Subtonal Features in a Three-Tone Language: Evidence from Laal

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1 Introduction

While featural representations are well established for segments, proposals to extend them to tone have been less successful (e.g. Wang, 1967; Yip, 1980; Clements, 1983; Pulleyblank, 1986; Snider, 1999, 2020; Hyman, 1993). The two-feature system proposed by Yip (Yip, 1980) and slightly modified by Pulleyblank (1986) is presented in (1), illustrating the featural analysis of a 4-height tone system.

(1)

Tone height		[upper]	[raised]
4	a̋	+	+
3	á	+	–
2	ā	–	+
1	à	–	–

As seen, the [upper] feature distinguishes a higher and a lower register, within which tone heights are further distinguished with the feature [raised].

Recently, authors such as Hyman, 2010 or Clements et al., 2010 have argued that African tone systems are better represented with tonal primitives (e.g. H, M, L) than with tonal features. The main arguments rest on the absence of parallelism between segmental and tonal features, notably:

(2)
a. there is no evidence for assimilation or dissimilation involving subtonal features;
b. there is no evidence for subtonal natural classes;
c. the specification of the M tone in three-tone languages is ambiguous (it could equally be the lower tone in the upper register or the higher tone in the lower register).

In this paper, I provide arguments in favor of tonal features, with novel data from Laal, a three-tone isolate language of southern Chad. I show that a two-feature system offers a straightforward account of properties of the mid (M) tone that are otherwise impossible to account for in a unified manner. The patterning of M in Laal shows evidence for subtonal natural classes and subtonal assimilation, as well as evidence that the M tone in a three-tone system is not necessarily ambiguous, making subtonal features appropriate for the analysis of three-tone systems.

The Laal data come from my own fieldwork (17 months between 2010 and 2020), and is taken either from my field notes, or from recorded texts whose recordings and transcriptions can be found in the Laal collection of the online DOBES archive hosted by the Max Planck Institute in Psycholinguistics in Nijmegen, The Netherlands.[1] This data confirms and expands on Pascal Boyeldieu's (1982; 1987) initial description of the nominal and verbal morphology of the language. Most of the data presented here were already described in Lionnet (2015). The analysis proposed here is, however, different.

In the remainder of this paper, I first describe the constrained distribution of the M tone in Laal in section 2, before presenting its constrained behavior in section 3, notably a conspicuous process of M-lowering. I then develop a subtonal analysis in section 4 accounting for this quirky distribution and behavior, and sketch

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[1] https://hdl.handle.net/1839/854da955-51a8-40ed-9fa9-12a3c33fc041

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an Optimality-Theoretic implementation of this analysis in section 5. Section 6 shows that the subtonal analysis is superior to alternatives making use of unit tones (H, M, L) only. Finally, section 7 concludes.

2 The constrained distribution of M

There are three contrastive tone heights in Laal, briefly illustrated with two minimal triplets in (3).

(3)

H:	tuáár	'to accept'	kúmá	'type of basket'
M:	tuāār	'evening'	kūmā	'to hide'
L:	tuààr	'chicken'	kùmà	'medicine'

The tone-bearing unit (TBU) is the mora, as evidenced by the fact that complex tone patterns are allowed only on bi- and tri-moraic syllables, i.e. CVV (VV = V:), CVL (L = sonorant), and CVVL. With only a handful of exceptions, complex tone patterns are unattested on CV and CVO (O = obstruent) syllables.

The three tones combine into a certain number of stem-level patterns involving at most three tones.[2] The three stem-level mono-tonal patterns H, M, and L, illustrated in (3) above, are regularly attested. As can be seen in (4), all bi- and tritonal combinations of H and L are also attested on native lexical items.

(4)

a.	Bitonal patterns:				
	LH	buǎl	'leaf'	gùmál	'melon'
	HL	pâl	'sorghum var.'	ndéwò	'knife (PL)'
b.	Tritonal patterns:				
	LHL	bòôr	'pigeon *sp.*'	bùúrà	'pigeon *sp.* (PL)'
	HLH	bûnnú	'okra (PL)'	kuáàrí	'monkey *sp.*'

Conspicuously missing are any patterns involving a M tone. Such patterns are only exceptionally found with a handful of functional items (5a), and about two dozen recent loanwords (5b).

