The features and geometry of tone in Laal

Abstract

Features are standard in segmental analysis but have been less successfully applied to tone. Subtonal features have even been argued to be less satisfactory for the representation of African tone than tonal primitives (e.g. H, M, L; Hyman 2010; Clements, Michaud, and Patin 2010). I argue that Yip (1980) and Pulleyblank's (1986) two-feature system offers a straightforward account of the tonology of Laal, an endangered, three-tone isolate of southern Chad – in particular properties of the Mid tone that are otherwise difficult to account for, namely the avoidance of complex patterns involving M, and a pervasive M-to-L lowering process, both straightforwardly analyzed as subtonal assimilation. Other tonal operations in Laal are shown to involve full-tone behavior, justifying a tone geometry *à la* Snider (1999, 2020) where subtonal features are linked to a Tonal Root Node, giving tones the ability to be either fully or partially active, just like segments.

1 Introduction

While featural representations are well established for segments, proposals to extend them to tone (e.g. Wang 1967; Yip 1980, 1989; Clements 1983; Pulleyblank 1986; Snider 1999, 2020; Hyman 1993a) have met more skepticism. Various proposals have been made regarding the featural representation of tone (see McPherson 2016 for a recent overview). The most widely used system is that of Yip 1980, which makes use of two features: one "register" feature [±upper], dividing the tone range into an upper and a lower register, and a secondary feature [±high] further subdividing each register into discrete tonal categories. The latter feature was renamed [±raised] by Pulleyblank (1986:125) to avoid any confusion with the vocalic feature [±high]. The analysis of a four-tone height system cast in these featural representations is given in (1) below.

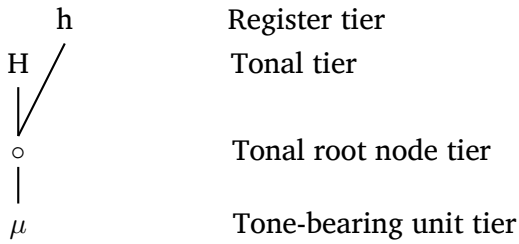
(1)

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

Other authors (Clements 1983; Hyman 1993b; Snider 1999, 2020) have proposed very similar systems with unary rather than binary features, e.g. Snider's (1999; 2020) register features *h* and *l* (≈ [±upper]), and tonal features H and L (≈ [±raised]). These two kinds of systems are mostly equivalent (although they differ on one non-trivial point: the definition of the register feature(s), as we will see in §5.1). Snider (1999, 2020) further refines the

featural representation of tone by proposing a geometry in which subtonal features are linked to a Tonal Root Node (TRN), which is itself associated with a Tone Bearing Unit (TBU), as shown in (2).

(2) Geometry of tone (Snider 2020:23)



Recently, authors such as Hyman (2010) or Clements, Michaud, and Patin (2010) have argued that African tone systems are better represented with tonal primitives (e.g. H, M, L) than with features. The main arguments rest on the absence of parallelism between segmental and subtonal features, and can be summarized in the following four points:

(3) a. there is no evidence for subtonal natural classes;
b. there is no evidence for assimilation or dissimilation involving subtonal features;
c. since combinations of two subtonal features allow for the representation of a four-way contrast, subtonal features are not suited for three-tone languages, where the specification of the M tone is ambiguous;
d. a two-feature system allows for interactions between non-adjacent tones, for which there is no solid empirical argument.

The main goal of this paper is to bring additional evidence in favor of subtonal features. To this effect, I present the tone system of Laal, an under-documented language isolate of southern Chad with three contrastive tone heights. I argue that a representation of tone *à la* Snider (1999, 2020) as a tonal root node linked to two subtonal features offers a natural account of the tonology of Laal. The main empirical support for subtonal features comes from the Mid tone, whose behavior is otherwise difficult to account for in a unified manner. The puzzling tonal realization of the ventive suffix also finds a straightforward explanation with subtonal features. In response to the criticisms listed in (3) above, I show that Laal has subtonal natural classes and assimilation patterns compatible with a featural approach, that the M tone in this three-tone system naturally lends itself to a non-ambiguous featural specification, and (iv) that the two non-adjacent tones H and L do interact and form a natural class. Laal is thus evidence that subtonal features are well-suited to account for three-tone systems.

Other tonal alternations attested in the morphophonology of Laal, such as replacive grammatical tone, high tone spread, or full-tone deletion, involve operations targeting full tones, and not just subtonal features. This constitutes evidence for a hierarchical structure of tone similar to that in (2) above, where two subtonal features are linked to a tonal root node (TRN). The Laal facts thus show that tones, just like segments, can be either fully active (TRN activity), or partially active (subtonal feature activity). I also show that subtonal features can exist on their own just like (floating) segmental features.

The paper starts with background information on the Laal language and data sources (§2). The distribution and behavior of the M tone are described in §3 and §4 respectively. I then propose a subtonal analysis of these facts in §5, and show in §5.5 that this analysis also accounts for the tonal behavior of the ventive suffix. The emergent nature of subfeatures is dicussed in §5.6. The inclusion of the Tonal Root Node in the proposed tone geometry is justified in §6 with the analysis of three other tonological processes: base tone pattern reduction upon suffixation, replacive grammatical tone in the gerund and passive suffixes, and High tone spread with inalienable possessive suffixes. Alternatives are presented in §7 and shown to be less adequate than the subtonal analysis. Finally, §8 concludes.

2 Preliminary remarks on Laal

2.1 Language and data

Laal is a language isolate spoken by about 800 people in Gori and Damtar, two villages along the Chari river in southern Chad, as well as in urban centers such as Sarh and N'Djaména. Prior work on the language was undertaken by Pascal Boyeldieu in the 1970's, who published a preliminary description of the sound system (Boyeldieu 1977), as well as a description of the nominal and verbal systems (Boyeldieu 1982, 1987) which includes the first description of the M-lowering patterns described and analyzed in this paper.

Unless explicitly stated, all the data presented in this paper come from my own fieldwork: about eighteen months between 2010 and 2020, with multiple speakers of various ages, both male and female, mostly in Gori, as part of a language documentation project funded by the DOBES (Documentation of Endangered Languages) program of the Volkswagen Foundation. Speaker participation and informed consent were obtained in accordance with IRB protocols #2011-03-3000 (University of California, Berkeley) and #10346 (Princeton University).

The data collected during the documentation project are archived and openly accessible as part of the DoBeS collection in The Language Archive hosted by the Max Planck Institute for Psycholinguistics in Nijmegen.[1]. Examples taken from archived text recordings are duly referenced. Examples without reference are taken from my fieldnotes or lexical database.

2.2 Phonological sketch

The 24 contrastive consonants and 12 contrastive vowel qualities of Laal are presented in (4). The stop inventory is reduced outside of the stem-initial position to one series of plain stops underspecified for voicing, realized as voiced word-internally, voiceless (and often unreleased) word-finally. The vowels /ia ua yo ya/ are most of the time realized as diphthongs, hence systematically transcribed as such, but are phonologically monomoraic vowels behaving exactly like /ɛ ɔ ø œ/ respectively. The low peripheral vowels /ia ua/ and the three front rounded vowels are attested only in the stem-initial position. Finally, length is contrastive for all twelve vowel qualities, but in the stem-initial position only. Length is transcribed by doubling the vowel, or the last vowel of a digraph, e.g. /aː/ = /aa/, /iaː/ = /iaa/.

[1] https://hdl.handle.net/1839/93472197-4462-489c-8cee-0d9a3587f3e5

(4) Laal vowel and consonant inventories

		Stem-initial					*Elsewhere*			
a.	*Vowels*	i	y	ɨ	u		i	ɨ	u	
		e	yo	ə	o		e	ə	o	
		ia	ya	a	ua			a		
b.	*Consonants*	p	t	c	k	(ʔ)	p∼b	t∼d	c∼ɟ	k∼g
		b	d	ɟ	g					
		mb	nd	ɲɟ	ŋg					
		ɓ	ɗ	ʔj						
			s			h		s		
		m	n	ɲ			m	n	ɲ	ŋ
			r					r		
			l					l		
		w		j			w		j	

Laal requires every syllable to start with an onset. Vowel-initial syllables in stem-initial position are always realized with an epenthetic glottal stop onset, otherwise not contrastive in the language. Attested syllable structures are CV, CVV, CVC, CVVC, where VV stands for a long vowel. No vowel sequences are allowed – the diphthongized vowels /ia ua yo ya/ are not phonologically vowel sequences or diphthongs, but single, monomoraic vowels phonetically realized as diphthongs.

Laal is characterized by strong stem-initial prominence (Lionnet and Hyman 2018:651-655 and references therein), mostly of a distributional nature: the number of consonantal and vocalic contrasts is by far more important stem-initially than elsewhere, as shown in (4) above. The stem is defined as a lexical root and any suffixes attached to it (there are no prefixes). Most morphological words involve only one stem, e.g. /nō/ 'person', /gùm-ál/ 'melon-SG.' The very few multi-stem words consist of frozen compounds, e.g. /gàà + kɨ̀rà/ '*Pluvianus aegyptius*, bird *sp.*', and reduplicative forms, e.g. /cī + cām/ 'today', /sí + sáál/ 'bird of prey *sp.*'. Stems in Laal are maximally disyllabic. When a suffix is added to a disyllabic root, the second vowel of the root is deleted in order to avoid creating a trisyllabic stem, e.g. /tuágár-àn/ → *tuágràn* 'break it'.[2]

Two morphophonological strata can be identified in Laal. Stratum 1 suffixes include number-marking suffixes on both nouns and verbs, the deverbal suffix (e.g. *pāj* 'be painful' → *pāj-āl* 'pain'), and the denominal suffix deriving nouns referring to ethnic or cultural characteristics (e.g. *ndààm* 'Ndam (village name)' → *ndààm-ál* 'characteristic of the Ndam people'). All other inflectional and derivational suffixes belong to stratum 2: alienable possessive suffixes, object suffixes, gerund, ventive, associative, medio-passive, and passive, all of which will be illustrated and discussed in the paper. This is summarized in Table 1. These strata are defined by different morphophonological processes, or the application of

[2]There are only 50 stems that have more than two syllables, out of a total of 2701 stems in my lexicon: 47 are trisyllabic, three are tetrasyllabic. All are clearly identifiable loanwords, *gùmásì* 'clothes' (< Chadian Arabic *gumâji*), *òrdìnàtêr* 'computer' (< French *ordinateur*). Additionally, trisyllabic derived forms are exceptionally attested with the two disyllabic object suffixes *-nùrú* 'us (excl.)' and *-nìrí* 'them (fem./masc.)', although both have a monosyllabic allomorph used with equal frequency: /ɓír-nùrú/ → *ɓýrnùrú* ∼ɓýrnǔ 'show us (EX)', and /ɓír-nìrí/ → *ɓírnìrí* ∼*ɓírnǐ* 'show them (M/F.

the same processes under different conditions – in particular the vowel harmony processes discussed below. Stratum 1 morphophonology is mostly irregular and unpredictable, contrary to stratum-2 morphophonology, which is extremely regular and knows no exception.

Table 1: Laal suffixes by stratum

	Stratum 1	Stratum 2
Noun base	- Number marking suffixes - Denominal	- Possessive suffixes
Verb base	- Number marking suffixes - Deverbal	- Object suffixes - Ventive - Associative - Gerund - Passive - Medio-passive

Three vowel harmony processes are attested in Laal: perseverative [+high] harmony, anticipatory [±low] harmony, and anticipatory rounding harmony, illustrated in (5), (6), and (7) respectively.

