Studies in African Linguistics
Volume 50 Number 2, 2021.

Tone alternation in Dàgáárè verbs: Perfectives and Imperfectives[1]

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While previous studies on Dàgáárè tone have looked at the nouns, this paper particularly examines tone in verbs, perfective vs imperfective forms. The verbal system has different patterns based on the form of the verb. There are three tone classes for Dàgáárè verbs and for each of the classes, the surface tone pattern it exhibits in the perfective is systematically different from the tone patterns in the imperfective. For the perfectives we have L, H and HL while the imperfectives have LH, HL and H!H, at least in the dialect under study. I treat tone as a combination of the features [±upper] and [±raised] which are connected to what is described as a Tone node (T-node). These Tone nodes in turn connect to the syllable. Under this system, I assume L is represented with the features [-upper] and [-raised] and H with the features [+upper] [+raised]. Underlying tonal melodies of the root morphemes are identical to the surface tones of the perfective forms whether these contain an overt suffix or not. For the imperfectives, the suffix comes with an unspecified underlying T-node. The grammar then chooses the features [±upper] and [±raised] to insert under the already existing T-node.

Keywords: perfective, imperfective, tone alternation, polarity, tone node

1. Introduction

This paper examines tone alternation and polarity in Dàgáárè (Central) verbs. Dàgáárè is a Mabia/Gur language of the Niger-Congo family spoken in northwestern Ghana and parts of Burkina Faso. It is a register tone language with two levels of tone, high (H) and low (L) (Kennedy 1966; Anttila and Bodomo 1996; Bodomo 1997). High tone is represented with the acute accent (á) while low is represented with the grave accent (à). Lexical pairs such as *tú* 'dig', *tù* 'follow' and *dɔ́ɔ́* 'man' and *dɔ̀ɔ̀* 'squat' are some examples that show the contrast between high and low tones in the language. There are also cases involving downstep; a phenomenon in which the second of two high tones is not equally as high as the first one (Hyman 1985; Selkirk and Tateishi 1991). Downstep is usually represented with an exclamation mark (!) as illustrated in *bɔ́m-!á* 'things'. Moreover, rising contour tones are attested in verbs such as *dî* 'take', *fáà* 'seize'.

Prior studies on Dàgáárè tone have looked at the nouns (e.g. Anttila and Bodomo 1996, 2007). In this paper, I particularly focus on tonal alternations and polarity in verbs, perfective vs imperfective forms. While in the nominal system most disyllabic words have three tone classes: LH, HL, and H and a few fall under H!H, the verbal system has different patterns based on whether the verb is perfective or imperfective. Thus, there are three tone classes for Dàgáárè verbs and for each of the classes, the surface tone pattern it exhibits in the perfective is systematically different from the tone pattern it exhibits in the imperfective. For the perfectives we have L, H and HL while the

[1] Data in this paper is based on consultations with native speakers of the Sombo variety of Central Dàgáárè. All data presented in the paper are in broad phonetic transcription. **Acknowledgements**: For their guidance, helpful comments, and suggestions, I would like to thank my Qualifying papers committee: Rose-Marie Déchaine, Gunnar Hansson and Anne-Michelle Tessier.

imperfectives have LH, HL and H!H (H!H analysed as HLH with the L tone floating; Pulleyblank 1986 and Kenstowicz 1994). These tone classes are the only classes in Dàgáárè verbs, at least in the dialect under study. In the following table, I show perfective and imperfective forms. The tone patterns of the perfectives and imperfectives are different. The imperfective adds a tone on the suffix which is of opposite height to the last root tone. The data also show that there is falling contour (HL) tones in verbs just as with nouns. Rising contour (LH) tones, though attested in nouns as in *wìɛ́* 'farm', *sùó* 'knife' are however unattested in verbs.

(1) Perfective vs imperfective

	Perfective	**Gloss**		**Imperfective**	**Gloss**
L	dì	'eat'	LH	dìré	'eating'
	jùò	'open'		jùòró	'opening'
	sàrì	'slip'		sàrá	'slipping'
H	pó	'share'	HL	póròˀ	'sharing'
	jɔ́ɔ́	'pay'		jɔ́ɔ́rɔˀ	'paying'
	sɔ́rí	'read/count'		sɔ́rɔˀ	'reading/counting'
HL	dî	'take'	HLH	dí!ré	'taking'
	fáà	'seize'		fáá!rá	'seizing'
	kɔ́rì	'cough'		kɔ́!rɔ́	'coughing'
LH	NA	NA			

The main objective of this paper is to lay out the general observations about tonal patterns in Dàgáárè verbs and to give an account based on an optimality theoretic approach (Prince and Smolensky 2008; McCarthy and Prince 1995) for the tonal patterns and distribution. Following the proposal of Yip (1980) and Pulleyblank (1986), I treat tone as a combination of the features [±upper] and [±raised] which are connected to what is described as a Tone node (T-node). These Tone nodes in turn connect to the syllable. Under this system, I assume the tones of a language like Dàgáárè with a two-way tone contrast will represent L with the features [-upper] and [-raised] and represent H with the features [+upper] [+raised]. My claim about the verbal tone system in Dàgáárè is that underlying tonal melodies of the root morphemes are identical to the surface tones of the perfective forms whether these contain an overt suffix or not. The underlying tone features in the root remain unchanged on the surface. The perfective forms involve a suffix which sometimes has segmental content and is sometimes null (-ø) but is always underlyingly toneless. Thus, the final or rightmost Tone node of the root (in case there is more than one tone, like HL roots) spreads onto the suffix if it is not a zero suffix or segmentally null. In terms of the imperfective forms, the suffix always has a segmental content, specifically a CV shape. I propose that the suffix comes with an unspecified underlying T-node with no features associated with it. The grammar then chooses the features [±upper] and [±raised] to insert under the already existing T-node. The questions I seek to address in this paper are as follows:

a. What causes the imperfective suffix to surface with a tone opposite in height to the (final) root tone?
b. Why are the imperfectives of HL verbs realised as HLH with L floating and resulting in downstep? Why is HLH not realised as HL-H with a contour on the first syllable and H on the second syllable?

c. Can both perfective and imperfective forms be analysed with the same set of constraints?