(5)

a.	wáā, PL wíī	itive marker ('go VERB')
	tāá, PL tīí	imperfective marker
b.	líbrā	'needle' (from Chadian Arabic *al-ʔibra*, via Lua *líbrā*)
	kēsé	'bow, arrow' (from Barma *kēsé*)
	tèmē	'sieve" (from Barma *tèmē*)

There is thus a static constraint against stem-level patterns involving a M tone in Laal: *MX/XM.

3 The constrained behavior of M: conspicuous M-lowering

Not only is M constrained in its static distribution, it is also constrained in its behavior. Notably, it is affected by a lowering process changing it to L in two types of environments: morphophonological, and morphosyntactic.

3.1 *Morphophonological M-lowering* Morphophonological M-lowering applies in response to a violation of the distributional constraint *MX/XM seen above. Whenever a H- or L-toned suffix is added to a M-toned root, the M tone of the root is changed to L to avoid creating a stem-level MX pattern, as illustrated in (6).[3]

[2] A stem is defined as a lexical root and all following suffixes, e.g. /nō/ 'person', /ɓàg-ál/ 'head-SG', /kár-án/ 'put-3M.SG.OBJ. Since Laal does not have prefixes, stems are most of the time coextensive with phonological words, with the exception of compounds and reduplicated forms, which are multi-stem words, e.g. /gàà.gùny-ál/ '*Uraeginthus spp.*, bird *sp.*', /ɟìRED.ɟèl/ 'chameleon'. Stems are maximally disyllabic in Laal, with only about 50 exceptions with three or four syllables (0.02% of the 2690 stems in the lexicon), mostly loanwords. The domain of assignment of tone patterns in Laal is the stem.

[3] Suffixation triggers vowel harmony processes. Three harmonies are attested in Laal: perseverative high harmony (a mid vowel is raised to high after a high vowel), anticipatory [low] harmony (a non-high vowel harmonizes with the [low] specification of the following vowel), and anticipatory rounding harmony (a vowel is rounded when followed by a round vowel). See Lionnet (2017) for more detail.

(6) a. /dāg-án/ dàg-án ‘drag him’
b. /dāg-àn/ dàg-àn ‘drag it’

H- and L-toned roots are not affected by any tone change in this context, as shown in (7) and (8) below.

(7) a. /kár-án/ kár-án ‘put him’
b. /kár-àn/ kár-àn ‘put it’

(8) a. /ɟàr-án/ ɟàr-án ‘sacrifice him’
b. /ɟàr-àn/ ɟàr-àn ‘sacrifice it’

3.2 *Morphosyntactic M-lowering* M-lowering also applies in two morphosyntactic contexts: a M-toned verb followed by an object *in-situ* is realized with a L tone (section 3.2.1), and the M-toned head of a genitive construction is realized with a L tone (sec 3.2.2).

3.2.1 *M-lowering in verbs* When a M-toned verb is followed by a syntactic object *in situ*, its M is systematically changed to L, as shown in (9)

(9) a. ɟá tō *vs.* ɟá tò kúdál
I carry I carry(M>L) stone
‘I carry (it).’ ‘I carry a stone.’
b. ɟá ŋāg *vs.* ɟá ŋàg tāā
I eat I eat(M>L) fish
‘I eat (it).’ ‘I eat fish.’

Verbs with other tone patterns do not undergo any change in this context, as can be seen in (10).

(10) a. H /kár/ ‘put’ ɟá kár ndiáw ɓó sàndùg
I put knife on trunk
‘I put the knife on the trunk.’
b. L /ɟàr/ ‘sacrifice’ ɟá ɟàr tuààr
I sacrifice chicken
‘I sacrificed a chicken.’
c. LH /jùgár/ ‘shake’ à jùgár jāān
he shake his.body
‘He shakes his body / he is fidgety.’
d. HL /múrì/[4] ‘run (PL)’ ì múrì gààm
they dance funeral.dance
‘They dance the funeral dance.’

M-lowering on transitive verb applies irrespective of the tone of preceding or following word, in both matrix and embedded clauses, irrespective of TAM marking, and irrespective of polarity or clause type: declarative, negative, interrogative (cf. Lionnet, 2015 for more detail).