(5) [+high] harmony: $V_{mid} \rightarrow V_{high} \ / \ V_{high}\_$

mīīw	'liver'	mììwɨr	'my liver'	(/-ər/ 'my' → -ɨr)[3]
mɪ̄lā	'eye'	mɪ̀lɪ̀l	'my eye'	
mbūl	'navel'	mbùlɪ̀l	'my navel'	

(6) Low harmony: [–high] → [αlow] / _[αlow]

a. e.g. [–low, +high] *medio-passive* /-ɨ́ŋ/ : stem low → mid

ia → e	ʔiáár	'choose'	→	ʔéérɨ́ŋ	'be chosen'
a → ə	màŋà	'gather'	→	məŋɨ́ŋ	'be gathered'
ua → o	ɟuāŋ	'buy, sell'	→	ɟòŋɨ́ŋ	'buy from one another'

b. e.g. [–low, –high] /-ər/ 'my': low → mid

ia → e	piáár	'shin'	→	péérər	'my shin'
a → ə	māl	'tongue'	→	mələ̀l	'my tongue'
ua → o	buàg	'chin'	→	bògər	'my chin'

c. e.g. [+low] /-àr∼-àn/ 'it' (OBJ)': stem mid → low

e → ia	léérí	'roll'	→	liáár-àn	'roll it'
ə → a	cə̄r	'want'	→	càr-àr	'want it'
o → ua	sór	'find'	→	suár-àr	'find it'

(7) Rounding Harmony: [–round] → [+round] / _[+round][4]
e.g. /-ò ∼ -òn/ 'her' (→ -ù ∼ -ùn, [+high] harmony)

i → y	pīg	'tie'	pỳgùn	'tie her'
e → yo	léér	'wrap'	lyóóròn	'wrap her'
ɨ → u	pɨ́r	'catch'	púrù	'catch her
ə → o	lər	'wait'	lòrò	'wait for her'

[3]The final /r/ of /-Vr/ suffixes is realized [l] when following a stem ending with /l/.

Finally, Laal has three contrastive tone heights: high (H), mid (M), and low (L), illustrated in the minimal triplet in (8) below.

(8) kúmá ‘type of basket”
kūmā ‘to hide’
kùmà ‘medicine, medication’

The tone-bearing unit is the mora, as shown by the fact that bitonal patterns are only found on CVV and CVL syllables (L= sonorant), and the only case of a tritonal pattern attested on a monosyllabic stem is *bòôr* ‘pigeon *sp.*’, a trimoraic CVVL syllable.[5] As is shown in the next section, the three tones can combine into a limited number of stem-level patterns. The distribution of tones as well as aspects of the morphotonology of the language point to a marked status of the M tone, as compared to both H and L. This is the object of the next two sections.

3 Tone distribution and the exclusivity of M

Stem-level tone patterns in Laal are tritonal at most.[6] All three single-tone patterns and all combinations of H and L (HL, LH, HLH, LHL) are attested, as shown in Table 2.[7] All are also attested as contours, when associated with monosyllabic stems, except LHL, likely an accidental gap (tritonal patterns are rare in general, and can only be realized as contours on trimoraic syllables, much less frequent than mono- and bimoraic ones).

The tone patterns in Table 2 represent 96% of all stems. The remaining 4% consists of tri- and tetra-syllabic stems (2%) – exceptional and ignored here – as well as a few bitonal patterns including a M tone: 24 HM (1%), 11 MH (0.5%), and 11 LM (0.5%). ML is strictly unattested. These include 17 HM and five MH native function words. Abstracting away from variants and forms inflected for gender and/or number, this number actually reduces to six HM and two MH function words, listed in (9a) and (9b) respectively.[8]

[4]Rounding harmony applies unconditionally only in stratum-2 morphophonology (mostly verbal morphology). In stratum 1 (mostly number marking morphology on nouns and verbs), it applies under very strict conditions: the target vowel must be in the vicinity of a labial consonant, and the trigger and target vowels must be of equal height and [front] specifications (cf. Lionnet 2017.

[5]There are only two exceptions in native vocabulary: *pǐ* ‘flower’, and *ɟuăb* ‘to walk fast’ – five with the three recent loanwords *sûg* ‘market’ (< Chadian Arabic /su:g/ [sû:kˇ]), *tûg* (< French *touque*), and *bîg* ‘pen, pencil’ (<French *bic*).

[6]The only few exceptions are found with lexical items that are exceptional in other respects, e.g. longer than two syllables, violating phonotactic requirements otherwise strongly enforced in the language, etc.

[7]The information in Table 2 is taken from my lexical database, collected in the field between 2010 and 2020, which contains 2,695 mono- and disyllabic stems.

[8] The forms of the purposive and demonstrative are /ɟáā/ and /ɟuáŋā/ respectively in the masculine singular, /ɟíī/ and /ɟúŋū/ in the feminine singular, /máā/ and /muáŋā/ in the neuter singular, /jáā/ and /juáŋā/ in the neuter plural, /jíī/ and /júŋū/ for all plurals and the abstract singular (this is a simplified description, cf. Lionnet 2001 for more detail on the gender system).

Table 2: Regular tone patterns on mono- and disyllabic stems

Tone Pattern	Number of stems	% stems
H	726	27%
M	599	22%
L	548	20%
LH	486	18%
HL	216	8%
LHL	16	1%
HLH	14	1%
Total	2,605	96%
3- and 4-syllable stems	50	2%
MX/XM patterns	46	2%
Total stems	2,701	100%

(9) a. wáā, PL wíī ITIVE ('go VERB')
náā, PL níī PROSPECTIVE ITIVE ('will go VERB')
máā, PL míī INTENTIONAL ('intend to VERB')
ɟáā PURPOSIVE ('for') (see footnote 8)
ɟuáŋā DEMONSTRATIVE (see footnote 8)
séélē 'when'

b. tāá, PL tīí IMPERFECTIVE (variant /tēé/)
ɟāá ~ ɟālá SIMILATIVE ('like')

The remaining HM and MH stems, as well as all LM stems, are all nouns borrowed from neighboring three-tone languages where tone patterns involving M are attested, e.g. *tíjāŋgō* '*Tockus sp.*, bird *sp.*' (cf. Sar *táỹ̄ng*), *kēsé* 'bow, arrow' (cf. Barma *kēsé*), *tèmē* 'sieve' (cf. Barma *tèmē*).[9]

Apart from these exceptional function items and loanwords, it can be concluded that the Mid tone in Laal is exclusive: if it is present in a stem-level pattern, it must be the only tone of that pattern (*MX/XM).

4 M-lowering and the instability of M

Not only is M exclusive, it is also unstable. Specifically, M is systematically changed to L in various morphophonological (§4.1) and morphosyntactic (§4.2) contexts.

4.1 Morphophonological M-lowering

Whenever a non-M-toned suffix is added to a M-toned root, the M tone is systematically changed to L. This lowering applies to avoid creating a complex stem-level tone pattern involving a M tone, i.e. to comply with the phonotactic constraint described above. This is

[9]Sar data are taken from Palayer (1992), Barma data from Keegan and Idris (2016).

illustrated in (10) with three suffixes carrying the three most frequent suffixal tone patterns: H, L, and LH.[10]

(10) a. /dāg-ə́n/ dəgə́n ‘drag me’
b. /dāg-àn/ dàgàn ‘drag it’
c. /dāg-nŭŋ/ dògnŭŋ ‘drag you (PL)’

As seen, the M tone of the verb root is systematically changed to L, irrespective of the nature of the following tone: H in (10a), L in (10b), LH in (10c). Only M tones are affected, as shown by the stability of H- and L-toned roots in (11).

(11) a. /kár-ə́n/ kə́rən ‘put me’
/kár-àn/ káràn ‘put it’
/kár-nŭŋ/ kórnŭŋ ‘put you (PL)’
b. /ɟàr-ə́n/ ɟərən ‘slice/sacrifice me’
/ɟàr-àn/ ɟàràn ‘slice/sacrifice it’
/ɟàr-nŭŋ/ ɟòrnŭŋ ‘slice/sacrifice you (PL)’

M-lowering applies with all stratum-2 suffixes (except the gerund and passive suffixes, whose tone is replacive, cf. §6.2): object suffixes as in all the above examples, but also inalienable possessive suffixes on nouns (both H-toned as in (12)a and L-toned as in (12)b), associative as in (13), mediopassive as in (15), and ventive as in (14).[11]

(12) a. /bāg-rúŋ/ bəgrúŋ ‘your (PL) shoulder’
/gōm-rú/ gòmrú ‘our (EX) voice’
/nīīnī-ráŋ nìnráŋ ‘our (IN) woman/wife’[12]
b. /bāg-ər/ bəgər ‘my shoulder’
/gōm-ò/ gòmò ‘her voice’
/nīīnī-àr nììnàr ‘his wife’

(13) a. /būl-V́/ bùlú ‘open with’
b. /pīg-V́/ pìgí ‘tie with’
c. /ɗīīn-V́/ ɗììní ‘swim with’

(14) a. /būl-V$_{[–r]}$/ bùlù ‘open (toward speaker / until now)’
b. /pīg-V$_{[–r]}$/ pìgì ‘tie (toward speaker / until now)’
c. /ɗīīn-V$_{[–r]}$/ ɗììnì ‘swim (toward speaker / until now)’

(15) a. /būl-ɨ́ny/ bùlɨ́ny ‘be open’
b. /pīg-ɨ́ny/ pìgɨ́ny ‘be tied’

[10]The last attested suffixal pattern is M, found only in the passive suffix, whose tone is replacive, as we will see in §6.

[11]The ventive and associative suffixes consist in a copy of the root vowel, represented with a capital “V”. The ventive suffix is tonally specified as [–raised], which explains why it causes M-lowering, as is discussed more in detail in §5.5.

[12]The stem initial vowel shortening in *nìnráŋ* (instead of *nììnráŋ) is regular, and applies in to comply with a stratum-1 phonotactic constraint against *VVCC sequences, i.e. against non-final CVVC syllables.

Note that M-lowering applies with both transitive and intransitive verbs (e.g. 'swim' in (13)c and (14)c), and with suffixes that are not related to transitivity, such as the associative and ventive. M-lowering is thus not related to transitivity or argument structure, or in general to any morphosyntactic category. It is a general phonological operation that applies without exception in stratum-2 morphophonology.

As mentioned in the introduction, stratum 1 morphophonology is complex and mostly irregular, including in its tonal effects. Suffixation of a number-marking suffix (by far the most numerous stratum-1 suffixes) onto a M-toned root does not always result in lowering of the M to L. Out of 208 nouns that are M-toned in the singular or in the plural, this M pattern corresponds to a L-initial pattern (L or LH) in the other number category in 143 cases (69%; e.g. /kòòg/, PL /kuāg-mī/ 'bone', or /siāāg/, PL /sèèg-ú/ 'milk'), to a M pattern (i.e. no tone change) in 36 cases (17%; /gār-āl/, PL /gər-ī/ '*Acacia spp.*), and to a H pattern in 29 cases (14%; e.g. /kūr-ā/, PL /kúr-ú/ 'stick', or /wúl-ú/, PL /wūl-māny/ '*Kigelia africana*, tree *sp.*'). That is, despite the relative unpredictability of the tonal alternations involved, no MX or XM pattern is ever created as a result of number-marking (and more generally stratum-1) suffixation. Furthermore, The expected M~L alternation is found in over two thirds of all cases, whereas the unexpected M~H alternation accounts for only 14%.

4.2 Morphosyntactic M-lowering

M-lowering is also attested in two morphosyntactic contexts where it does not appear to be an effect of the *MX/XM constraint: on M-toned transitive verbs followed by an in-situ object (§4.2.1), and on the M-toned head of a genitive construction (§4.2.2).

4.2.1 M-lowering in transitive verbs

A M-toned transitive verb undergoes M-lowering whenever its syntactic object is present *in situ* – i.e. neither elided nor extracted. This is shown in the three examples in (16).[13]

(16)	a.	ɟá	tō	*vs.*	ɟá	tò	kúdál
		I	carry		I	carry(M>L)	stone
		'I carry (it).'			'I carry a stone.'		
	b.	ɟá	ɲāg	*vs.*	ɟá	ɲàg	tāā
		I	eat		I	eat(M>L)	fish
		'I eat (it).'			'I eat fish.'		
	c.	ɟá	jīrā	*vs.*	ɟá	jìrà	guàmàn
		I	hear		I	hear(M>L)	your.voice
		'I hear (it).'			'I hear your voice.'		

Only M-toned verbs are affected. H, L, LH, and HL verbs (the four attested tone patterns on verbs) are all realized with their underlying tone in the same context, as shown in (17).

[13] Aspect and modality are marked with preverbal particles. Verbs unmarked for aspect or modality have a wide range of possible interpretations, and will be translated either as present or past, depending on context and on the translation given by language consultants.

(17) a. H kár ‘put’ ɟá kár ndiáw ɓə́ sàndùg
I put knife on trunk
‘I put a/the knife on a/the trunk.’

b. L ɟàr ‘slice’: ɟá ɟàr tuààr
I slice chicken
‘I cut the chicken’s throat.’

c. LH jùgár ‘shake’: à jùgár jāān
he shake his.body
‘He is fidgety.’

d. HL múrì[14] ‘run (PL)’: ì múrì gààm
they.M/F run:PL dance.sp
‘They did the funeral dance.’