This analysis is concerned with perfective and imperfective verbs in Dàgáárè, but it is not immediately known whether the analysis can be extended to other domains such as tone patterns and tone alternations in nominals. The remainder of this paper proceeds as follows: section 2 lays out the morphological structure of Dàgáárè verbs. In section 3, I present the tonal patterns for perfective and imperfective verbs in descriptive terms. Sections 4 and 5 present the constraint inventory and an analysis of tonal alternations in Dàgáárè verbs. Finally, section 6 offers discussion and conclusion.

2. Morpho-phonology of Dàgáárè verbs

The basic verb morphology of Dàgáárè has the verb root and an aspectual suffix. The verbs only bear one of these suffixes at a time. The verb can be identified as either perfective or imperfective (Dakubu 1989; Bodomo 1997; Saanchi 2003). The perfective form is composed of the verb root and a -V or -CV suffix or it may come just with zero suffix. Perfective forms such as *sɔ́rí* 'read/count' and *wùlì* 'teach/show' are treated as having CVC roots with -V suffixes, and forms like *pùòrì* 'pray/greet' and *jíélì* 'sing' are considered to have CVVC roots with -V suffixes. Evidence for this claim arises from processes such as reduplication. In the examples below, if the word is reduplicated, the final -V is dropped in both CVCV and CVVCV forms, leaving CVC and CVVC respectively which are then followed by the reduplicant.

(2)

Verb	Gloss	Reduplicated form	Gloss
sɔ́rí	'read/count'	sɔ́r-sɔ́rɔ̀	'reader/counter'
wùlì	'teach/show'	wùl-wúló	'teacher/ a person that shows' (e.g. direction)
pùòrì	'pray/greet'	pùòr-púóró	'preacher/worshipper'
jíélì	'sing'	jíèl-jíél!é	'singer'

If we consider CV and CVV as the roots, then we will predict incorrect forms such as *[sɔ́-sɔ́rɔ̀], *[wù-wúló], *[pùò-púóró] and *[jíè-jíél!é]. With the imperfectives, there are always two overt morphemes: a root followed by either a -V or a -CV suffix. Let us look at the following verbs and the morphological shapes they take.

(3) Structure of verbs[2]

Verb root	**Perfective**	**Gloss**	**Imperfective**	**Gloss**
dì-	dì	'eat'	dì-ré	'eating'
ɲú-	ɲú	'drink'	ɲúú-rò	'drinking'
dó-	dó	'climb'	dúó-rò	'climbing'
fáà-	fáà	'seize'	fáá-!rá	'seizing'
dóg-	dóg-í	'boil/cook'	dóg-rɔ̀	'boiling/cooking'
sɔ́g-	sɔ́g-lì	'hide'	sɔ́g-!lɔ́	'hiding'
sɔ́r-	sɔ́r-í	'read/count'	sɔ́r-ɔ̀	'reading/counting'
wùl-	wùl-ì	'teach/show'	wùl-ó	'teaching/showing'
bɔ̀ɔ̀l-	bɔ̀ɔ̀l-ì	'call'	bɔ̀ɔ̀l-ɔ́	'calling'
pùòr-	pùòr-ì	'pray/greet'	pùòr-ó	'praying/greeting'
tùùr-	tùùr-ì	'pick'	tùùr-ó	'picking'
sɔ̀ŋ-	sɔ̀ŋ	'help'	sɔ̀n-nɔ́	'helping'

The choice of the imperfective suffix is completely predictable based on the phonological shape of the root and the perfective form. For instance, CV and CVV roots take –rV suffixes; CVg roots take –rV, or else –lV if the perfective has an –lV suffix; CVr/l and CVVr/l roots take –V suffixes and finally CVN roots take –(n)V suffixes.

When we compare the perfectives vs the imperfectives, apart from the fact that the tone on the imperfective suffix is opposite to the root tone, it is also observed that there are some perfectives and imperfectives which involve lengthening and diphthongisation in the root. There are also cases in which the perfective root has short vowel, but it gets an extra vowel in the imperfective form. Moreover, the vowel quality of both perfective and imperfective suffixes is completely predictable. The perfective suffix if any, always has high front unrounded vowel and the imperfective always has a nonhigh vowel. Both suffixes harmonise in ATR with the root, and the imperfective suffix harmonises in backness, rounding and [±low] with the root. Given that the focus of this paper is on tonal alternations and polarity, alternations in properties such as length, diphthongs, ATR, backness and rounding are not further discussed.

3. Tone Classes of Dàgáárè verbs

Before describing the tone classes of verbs, I state as a point of departure that overall, in Dàgáárè, the syllable and not the mora is the tone-bearing unit (TBU) as mentioned in Kennedy (1966:42) and in Anttila and Bodomo 1996:6). TBU refers to the individual landing sites to which tones anchor (Hyman and Leben 2017). Evidence for the claim that the syllable is the TBU stems from the fact that in spreading and in other processes like lengthening, the tone of the whole syllable is affected, not just the tone of the mora. Consider the following nouns and verbs in (4).