M-lowering does not apply when the object of the verb is not *in situ*, e.g. when it is elided or understood (11), or when it is extracted for relativization (12).

(11) ò sór nàr biàár ò ŋāg (*ŋàg)
you.SG find little *Tilapia.sp* you.SG eat
‘You find a little *Tilapia* and you eat [it].’ (121120-09-OK1:164)

(12) mɨ̄rā jí ɟá ɟuāŋ (*ɟuàŋ)
cows REL:PL I buy
‘The cows that I bought.’ (140316-02-AK1)

Finally, adjacency between the verb and its *in-situ* object is not required for M-lowering to take place, as shown in (13).

[4] The intransitive verb /múr/, PL /múrì/ ‘to run (away)’ can be used transitively to mean ‘to dance (specifically the funeral dance)’, or ‘to drive (a vehicle)’.

(13) a. à ɟuàŋ kɨ́ nīīnī sààb ɓɨ̀dɨ́l
he buy(M>L) to woman cloth one
'He bought the woman one piece of cloth.' (Boyeldieu, 1982:153)
b. kùŋú jàg nàná ɟámdéd
panther put(M>L) to.it bit
'Panther put the bit in its mouth (lit. put it the bit).' (121120-OK1-159)

M-lowering is thus not caused by the surface adjacency between the M of the verb and the tone of the following object, but by a structural configuration: the presence of the object of the verb *in situ*, i.e. neither elided nor extracted.

I analyze morphosyntactic M-lowering as head-marking inflectional morphology: the verb, head of the VP, is marked for the overt presence of a complement in situ – its object. An additional argument for this analysis is paradigmatic systematicity: M-lowering is indeed only one of two morphological exponents of this inflectional category, the second one being found with the gerund form. The gerund is a nominalized form of the verb which can be used as an argument as in (14)a-a'. It is required after a number of aspectual markers, e.g. prospective *ná* in (14)b-b'. The gerund has two forms: one that is homophonous with the simple form of the verb, used when there is no overt object in situ as in (14)a,b, and a marked transitive form, which is used only with transitive verbs followed by an *in-situ* object as in (14)a',b'. The marked form of the gerund is used in exactly the same context as M-lowering: this parallelism is briefly illustrated in (14)b-b' and (14)c-c', repeated from (9)b above.

(14) a. ŋāg pāj
eat(:GER) be.difficult
'Eating is difficult.'
a'. ŋàg-à tāā pāj
eat-GER:T fish be.difficult
'Eating fish is difficult.'
b. ɟá ná ŋāg
I PROS eat(:GER)
'I will eat (it).'
b'. ɟá ná ŋàg-à tāā
I PROS eat-GER:T fish
'I will eat fish.'
c. ɟá ŋāg
I eat
'I eat (it).'
c'. ɟá ŋàg tāā
I eat(M>L) fish
'I eat fish.'

The marked form of the gerund is not limited to M-toned verbs, but affects all verbs. As seen in (14)a' and (14)b', it is formed with a suffix consisting in a copy of the root vowel and a replacive L tone which wipes out the underlying tone of the verb: /-V^{L}/, e.g. /pɨ́r-V^{L}/ → *pɨ̀r-ɨ̀* 'catch-GER:T, /sór-V^{L}/ → *sòr-ò* 'find-GER:T, /sə̌ŋ-V^{L}/ → *sə̀ŋ-ə̀*, etc.

The morphosyntactic category exponed by M-lowering and the marked gerund can be analyzed as a form of extraction marking (in this case more specifically "non-extraction" marking), which is typologically well-attested (cf. Crysmann, 2004, 2005, 2011 for a similar analysis of Hausa final vowel lengthening).[5] Table 1 summarizes the morphological exponence of the "non-extraction-marking" morphosyntactic feature in the Laal verbal system.

3.2.2 *M-lowering in nouns* M-lowering is also systematically observed in the genitive construction[6]. This construction, used to express inalienable possession and related concepts, is formed in Laal by juxtaposing the head noun and its genitive modifier in that order. If the head of a genitive construction is M-toned, its M is systematically changed to L, as shown in (15).