As shown in (16) above, M-lowering occurs irrespective of the tone of the following word: H (16a), M (16b), or L (16c). The following examples show that it is not caused by the preceding tone either.

(18) a. náár tō *vs.* náár tò kúdál
his.mother carry his.mother carry(M>L) stone
‘His mother carried (it).’ ‘His mother carried a stone.’

b. nīīnī tō *vs.* nīīnī tò kúdál
woman carry woman carry(M>L) stone
‘The woman carried (it).’ ‘The woman carried a stone.’

c. bààr tō *vs.* bààr tò kúdál
his.father carry his.father carry(M>L) stone
‘His father carried (it).’ ‘His father carried a stone.’

M-Lowering is attested with both matrix clauses (as in (16)-(18) above) and subordinate clauses, as in (19).

(19) a. ìn ɓílá mí Kábó mí́ tò kúdál
she say (say)that Kabo QUOT.EV carry(M>L) stone
‘She said that Kabo carried a stone.’

It occurs in all clause types: affirmative as in (16)-(18), negative as in (20a), or interrogative as in (20b).

(20) a. ɟá tò kúdál wó
you.SG carry(M>L) stone NEG
‘I did not carry a stone.’

b. ò tò kúdál à
you.SG carry(M>L) stone Q
‘Did you carry a stone?’

[14]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)’.

Finally, it also occurs with all TAM markers combining with the base form of the verb (and not the gerund, cf. §4.2.3), e.g. habitual *kó* in (21).

(21) e. à kò tò kúdúr
he HAB carry(M>L) stone:PL
'He usually carries stones.'

It is attested with nominal objects, as illustrated in (16), (18), and (21) above, but also with wh-objects, as shown in (22).

(22) ɲààn jìrà ɟè
bush know(M>L) who
'Who does the bush know?' (proverb)

It is also attested with gerund complement clauses, which can be considered nominalized clauses acting as argument of the main verb, as shown in (23a), where /cər/ 'want' is realized with a L-tone, just like in (23)b.

(23) a. ɟá cər kàrà páátĭ nììn-ìr
I want(M>L) do:GER wedding+CON[15] woman-my
'I want to organize my wife's wedding ceremony.' (110612-AK1:84)

b. ɟá cər cǎn ɗāā
I want(M>L) child+CON your
'I want your child.' (110612-AK1:21)

As seen, *cər* 'want' undergoes M-lowering when followed by a gerund complement clause (23a) as well as by a nominal object (23b). M-lowering is not triggered, however, by a following embedded clause introduced by a complementizer, as shown in (24).

(24) ìrí cər mí *absolument* ì mínì ìrì pəəl kán
they.M/F.IND want (say)that absolutely(Fr.) they INT.PL take:GER village DEF
'They are determined to conquer the village.' (170703-KN2:709)

M-lowering applies only if the syntactic object is present *in situ* (but not necessarily immediately after the verb, as we will see in §4.2.3). Whenever the object is not in its original post-verbal position, there is no M-lowering. This is the case, for example, when the object is understood or elided, as with the verb *ɲāg* 'eat' in (25) (see also (16)).

(25) ò sór nàr biàár ò ɲāg
you find little *Tilapia* you eat
'You find a little *Tilapia* and you eat [it].' (121120-09-OK1:164)

[15]The connective (CON) is a function word used for noun modification by any type of modifier: noun, prepositional phrase, adverb, relative clause, alienable possessive markers, etc. The connective agrees in gender and number with the head noun: /ɟá/ = masculine singular, /ɟí/ = feminine singular, /má/ = neuter singular, /já/ = neutral plural, /jí/ = all plurals, abstract singular. The connective has a H floating tone allomorph, which is realized on the last mora of the preceding word, creating a contour if this mora is associated with a M or H tone. This post-lexical contour is unrestricted, i.e. it is subject neither to the limit of one tone per mora nor to the *MX/XM constraint, e.g. /sū H nīīr/ = [sǔ nīīr] (water CON be.hot) 'hot water'.

It is also the case when the object is topicalized, as with *ɲāg* 'eat' in (26) (also (28a)), or relativized, as *ɟuāŋ* 'to buy' in (27).

(26) tuààr ↗[16] sárú ↗ mōɲ ↗ [jí ɗāŋ]$_{TOP}$ ɟí ɲāg wó
chicken LIST tortoise LIST crocodile LIST CON.A ANAPH I.F eat NEG
'Chicken, tortoise, crocodile, [all that]$_{TOP}$, I don't eat.' (120322-FN1)

(27) ɟá jìrà ɓə̀ mīrā yá à ɟuāŋ
I.M know(M>L) head:CSTR cattle:PL CON:N.PL he buy
'I know how many heads of cattle he bought.' (lit. I know the heads of cattle that he bought) (140402-028-HN1)

An adverb or prepositional phrase does not trigger M-lowering on the immediately preceding transitive verb with an elided object, as shown with *jīrā* 'to know' in (28a) and *jāg* 'to pour' in (29a). Compare with similar clauses with an in-situ object in (28b) and (29b).

(28) a. jə̀w cáŋ nūŋ ɟí jīrā tál wó
language Sar TOP I.F know well NEG
'The Sar language, I don't speak [it] well.' (120405-04-AK3:70)

b. ɟá jìrà máánà nìrí
I.M know(M>L) history their
'I know their history.' (170703-KN2:278)

(29) a. wógə̀d jí àn míín gàná ò suám ò jāg jà té
time CON it be.dry then you.SG take you.SG pour/put LOC on.ground
'When it [the salt loaf] is dry, you take [it] and you put [it] down on the ground.' (120322-FN1)

b. ɓə̀ jə́ dā ò jàg tílá jà té
for what firstly you pour(M>L) sand LOC on.ground
'Why do you put sand on the ground?' (120322-FN1:60)

The post-verbal noun phrase must be the syntactic object of the verb in order to trigger M-lowering. This can clearly be seen when comparing post-verbal objects with locative nouns used as adjuncts, e.g. *ɲààn*, which translates as 'bush', as in (22) above, or 'in the bush', as in (30a). In the latter case, it does not trigger M-lowering on the preceding verb. The same verb does undergo M-lowering, however, when the following noun is its object, as in (30b).

(30) a. ɟá tāār ɲààn
I hunt bush
'I hunt in the bush.'

[16] ↗ stands for a pitch rise used as a list coordination marker.

b. ɟá tààr ɲuáɲá
I hunt(M>L) elephants
'I hunt elephants.'

Finally, M-lowering is not triggered by a dative pronoun immediately following a verb whose object is elided or extracted. For example, the third person neuter singular *nànáˊ* 'to it' in (31) does not trigger M-lowering on the immediately preceding verb *pīg* 'to tie'.

(31) [Context: Lion, a folktale character, decides to attach a shell filled with ashes to Hare's tail in order to be able to follow Hare's tracks; the storyteller addresses Lion in the second person, as is frequent in folktales.]
... ò pīg nànáˊ jà tɨ̀màn
you tie to.it LOC its.tail
'... you tie [it] (=the shell) to its (=Hare's) tale.' (lit. you tie [it] to it (=Hare) at its (=Hare's) tail)' (120322-AK3:74)

To summarize, M-lowering targets M-toned transitive verbs whose syntactic object is present *in situ*.

4.2.2 M-lowering in genitive constructions

Morphosyntactic M-lowering is not limited to the verb phrase. It also applies in the noun phrase, specifically to the M-toned head of a genitive construction. What I call 'genitive construction' is the direct modification of a noun by a noun or noun phrase in apposition, expressing a form of intrinsic relation between the two entities referred to by the modified and modifying elements, including but not limited to inalienable possession (cf. Boyeldieu 1987 for more detail). The genitive construction is head-initial and, as we will see, head-marked (at least for M-toned head nouns). The marking of the genitive relation on the head noun is what Creissels (Creissels 2009, Creissels 2018:724–733) calls 'construct form'. In Laal, only M-toned nouns have a dedicated construct form, marked by M-lowering, as shown in (32).

(32)	a.	dōrūm	'rope':	dòrùm	hól	'rope made of plant *sp.*'
				rope(M>L)	plant.sp	
	b.	mɪ̄lā	'eye, point':	mɨ̀là	sōōl	'spear point'
				point(M>L)	spear	
	c.	ɲūm	'oil, fat':	ɲùm	mèrɨ̀m	'animal fat'
				fat(M>L)	animal	

The examples in (33) show that only M-toned nouns undergo any tone change when heading a genitive construction. In other words, non-M-toned nouns do not have a dedicated construct form.

(33)	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	

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 (34).

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

The genitive complement may also be a syntactically complex noun phrase, as in (35), where *jēn* (lowered to *jèn*) 'body' is the head and *cǎn nīīnī kán wùrù* 'the girl's family' the complement.

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

Finally, as shown in (36), there is no M-lowering in Noun-Noun compounds – which are not frequent in Laal, and often fossilized and opaque (the sign "+" is used to separate the individual stems making up each compound; see §5.2) for further discussion and (56) for more examples).

(36)	mōō+gà+díígí	'hippopotamus'	(hippopotamus+?+?)
	wār+bìíg	'bat'	(?.shellfish?)
	ɲā+píírá	'skink (PL)'	(?+?)

Exactly as we observed in the case of M-toned verbs, M-lowering on nouns is not attested in any other context. A M-toned noun keeps its M tone when modified by a connective construction, as seen in (37). The connective construction (Noun + connective + modifier) is used to modify nouns with any type of modifier: noun (phrase), adverb, relative clause, etc.

(37)	miān	má	dōŋ
	road	CON	be.long
	'long road'		

M-lowering is not triggered by a modifying numeral, as shown in (38).

(38)	dōrūm	ɓìdíl	/	wūrā	māā
	rope	one		men	three
	'one rope'			'three men'	

Determiners (all post-nominal) do not trigger M-lowering either, as can be seen with the definite, indefinite, and partitive indefinite ('one of...') markers in (39).

[17] /wə́n/ 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').

(39) a. nīīnī kán ɲíní
woman DET come
'The woman came.'

b. nō ɟàn ɲíní cuàr-á
person INDF.M.SG come look.for-you(SG)
'Someone came looking for you.' (140329-34-HN1)

c. nō ɟánàn ɲíní cuàr-á
person INDF.PART.M.SG come look.for-you(SG)
'One of the people came looking for you.' (140329-36-HN1)

Focus and topic markers do not cause M-lowering on a preceding M-toned noun, as shown in 40 with the focus marker *jì* (40a), the topic marker *muāŋ* (40b), and the contrastive topic marker *lē* (40c).

(40) a. wūrā jì mɨ́ tēé kí ɓēē jīnān jì mɨ́ tēé kí
men FOC.PL QUOT.EV IPFV do.PL or women FOC.PL QUOT.EV IPFV do.PL
'[He is asking:] was it the men who used to do [this job], or the women.' (120409-AK3[HN1]:152)

b. ŋgiāāl muāŋ èènán ná ɲíní ná pìr-ì nā gòò
hyena TOP.N.SG (at)night PROS come PROS catch-GER.TR DAT:you(SG) goat
'(As for) the hyena, at night it will come and snatch a goat from you.' (121120-OK1:33)

c. nīīnī lē ɨ́ny ɓɔ́ miàdál
woman TOP.CONTR sit on tree
'The woman, on the other hand, sits on the tree.' (120322-HN1:88)

Finally, M-lowering is not triggered by a following adverb, e.g. *bɨ̀là* 'only' in (41a), *kɔ́w* 'too, also' in (41b), or the negative marker *wó* in (41c).

(41) a. [ɨ̀n] tāá tùù siāāg bɨ̀là
she IPFV suck:GER.TR milk only
'She was still only suckling.' (120405-4-AK3:59)

b. mālā kɔ́w ɗìààn[18]
"mala" too there
'There is also (a tradition called) *mālā*.' (120331-DK4-160)

c. àn ná sèè nō wó
it PROS kill:GER.TR person NEG
'It will not kill anyone.' (lit. it will not kill a person) (120321-02-AK3:11)

In sum, M-lowering affects the M-toned head of a genitive construction.

