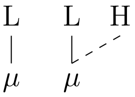
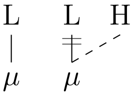
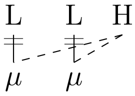
For toneless bisyllabic stems (30), the constraint interaction in (25) where *Asso is the most crucial constraint for the evaluation of the competition is informative. The floating H simply associates to the toneless TBUs.

(30) **CVCV Toneless→HH e.g. /kata/→[kátá-ꜜmɔ́]** Aln-L ≫*Asso

	Mx-H	Aln-L	*Asso	Dep
a. 	W		L	
b. 		W	L	W
c. 		W	L	
☞ d. 				

For underlyingly L.L stems (31), the H tone suffix overwrites the L tone on both syllables of the stem of the optimal candidate (31-e). This is essentially achieved with the higher-ranked Aln-L. It is this constraint that makes the closest competitors (31-b and d) the sub-optima.

(31) **LL→HH e.g./kàtà/→[kátá-ꜜmɔ́]** Aln-L ≫*Asso

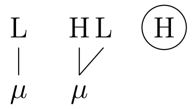
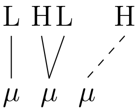
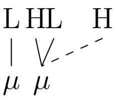
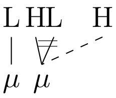
	*LH(μ)	Mx-H	Aln-L	*Asso	Dep	*Dis
a. 		W		L		L
b. 			W	L	W	L
c. 	W		W	L		L
d. 			W	L		L
☞ e. 						

In sum, we have seen that the constraint ranking that accounts for the asymmetry between surface L-toned monosyllabic stems also readily accounts for the bisyllabic stems that surface as L.L. More importantly, this ranking information suggests that the Aln-L constraint which drives the association of the floating imperative H tone to the first syllable will always ensure that any surface bisyllabic L-toned stem i.e. toneless.L, L.toneless, L.L or toneless (as claimed by Paster) is ultimately realized as H.H as in (30) and (31).

4.4 $\widehat{\text{HL}}$ stems

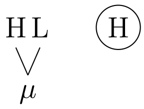
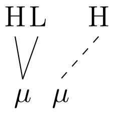
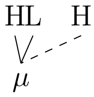
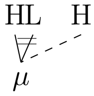
In the data (as presented in (12) and (13), we also find monosyllabic and bisyllabic stems which end in $\widehat{\text{HL}}$ tone. This is where the ranking of R-(Cont) is relevant. We need to mention also that given the distribution of $\widehat{\text{HL}}$ contours in the language, the role of the segmental part of the imperative morpheme i.e. *-mɔ́*, in these paradigms is equally crucial. With *-mɔ́* following the stem, the right edge of the stem ceases to be the right edge of phonological word. This means that certain morphophonological processes may or may not occur. For instance, the final L of the contour in (32) will not be realized because the contour is in a non-final position. Note that (32) is bisyllabic. I assume that the ranking of R-(Cont) is not so crucial for the bisyllabic stems with a final contour given that for such L.$\widehat{\text{HL}}$ stems, the constraints that have been active so far predict the right output. This is exemplified (32).

(32) **L$\widehat{\text{HL}}$→LH e.g./fèê/→[fèé-$^{!}$mɔ́]** Max-H≫*Asso

	*LH(μ)	Mx-H	*Asso	Dep	*Dis
a. 		W	L		L
b. 				W	L
c. 	W				L
☞ d. 					

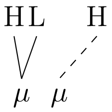
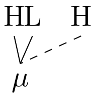
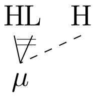
For monosyllabic $\widehat{\text{HL}}$ stems such as (33), the desired candidate (33-d) deassociates the final L and thus violates a higher-ranked constraint: Id-T(σ_1). This is because the stem comprises one TBU and thus deassociating the L but not mora insertion violates Id-T(σ_1). However, given the constraint R-(Cont), (31-b) actually emerges as a sub-optimum. R-(Cont) only needs to dominate Id-T(σ_1) as shown in (34).