(15) a. ŋūm 'oil, fat': ŋùm tāā 'fish fat'
fat(M>L) fish
b. dōrūm 'rope': dòrùm hól 'rope made of *Urena lobata* (plant *sp.*)'
rope(M>L) plant.sp

The examples in (16) show that only M-toned nouns are affected.

[5] It is also an argument against a Precomplied Phrasal Phonology (PPP; Hayes, 1990) analysis, as shown in Lionnet (2015) (cf. Crysmann, 2004, 2005 for similar arguments against a PPP analysis of Hausa final vowel shortening).
[6] Boyeldieu's 1982, 1987 *détermination immédiate*.

	Unmarked (*No object* in situ)		*Non-extraction-marked* (*Object* in situ)	
Simple form	Ø		*M-lowering*	
H	kár	'put'	kár	'put +OBJ'
M	ɲāg	'eat'	**ɲàg**	'eat +OBJ'
L	ɟàr	'sacrifice'	ɟàr	'sacrifice +OBJ'
Gerund form	Ø		/-V^L/ *suffix*	
H	kár	'put:GER'	**kàr-à**	'put-GER:T +OBJ'
M	ɲāg	'eat:GER'	**ɲàg-à**	'eat-GER:T +OBJ'
L	ɟàr	'sacrifice:GER'	**ɟàr-à**	'sacrifice-GER:T +OBJ'

Table 1: Non-extraction marking morphology in the Laal verbal system

(16)	a.	H	hóy	'shells':	hóy	ɟūūrū	'peanut shells'
					shells	peanuts	
	b.	L	ɲàw	'house':	ɲàw	ndíí	'bird's nest'
					house	bird	
	c.	LH	gàáw	'wing':	gàáw	ndíí	'bird's wing'
					wing	bird	
	c.	HL	nápàr	'kind, sort':	nápàr	ɓààgàmɛ́	'The Bagamin clan'
					sort	(clan.name)	

M-lowering on nouns is not attested in any other context: a M-toned noun keeps its M tone when followed by a determiner, a numeral, a relative clause, or a focus or topic marker (cf. Lionnet, 2015 for more detail).

There are three pieces of evidence showing that the genitive construction has syntactic status and is not simply a case of noun compounding. First, the genitive complement may be pronominalized, as in (17).

(17)	a.	ɲàw	ndíí		→	ɲàw	nàná
		house	bird			house	its
		'bird's nest'				'its nest'	
	b.	wɔ́n	mòl		→	wɔ́n	nàná
		boule[7]	pearl.millet			*boule*	its
		'boule made of pearl millet'				'boule made of it'	

The genitive complement may also be a complex noun phrase, as in (18), where jēn/ (lowered to /jèn/) 'body' is the head, and /căn nīīnī kán wùrù/ 'the girl's family' the complement.

(18)	kɨ́	jèn	[[[căn	nīīnī]	kán]	wùr-ù]$_{NP}$
	to	body(M>L)	child.+CON[8]	woman	DEF	family-her
	'to the young woman's family' (110612-AK1:18)					
	(lit. to (*kɨ́ jèn*) the young woman (*căn nīīnī kán*) her family (*wùrù*))					

Finally, as shown in (19), there is no M-lowering in Noun-Noun compounds, which are not frequent in Laal, and often fossilized and opaque.

(19)	a.	mōō.gà.díígí	'hippopotamus'	(hippopotamus.?.?)
	b.	wār.bìíg	'bat'	(?.shellfish)

The morphosyntactic nature of this M-lowering is further revealed by the fact that, much like M-lowering in verbs, it is only one of two ways in which the head of a genitive construction is marked in Laal. The

[7] *wɔ́n* is a dough-like food made from millet or sorghum flour. It is served in a hemispheric shape, hence its local French name: *boule* ('ball').

[8] /căn/ = /càn/ 'child' + a floating H tone acting as a 'connective', i.e. a noun-modifying operator, used for noun modification by any category: noun (phrase), adverb, relative clause, etc. /caăn nīīnī/ (child+CON woman) literally translates as 'child [who is] female', i.e. 'girl, young woman'.

second strategy is observed with a dozen nouns which have an irregular form when heading a genitive construction, usually obtained through truncation (together with M-lowering when the noun is M-toned), as briefly illustrated in (20).