[18]Locative predication is direct in Laal, and requires neither a verb not an overt copula: /mālā kɔ́w Ø ɗìààn/ = *mālā* also [is] there.

4.2.3 M-lowering as inflectional morphology

Morphophonological M-lowering seems at first sight to be analyzable as a syntactically conditioned phonological alternation: in certain specific syntactic contexts – transitive verb followed by its object, genitive head followed by its complement – M is changed to L. I show in this section that this is not the correct analysis. I argue that these two cases of morphosyntactic M-lowering are best analyzed as head-marking inflectional morphology, i.e. specific forms of verbs and nouns exponing a specific morphosyntactic feature – in this case, the presence of a complement *in situ*: object of the transitive verb, genitive complement in a genitive construction, i.e. a form of non-extraction marking (cf. Lionnet 2015).[19]

Two arguments can be put forth in favor of an inflectional analysis of M-lowering on transitive verbs: adjacency, and morphological systematicity.[20]

Surface adjacency is not required between the verb and its object for M-lowering to occur. Indeed, the dative complement or adjunct frequently occurs before the object (this is its preferred position, if it is not too long), as shown in (42b). When it is pronominal, it obligatorily follows the verb, i.e. intervenes between the verb and its object, as in (43).

(42) a. à ɟuàŋ/*ɟuāŋ [sààb ɓìdíl]$_{OBJ}$ [kɨ́ nīīnī]$_{DAT}$
he buy(M>L) cloth one for woman
'He buys/bought one piece of fabric for the woman.' (Boyeldieu 1982:153)

b. à ɟuàŋ/*ɟuāŋ [kɨ́ nīīnī]$_{DAT}$ [sààb ɓìdíl]$_{OBJ}$
he buy(M>L) for woman cloth one
'He buys/bought the woman one piece of fabric.' (Boyeldieu 1982:153)

(43) a. à ɟuàŋ/*ɟuāŋ [nùg]$_{DAT}$ [sààb ɓìdíl]$_{OBJ}$
he buy(M>L) DAT:3F.SG cloth one
'He buys/bought her one piece of fabric.'

b. kùŋú jàg/*jāg [nànáá]$_{DAT}$ [ɟámdéd]$_{OBJ}$
leopard pour(M>L) DAT:3N.SG bit
'The leopard put the bit in its mouth. (lit. leopard poured to.it the bit) (121120-OK1:159)

The second argument 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 (44)a-a'. It is required after certain aspectual and modal markers: imperfective *tāá/tīí~tēé*, prospective *ná/ní*, itive *wáā/wíī*, prospective-itive *náā/níī*, injuctive-itive *màá/mìí*, counterfactual *mɨ̀ná/mɨ̀ní*, and intentional *mɨ́nà/mɨ́nì* (all are number-sensitive:

[19] A detailed syntactic analysis of the genitive construction is beyond the scope of the present paper. The noteworthy parallel with transitive verb + object constructions, already noted by Boyeldieu (1987:84), suggests parallel structures, which is what underlies my choice of treating them both as head + complement structures. If a more thorough study of the syntactic properties of the genitive construction were to show otherwise, it would not radically change the analysis proposed here: the inflectional category expressed by M-lowering on a genitive head would simply be different from that expressed by the same M-lowering on a transitive verb.

[20] Cf. Crysmann 2004, 2005, 2011 for similar arguments in favor of an inflectional analysis of similar facts in Hausa.

SG/PL). This use is illustrated with the prospective marker *ná* in (44)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 (44)a,b, and one which is marked with a suffix and used only with transitive verbs followed by an *in-situ* object as in (44)a',b'. The marked form of the gerund is used in exactly the same context as M-lowering: this parallelism is briefly illustrated in (44)b-b' and (44)c-c', repeated from (16)b above.

(44)

a.	ɲāg	pāj		a'.	ɲàg-à	tāā	pāj	
	eat(:GER)	be.difficult			eat-GER.TR	fish	be.difficult	
	'Eating is difficult.'				'Eating fish is difficult.'			
b.	ɟá	ná	ɲāg	b'.	ɟá	ná	ɲàg-à	tāā
	I	PROS	eat(:GER)		I	PROS	eat-GER.TR	fish
	'I will eat (it).'				'I will eat fish.'			
c.	ɟá	ɲāg		c'.	ɟá	ɲàg	tāā	
	I	eat			I	eat(M>L)	fish	
	'I eat (it).'				'I eat fish.'			

This form is derived by addition of the suffix /-V^L/, which consists of an underspecified vowel realized as a copy of the verb root's final vowel, and a replacive L tone that overwrites the underlying tone of the verb – i.e. all verb roots, irrespective of their underlying tone, are realized with a L tone when combining with this suffix (see §6.2 for more detail). Lexical tonal contrasts are thus completely neutralized in the marked gerund form, as shown in the bottom-right quadrant of Table 3 (cf. §6 for more detail).[21]

The marked form of the gerund is used with exactly the same function as M-lowering: on transitive verbs with an overt object *in situ*. Just like M-lowering, it does not occur when the object is topicalized (45) or relativized (46).

(45) [jí ɗāŋ]$_{top}$ mālā tēé cər/*cərə wó pār.
CON.A ANAPH *mala* IPFV want:GER/GER.TR NEG all
'Those things [I've just mentioned], the *mala* does not like any of them.' (120331-DK4:176)

(46) jí rāāg ná ká/*kàrà nǔŋ
CON.A God PROS do:GER/GER.TR DAT:you(PL)
'what God will do to you (pl.)' (110612-AK1:116)

It is not used when the verb is followed by an adjunct locative noun (47a) (compare with the effect of an *in situ* object in (47b)).

(47) a. ɟá náā tāār/*tààr-à ɲààn
I PROS.IT hunt:GER/-GER.TR bush
'I will go hunt in the bush.'

[21] With a subset of Ca(a) verbs, an [r] is epenthesized between the root and the following suffix, e.g. *'já* 'take', *'jà-r-à* 'take (GER)'. This epenthesis occurs with all suffixes for this set of verbs – the only exception is *ká* 'do', for which r-epenthesis is not found with pronominal suffixes, e.g. *kà-r-à* 'do (GER), but *ká-àn* 'do it'.

b. ɟá náā tààr-à/*tāār ɲé
I PROS.IT hunt-GER.TR/GER elephant
'I will go hunt an elephant.'

Finally, like with M-lowering, the marked form of the gerund is used when a dative complement or adjunct intervenes between the verb and the object, as shown in (48), repeated from (40).

(48) ... ná ɲíní ná pɪ̀r-ɪ̀/*pír nā gòò
PROS come PROS catch-GER.TR/GER DAT:you(SG) goat
'... [it] will come and snatch a goat from you.' (121120-OK1:33)

Both M-lowering and the /-V^{L}/ suffix are thus exponents of the same inflectional category, in morphosyntactic complementary distribution: M-lowering on simple finite verbs (i.e. non-derived and not otherwise inflected), the suffix /-V^{L}/ on gerunds. This is summarized in Table 3.

Table 3: Simple and gerund forms

	No object in situ		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 + OBJ'
M	ɲāg	'eat:GER'	ɲàg-à	'eat:GER + OBJ'
L	ɟàr	'sacrifice:GER'	ɟàr-à	'sacrifice:GER + OBJ'

As for M-lowering in the genitive construction, the same argument of paradigmatic systematicity can be used as evidence of its status as inflectional morphology. Indeed, there are ten nouns in Laal which have a specific construct form, usually obtained through truncation of the number marking suffix, and used in exactly the same context as M-lowering:

(49)

regular form	*genitive form*	
ɓír-ál	ɓír (~ɓírál)	'pit (of fruit)'
bɪ̀n.mɪ̀n-án	bɪ̀n.mɪ̀n	'forehead'
ɟɪ̀n-án	ɟɪ̀n	'belly'
ɓàg-ál	ɓə̀ (~ɓàgál)	'head'
jəw-əl	jəw	'mouth, language'
mēē-l	mèè (~mèèl)	'name'
ɟē-n	ɟèè (~ɟèn)	'bottom'
jē-n	jèè (~jèn)	'body'
nīīnī	nɪ̀n	'woman, wife'
wúrá	wúr	'thing (PL)'

Consequently, M-lowering, both in the verb phrase and in the genitive construction, must be analyzed as the morphological exponent of a morphosyntactic category. This category can be defined as "non-extraction marking" (or "presence of complement *in situ*").

4.3 Interim summary

The three-tone system of Laal displays a number of distributional restrictions on the M tone that the H and L tones are exempt from. The M tone is exclusive, i.e. there is a strong constraint against stem-level tone patterns involving a M tone (*MX/XM, with a few exceptions among function words and recent loanwords). To avoid creating this banned structure, 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 raises at least the following five questions:

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

I show in the next section that a subtonal analysis of the Laal tone system offers a unified, straightforward account of all these phenomena.

5 Subtonal analysis

5.1 Subtonal features

Using Pulleyblank's (1986:125) version of Yip's (1980) two-feature model, I propose the following analysis of the Laal tone system:

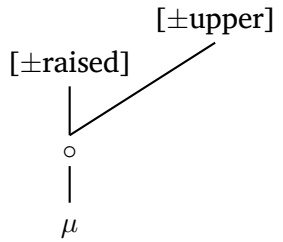
(51) Tone features:

	[upper]	[raised]
H	+	–
M	–	+
L	–	–

Specifically, M is analyzed as 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]. This gap is reminiscent of similar segmental gaps (i.e. unattested featural combinations) in phonemic inventories, e.g. cross-linguistically frequent lack of a voiceless bilabial plosive or absence of front rounded vowels (cf. §5.6 for further discussion). 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 (ii) the analysis of H as [–raised].

I further assume the tone geometry in (52), borrowed from Snider's (1999; 2020) Register Tier Theory.

(52) Tone geometry (after Snider 2020:23)



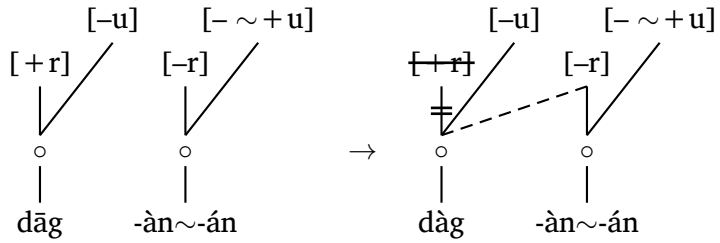
The two subtonal features [upper] and [raised] are on two separate tiers. They are linked to a Tonal Root Node (TRN), which is a representation of a "full" tone, i.e., H, M, or L. The TRN is in turn associated with the TBU, i.e., the mora in Laal. This representation allows for both feature spreading and "full tone" (i.e. TRN) spreading, both of which are necessary to account for the tonology of Laal, as I show in this and the next section.

I do not adopt Snider's features H, L, *h*, and *l* here. Indeed, while his two "tone features" H(igh) and L(ow) can be considered to be the exact equivalent of Pulleyblank's (1986) [+raised] and [–raised] respectively (and Yip's (1980) [+high] and [–high]), his two register features *h(igh)* and *l(ow)* are not equivalent to Yip and Pulleyblank's register feature [±upper]. The latter is defined on purely paradigmatic grounds: [+upper] tones are realized within a higher register than [–upper] tones. In contrast, Snider's *h* and *l* register features are defined in both paradigmatic and syntagmatic terms: they "effect a register shift *h* = higher and *l* = lower *relative to the preceding register setting* (Snider 2020:25, emphasis mine; see also p.151-153). This definition allows Snider to account for downstep and upstep phenomena with register features. Since downstep is not at issue here, I prefer to adopt a purely paradigmatic definition of the register feature.

5.2 Morphophonological M-lowering as [–raised] assimilation

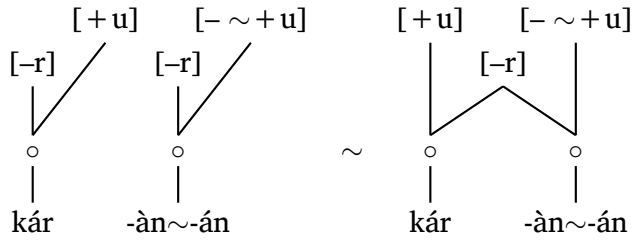
Within the subtonal feature system proposed in (51) above, I propose to analyze M-lowering as the result of one simple process: [–raised] agreement/assimilation, which applies in response to a stem-internal constraint against sequences of disagreeing [raised] features: *[αraised][βraised]$_{\text{STEM}}$. This straightforwardly accounts for morphophonological M-lowering, and explains (i) why only M is targeted – 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 (53) below, with assimilation/agreement formalized as [–raised] spreading. H- and L-toned suffixes are represented together, the only featural difference between them being the value of the [upper] feature, which plays no role in [–raised] assimilation. The features [upper] and [raised] are shortened to [u] and [r] respectively in autosegmental representations, for lack of space.