[2] Verbs in Dàgáárè do not have prefixes; rather they have preverbal particles such as tense markers (*dà* and *nà*); infinitive marker (à); negation (*bá, tá, tɔ̀ɔ̀, kʊŋ*) markers; habitual markers *(máŋ),* emphatic markers *(sìrìŋ);* repetitive markers *(là)* and others. There is also a post verbal particle *lá* which occurs after the verb. This has been referred to as the affirmative marker (Bodomo 1997)

(4)		Nouns		Verbs	
	LH	bààl-á	‘sick person-sg’	tùù-ró	‘following’
		jùòn-í	‘year-sg’	kòɔ̀r-ɔ́	‘selling’
	HL	váá-rì	‘leaf-pl’	túú-rò	‘digging’
		júó-rì	‘name-sg’	kóɔ́-rɔ̀	‘farming’

As illustrated, the first syllable is either a long vowel or a diphthong, but the tone melody associates one-to-one left to right with syllables, without regard to the bimoraic content of the first syllable. If we considered the mora to be the syllable, then we might expect forms like *[bàál-á] *[kòɔ́r-ɔ́].

Now in what follows, l lay out the tone classes in verbs in purely descriptive terms. As I mentioned before, in the perfective form there are three tone melodies: L, H, and HL. All these melodies are attested on monosyllabic CV(V)-∅ forms, where an HL melody is realised as a falling contour. These melodies (L, H, HL) are the same in the disyllabic perfective forms. In these cases, the suffix is either an overt mora or a CV syllable with the preceding root either being CV or CVV or CVC or CVVC. In the imperfective forms, we have LH, HL and HLH.

For the perfectives of L and H roots, there are cases with CV or CVV or CVC roots which come with a zero suffix and so we can have L tone across a bimoraic but monosyllabic form as with *tùò* ‘carry’ and we can have H tone on a bimoraic but monosyllabic form as with *lɔ́ɔ́* ‘drop/throw’ In addition, there are CVC roots which are followed by either –V or –CV suffix *wùl-ì* ‘show’, *zàg-rì* ‘refuse/reject’ and *dóg-í* ‘boil’ while CVVC roots take –V suffixes. In the H class CVVC roots are unattested; this probably is an accidental gap.

In the imperfectives of these L and H roots, there are CV root syllables preceding CV suffix syllables where the suffix comes with an opposite tone to that of the root as in *dì-ré* ‘eating’ and *lé-rè* ‘tying’. We also see CVV root syllables followed by CV suffix syllables and in this case, there is never a LH or HL contour on the CVV root. The CVC roots in the imperfective behave similarly to what is observed in the perfectives; the imperfective suffix is either –V or –CV. Finally, the L CVVC roots in the imperfective have a –V suffix just as in the perfective counterparts. These patterns are shown in tables (5) and (6) below

(5) L roots (perfective L; imperfective LH)

Verb root	**Perfective**	**Gloss**	**Imperfective**	**Gloss**
dì-	dì	'eat'	dì-ré	'eating'
tù-	tù	'follow'	tùù-ró	'following'
kʊ̀	kʊ̀	'give'	kʊ̀-rɔ́	'giving'
lè	lè	'fall'	lè-ré	'falling'
jùò	jùò	'open'	jùò-ró	'opening'
tùò-	tùò	'carry'	tùò-ró	'carrying'
zɛ̀l-	zɛ̀l-ì	'lift'	zɛ̀l-ɛ́	'lifting'
wùl-	wùl-ì	'show'	wùl-ó	'showing'
sɔ̀r-	sɔ̀r-ì	'beg'	sɔ̀r-ɔ́	'begging'
sàr-	sàr-ì	'slip'	sàr-á	'slipping'
pɔ̀g-	pɔ̀g-ì	'close'	pɔ̀g-rɔ́	'closing'
zàg-	zàg-rì	'refuse'	zàg-rá	'refusing'
tùùr-	tùùr-ì	'pick'	tùùr-ó	'picking'
kʊ̀ɔ̀r-	kʊ̀ɔ̀r-ì	'sell'	kʊ̀ɔ̀r-ɔ́	'selling'
bʊ̀ɔ̀l-	bʊ̀ɔ̀l-ì	'call'	bʊ̀ɔ̀l-ɔ́	'calling'
sʊŋ-	sʊŋ	'help'	sʊ̀n-nɔ́	'helping'

(6) H roots (perfective H; imperfective HL)

Verb root	**Perfective**	**Gloss**	**Imperfective**	**Gloss**
lé-	lé	'tie'	lé-rè	'tying'
tú-	tú	'dig'	túú-rò	'digging'
kʊ́	kʊ́	'kill'	kʊ́ʊ́-rɔ̀	'killing'
kɔ́	kɔ́	'farm'	kɔ́ɔ́-rɔ̀	'farming'
lɔ́ɔ́-	lɔ́ɔ́	'drop/throw'	lɔ́ɔ́-rɔ̀	'dropping/throwing'
jɔ́ɔ́	jɔ́ɔ́	'pay'	jɔ́ɔ́-rɔ̀	'paying'
kpér-	kpér-í	'slice'	kpér-è	'slicing'
sɔ́r-	sɔ́r-í	'count/read'	sɔ́r-ɔ̀	'counting/reading'
vɔ́l	vɔ́l-í	'swallow'	vɔ́l-ɔ̀	'swallowing'
síg-	síg-í	'come down'	síg-rè	'coming down'
dʊ́g-	dʊ́g-í	'boil/cook'	dʊ́g-rɔ̀	'boiling/cooking'
nɔ́ŋ	nɔ́ŋ	'massage'	nɔ́n-ɔ̀	'massaging'

Now let us look at the HL roots.