(20)	*regular form*	*head of genitive*	
	ɓàgál	ɓə̀ (∼ɓàgál)	'head'
	jə̄wə̄l	jə̀w	'mouth, language'
	jēn	jèè (∼jèn)	'body'
	nīīnī	nìn	'woman, wife'
	wúrá	wúr	'thing (PL)'

This head-marking genitive is akin to what Creissels (2009, 2018: 724–733) has termed 'construct form' of the noun. M-lowering (and irregular truncation) of the head of the genitive construction seems to be marking the same morphosyntactic configuration as M-lowering (and the marked gerund form) on the verb: the presence of a complement *in situ*.

3.3 *Summary and puzzles* Laal has a three-tone system with a strong distributional constraint against stem-level tone patterns involving a M tone (*MX/XM). To avoid violating this constraint, M tones followed by H- or L-toned suffixes are systematically changed to L. Additionally, Generalized M-lowering is observed as the exponent of a morphosyntactic category (presence of a complement *in situ*) in two specific morphosyntactic environments, in the absence of any violation of *MX/XM. This begs at least the following five questions, which the remainder of this paper will answer.

(21) a. Static distribution: why is there no MX or XM pattern?
b. Target: Why is only M affected by M-lowering, and not H?
c. Trigger: Why is M changed to L when followed by both L and H?
d. Result: Why is M changed to L and not H?
e. Finally, is a unified account of all this possible?

4 Subtonal analysis

I propose to analyze the Laal tone system with the subtonal specifications summarized in (22).

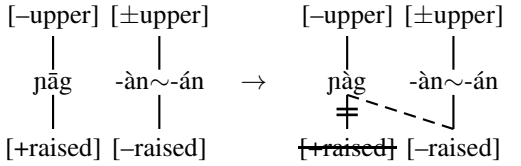
(22)

	[upper]	[raised]
H	+	–
M	–	+
L	–	–

Specifically, M is analyzed the higher tone within the lower register, i.e. [–upper, +raised], while the [+upper] register is limited to H, analyzed as [+upper, –raised]. Missing from this system is the subtonal specification [+upper, +raised], which would correspond to a super-H tone, which Laal simply lacks. This gap is reminiscent of similar segmental gaps in phonemic inventories, e.g. lack of a voiceless bilabial plosive (*p) in many languages including standard Arabic, or absence of front rounded vowels (*[+front, +round]), more frequent typologically than their presence. This subtonal analysis will be justified in the following sections – in particular (i) the treatment of M as [–upper] and as the only [+raised] tone in the system, and the analysis of H as [–raised].

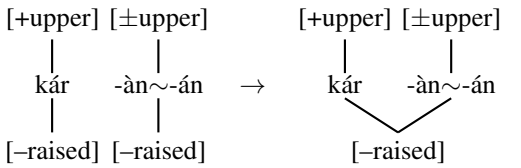
Within this system, I propose to analyze M-lowering as the result of one simple process: [–raised] agreement/assimilation, which applies in response to a stem-internal constraint against sequences of disagreeing [raised] features: *[αraised][βraised].

This straightforwardly accounts for morphophonological M-lowering, and explains (i) why only M undergoes it – it is the only [+raised] tone, i.e., the only possible target of [–raised] assimilation – and (ii) why both H and L trigger it – they both carry the assimilating feature [–raised]. This is illustrated in (23) below, with assimilation/agreement formalized as [–raised] spreading. H- and L-toned suffixes are represented together, the only featural difference between them being the [upper] feature, which plays no role in [–raised] assimilation.

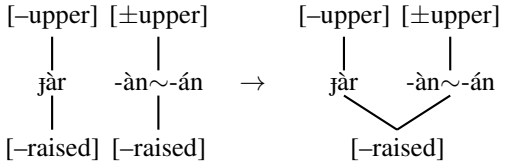
(23)


'drag it∼him'

This analysis also naturally accounts for the fact that neither L nor H are targeted by any tonal changes in the same context: they are both already [–raised] and therefore (i) they do not violate the [αraised][βraised] constraint when followed by a a suffix carrying a [–raised] feature, and (ii) they are never targeted by [–raised] assimilation. This is shown in (24) and (25).