(53) /dāg-àn∼-án/ → *dàgàn* ∼ *dàgán* ‘drag it∼him’

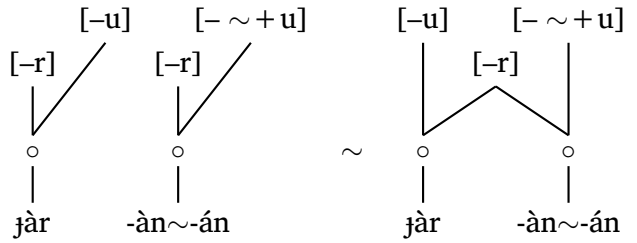


This analysis also naturally accounts for the fact that neither L nor H are targeted by any tonal changes in the same context: they are both already [–raised] and therefore (i) they do not violate the *[αraised][βraised]$_{\text{STEM}}$ constraint when followed by a a suffix carrying a [–raised] feature, and (ii) they are never targeted by [–raised] assimilation. This is shown in (54) and (55), where the root and suffix [–raised] features either stay as they are, or merge (depending on whether one wants to enforce an OCP-[raise] constraint within stems, which is not necessary in the present analysis).

(54) /kár-àn∼-án/ → *káràn* ∼ *kárán* ‘put it∼him’



(55) /ɟàr-àn∼-án/ → [ɟàràn]∼[ɟàrán] ‘sacrifice it∼him’



Evidence that the domain of application of this constraint is the stem rather than the phonological word comes from frozen nominal compounds. Compounding is not productive in present-day Laal, but 95 words in the lexical can be identified as frozen compounds. In most cases, the elements of the compounds are not attested on their own, and cannot be ascribed a meaning anymore. They can only be identified as members of a compound because they occur in several words, and/or are marked for number separately (e.g. /mōō + gà + díígí/, PL /mùù-rí + gà + díígí/ ‘hippopotamus’, /gà + jàw/, PL /gà + jəw-ó/ ‘fish trap’, where the plural suffix /-o/ attaches to and triggers [±low] harmony on the second element of the compound only). If these frozen compounds were to be analyzed as one-stem words, most would violate one or more stem-level phonotactic constraints, e.g. words longer than two syllables, long vowels in non-initial syllables, violations of vowel harmony, etc.[22]

[22]Conversely, if the phonotactic constraints of Laal were to hold over the domain of the phonological word

Importantly for our discussion, many of these compounds violate stem-level tonotactic constraints as well in that they display complex tone patterns unattested on uncontroversial one-stem words, in particular ones involving M, as shown in (56) (see also the examples in (36) above). Once analyzed as multi-stem words, these fall back into the realm of regular phonotactics, since each one of the stems they are made up of abides by all stem-level phonotactic constraints.

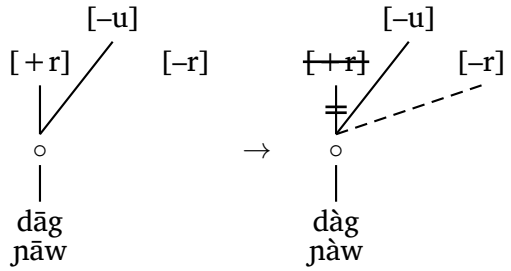
(56)

mùn + gēl	'*Dichrostachys cinerea*, tree *sp.*'
mùn + gəw	'ant *sp.*'
màɲ + dū	'dragonfly'
màɲ + gūrmāɲ	'fish *sp.* (PL)'
màɲ + mbīlā	'insect *sp.*'
tuág + gà + mbīlā	'bird *sp.*'
mōō + gà + díígí	'hippopotamus'

5.3 Morphosyntactic M-lowering: floating [–raised] suffix

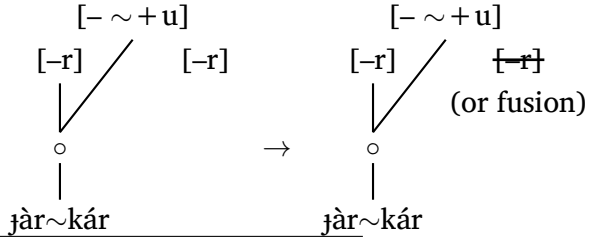
The same mechanism accounts for morphosyntactic M-lowering, analyzed as the effect of a floating [–raised] suffix flagging the presence of an *in-situ* complement (on a par with the gerund suffix /-V^{L}/, or truncating morphology on the irregular nouns mentioned above).[23] This is shown in (84) with the verb /dāg/ 'drag' and the noun /ɲāw/ both followed by a floating [–raised] suffix.

(57) /dāg-[–raised]/ → [dàg] 'drag (+OBJECT)'
/ɲāw-[–raised]/ → [ɲàw] 'house (construct form)'



With H- and L-toned roots, the [–raised] suffix is either stray-erased or fused with the root [–raised], as seen in (58), where L- and H-toned verb roots are represented together.

(58) /ɟàr ∼ kár-[–raised]/ → ɟàr ∼ kár 'sacrifice ∼ put (+OBJECT)'



rather than the stem, these constraints would be violated by most compounds, i.e. compounds would have to be seen as exceptions.

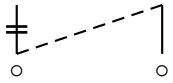
[23]The analysis of this floating element as a suffix rather than a prefix is justified by the fact that all segmental morphology is suffixal in Laal, which lacks segmental prefixes altogether.

5.4 Distributional constraint *MX/XM: bidirectional [–raised] assimilation

So far all examples illustrate leftward spreading. This is accidental and due only to the fact that there are no M-toned suffixes that would show rightward spreading of [–raised] from the root (the only M-toned suffix has a replacive tone, as we will see in §6). But the absence of LM and HM patterns in the lexicon (*modulo* the exceptions mentioned at the end of §3) proves that the structure the language seeks to avoid is not only stem-internal [+raised][–raised], but also [–raised][+raised], i.e. the constraint is bidirectional: *[αraised][βraised]$_{\text{STEM}}$. In a constraint-based approach with parallel evaluation, ill-formed inputs with a stem-level LM or HM pattern would violate this constraint. Given the preponderance of M-lowering in the language and the absence of L-raising ([–raised]→[+raised]) or H-lowering ([+upper]→[–upper]), the only possible repair to posit in such cases is progressive [–raised] assimilation/spreading. All potentially ill-formed tone patterns are thus repaired in the same way, as schematized in (59).[24]

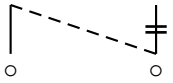
(59) a. M̲H → L̲H
M̲L → L̲L → L

~~[+raised]~~ [–raised]



b. HM̲ → HL̲
LM̲ → LL̲ → L

[–raised] ~~[+raised]~~



Potential underlying tritonal patterns with one or more M tones would likewise surface with no M tone. This would involve leftward spreading (e.g. M̲HL → L̲HL), rightward spreading (e.g. LHM̲ → LHL̲), or both (e.g. M̲HM̲ → L̲HL̲), as well as indistinct cases (e.g. HM̲L → HL̲L → HL, with [–raised] spreading either from H or from L).

All cases of M-lowering (M instability), as well as the static constraint against complex stem-level patterns involving M (M exclusivity) are thus straightforwardly accounted for by one simple general phonological process ([–raised] assimilation) applying to comply with one simple phonotactic constraint (that against disagreeing [raised] feature sequences within a stem). M-lowering is thus a phonological phenomenon: morpheme concatenation simply creates the phonotactic context triggering [–raised] assimilation. In that sense, the root tone change in this case is no different from the root vowel changes involved in the anticipatory vowel harmony patterns described in (6) and (7) above. I come back to this parallel behavior in the conclusion.

5.5 The case of the ventive suffix

The ventive morphology on verbs can be used as another argument in favor of the subtonal approach defended in this paper. The ventive suffix on verbs is segmentally identical to the gerund seen in §4.2.3 above: it consists of a copy of the root vowel. It differs in its tonal behavior. It carries the same tone as the root with H- and L-toned roots. With M-toned roots, on the other hand, the entire ventive form is realized with a L tone – another case of M-lowering. This is shown in (60).

[24] For an Optimality-Theoretic account of M-lowering in Laal, cf. Lionnet Forthcoming.

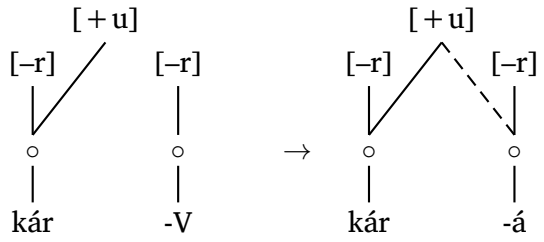
(60)

H	kár	‘put’	kár-á	‘put-VEN’
M	dāg	‘drag’	dàg-à	‘drag-VEN’
L	ɟàr	‘sacrifice’	ɟàr-à	‘sacrifice-VEN’

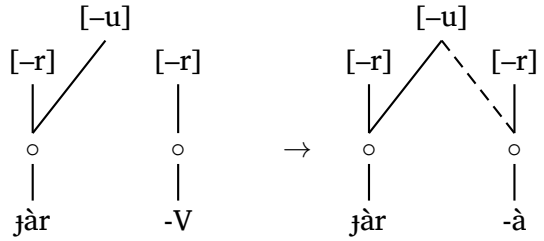
The fact that this suffix is realized with a L-toned in two cases out of three makes it tempting to analyze it as underlyingly L-toned. The H-toned realization in combination with a H-toned root would then have to be analyzed as a case of High tone spread: /kár-V̀/ → *kárá*. The problem with this analysis is that this specific High tone spread rule is unique to this suffix: it is not found with any other stratum-2 L-toned suffix following a H-toned root, e.g. /kár-àn/ → *káràn* ‘put-it’. While high tone spread is attested with L-toned inalienable possessive suffixes, as discussed in §6.3, the two processes are not identical. Indeed, in the case of possessive suffixes, the initial H tone of the root spreads only one mora to the right: /tɨ́m-àr/ → *tɨ́már* ‘his hand’, but /wúúr-àr/ → *wúúràr* ‘his thigh’ (cf. examples (72)-(73)). With the ventive suffix, on the other hand, spreading would have to be analyzed as unbounded, as evidenced by the trimoraic form /máár-V̀/ → *máárá* ‘knead-VEN’.

The featural representations proposed above to account for the behavior of the M tone offer a better alternative. I propose to analyze the ventive suffix as consisting of a copy vowel associated with a TRN specified as [–raised], but underspecified for [upper]. Specification of the upper feature comes from the root, which explains the H realization after H-toned (i.e. [+upper]) roots, and the L realization after M- and L-toned (i.e. [–upper]) roots, as illustrated in (61), (62), and (63). Additionally, the [–raised] feature of the suffix triggers [–raised] assimilation, thus causing M-toned roots to lower to L, as shown in (63).

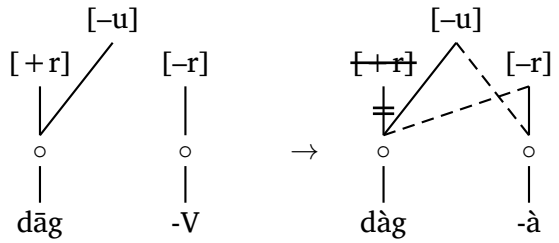
(61) /kár-$V_{[-raised]}$/ → kárá ‘put-VEN



(62) /ɟàr-$V_{[-raised]}$/ → ɟàrà ‘put-VEN



(63) /dāg-$V_{[-raised]}$/ → dàgà ‘drag-VEN



The advantage of this representational approach over the high-tone-spread analysis is that it does not posit a morpheme-specific tone rule, and does not treat the ventive suffix as exceptional in its tonal behavior. Rather, this behavior simply results from [–raised] assimilation, which is a general, independently attested tonological rule of the language, and spreading of features to unspecified elements, which is a general mechanism built into the theory of autosegmental phonology (Leben 1973; Goldsmith 1976), which I use here to account for the tonology of Laal.