As already observed, the imperfective involves adding a tone at the end of the perfective. That is, L perfective becomes LH imperfective and H perfective becomes HL imperfective. Therefore, if we are to apply the same logic or mechanism for the imperfectives of HL roots, we would predictably expect HLH in the imperfective. However, what we see instead is H!H downstep, a phenomenon in which the second of two H tones is lower in pitch compared to the first H (Hyman 1985; Selkirk and Tateishi 1991). That is, in a sequence of H_1LH_2, H_2 has a lower pitch than H_1. The L which is not linked to any syllable is referred to as a floating L. It is this floating L that is phonetically realised as downstep.

In the HL class only one CV monomoraic perfective is attested in the language and it comes with a contour tone. There are CVV syllables with zero suffixes and in this case, there is HL contour

across the bimoraic but monosyllabic CVV form as in examples like *fáà* 'seize'. There are CVC roots which are followed by a –V or a –CV suffix. In these cases, the root syllable has a HL contour and when the perfective suffix is added the L tone docks on the suffix thereby resulting in a HL disyllabic form. Other forms involve a CVVC root syllable followed by a –V suffix syllable. As in the case of CVC roots, the CVVC root has an underlyingly HL contour as in *jíèl-* 'sing' and when the perfective -V suffix is added the L tone moves onto the suffix syllable resulting in HL disyllabic form as *jíél-ì.* When it comes to the imperfectives, the only CV root has a CV suffix as in *dí-!ré* 'taking'. The CVV roots precede CV suffixes; CVC roots are followed by –V or –CV suffixes and CVVC roots come with –V suffixes. See the data below in (7).

(7) HL roots (perfective HL; imperfective H!H=HLH)

Verb root	**Perfective**	**Gloss**	**Imperfective**	**Gloss**
dî[3]-	dî	'take'	dí-!ré	'taking'
díɛ̀-	díɛ̀	'receive'	díɛ́-!ré	'receiving'
vóɔ̀-	vóɔ̀	'uproot'	vóɔ́-!rɔ́	'uprooting'
fáà-	fáà	'seize'	fáá-!rá	'seizing'
dáà-	dáà	'push'	dáá-!rá	'pushing'
lôr-	lórì	'untie'	lór-!ó	'untying'
kɔ̂r-	kɔ́r-ì	'cough'	kɔ́r-!ɔ́	'coughing'
sɔ̂g-	sɔ́g-lì	'hide'	sɔ́g-!lɔ́	'hiding'
jɔ̂g-	jɔ́g-lì	'baby-sit'	jɔ́g-!lɔ́	'baby-sitting'
jíèl-	jíé-lì	'sing'	jíé-!lé	'singing'
dúòr-	dúór-ì	'urinate'	dúór-!ó	'urinating'
hɔ́ɔ̀r	hɔ́ɔ́rì	'yawn'	hɔ́ɔ́r-!ɔ́	'yawning'
háàr-	háár-ì	'shoo'	háár-!a	'shooing'

Let us turn the attention to proposing an analysis for verbal tone in Dàgáárè

4. Analysis of Dàgáárè tone patterns

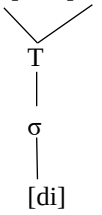
Based on the description presented in section 3, my assumptions are that the underlying melodies of verb roots are the same as the surface tones of the perfective forms whether these contain an overt suffix or not. In the imperfective forms, there is an additional tone to the right of the root tone(s). What the phonology does is choose what form that additional tone takes. That is, the imperfective suffix comes with an underlying unspecified tone which is then realised as H or L based on some phonological constraints. Before proceeding to propose an analysis in terms of tableaux, I show briefly in the next section how tones are represented in terms of features.

4.1. Representation of tone: tone as a set of features. As phonological segments such as speech sounds and morphemes are represented as sets of distinctive features, it is possible that tone can also be represented as a set of features. Under the proposal of Yip (1980), tone is specified by a

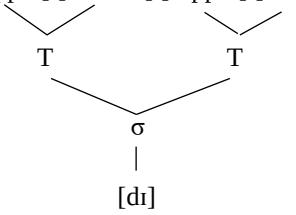
[3] The verb 'take' is quite unusual in Niger-Congo languages and this could be why it is the only monomoraic form with a contour in Dàgáárè.

combination of features and following Pulleyblank (1986), these features[4] include [upper] and [raised]. Under this system the tones of a language are represented as follows: H = [+upper, +raised] M = [-upper, +raised]; L = [-upper, -raised]. Considering that Dàgáárè does not have a mid tone but just a two-way tonal system, I adopt the feature representations for the H and L tones. Each set of features anchor on a Tone node (T-node). For example, the perfective forms *dì* 'eat' and *dî* 'take' which are L and HL are represented in (8a) and (8b) respectively and their imperfective counterparts *dìré* 'eating' and *dí!ré* 'taking' which are LH and H!H are represented in (9a) and (9b) respectively. The Tonal node in each case is associated with the syllable σ which in turn dominates the set of segments in each form. As seen in the downstep case in (9b), there is a T-node in the middle which is unassociated to either of the two σ nodes.

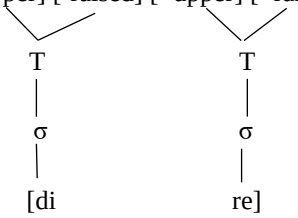
(8) a. dì (L) – 'eat', perfective
[-upper] [-raised]



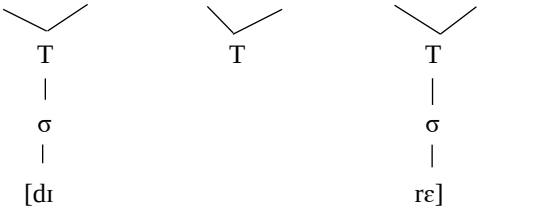
b. dî (HL) – 'take', perfective
[+upper] [+raised] [-upper] [-raised]



(9) a. dì-ré (LH) – 'eating', imperfective
[-upper] [-raised] [+upper] [+raised]



b. dí-!rɛ́ (H!H) – 'taking', imperfective
[+upper] [+raised] [-upper] [-raised] [+upper] [+raised]



With this representation, it is possible to assume that the underlying T on the imperfective suffix has the features [+upper, +raised] embedded in it. The phonology then changes these feature values to their opposite in certain contexts. Alternatively, it is possible that the underlying T has neither set

[4] Pulleyblank (1986) proposes that the two independent tone features [±upper] [±raised] are required to account for languages with three or four contrastive tones that all surface as distinct. I acknowledge that this mechanism is not motivated in the analysis of Dàgáárè tone, given that it is a two-toned language, but I am assuming that it can be applied to the analysis of Dàgáárè in terms of tone features.

of features, but it eventually ends up with a set of features. In the analysis that will follow, I will assume the latter hypothesis that the T is unspecified in terms of features.