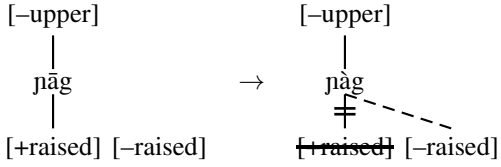
(24)


'put it∼him'

(25)


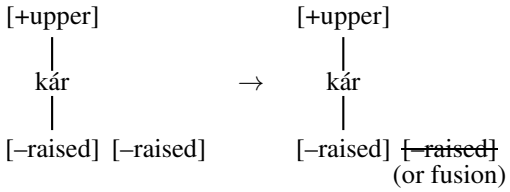
'sacrifice it∼him'

The same mechanism accounts for morphosyntactic M-lowering, analyzed as the effect of a floating [–raised] suffix flagging the presence of an *in-situ* complement (on a par with the gerund suffix /-V^{L}/, or trunctating morphology on the irregular nouns mentioned above). This is shown in (26)

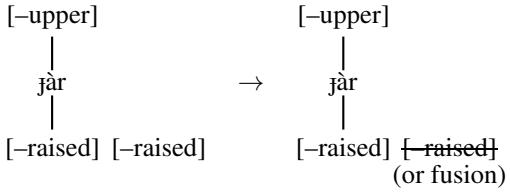
(26)


'eat +OBJ'

With H- and L-toned verb roots, the [–raised] suffix is either stray-erased or fused with the root [–raised], as seen in (27) and (28)

(27)


'put +OBJ'

(28)


'sacrifice +OBJ'

5 Optimality-Theoretic implementation

In this section, I sketch an implementation of the subtonal analysis proposed above in Optimality Theory (OT, Prince & Smolensky, 1993, 2004). The goal is not to defend any specific OT analysis, but rather to use standard constraints to show that a subtonal analysis is entirely compatible with a basic constraint-based approach.

The markedness constraint driving M-lowering and accounting for the static *MX/XM pattern is *[αraised][βraised] (*[αr][βr] for short), penalizing adjacent disagreeing [raised] features. The optimal repair to a violation of this constraint is [–raised] assimilation, which is driven by the ranking of both this

markedness constraint and IDENT[–raised] above IDENT[+raised]. Undominated IDENT[upper] explains why the [upper] feature is not affected by any change. Tableau (29) illustrates morphophonological M-lowering: the optimal output is (29)b, which avoids a violation of *[αraised][βraised] by changing the M tone of the root to L, i.e. the [+raised] feature of the root to [–raised], thus incurring a violation of the lowest-ranked constraint IDENT[+raised] only. Any other tonal change violates either IDENT[–raised] (candidate (29)c) or IDENT[upper] (candidate (29)d), both ranked as high as the markedness constraint the language seeks not to violate.

(29) /ŋāg-àn/ → ŋàgàn 'eat it'

	[−u +r] ŋāg	[−u −r] -àn	IDENT [upper]	IDENT [–raised]	*[αr][βr]	IDENT [+raised]
a.	[−u +r] ŋāg	[−u −r] -àn			*!	
☞ b.	[−u −r] ŋàg	[−u −r] -àn				*
c.	[−u +r] ŋāg	[−u +r] -ān		*		
d.	[+u −r] ŋág	[−u −r] -àn	*!			*

As seen in Tableau (30), when the root does not have a M tone, the faithful candidate violates none of the constraints, and harmonically bounds all other candidates, which explains why neither M-lowering nor any other tonal change takes place. This is holds for H-toned roots (illustrated in (30)) as well as for L-toned roots (not illustrated here to save space).

(30) /kár-àn/ → káràn 'put it'

	[+u −r] kár	[−u −r] -àn	IDENT [upper]	IDENT [–raised]	*[αr][βr]	IDENT [+raised]
☞ a.	[+u −r] kár	[−u −r] -àn				
b.	[−u −r] kàr	[−u −r] -àn	*!			
c.	[−u +r] kār	[−u −r] -àn	*!	*	*	
d.	[−u +r] kār	[−u +r] -ān	*!	**		