5.6 The emergence of subtonal features and the ambiguity of M

I assume that subtonal features, just like segmental distinctive features, are emergent (Boersma 1998; Mielke 2008), i.e. they are “created by learners in response to a phonological pattern” (Mielke 2008:101). The subtonal specification associated with a tone is not determined *a priori* by the theory. A featural analysis is thus necessarily a bottom-up approach, guided by empirical facts. Consequently, it is not expected that all featural combinations should necessarily be used in a language. Only the ones that are justified by the data are likely to emerge. Subtonal features are not even expected to be necessary in the analysis of all tonal systems. In the absence of any phonological pattern that would benefit from a featural analysis (e.g. tonal patterns showing natural class behavior that cannot be captured by tonal units alone), subtonal features are simply unnecessary to both the learner and the analyst.

The emergent nature of features allows us to address the third argument put forth against subtonal features, that is, the fact that the specification of the Mid tone in a three-tone system is necessarily ambiguous (cf. Hyman 2010; Clements, Michaud, and Patin 2010; and references therein). A system with two binary features allows for four combinations, which is perfect for the characterization of a four-tone system. In a three-tone system, one of these combinations is unattested. In principle, the missing category could be any one of the four possible combinations. There are thus four possible analyses of a three-tone system, as shown in (64), and the problem lies is in determining which combination is missing.

(64)

A		B		C		D	
*	[+u, +r]	H	[+u, +r]	H	[+u, +r]	H	[+u, +r]
H	[+u, –r]	*	[+u, –r]	M	[+u, –r]	M	[+u, –r]
M	[–u, +r]	M	[–u, +r]	*	[–u, +r]	L	[–u, +r]
L	[–u, –r]	L	[–u, –r]	L	[–u, –r]	*	[–u, –r]

Yip (2001) rules out options A and D on the basis of the dispersion principle and the pressures it places on inventories: in order for contrastive tones to be maximally distinct

phonetically, the two ends of the pitch range must be as far as possible from each other. Consequently, H is always encoded as the highest possible value on the featural scale, i.e. [+upper, +raised], and L as the lowest value, i.e. [–upper, –raised]. The M tone is necessarily one of the two intermediate values – in Yip's terms, "the gap [is] a missing mid tone, not a missing H or L" (p. 162).

I contend that dispersion is active in phonetic implementation (i.e. in translating the featural specifications into actual sounds), but not in determining feature specifications in the first place. In general, there need not be a one-to-one correspondence between specific featural specifications and specific pitch ranges. A system with three different subtonal feature combinations is expected to be interpreted as a partition of the total pitch range into three equidistant pitch targets, irrespective of the exact featural specifications of the three combinations. In other words, the highest tone does not have to be [+upper, +raised] in order to be interpreted as a pitch target located toward the higher end of the pitch range, maximally different from the pitch target corresponding to the lowest tone in the system.[25]

In an emergent approach, all four options in (64) are in principle possible, as long as they are evidenced by phonological patterns. The only (trivial) restriction needed is a form of paradigmatic phonetic naturalness: the relative position of the different featural combinations on the featural scale should correspond to the relative position of the corresponding pitch targets within the pitch range (i.e. H corresponds to the highest feature combination irrespective of its actual featural content, L to the lowest one, M to a combination intermediate between that of H and that of L). The choice of the missing combination is entirely determined by the phonological pattern under analysis.

Whether all four types in (64) are indeed attested or not cannot be confirmed at this point, given the very limited number of three-tone systems that have been given a featural analysis so far. Laal is a system of type A, as clearly shown by the behavior of the Mid tone: *MX/XM and M-lowering both characterize M as [–upper, +raised] ([+raised] because it is targeted by [–raised] assimilation, [–upper] because it merges with L under assimilation) and H as [+upper, –raised] ([–raised] because it triggers [–raised] assimilation, just like L, and [+upper] because it is higher than both M and L and in contrast with L which is also [–raised]). The feature combination [+upper, +raised] has no use in the system, and is thus naturally absent form the tonal inventory. Snider (2020:101) analyzes Acatlán Mixtec as a language of type B,[26] while Gjersøe, Nformi, and Paschen (2019) propose to view Limbum

[25] A possible alternative to Yip's (2001) proposal would be to rule out B and C by restricting the theory to allow only for adjacent (non-gapped) combinations, as a phonological representation of the equidistance between pitch targets. In this case, the missing combination would always be a high or a low tone, never a mid tone. The indeterminacy is about whether the mid tone is part of the upper or lower register.

[26] Snider's analysis is complex and resorts to underspecification and default feature specifications. The register feature *l* (≈ [–upper]) is analyzed as default, and the tonal features H and L ([+raised] and [–raised] respectively) are considered to correlate by default with the higher and lower register features respectively. The low tone is analyzed as underlyingly Ø; it receives default *l*, then the register feature L, by default associated with *l*. Its surface specification is thus L/*l* (≈[–upper, +raised]). The mid tone is underlying specified as H (≈ [+raised]), but underspecified for register; it thus receives default *l* and is on the surface specified as H/*l* (≈[–upper, +raised]). This specification of the mid tone is necessary to account for a pervasive alternation between mid and low in disyllabic mid-toned words: both must share the same register feature *l*. Finally, the high tone is underlyingly specified for the register feature *h*, but underspecified for tone; it thus receives the H tone feature that correlates by default with *h*, and ends up being specified as H/*h* (≈ [+upper, +raised]). The combination L/*h* (≈ [+upper, –raised]) is unattested.

as instantiating type C.[27] I don't know of any language or analysis corresponding to type D, where the missing combination is the lowest on the featural scale, but in the emergent approach to subtonal features taken here, there is no reason to exclude it *a priori*.

To conclude, the subtonal specification of the mid tone in a three-tone system is not necessarily ambiguous. In the three languages mentioned above, the featural content of the mid tone can clearly be established by the analyst on the basis of its behavior with respect to the other tones. Systems in which the subtonal specification of the mid tone cannot be established might simply be cases where evidence for subtonal features is lacking, i.e. systems whose learning is unlikely to lead to the creation of something like a feature system in the learner's grammar, and whose analysis does not require it.

6 Evidence for the tonal root node: full tone spread and deletion

Tonal interaction in Laal is not limited to subtonal processes: some tonal alternations do involve interaction between full tones. Tones are thus not just the emerging result of combinations of subtonal features, but may also act as units, i.e. be referred to as units by the phonological grammar. This is made possible by the Tonal Root Node (TRN) in the tone geometry in (52) above. Three such processes are attested in the morphotonology of Laal: base pattern reduction under suffixation (§6.1), replacive grammatical tone (§6.2), and High tone spread in inalienable possessive morphology (§6.3).

6.1 Base pattern reduction under suffixation

Stratum-2 suffixes require their base of affixation to bear only one tone – which has always been the case in the examples presented until now. If the base of suffixation bears a complex tone pattern, this pattern is simplified by deletion of all but its first tone: /T_1T_2-sfx/ → /T_1-sfx/ (only the bitonal patterns LH and HL are ever attested in the relevant contexts). This reduction is observed irrespective of the nature of the base (noun or verb) or affix (inflectional, derivational), and irrespective of the base and suffix tones. This is shown in the examples below, where the LH (65) and HL (66) root patterns are systematically changed to L and H respectively upon suffixation, whether the suffix is L, as in (65)a and (66)a, H, as in (65)b and (66)b, or LH, as in as in (65)c and (66)c.[28]

[27] Using Snider's (1999; 2020)'s register and tone features, the authors show that the M tone has to be specified as L/h (≈ [+upper, –raised]) because it forms a natural class with H (defined by the register feature *h*/[+upper]). They consider that the other "mid" combination, i.e. H/l (≈ [–upper, +raised]), is unnecessary in the analysis of the tonal system of the language and thus "not part of the tonal lexicon."

[28] The only complex pattern attested in the 65 nouns compatible with inalienable possessive suffixes is LH, and the only tones attested on possessive suffixes are L and H.

(65)

a.	/duàgál-àr/	→	duàglàl	'his upper arm'
	/gàáw-àr/	→	gààwàr	'his armpit'
	/sèègé-àn/	→	siààgàn	'shake it'
	/sǎɲ-àn/	→	sàɲàn	'fight it'
b.	/duàgál-rú/	→	dòglú	'our (EX) upper arm'[29]
	/sèègé-án/	→	siààgán	'shake him'
	/sǎɲ-án/	→	sàɲán	'fight him'
c.	/sèègé-nǐ/	→	sèègnǐ	'shake them (M/F)'
	/sǎɲ-nǐ/	→	sə̀ɲnǐ	'fight them (M/F)'

(66)

a.	/págàr-àn/	→	págràn	'think about it'
	/táàb-àn/	→	táábàn	'cause distress to it'
b.	/págàr-án/	→	págrán	'think about him'
	/táàb-án/	→	táábán/	'cause distress to him'
c.	/págàr-nǐ/	→	pə́gə́rnǐ ~ pə́grǐ[30]	'think about them (M/F)'
	/táàb-nǐ/	→	tə́ə́bnǐ	'cause distress to them (M/F)'

Form like /duàgál-àr/ → *duàglàl* or /sèègé-àn/ → *siààgàn* in (65)a may suggest that the tone reduction on the base is due to V2 deletion, applying to avoid creating a trisyllabic stem. However, the forms /gàáw-àr/ → *gààw-àr* or /sǎɲ-àn/ → *sàɲ-àn* clearly show that tone pattern reduction is independent of V2 deletion, and is only caused by the presence of the suffix. Furthermore, the existence of stem-level LHL and HLH patterns shows that reduction is not caused by the necessity to avoid tritonal stem patterns.

The examples above all involve pronominal suffixes. The following examples further show that pattern reduction occurs with the ventive, associative, and medio-passive suffixes, i.e. all stratum-2 suffixes except the gerund /-V^{L}/ and passive /-Vl^{M}/ suffixes, whose tones are replacive, as discussed in §6.2.

(67)

a.	/yùgár-V$_{[-r]}$/	yùgrà	'shake-VEN'
b.	/yùgár-V́/	yùgrá	'shake-ASS'
c.	/yùgár-ɨ́ɲ/	yùgrɨ́ɲ	'shake-MP'

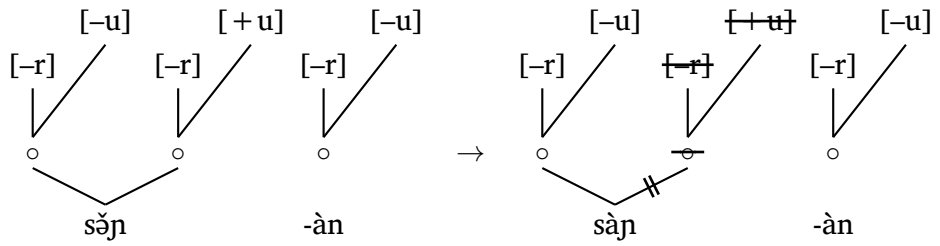
We saw that the ventive suffix is tonally deficient: it is specified as [–raised] and gets its [upper] feature value from the last tone of the base of affixation. When following a LH root, as in (67)a /yùgár-V$_{[-r]}$/, the [upper] specification inherited by the suffix is not the [+upper] of the final H tone of the root (**yùgr-á*), but the [–upper] of the initial L tone (*yùgr-à*), after deletion of the H tone, i.e. after base reduction. This indicates that the spreading of the root [upper] feature to the underspecified vowel of the suffix occurs after V2 deletion – very likely postlexically, as do most default structure-filling rules.

[29] In the case of *dòglú*, the initial /r/ of the suffix is deleted to avoid creating a triconsonantal cluster.

[30] CV(V).CVC verbs combining with C-initial suffixes pose a number of phonotactic problems: V2 deletion is expected to apply in order to avoid creating a trisyllabic form, but it creates a new phonotactic problem by yielding a triconsonantal cluster, impossible in the language. One solution to the latter problem is the deletion of one of the consonants: either the last consonant of the root, or the first consonant of the suffix, which is not seen anywhere else in the language and seems to be a last-resort solution, with much intra- and inter-speaker variation. The two variants presented here are the trisyllabic variant *pə́gə́rnǐ*, where the non-application of V2 deletion avoids the triconsonantal cluster /grn/, and the version with V2 and consonant deletion: *pə́grǐ*.