4.2. Constraint system. Following the common view that the notion of correspondence extends to tone and TBU relations (e.g. Myers 1997, Zoll 2003, Pulleyblank 2004), I adopt input-output constraints in which various MAX and DEP constraints compare input-output and penalise differences. I also adopt various basic tone well-formedness constraints for this analysis. That is, constraints against toneless TBUs, floating tones, multiply-linked tones and contour tones are adopted in this analysis. These constraints are split into families with separate constraints for tone. First, I show the relevant markedness constraints, but before that some important descriptive generalizations for Dàgáárè tone are in order.

(10) Descriptive generalizations for Dàgáárè tone
   a. Every TBU has a tone. Toneless syllables are prohibited
   b. HL contours are allowed as illustrated in *dî* 'take' and *fáà* 'seize'; LH contours are unattested in verbs.
   c. Contours are found word-finally but never on a nonfinal TBU

These generalizations lead us to the following markedness constraints

(11) Markedness constraints
   a. *TNLESS (Cahill 1998; Yip 2002)
      Assign a violation mark for every TBU that is not associated to a T-node.
   b. *CONTOUR (Cahill 1998; Yip 2002; Zoll 2003)
      Assign a violation mark for every TBU that is associated with more than one T-node.
   c. *FLOAT (Yip 2002)
      Assign a violation mark for every T-node that is not associated to a TBU.
   d. *LH: Assign a violation mark for every TBU that has rising contour. This constraint is motivated because LH contours are not found in verbs. Thus, rising tone on any position of a verb is prohibited. Note that *LH is not violated by a CVCV imperfective that has L on the first syllable and H on the second syllable
   e. OCP (Leben 1973; Suzuki 1998; Yip 2002; Zoll 2003)
      Obligatory Contour Principle: Assign a violation mark for identical adjacent T-nodes within a given domain[5].

In the following tableau, I show how the above markedness constraints work. In the tableau, I consider the input to contain the kind of segmental combination that get parsed as two syllables, i.e., two TBUs in the output such as CVC-V or CVVC-V.

[5] For the purposes of this analysis, I treat the word (root + aspectual suffix) as the relevant domain for the OCP

(12)

/[-u] [-r]/ \ / T_1 /σσ/	*TNLESS	OCP	*LH	*FLOAT	*CONT
[-u] [-r] \ / T_1 /\ σ σ **a.** ⇒					
[-u] [-r] [-u] [-r] \ / \ / T_1 T_2 | σ σ **b.**		*!			
[-u][-r] [+u][+r] \ / \ / T_1 T_2 | σ σ **c.**	*!			*	
[-u] [-r] [+u] [+r] \ / \ / T_1 T_2 \ / σ σ **d.**	*!		*		*

Candidate (a) wins, satisfying all constraints. Candidate (b) violates OCP because of adjacent identical T-nodes; candidate (c) violates *FLOAT because a tone is left unassociated to a TBU and then it violates *TNLESS. Finally, (d) is ruled out by *TNLESS because the second TBU is left unassociated to a tone; it violates *LH and *CONT because of the rising contour on the first TBU. Note that *TNLESS is not dominated. Though it is active, it is not necessary to keep illustrating it in the analysis.

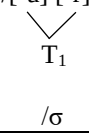
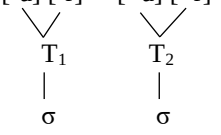
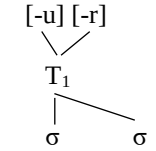
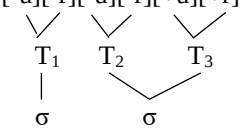
(13) Tone faithfulness constraints

a. MAX-T: Assign a violation for mark for every input T-node that has no output correspondent (= no deletion of T-node)
b. DEP-T: Assign a violation mark for every output T-node that has no input correspondent (= no insertion of T-node)
c. DEP-Link-T: Assign a violation mark for every new association line (present in the output but not in the input) between an output TBU and a T-node (= no insertion of association lines).

d. IDENT-T**:** Assign a violation mark if an input tone node (T-node) and its corresponding output tone node (T-node) do not share identical features (= no change in corresponding tone features)

I give an illustration on how these faithfulness constraints operate. I am not assuming any input associations. That is the roots have tonal melodies which are unassociated in the input.

(14)

/[-u] [-r] / 	DEP-T	MAX-T	IDENT-T	DEP-Link-T
[-u] [-r] [+u] [+r]  **a.** ⇒			*(T2)	*
[-u] [-r]  **b.**		*!(T2)		*
[-u][-r][-u][-r][+u][+r]  **c.**	*! (T3)		*(T2)	**

[6]

Candidate (a) which emerges optimal violates IDENT-T because of the change from input T_2 to output T_2. The output T_2 has features which are not found in the input. In (b), MAX-T is violated because T_2 in the input is deleted in the output. Candidate (c) violates DEP-T for the insertion of a new tone, T_3. It also violates IDENT-T for the changed tone features of T_2. Note that there are numeric indices on the tone nodes. This numeric indexation in the input and output candidates indicates the shared tone node. If an output T-node has a different index compared to the input T-node, then there is an epenthetic tone node.