Morphosyntactic M-lowering, caused by a floating [–raised] feature, requires additional constraints to enforce the realization of the floating feature. The option I choose here is to resort to both *FLOAT, which penalizes floating features in the output (Wolf, 2007), and REALIZE-MORPHEME (REAL-MRPH for short), which requires that for every morpheme in the input, some phonological element should be present in the output

(van Oostendorp 2005). Both constraints, together with MAX[–raised] preventing deletion of a [–raised] feature, must dominate MAX[+raised], because the realization of the floating [–raised] feature is obtained to the detriment of the root [+raised] feature. MAX constraints are necessary here since the optimal repairs involve feature deletion and/or replacement rather than feature value change (cf. Lombardi, 1995, 1998). This analysis of morphosyntactic M-lowering is illustrated in the tableau in (31). As seen, the [–raised] suffix cannot be kept floating in the output (this violates high-ranked *FLOAT, cf. candidate (31)a), nor can it be simply deleted (this violates REALIZE-MORPHEME, cf. candidate (31)b). The optimal solution is to replace the root [+raised] feature with the floating [–raised], as seen in candidate (31c), which violates only the lowest-ranked constraint IDENT[+raised]. Changing the root M to H is not an optimal repair, since it violates high-ranked IDENT[upper], as seen in candidate (31)d.

(31) /ɲāg-[–raised]/ → ɲàg 'eat +OBJ'

$\begin{bmatrix} -u \\ +r \end{bmatrix}[-r_i]$ ɲāg	*FLOAT	REAL-MRPH	IDENT [upper]	MAX [–raised]	*[αr][βr]	MAX [+raised]
a. $\begin{bmatrix} -u \\ +r \end{bmatrix}[-r_i]$ ɲāg	*!				*	
b. $\begin{bmatrix} -u \\ +r \end{bmatrix}$ ɲāg		*!		*		
☞ c. $\begin{bmatrix} -u \\ -r_i \end{bmatrix}$ ɲàg						*
d. $\begin{bmatrix} +u \\ -r_i \end{bmatrix}$ ɲág			*!			*

To account for non-M tone roots, with which the floating [–raised] is not visibly realized, one could appeal to either deletion of the floating [–raised] feature, or fusion of this feature with the root [–raised]. I arbitrarily choose the latter here, which requires the constraint UNIFORMITY, penalizing fusion in the output of elements that are distinct in the input McCarthy & Prince, 1995). Ranking UNIFORMITY (UNIF for short) lower than *FLOAT and REALIZE-MORPHEME enforces fusion of the floating and root [–raised] features, as seen in candidate (32)b. Changing the H tone of the root to L as in candidate (32)d can only be suboptimal, since (i) it is not a repair to the markedness constraint *[αraised][βraised], which is not violated by the faithful candidate (32)a (or by any other candidate in (32)), and (ii) it violates high-ranked IDENT[upper].[9]

[9] The alternative analysis, deletion of the floating [–raised] suffix after non-M roots, is easily modeled with the following ranking of the same constraints: *FLOAT, IDENT[upper], *[αraised][βraised] $\gg$ REALIZE-MORPHEME, MAX[–raised] $\gg$ MAX[+raised].

(32) /kár-[–raised]/ → kár ‘eat +OBJ’

$\begin{bmatrix} +u \\ -r \end{bmatrix}[-r_i]$ kár	*FLOAT	REAL-MRPH	IDENT [upper]	MAX [–raised]	*[αr][βr]	UNIF
a. $\begin{bmatrix} +u \\ -r \end{bmatrix}[-r_i]$ kár	*!					
☞ b. $\begin{bmatrix} +u \\ -r \end{bmatrix}$ kár		*!		*		
c. $\begin{bmatrix} +u \\ -r_i \end{bmatrix}$ kár						*
d. $\begin{bmatrix} -u \\ -r_i \end{bmatrix}$ kàr			*!			*

6 Inadequacy of Tone-as-Unit analysis

Instead of positing subtonal features, one could try and analyze M-lowering as involving L-spreading onto M rather than [–raised] assimilation. This would straightforwardly account for morphophonological M-lowering before a L-toned suffix (33), as well as morphosyntactic M-lowering, analyzed as involving a floating L suffix (rather than [–raised]), as shown in (34) below.