(33) **CV $\widehat{\mathbf{HL}}$→H e.g./hê/→[hé-mɔ́]**

	*LH(μ)	Mx-H	Id-T(σ_1)	*Asso	Dep	*Dis
a. 		W	L	L		L
☛ b. 			L		W	L
c. 	W					L
d. 			1			1

In Gã thus, R-(Cont) penalizes any moraic intervention between a contour tone and the right-most edge of the phonological word. Thus $\widehat{\text{HL}}$ tone is permitted only at the right edge. In that context, we correctly predict the optimal candidate as in (34-d). Note that no downstep is expected after the deassociation of the intervening L. This is because the condition for downstep in Gã i.e. a floating L between two H tones that are associated to different TBUs, is not satisfied. Thus on the surface, the deassociated L (which floats) is insignificant.

(34) **CV $\widehat{\mathbf{HL}}$→H e.g./hê/→[hé-mɔ́]** R-(Cont)≫Id-T(σ_1)

	*LH(μ)	Mx-H	R-(Cont)	Id-T(σ_1)
a. 		W		L
b. 			W	L
c. 	W			L
☞ d. 				

5 Summary and Conclusion

A summary of the constraints interaction with respect to each input and output discussed above is presented in (35). With regard to (35-g), where H.H stems are involved, the prediction is that it will pattern like (35-d) where the imperative H associates to the final H of the stem.[7]

(35) *Summary of constraints interaction*
*Fl-H≫*LH≫MxH≫*T_i-T_i≫Aln≫R(Cont)≫Id-T_1≫*Asso≫Dep-μ≫*Dis

Input	*FL-H	*LH	MxH	*T_i-T_i	Aln	R(Cont)	Id-T_1	*Asso	Dep	*Dis
a. ba (26) ☞**bá**								✗		
b. fò (27) ☞**fòó**								✗	✗	
c. kánè (28) ☞**káꜜné**					✗			✗		✗
d. kòʤó (29) ☞**kòʤó**				✗				✗		
e.kata (30) ☞**kátá**								✗		
f.kàtà (31) ☞**kátá**								✗		✗
g.fíté(32) ☞**fíꜜté**				✗				✗		
h.fèê ☞**fèé**				✗	✗		✗	✗		✗
i.hê (34) ☞**hé**							✗			✗

Thus the floating H imperative marker in Gã always strives to associate to the initial syllable of a given stem, using the Aln-L constraint. In this quest, it overwrites all less important tones i.e. low tones, but never high tones since the latter are so important such that they are preserved by higher-ranked constraints i.e. *Fl-H and Mx-H. In the worse case scenario, the imperative H associates to an existing H in a syllable thereby violating a lower-ranked constrant *T_i-$T_i(\sigma)$ but which is ranked higher than the Aln constraint.

The phonology of Ga verbs in the imperative presents an interesting perspective to tackling an instance of a Richness of The Base problem in the language i.e. the contrast between surface L-toned monosyllabic verb stems which are underlyingly L-toned, and those which are underlyingly toneless, with respect to the imperative suffix, though we do not find a similar surface contrast for low-toned bisyllabic stems. Paster's analysis suggests that underlyingly L, or L.L stems are non-existent in the input, a claim that is problematic for the spirit of OT as expressed in the RotB hypothesis i.e. that inputs are universal, and all surface differences arise out of constraint reranking.

The OT analysis proposed in this paper however points to the fact that L.L stems may exist in the language except that they cannot be contrasted with the so-called toneless bisyllabic stems on the surface given that both groups strive to satisfy the Aln-L contraint which forces the floating high tone suffix of the imperative morpheme to associate to the first syllable of the stem except when this is injuncted by higher ranked constraints that ban a floating high tone, creation of a high-low contour on a single mora, deletion of a high tone or an association of identical tones to a single syllable (35). So even if one assumes that the surface L.L stems actually have just

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[7] I acknowledge another instance of downstep in Gã in (35-g) where the first of two successive H tones in different syllables is interpreted to be lower. This is orthogonal to the analysis presented here.

one L tone associated to either of two TBUs in the two syllables of the surface L.L stems, we still are able to derive only the surface H.H output forms in imperative constructions. Thus the empirical data observed in these constructions do not necessarily contradict the essence of the Richness of the Base hypothesis, at best they provide further evidence in surport of it.

The conclusions reached with this analysis undoubtedly has consequencies for the surface behaviour of Gã verb stems in other morphophonological context. One that readily comes to mind is the marking of generic negatives on such verbs. It would seem that such verbs, based on Paster's account, would not support the theoretical claim I make here. However it is apparent that the details of such interactions are more complicated than appear to be. That bit requires further studies.

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