5. Tableaux

In this section I present the analysis in terms of tableaux. The section proceeds as follows: section 5.1 presents the analysis of the perfective forms. Section 5.2 presents the analysis of the imperfective forms.

[6] The features [±upper] and [±raised] are shortened as [±u] and [±r] respectively.

5.1. The perfectives. This section gives an analysis for the perfective forms. The surface melody of the perfective form (as a whole) is the same as the tone melody that the root has underlyingly. Let us begin with the L pattern.

(15) sàr-ì 'slip, perfective'

/[-u] [-r]/ T_1 /sar-ɪ/	OCP	DEP-T	DEP-Link-T
[-u] [-r] T_1 sar-ɪ **a. ⇒**			**
[-u] [-r] [-u] [-r] T_1 T_2 sar- ɪ b.	*!	*(T_2)	**
[-u] [-r] [+u] [+r] T_1 T_2 sar- ɪ c.		*!(T_2)	**

In tableau (15) candidate (a) wins, satisfying all constraints except DEP-Link-T due to insertion of association lines. From this tableau, it is clear that spreading existing L tone features (a) is preferred over inserting a new L or H in (b) and in (c) respectively. In (b), a new tone node bearing the features [-upper] [-raised] is inserted and this results in it being ruled out by OCP because the suffix T-node is identical to that of the adjacent root; it is also ruled out by DEP-T for the insertion of new T-node (T_2). In (c) a new T-node bearing the features [+upper] [+raised] is inserted thereby ruling it out. Moreover, both (b) and (c) are harmonically bounded by (a) in that they will always lose against (a) under any conceivable ranking. Given this analysis, this particular word form does not allow us to determine whether any crucial rankings hold in the Dàgáárè grammar with respect to the other constraints. Now, let us look at the perfective H *sɔ́rí* 'read/count' in the following tableau.

The analysis presented in L root perfective in (15) is exactly the same as the analysis shown in the H root perfective form in (16) below. The only difference has to do with the specific tone features [±upper] and [±raised] involved. Both root forms operate the same way.

(16) sɔ́rí ‘read/count, perfective’

/[+u] [+r]/ T_1 /sɔr-ɪ/	OCP	DEP-T	DEP-Link-T
[+u] [+r] T_1 sɔr-ɪ **a.** ⇒			**
[+u] [+r] [+u] [+r] T_1 T_2 sɔr- ɪ b.	*!	*(T_2)	**
[+u] [+r] [-u] [-r] T_1 T_2 sɔr- ɪ c.		*!(T_2)	**

In the analysis of the HL perfective form, *CONTOUR is required. Recall that *CONTOUR rules against contour T-nodes. It is not invoked in the analysis of the L and H perfective forms, but it is present in the grammar of Dàgáárè and it is somewhere in the overall constraint ranking but in the L and H forms it does not influence the outcome in any way. Let us examine the HL perfective form *fáà* ‘seize’ in the following tableau. Note that the TBU is the syllable (not the mora), so there is only one TBU in *fáà* for the tones to anchor on.

(17) fáà 'seize, perfective'

/[+u] [+r] [-u] [-r]/ T$_1$ T$_2$ /faa/	MAX-T	*FLOAT	*CONT	DEP-Link-T
[+u] [+r] [-u] [-r] T$_1$ T$_2$ faa **a. ⇒**			*	**
[+u] [+r] T$_1$ faa b.	*!(T$_2$)			*
[+u] [+r] [-u] [-r] T$_1$ T$_2$ faa c.		*!		*

Candidate (a) violates *CONT and DEP-LINK but emerges as optimal. Candidate (b) is ruled out by MAX-T as it deletes input T_2. Candidate (c) is checked against *FLOAT given that T_2 is left floating and unassociated. It is crucial that MAX-T outranks *CONTOUR so that candidate (a) wins. A reverse in this ranking will rule out (a) and rule in (b). Also *FLOAT ranks above *CONTOUR but it is not evident as to which of MAX-T and *FLOAT ranks above the other. Considering this, the following rankings are established.

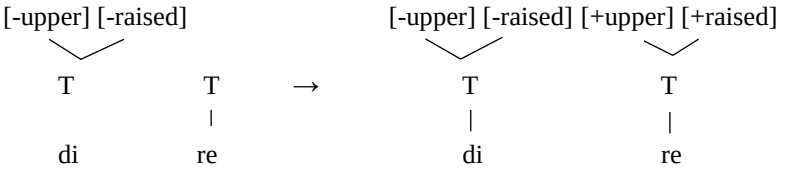
(18) {MAX-T, *FLOAT} >> {*CONT, DEP-Link-T}

In summary, we see that the underlying tones of the perfectives are identical to the surface tones. In the L and H patterns, it is observed that spreading an existing L or an existing H is better than inserting a new L or a new H, hence DEP-T rules out inserting new T-nodes while OCP bans new T-nodes that are identical to the existing adjacent root T-node. It is not clear; however, which constraint ranks over the other. In HL forms, we see that it is better to violate *CONTOUR than delete a tone or leave a tone unassociated. Thus, MAX-T and *FLOAT play a crucial role at ensuring forms with deleted or floating tones are banned. This analysis of perfective verbs now leads us to the analysis of the imperfective forms in the next section.