(33) ŋāg -àn → ŋàg -àn ‘eat it’
M L ~~M~~ L

(34) ŋāg → ŋàg ‘eat +OBJ’
M (L) ~~M~~ (L)

However, there are at least three problems with this approach. First, it does not account for morphophonological M-lowering before a H-toned suffix – unless one posits a floating L before every H-toned suffix in the language, as in (35), for which there is no independent evidence.

(35) ŋāg -án → ŋàg -án ‘eat him’
M (L) H ~~M~~ (L) H

Secondly, the fact that the L spreads only onto a preceding M and never a preceding H, does not follow from any property of the three tones H, M and L, and must be stipulated – contrary to the subtonal approach, in which the subtonal makeup of each tone directly explains their different behaviors.

Finally, the *MX/XM constraint on stem-level tone patterns is not fully accounted for. The absence of *ML and *LM patterns can be explained through bidirectional L spreading. However, the absence of *MH and *HM has to be stipulated – or explaining by positing a floating L tone between H and M, which, again, is not independently motivated.

Another alternative would be to analyze M as underspecified: underlyingly toneless TBUs are specified for tone through spreading of neighboring tones, or through default M-insertion if spreading could not take place. This would naturally explain the *MX/XM constraint. However, it would pose the same problem as the preceding analysis: while it accounts for M-lowering before a L-toned suffix ($\emptyset$-L_i → L_i-L_i), it still fails to account for M-lowering before a H-toned suffix without gratuitously positing a floating L tone before all such suffixes. An additional problem is the existence of a suffix with a replacive M: passive /-Vl^M/, illustrated in (36).

(36) a. /kár-Vl^{M}/ → kārāl ‘put-PASS’
b. /ɲāg-Vl^{M}/ → ɲāgāl ‘eat-PASS’
c. /ɟàr-Vl^{M}/ → ɟārāl ‘sacrifice-PASS’

If M really is ∅, then this would have to be subtractive morphology: /kár-Vl/ → (subtraction) kar-al → (default M-insertion) kārāl. This is an analytical last resort that is unnecessary in the subtonal approach. One could argue that the replacive M is in fact an underlying M, different from the default [M] realization of toneless TBUs. This would take care of this last counterargument, but would still fail to solve the problem of M-lowering before H-toned suffixes.

7 Conclusion

In conclusion, The subtonal analysis proposed in this paper provides a simple, unified analysis of the behavior of the M tone in Laal (cf. question (21)e). This analysis is not *ad-hoc*, but motivated by the behavior of the M tone, which constitutes evidence against the three main counter-arguments to subtonal features listed in (2), and answers all the questions listed in (21), as detailed in (37).

(37) a. there IS evidence for assimilation involving subtonal features – [–raised] assimilation in this case, which offers a unified analysis of both the *MX/XM constraint and all cases of M-lowering;
b. there IS evidence for subtonal natural classes:
i. [+raised] defines the natural class of targets of M-lowering, i.e. only M; this explains why only M fails to take part in complex stem-level tone patterns (question (21)a) and why only M is affected by lowering (question (21)b;
ii. [–raised] defines the natural class of triggers: H and L; This explains why M is changed to L when followed by both L and H (question (21)c);
iii. [–upper] defines the natural class consisting of M and L, which explains why M is changed to L rather than H (question (21)d);
c. finally, the specification of the M tone in three-tone languages is not necessarily ambiguous: its behavior in Laal clearly specifies it as [–upper, +raised].

Analyzing tone as the emergent result of specific feature combinations puts it on a par with segments. This similarity between tonal and segmental phonology is particularly noticeable in Laal, where [–raised] assimilation in response to the *[αraised][βraised] constraint is very reminiscent of vowel harmony. It could, indeed, be described as a case of [–raised]-dominant tone harmony, similar to the many documented cases of [+ATR]- or [–ATR]-dominant vowel harmony (Casali, 2003, 2008, 2016; Rose, 2018, a.o.).

Laal thus joins the growing cohort of languages (e.g. Seenku, McPherson, 2016; Babanki, Akumbu, 2019; Gaahmg, Trommer, 2021; Tenyidie, Meyase, 2021) that have recently been shown to demonstrate the aptness of subtonal features in phonological analysis. Laal is especially interesting in showing that the validity of subtonal features is not limited to four-height tone systems.

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