Base pattern reduction can be represented as the deletion of all but the initial TRNs of the base of affixation (in effect, deletion of the second of two TRNs, since no tritonal pattern is attested in the relevant contexts). This is illustrated in (68).

(68) /sə̌ŋ-àn/ → sàŋàn ‘fight it’



6.2 Full-tone spread in replacive tone patterns

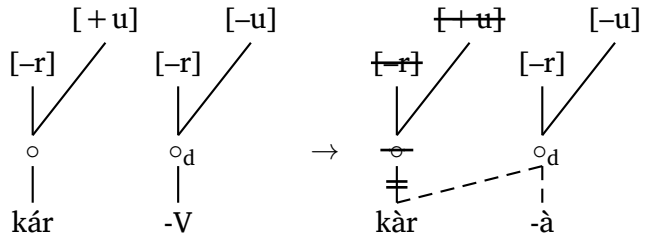
Two suffixes display “replacive” tone (Welmers 1973:132–133), i.e., they impose a single tone pattern to their stem, wiping out the underlying tone of the root to which they attach. These two suffixes are gerund /-V^{L}/ seen in §4.2.3 and Table 3, and passive /-Vl^{M}/. Both are illustrated in (69) with H-, M-, and L-toned verbs. In both cases, the vowel of the suffix is realized as a copy of the root vowel.

(69)

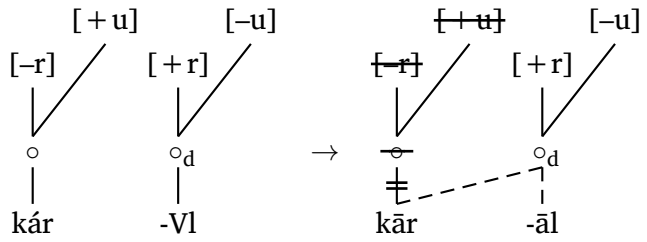
			Gerund /-V^{L}/	Passive /-Vl^{M}/
H	kár	‘put’	kàr-à	kār-āl
	siáág	‘close’	siààg-à	siāāg-āl
	síráŋ	‘take out’	sìrŋ-à	sīrŋ-āl
M	dāg	‘drag’	dàg-à	dāg-āl
	ɟuāŋ	‘buy’	ɟuàŋ-à	ɟuāŋ-āl
	tūrūg	‘sew’	tùrg-ù	tūrg-ūl
L	ɟàr	‘sacrifice’	ɟàr-à	ɟār-āl
	lòb	‘wet’	lòb-ò	lōb-ōl
	lùrùg	‘shorten’	lùrg-ù	lūrg-ūl

These two suffixes contrast with all other segmental suffixes, whose tones are never replacive, e.g. /kár-àn/ → [káràn] (*[kàràn]) ‘put-it’, /ɟàr-án/ → [ɟàrán] (*[ɟárán]) ‘sacrifice-him’. This replacive pattern corresponds to what Rolle (2018:47) calls “replacive-dominant grammatical tone”, defined as a tone pattern associated with a specific morpheme or morphological construction which deletes and replaces the underlying tone of its target. It is beyond the scope of this paper to offer an analysis of dominance and replacive grammatical tone. The reader is referred to Rolle (2018), Sande, Jenks, and Inkelas (2020), and Trommer (2022) for recent proposals (and references therein for previous accounts). For now, I simply represent the dominance of the tone pattern imposed by the gerund and passive suffixes with a diacritic mark on the TRN (“d” for “dominant”). The main point here is that these patterns involve spreading and deletion of entire TRNs, justifying the tone geometry in 52, as illustrated in (70) and (71).

(70) /kár-V^{L}/ → kàrà ‘put-GER (+OBJECT)’



(71) /kár-Vl^{M}/ → kārāl ‘put-PAS’



Neither the replacive L of the gerund nor the replacive M of the passive can be analyzed as involving subtonal interaction alone. The universal change to L observed with the gerund requires both [–raised] (M→L) and [–upper] (H→L) assimilation/spreading, i.e. full assimilation, better represented as TRN spreading. As for the passive suffix, the systematic change to M that it triggers could be viewed as a case of regressive [+raised] assimilation/spreading.[31] This would straightforwardly account for the L-to-M change observed with L-toned roots. With H-toned roots, one additional step would be required: spreading the suffixal [+raised] to the root would create a [+upper, +raised] combination, unattested in the language. The [+upper] feature of the root would then have to be changed to [–upper] to comply with the constraints of the inventory. This abstract extra-step is unnecessary in the TRN-spreading analysis in (71) above. Furthermore, this would be the only case of [+raised] assimilation/spreading, all the more suspicious that it goes against the otherwise exceptionless [–raised] assimilation/spreading at work in the language.

The fact that there are no non-replacive M-toned suffixes is intriguing. One could hypothesize that the replaciveness of suffixal M is a last-resort solution to preserve the grammatical information conveyed by the suffix. Indeed, in order to comply with the unviolable *MX/XM constraint, there are two solutions: either change the suffixal M (e.g. to L, as in other cases of M-lowering), or change the lexical tone of the root to M, in order to keep the suffix intact – which appears to be what Laal does. The problem is that such an explanation is not available for the replacive L tone of the gerund, which has no need to be replacive. Like the other L-toned suffixes (e.g. third person neuter object /-àn/ seen in (10), (11), and (53)-(55)), it could indeed in theory be kept without violating any tonotactic constraint (other than *MX/XM when attaching to a M-toned root, in which case M-lowering of the root M would apply, as it does elsewhere). In other words, the last-resort analysis does not generalize to all cases of replacive tone. Replaciveness thus has to be accounted for in its own terms.

[31] The suffix could even be said to carry only a [+raised] feature, the [–upper] feature being redundant in this case.

6.3 High Tone Spread in inalienable possessive morphophonology

When a H-toned noun root combines with a L-toned inalienable possessive suffix, the H tone of the root spreads one (and only one) mora to the right. If the first syllable of the resulting stem is monomoraic, the H spreads onto the suffix, deleting its L tone, as in (72) (all examples in this section take the third person singular suffix *-àr* for illustration).[32]

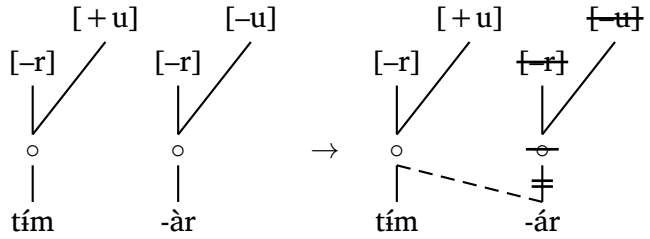
(72)	/tɨ́m-àr/	tɨ́már	(*tɨ́màr)	'his hand'
	/kúrá-àr/	kúrár	(*kúràr)	'his leg'[33]
	/ság-àr/	ságár	(*ságàr)	'his brother-in-law'

If the first syllable is bimoraic, on the other hand, the H does not spread onto the suffix, which keeps its low tone, as in (73).

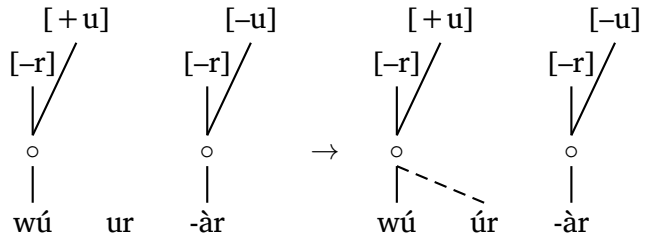
(73)	/wúúr-àr/	wúúràr	(*wúúrár)	'his thigh'
	/ndáár-àr/	ndáàràr	(*ndáárár)	'his skull'
	/piáár-àr/	piáàràr	(*piáárár)	'his lower leg'

This H tone spread can easily be analyzed as the spreading of the initial H tone's TRN one mora to the right, as shown in (74) and (75).

(74)



(75)



High Tone Spread is regular within the closed class of nouns compatible with inalienable possessive suffixes,[34] and provides additional evidence for the TRN. Indeed, a subtonal feature analysis offers no advantage. One featural analysis that would capture the data consists in analyzing this pattern as involving rightward [+upper] spread from the initial mora onto the following mora. Indeed, replacing the [–upper] feature of the L-toned suffix with a [+upper] specification changes it to a H tone, since both H and L are [–raised]. Both analyses are descriptively adequate, and it is impossible to find definitive evidence in favor or against either one. The fact that the [upper] feature is not involved in any active

[32]Inalienable possessive suffixes are either L-toned (/-ər/ 'my', /-à/ 'your', /-àr/ 'his/, /-ò(g)/ 'her', /-àn/ 'its', and /-uàn/ 'their (N)) or H-toned (/-rú/ 'our (EX)', /-ráŋ/ 'our (IN)', /-rúŋ/ 'your (PL)', and /-rí/ 'their (M/F)').

[33]This form involves V2 deletionn: /kúrá-àr/ → kúr-àr → *kúrár*.

[34]There are only three exceptions, ignored here.

spreading/assimilative pattern elsewhere in the language (the spreading involved in the realization of the ventive suffix is only structure-filling), and that cases of TRN spread are independently attested militate in favor of the TRN-spread analysis of High Tone Spread.

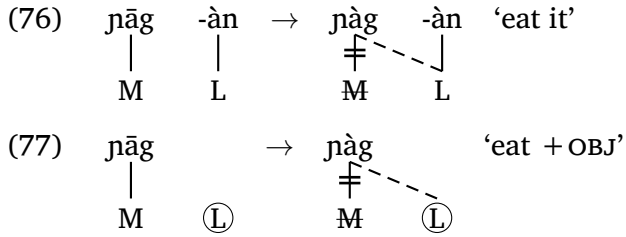
7 Alternatives

In this section, I argue that the subtonal approach proposed above is stronger than two more classical alternatives: a tone-as-unit analysis (§7.1) and an analysis of M as ∅ (§7.2). Finally, I sketch a tentative analysis in terms of one gradient tone height feature (§7.3), which appears to be a promising competitor to the subtonal feature analysis, but currently lacks empirical support. A variant of the subtonal analysis proposed here where the M tone is only partially specified is developed in the appendix.

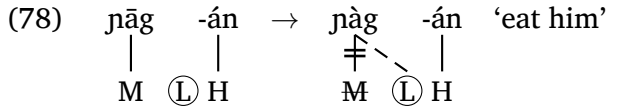
7.1 Tone-as-unit analysis

A featural analysis would be unwarranted if it could be demonstrated that an analysis resorting only to the tonal primitives H, M, and L accounts for all the facts listed in (50) above. I show in this section that such an analysis is impossible without stipulating (i.e. circularly including the descriptive generalization in the analysis) some of the points in (50).

Instead of positing subtonal features and viewing M-lowering as resulting from [–raised] assimilation, one could analyze M-lowering as involving a L assimilation rule targeting M tones within the stem. This can be represented as spreading of L onto M followed by delinking of the M tone, as shown in (76) and (77) below. This would straightforwardly account for morphophonological M-lowering before a L-toned suffix (76), as well as morphosyntactic M-lowering, analyzed as involving a floating L (rather than [–raised]) suffix (77).



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 (78), for which there is no independent evidence.



Note that this floating L tone cannot be viewed as marking the presence *in situ* of the object of the verb, nominal or pronominal, as in example (76) and (78). Indeed, we saw that M-lowering does not apply solely before object suffixes, but before all stratum-2 suffixes, including suffixes unrelated to the presence of the object or even transitivity at large, e.g.

medio-passive /-íɲ/ and instrumental /-V́/, which we saw is compatible with intransitive verbs.

An alternative to explain why M changes to L before H would be to posit a M to L change satisfying the *MX/XM phonotactic constraint. This solution is far from satisfactory, as it consists solely in formalizing the surface descriptive generalization, i.e. stipulating the alternation rather than accounting for it. The featural analysis I propose does not stipulate M-lowering, but derives it from the properties of the subtonal features that make up the three tones H, M, and L, i.e. from simple representations not directly related to the surface pattern it purports to analyze. These representations, in turn, are not stipulated, but posited on the basis of evidence consisting of natural classes involved in an assimilation process and defined by common phonological behavior (H and L are both triggers, M is the only target, M and L merge under assimilation).