5.2. The imperfectives. With the imperfective verbs, there is always an additional tone that appears in imperfectives relative to their perfective counterparts, always surfacing on the suffix syllable and realised as either H or L based on the tone class of the root. I propose that the phonology chooses between the tones as appropriate. This additional tone is what I consider as an underlyingly unspecified tone (T) which comes without any features associated with it. Then depending on what features the root T-nodes have, the unspecified suffix T-node chooses to surface with a combination of the features [-upper, -raised] (=L) or [+upper, +raised] (=H). Thus, there are two possible tones

(T-nodes) for the imperfective suffix; either it surfaces with H following a root with L or HL, or it appears as L following a root with H. I show how this mechanism works with the following illustrations

(19)



As shown in (17) the suffix comes with an associated T following a root that has a floating T-node with the features [-upper, -raised]. Then when the root T-node gets associated with a TBU, the suffix T gets features that are opposite to those of the root. This is termed tonal polarity; a phenomenon in which a tone-bearing unit, generally in an affix, shows a tonal value opposite to that immediately adjacent to it (Hoffman 1963; Pulleyblank 1983, 1986; Kenstowicz, Nikiema & Ourso 1988). There is never a HH or a LL surface tone pattern in Dàgáárè imperfective forms. So, I propose that the absence of H and L surface imperfective forms is a result of some dissimilatory process based on OCP (Leben 1973; Suzuki 1998). Let us begin the analysis of the imperfectives with a L root form in the following tableau.

(20) sàr-á ‘slipping, imperfective’

/[-u] [-r] / T_1 T_2 /sar- a/	OCP	MAX-T	IDENT-T	DEP-Link-T
[-u] [-r] [+u] [+r] T_1 T_2 sar- a **a. ⇒**			*(T_2)	*
[-u] [-r] [-u] [-r] T_1 T_2 sar- a b.	*!		*(T_2)	*
[-u] [-r] T_1 sara c.		*!(T_2)		*

When we treat the imperfective suffix as having an underlying unspecified T, it simply means that what we see in candidate (a) only involves a change in tone features from unspecified T-node to a specified T-node on the suffix with [+upper, +raised] features because the root T-node has [-upper, -raised]. This change in features only violates IDENT-T but fulfils DEP-T and MAX-T

since no tone is inserted or deleted. Only association lines are inserted thereby violating DEP-Link-T. In (b) the suffix T-node has the same features [-upper, -raised] as the adjacent root T-node and that means a certain violation of OCP which crucially rules it from competing with (a). Also note that in (b) the suffix tone node in the output is different from what we see in the input suffix; this leads to IDENT-T violation. In (c) the suffix T_2 is deleted, and root tone just spreads to the suffix TBU. This deletion of the input T_2 means violation of MAX-T. In addition, candidate (c) which involves deletion and spreading would result in exactly same output form as the perfective of this verb. The key reason imperfectives differ from perfectives is that they have an underlying T-node which, due to high-ranked MAX-T must be preserved in the output, while the perfectives have no such T-node. The OCP constraint then controls how the preserved T-node is realised on the surface namely, as a polar tone. Based on this example the crucial ranking that is established ensures that candidate (c) does not win over (a) is as follows:

(21) MAX-T >> IDENT-T

Next is the imperfective form of H roots. The analysis in the L root imperfective form above (20) applies exactly to the H root form in (22) below, except for the specific values [±upper] [±raised] involved. That is, these root forms work the same way. There is a suffix T-node that needs to be associated with features and then OCP makes this T-node to get filled with features that are opposite to the preceding root features. The analysis presented in (22) below has the same crucial ranking shown above in (21).

(22) sórɔ̀ 'reading/counting, imperfective'

/[+u] [+r] / T_1 T_2 /sɔr- ɔ/	OCP	MAX-T	IDENT-T	DEP-Link-T
[+u] [+r] [-u] [-r] T_1 T_2 sɔr- ɔ a. ⇒			*(T_2)	*
[+u] [+r] [+u] [+r] T_1 T_2 sɔr- ɔ b.	*!		*(T_2)	*
[+u] [+r] T_1 sɔrɔ c.		*!(T_2)		*

In the next tableau (24) I analyse the imperfective form of a HL root *fáá!rá* 'seizing'. This form independently requires some constraints for its analysis, namely *CONTOUR, *CONTOUR-

NON-FINAL (*CONT-NF) and *LH. Since *CONTOUR and *LH are already defined earlier, I only formally define *CONT-NF as follows:

(23) ***CONTOUR-NONFINAL** (*CONT-NF): Assign a violation mark for every nonfinal TBU that is associated with more than one T-node.

As mentioned before these three constraints are excluded in the analysis of the L root and H root perfectives and imperfectives, but they are nonetheless present in the grammar of the language, and in some particular positions in the overall constraint ranking. So, they are being applied irrespective of the form of word that is under analysis. Whatever their ranking, they do not influence the outcome for L and H root perfectives and imperfectives in any way. Moreover, OCP is not violated and therefore it is not applied in the following analysis (24).

Recall that the tonal melodies of the root are unassociated with TBUs in the input. If the root tones are pre-linked in the input, it will mean that the L in HLH imperfective will be underlyingly associated, and then it will have to be dissociated in the output. Therefore, to prevent this input pre-linking and output delinking of the L, it is better to assume that all root tones are unassociated in the input and then they get associated in the output if necessary.

(24) 'fáá!rá 'seizing'

/[+u] [+r] [-u] [-r] / T_1 T_2 T_3 /faa ra /	MAX-T	*CONT-NF	*LH	*FLOAT	IDENT-T	*CONT	DEP-Link-T
[+u][+r][-u][-r][+u][+r] T_1 T_2 T_3 faa ra a. ⇒				*	*(T_3)		*
[+u][+r][-u][-r][+u][+r] T_1 T_2 T_3 faa ra b.		*!			*(T_3)	*	**
[+u][+r][-u][-r][+u][+r] T_1 T_2 T_3 faa ra c.			*!		*(T_3)	*	**
[+u] [+r] [-u] [-r] T_1 T_2 faa ra d.	*!(T_3)						*

In tableau (24), candidate (a) which emerges optimal, violates markedness constraint *FLOAT due to a floating T_2 node. It also falls short of the faithfulness constraints IDENT-T and DEP-Link-T. It violates IDENT-T for changing featureless suffixal T_3 in the input to a specified T with features in in the output; and DEP-LINK for insertion of association lines. Word-medial contours are not allowed which means *CONT-NF must rank above *FLOAT to keep (a) in winning position ahead of (b). Rising contours are prohibited in verbs and this means candidate (c) is crucially ruled out by *LH, which outranks *FLOAT to prevent (c) from outcompeting (a). Finally, we see in (d) that underlying unspecified T_3 is deleted, which is a MAX-T violation. What happens here is that the tone node (=L) that was floating in the input now docks onto the suffixal TBU. MAX-T must outrank *FLOAT and IDENT-T in order that candidate (d) does not win. Based on this analysis, we have the following crucial ranking:

(25) {MAX-T, *CONT-NF, *LH} >> *FLOAT
(26) MAX-T >> IDENT-T

This analysis shows that it is better to have a floating L between two H T-nodes than have a HL-H with the L associated between the two H T-nodes. This is because the grammar rules against non-final contour T-nodes.

In a nutshell, the imperfective suffix comes with an unspecified T. The grammar (= constraint ranking) forces that T-node to acquire tone features, and determines which features are the optimal choice depending on the context. Unlike the perfective L and H forms where tone features are spread to the suffix from the root, their corresponding LH and HL imperfectives do not involve spreading. Instead, the imperfective suffix T changes by acquiring features that are opposite to the features of the root. Any change in the suffix tone node that results in features that are identical to the preceding root node is ruled out by OCP.

It is important to mention that all perfective forms can be analysed with same set of constraints just as the imperfective forms and the ranking with these constraint set is the same. That is, both the perfective patterns and the imperfective patterns results from a single ranked set of constraints, given the assumption of how the underlying representations of the roots and suffixes look like. I summarise below the crucial ranking information assembled in this analysis.

(27) {MAX-T, *FLOAT} >> {*CONT, DEP-Link-T}
MAX-T >> IDENT-T
{MAX-T, *CONT-NF, *LH} >> *FLOAT
*TNLESS >> DEP-Link-T

Note however that, not all constraints are relevant in the analysis of each individual tonal class. That is, all constraints are applied all the time (subject to being overridden by a higher-ranked constraint), but in many cases a particular constraint has no bearing on the outcome because it will not be violated by any of the candidates. For instance, though MAX-T and *CONTOUR are relevant for HL perfective, they are certainly not relevant in the analysis of L and H and therefore not required.

6. Discussion

In this paper I have discussed the tone system of Dàgáárè verbs based on the morphological forms perfective and imperfective. I establish that there are three tone classes of Dàgáárè verbs and for each of the classes, the surface tone pattern it exhibits in the perfective is systematically different from the tone pattern it exhibits in the imperfective. The imperfective involves an additional tone which is realised as a polar tone. While the perfective tone classes are realised in three patterns, namely L, H and HL, the imperfectives are realised as LH, HL and H!H. The H!H is a result of floating L between two H tones. These tone classes in verbs are contrary to what is observed in nouns (Anttila and Bodomo 1996; Bodomo 1997). In nouns, the tone patterns in singular forms are the same as the tone patterns in the plural forms, namely LH, HL and H. Our data show that LH is never attested in perfective verbs while H and L patterns are never attested in imperfective verbs. Also rising contour (i.e. LH contour) is unattested in verbs; perfective and imperfective. I treat the absence of the LH patterns in the perfective forms and LH contours as a systematic gap. The data also shows that the imperfective tone pattern is much more general in that it remains the same even in reduplication as illustrated earlier in (2)

Using Optimality Theory (Prince and Smolensky 2008), I propose an analysis for both perfective and imperfective forms. I treat tone as a combination of features following Yip (1980) and Pulleyblank (1986). Under this representation, H tone has the features [+upper, +raised] and L has the features [-upper, -raised]. In the perfective forms, underlying and surface tone melody are identical. The analysis of the perfective shows that spreading an existing root L or H is preferred over inserting a new tone. The analysis shows that the absence of surface HH and LL in the imperfective forms is a result of OCP ruling against adjacent identical T-nodes. It is observed that the L in HLH forms is left unassociated because of a constraint against non-final contours and a constraint that prohibits LH contours on Dàgáárè verbs.

In terms of the imperfective, the suffix comes with an underlying unspecified T. This unspecified T gets specified with either [+upper] [+raised] or [-upper] [-raised] which is always opposite in height to the features of the preceding root T-node. I argue that the absence of identical features (i.e. L and H) in the imperfective forms is attributed to some constraints in the grammar such as OCP which prohibits sequence of identical surface T-nodes within a domain.

Moreover, we notice that HLH are unattested in Dàgáárè. What is actually possible is a pattern with a floating L between two associated H tones, which results in downstep. Another issue worthy of mention is the location of polarity. As Pulleyblank (1986) observes, polarity effects occur at the edges of domains and this is evident in cases involving LH, HL and HLH imperfectives in Dàgáárè where the polar tone occurs at the right edge.

In summary this paper has addressed its set goals — describing and accounting for all tonal patterns in perfective and imperfective. Some issues that would require further investigation is the lengthening and diphthongisation that result from the imperfective suffix. The analysis presented in this paper is concerned with the tonal grammar of verbs in Dàgáárè. As to whether this analysis applies to other domains such as nominal tone patterns and alternation remains a question for further investigation. Finally, the paper also invites examination of how verbal tones behave in phrases and sentences.

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