The second problem with the tone-as-unit analysis is that L spreads only onto a preceding M and never a preceding H, which does not follow from any property of the three tones H, M and L, and must be stipulated. In the subtonal approach, on the other hand, the featural makeup of each tone directly explains their different behaviors: H is immune to lowering because lowering is [–raised] assimilation, and H is already specified as [–raised]; M being [+raised], it is by necessity the only possible target of [–raised] assimilation.

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

Note, also, that with the tone-as-unit approach, the ventive suffix would have to be analyzed as carrying a full tone, e.g. a L tone subject to high tone spread, as suggested in §5.5 above. This is not impossible of course, in particular given that high tone spread is attested in possessive morphology. But, as discussed in §5.5, it is a morpheme specific tonal process that is unnecessary in the featural approach.

7.2 Mid as zero

The exclusivity and instability of the M tone in Laal suggests a certain weakness of the M tone compared to both H and L. This weakness is not analyzed as such in the featural approach I propose, where M is weak only by virtue of being specified as [+raised], which makes it a target of [–raised] assimilation. An alternative analysis could be proposed which represents M weakness more directly, for example by analyzing M as Ø within a tone-as-unit analysis. The weakness of the M tone could indeed be seen as evidence of its underlying non-existence and default status. That is, the only two underlying tones of Laal are H and L, with TBUs specified as H, L, or Ø. Ø TBUs get their tonal specification through spreading of neighboring tones, otherwise through default M insertion. This would naturally explain the static *MX/XM constraint, as well as M-lowering before a L tone, as seen in (79) and (80).[35]

[35] In this analysis, the passive suffix would have to be analyzed as consisting solely of subtractive morphology. The suffix deletes the tone(s) of the verb root (as it does in the featural analysis, and as it would have to do in any analysis), but since it is itself toneless, the resulting form is assigned default M tone: /kár-^{sub}Vl/ → kar-al → *kārāl*.

(79) ŋag -àn → ŋàg -àn 'eat it'

L L

(80) ŋag → ŋàg 'eat +OBJ'

Ⓛ Ⓛ

However, it would pose the same problem as the preceding analysis, i.e. it would still fail to account for M-lowering before a H-toned suffix without gratuitously positing a floating L tone before all such suffixes (or giving up on accounting for it and stipulating a M to L tone change instead, to avoid a violation of *MX/XM), as shown in (81).

(81) ŋag -án → ŋàg -án 'eat him'

Ⓛ H Ⓛ H

In general, any tone-as-unit approach runs into one fatal problem, which is that it cannot account for the fact that both H and L trigger M-lowering without stipulating all or part of the description in the analysis. That is, a tone-as-unit analysis fails to capture the natural class formed by the two non-adjacent tones H and L – which the subtonal feature approach straightforwardly accounts for, as we saw.

7.3 Tone height as one gradient feature

One final alternative I will consider is to view tone height, not as a combination of two features, but as one gradient feature.[36] I do not have space here to go into details. I only give a brief sketch, and leave the full development and evaluation of this alternative to future research.

Let us represent tone height as one single gradient feature [*n* T-height], with *n* arbitrarily comprised between 0 (the lowest tone height) and 1 (the highest). This is the gradient equivalent of a multivalued feature (cf. Trubetzkoy 1939; Ladefoged 1971; Lindau 1978; Clements 1991, 2015). On the scale from [0 T-height] = L to [1 T-height] = H, M would occupy an intermediate position. If this position were to be defined as closer to L than to H, say [0.4 T-height], this would explain both the *MX/XM constraint and M-lowering, as I show below.

With such representations, the *MX/XM constraint can be restated as $*\Delta\text{T-height} < 1$, i.e., within a stem, adjacent tones must be distant by at least 1 T-height level. Consequently, only HL [1-0] and LH [0-1] sequences are allowed. Any sequence involving a M tone violates this constraint since the distance is always less than 1: ΔT-height(H∼M) = .6, and ΔT-height(L∼M) = .4. The optimal repair to this violation is to change the M tone to L, because L is the closest tone in terms of T-height distance (.4, whereas the distance between M and H is .6). Changing M to L thus incurs a lesser violation of faithfulness (on the condition that violation of IDENT-T-height is defined as gradient). In this alternative, M-lowering is analyzed as a M to L tone change, but the tone change does not need to be stipulated: it is motivated by the proximity of M with L on the tone-height gradient.

[36] Thanks to **[redacted]** for suggesting gradience as an alternative.

Table 4: TRN and subtonal features in Laal regular tonal morphophonology

Tonal phenomenon	TRN (full tone)	Subtonal features
1. M tone behavior: - Static *MX/XM - M-lowering	—	[–raised] assimilation
2. Ventive suffix specification	—	[–raised] specification, unspecified [upper]
3. Base pattern reduction	TRN deletion	—
4. Replacive tone	TRN spread and deletion	—
5. High Tone Spread	TRN spread (and deletion)	—

The main challenge with such an alternative analysis is to justify the asymmetric position of M on the T-height scale. As it currently is, the theory has to stipulate it. Instrumental data are necessary to determine whether M is indeed on average realized closer to L than to H. I have not conducted this acoustic analysis. This alternative must thus remain at a tentative stage for now. It seems worth sketching it here, however, as it appears to be a potential competitor to the subtonal analysis proposed in this paper.

8 Conclusion

In conclusion, the subtonal analysis proposed in this paper provides a simple, unified analysis of the tone system of Laal, which involves both processes manipulating subtonal features and ones manipulating full tonal root nodes, as summarized in Table 4. This analysis is motivated by the behavior of the M tone, which constitutes evidence against the four main counter-arguments to subtonal features listed in (3), and answers all the questions listed in (50). Laal provides evidence for the existence of assimilation patterns 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. This, in turn, provides evidence for subtonal natural classes. First, [+raised] defines the M tone as the natural class of targets of M-lowering, which explains why only M fails to take part in complex stem-level tone patterns (question (50)a) and why only M is affected by lowering (question (50)b). Secondly, [–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 (50)c). This is particularly important in that it provides evidence that non-adjacent tones can interact, which is a prediction made by the two-feature model which was thought until now to lack empirical support (cf. in particular Clements, Michaud, and Patin 2010). Finally, the feature [–upper] defines the natural class consisting of M and L, which accounts for the fact that M is changed to L rather than H (question (50)d). One can interpret the M→L lowering process as a form of register simplification: for the creation of complex tone patterns and for marked forms of genitive head nouns and transitive verbs, the two registers [+upper] and [-upper] are each reduced to their [–raised] tone.

Finally, the specification of M in Laal is not ambiguous. M→L lowering unambiguously shows that M must be specified as [+raised], hence also as [–upper]. Additionally, the

insensitivity of H to [–raised] assimilation demonstrates that the only possible specification for H is [+ upper, –raised]. There is no *a priori* incompatibility between tone features and three-tone systems.

Analyzing tone as a feature bundle 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]$_{\text{STEM}}$ 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 harmony with dominant [+ATR] or [–ATR] (Casali 2003, 2008, 2016; Rose 2018, a.o.). Additionally, just like segments, tone has the capacity to be either partially active (through one of its features), or fully active (through its root node, just as in total segmental assimilation). Finally, just like segments, a tone may be fully or only partially specified in underlying representation, as with the ventive suffix seen in §5.5.

Laal thus joins the growing cohort of languages (e.g. Seenku, McPherson 2016; Babanki, Akumbu 2019; Limbum, Gjersøe, Nformi, and Paschen 2019; Tenyidie, Meyase 2021; Gaahmg, Trommer 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.

Abbreviations

Abbreviations follow the Leipzig glossing rules, except the following: A = abstract, ANAPH = anaphoric, CON = connective, CONTR = contrastive topic, EX = exclusive, EV = evidential, GER = gerund, IN = inclusive, IND = independent (pronoun), INT = intentional, H = human, PART = partitive, PROS = prospective.

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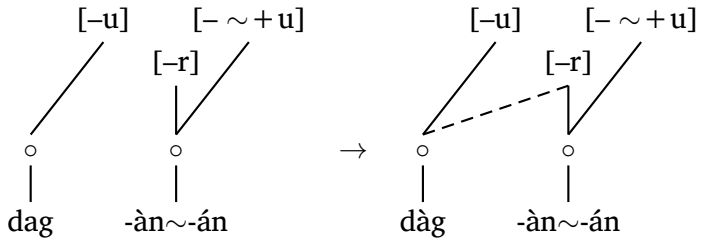
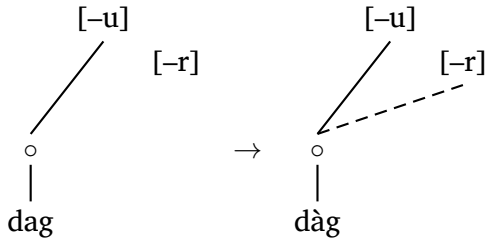
Appendix: Alternative subtonal analysis

One anonymous reviewer suggests another account of the weakness of M, couched in the featural analysis I propose in this paper. One could analyze M as [–upper] and unspecified for [raised]. This would work for all cases of M-lowering, analyzed as spreading of the [–raised] feature of the suffix to the [raised]-deficient TRN of the root M. All suffixes (except the passive) are indeed specified as [–raised]: H, L(H) and the floating [–raised] of the the transitive and genitive suffixes. This is illustrated in (83) and (82) below with H- and L-toned verbal suffixes and the floating [–raised] suffix respectively.

(82) /dag-àn∼-án/ → *dàgàn* ∼ *dàgán* ‘drag it∼him’

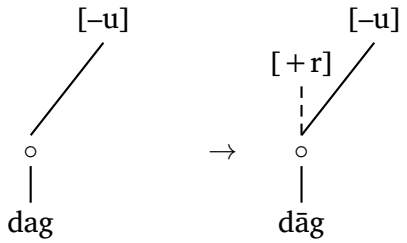


(83) /dag-[–raised]/ → [dàg] ‘drag (+OBJECT)’



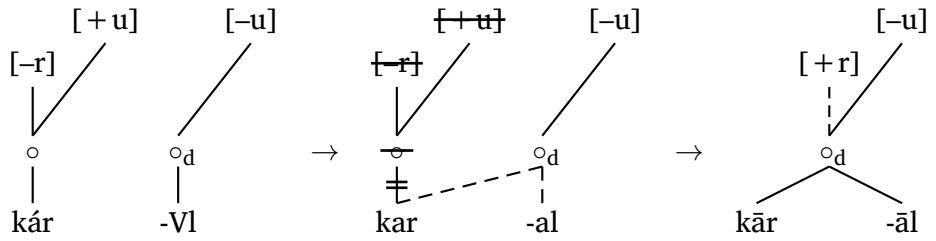
One would have to posit [+raised] as the default value of [raised], assigned to [raise]-deficient TRNs in the absence of any available (i.e. spreadable) [–raised] in the stem, as illustrated in (84). Since [+raised] is never active in the tonology of Laal, this does not seem to be problematic.

(84) /dag/ → *dāg* ‘drag’



The passive suffix would have to be analyzed as a replacive defective TRN: a TRN specified only as [–upper] which spreads and deletes the TRNs of the root, and then sees its missing [raised] feature filled in by default [+raised] insertion, as in (85).

(85) /kár-Vl^{M}/ → kārāl ‘put-PAS’



This analysis is as descriptively and explanatorily adequate as the full-specification analysis I propose in §5 above. However, I think it is slightly less satisfactory, for two reasons. First, it requires default [+raised] insertion, and the definition of a default value of [raised], which is unnecessary in the full-specification analysis.[37]

Secondly, it offers an unnecessarily complex representation of the contrast between L and M, which is robust in the language, despite the frequency of M-lowering. Indeed, in this approach, L and M contrast underlyingly only by the specification vs. non-specification of the feature [raised]. That is, they differ not not only by the fact that, on the surface, one is [–raised] and the other [+raised], but also by the timing of the assignment of the [raised] feature value. This is of course an option that is made entirely possible by the theory and is not in and of itself problematic. But I don’t see any necessity to resort to this level of abstraction or complexity. In any case, this analysis can be considered a variation of the one I propose, and does not question the aptness of subtonal features for the analysis of the tonology of Laal.

[37]The ventive suffix is analyzed as unspecified for [upper], but this is morpheme-specific, does not require the definition of a default value of [upper], and in general does not pertain to the general phonology of the language.